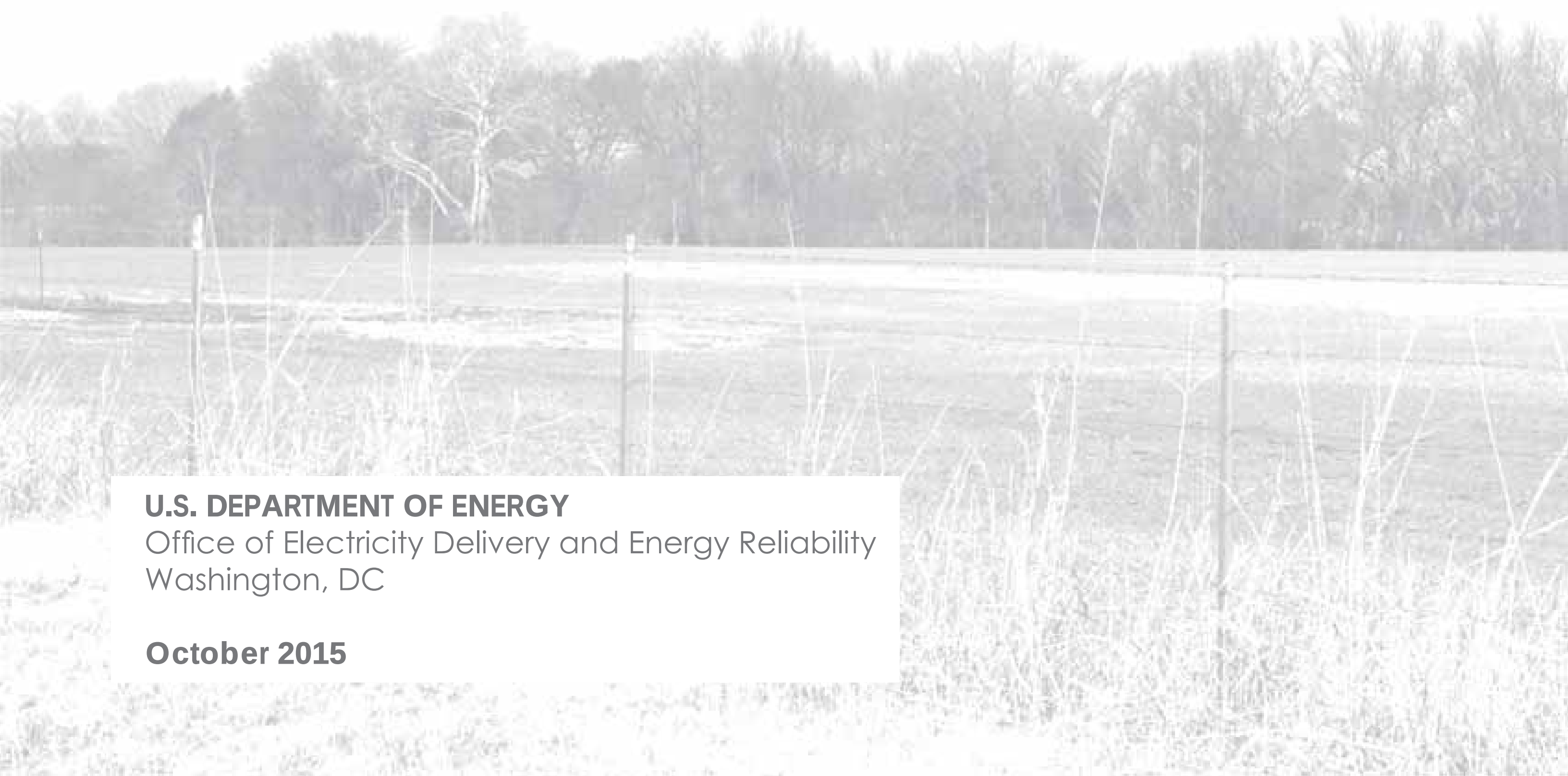
DOE/EIS-0486

Final

PLAINS & EASTERN CLEAN LINE TRANSMISSION PROJECT

ENVIRONMENTAL IMPACT STATEMENT

Volume I of VIII



U.S. DEPARTMENT OF ENERGY
Office of Electricity Delivery and Energy Reliability
Washington, DC

October 2015

This page intentionally left blank.

Department of Energy
Washington, DC 20585

Dear Reader:

Enclosed is the U.S. Department of Energy's (DOE's) Final *Environmental Impact Statement for the Plains & Eastern Clean Line Transmission Project* (DOE/EIS-0486; Final EIS). Included with the Final EIS is a Reference CD, which includes key Project-specific documents. The Final EIS also is available on the DOE National Environmental Policy Act (NEPA) website at http://nepa.energy.gov/nepa and on the Plains & Eastern EIS website at http://www.plainsandeasterneis.com/. DOE has prepared this Final EIS in consultation with the following cooperating agencies: the Bureau of Indian Affairs, Natural Resources Conservation Service, Tennessee Valley Authority, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, and the U.S. Fish and Wildlife Service.

In 2010, DOE, acting through the Southwestern Power Administration (Southwestern) and the Western Area Power Administration, both power marketing administrations within DOE, issued *Request for Proposals for New or Upgraded Transmission Line Projects Under Section 1222 of the Energy Policy Act of 2005* (75 *Federal Register* 32940; June 10, 2010). In response to the Request for Proposals, Clean Line Energy Partners LLC of Houston, Texas, the parent company of Plains and Eastern Clean Line LLC and Plains and Eastern Clean Line Oklahoma LLC (collectively referred to as Clean Line or the Applicant in the EIS) submitted a proposal to DOE for the Plains & Eastern Clean Line Project (Applicant Proposed Project).

The Applicant Proposed Project would include an overhead ± 600-kilovolt (kV) high voltage direct current (HVDC) electric transmission system and associated facilities with the capacity to deliver approximately 3,500 megawatts primarily from renewable energy generation facilities in the Oklahoma and Texas Panhandle regions to the Mid-South and Southeast United States via an interconnection with the Tennessee Valley Authority in Tennessee. Major facilities associated with the Applicant Proposed Project consist of converter stations in Oklahoma and Tennessee; an approximately 720-mile HVDC transmission line; an alternating current collection system; and access roads. The Final EIS also analyzes potential environmental impacts of a No Action Alternative and a range of reasonable alternatives to the Applicant Proposed Project, including alternative routes for the HVDC transmission line and adding a converter station in Arkansas (to deliver power to the Arkansas electrical grid). The potential environmental impacts resulting from connected actions (wind energy generation and currently identified substation and transmission upgrades related to the Project) are also analyzed.

The Final EIS considers comments submitted on the Draft EIS, including those submitted during the public comment period that began on December 19, 2014, and ended on April 20, 2015, after an extension to the original 90-day comment period. During the comment period, DOE held 15 public hearings in Oklahoma, Texas, Arkansas, and Tennessee. Approximately 950 comment documents (including several email and letter campaigns) were received during the public comment period. Late comments have been considered to the extent practicable. The primary topics raised include, concern about electric and magnetic fields from the transmission line; concern about reductions in property value; concern about impacts to agricultural resources such as crop production, irrigation, and aerial spraying; concern about the use of eminent domain; and concern about visual impacts from the transmission line and requests to bury the electric transmission line underground. Appendix Q of this EIS contains the comments received on the Draft EIS and DOE's responses to these comments.

This Final EIS was revised to incorporate new information gathered since the issuance of the Draft EIS, including updated resource-specific analytical data as well as information received from commenters on the Draft EIS. Vertical bars in the margins of the pages of the Final EIS indicate where revisions, including deletions, were made. Appendices M–Q are entirely new parts of this EIS; therefore, they do not contain bars indicating changes from the Draft EIS.

DOE's purpose and need for agency action is to implement Section 1222 of the Energy Policy Act of 2005. To that end, this Final EIS will assist DOE as it decides whether and under what conditions it would participate in the Applicant Proposed Project. DOE has considered the range of reasonable alternatives, the comparison of potential impacts for each resource area, and the input received on the Draft EIS. Based on the information presented in the Final EIS, DOE has identified participation in the Project as its preferred alternative in the Final EIS. The Project would include the Oklahoma converter station and AC interconnection, the AC collection system, the Applicant Proposed Route for the majority of the HVDC transmission line (with the exception of route variation Region 4, APR Link 3, Variation 2), and the Arkansas converter station and AC interconnection.

DOE has continued consultation pursuant to Section 106 of the National Historic Preservation Act (NHPA), which considers the potential effects of the Project on historic properties. The Final EIS includes a draft Programmatic Agreement in Appendix P developed pursuant to 36 CFR 800.14(b) to address obligations under NHPA Section 106, including government-to-government consultation with Indian Tribes and Nations that may attach religious and cultural significance to historic properties that may be affected by the undertaking, and consultation with the Arkansas, Oklahoma, Tennessee, and Texas State Historic Preservation Officers. DOE intends to execute the PA prior to issuance of the ROD or otherwise comply with procedures set forth in 36 CFR Part 800.

DOE and the Applicant have prepared a Biological Assessment of potential impacts on special status species protected under the Endangered Species Act (ESA) as part of the Section 7 consultation between DOE and the U.S. Fish and Wildlife Service. The Section 7 consultation review is a parallel, but separate, process to the NEPA process, conducted pursuant to the requirements of ESA and the applicable implementing regulations. The Biological Assessment and associated addendum are included as Appendix O to the Final EIS. The Biological Opinion, to be issued by the U.S. Fish and Wildlife Service prior to the issuance of the Record of Decision, may identify additional protective measures may be identified and adopted to avoid or minimize impacts to special status species.

For additional information, contact me at Jane.Summerson01@nnsa.doe.gov or visit the EIS website at: http://www.plainsandeasterneis.com.

Thank you for your interest and participation in the NEPA process.

Sincerely,

Jane Summerson, Ph.D.
NEPA Document Manager
on behalf of DOE’s Office of Electricity Delivery and Energy Reliability

This page intentionally left blank.

Contents

Tables

Figures Presented in Text*

*Other EIS figures presented in Appendix A.

Figures Presented in Appendix A

List of Appendices

This page intentionally left blank.

Acronyms and Abbreviations

°C	Degrees Centigrade
°F	Degrees Fahrenheit
1/d2	One Divided by the Distance Squared
AADT	Annual Average Daily Traffic
AASHTO	American Association of State Highway and Transportation Officials
AC	Alternating Current
ACA	Arkansas Code Annotated
ACGIH	American Conference of Governmental Industrial Hygienists
ACHP	Advisory Council on Historic Preservation
ACR	Alternative Capacity Requirement
ADEQ	Arkansas Department of Environmental Quality
ADTC	Average Daily Traffic Count
AGFC	Arkansas Game and Fish Commission
AGNIR	Advisory Group on Non-ionizing Radiation
AHTD	Arkansas State Highway and Transportation Department
AIRFA	American Indian Religious Freedom Act
ALL	Acute Lymphocytic Leukemia
AM	Amplitude Modulation
AML	Acute Myelogenous Leukemia
AMSL	Above Mean Sea Level
ANHC	Arkansas Natural Heritage Commission
ANRC	Arkansas Natural Resources Commission
APCEC	Arkansas Pollution Control and Ecology Commission
APE	Area of Potential Effects
APLIC	Avian Power Line Interaction Committee
APP	Avian Protection Plan
APR	Applicant Proposed Route
AQCE	Air Quality Control Regions
AR	Alternative Route
ARHP	Arkansas Register of Historic Places
ARPA	Archaeological Resources Protection Act of 1979
ARRA	American Recovery and Reinvestment Act
AS	Antenna Structure
ASIS	Affected System Impact Studies
BA	Biological Assessment
BG	Background
BGEPA	Bald and Golden Eagle Protection Act
BGS	Below Ground Surface

BIA	Bureau of Indian Affairs
BISON	Biodiversity Information Serving Our Nation
BLM	Bureau of Land Management
BLS	Bureau of Labor Statistics
BMP	Best Management Practice
BNSF	Burlington Northern Santa Fe Railway
BO	Biological Opinion
BPA	Bonneville Power Administration
BR	Biennial Report
C/acre-yr	Carbon Per Acre Per Year
CAA	Clean Air Act
CAFE	Corona and Field Effects
CCN	Certificate of Public Convenience and Necessity
CEGT	CenterPoint Energy Gas Transmission Company
CENELEC	European Committee for Electrotechnical Standardization
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CH4	Methane
CHAT	Crucial Habitat Assessment Tool
CIP	Critical Infrastructure Protection
CL	Centerline
cm	Centimeter
CM	Commercial Land Mobile
CMUP	Comprehensive Management and Land Use Plan
CO	Carbon monoxide
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
CR	County Road
CRD	Comment Response Document
CRP	Conservation Reserve Program
CT	Cellular Tower
CUH NDB	Cushing Non-directional Radio Beacon
CZE NDB	Clarksville Non-directional Radio Beacon
dB	Decibels
dBA	A-weighted dB scale
dBµV/m	One-Millionth of a Volt Per Meter
DC	Direct Current
DNR	Dedicated Neutral Return

DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DPP	Definitive Planning Phase
eGRID	Emissions & Generation Resource Integrated Database
EHS	Electromagnetic Hypersensitivity
EIA	Energy Information Administration
EIS	Environmental Impact Statement
ELF	Extremely Low Frequency
EMF	Electric and Magnetic Fields
EMI	Electromagnetic Interference
EMW	Electromagnetic Wave
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EPA Hazardous Waste Report BR	EPA Hazardous Waste Report Biennial Report
EPAct	Energy Policy Act of 2005
EPM	Environmental Protection Measure
EPRI	Electric Power Research Institute
ERS	Economic Research Service
ESA	Endangered Species Act
ESRI	Environmental Systems Research Institute, Inc.
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FDA	U.S. Food and Drug Administration
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FFY	Federal Fiscal Year
FG	Foreground
FHWA	Federal Highway Administration
FLMPA	Federal Land Policy and Management Act of 1976
FM	Frqeuency Modulation
FPPA	Farmland Protection Policy Act
FR	Federal Register
FRA	Federal Railroad Administration
FRS	Facility Registry Service
FSA	Farm Service Agency
FT	Federally Threatened
FTA	Federal Transit Administration
FTE	Full-Time Equivalent
G	Gauss

g	Gravity
g/kWh	grams per kilowatt hour
GCCRP	U.S. Global Climate Change Research Program
GHG	Greenhouse Gas
GHz	Gigahertz
GIS	Geographic Information System
GNSS	Global Navigation Satellite Systems
GPS	Global Positioning System
GRP	Grassland Reserve Program
HUC	Hydrologic Unit Code
HVDC	High-Voltage Direct Current
Hz	Hertz
I	Interstate
IARC	International Agency for Research on Cancer
IBA	Important Bird Area
ICD	Implantable Cardioverter Defibrillators
ICES	International Committee on Electromagnetic Safety
ICIS	Integrated Compliance Information System
ICNIRP	International Committee on Non-Ionizing Radiation Protection
IEEE	Institute of Electrical and Electronics Engineers
IFR	Instrument Flight Rules
INV	Inventory Element
ions/cm^3	Ions per Cubic Centimeter
IPCC	Intergovernmental Panel on Climate Change
IRP	Integrated Resource Plan
IS TEA	Intermodal Surface Transportation Efficiency Act of 1991
ISO	Independent System Operation
IVM	Integrated Vegetation Management
JEDI	Jobs and Economic Development Impact
Kf	K-factor
kHz	Kilohertz
KOP	Key Observation Point
KSDOT	Kansas Department of Transportation
kV	Kilovolt
kV/m	Kilovolts Per Meter
L_{dn}	Equivalent Day-Night Sound Level
LEPC	Lesser Prairie-Chicken
L_{eq}	Equivalent Sound Level
LESA	Land Evaluation and Site Assessment

L_{max}	Maximum Sound Level
LOS	Level of Service
LRMP	Land and Resource Management Plan
LUST	Leaking Underground Storage Tank
M	Magnitude
mA	Milliamps
MA	Management Area
MBTA	Migratory Bird Treaty Act
mG	milliGauss
MG	Middleground
MHz	Million Hertz
MIG NDB	Millington Non-directional Radio Beacon
MISO	Midcontinent Independent System Operator
MKO NDB	Muskogee Non-directional Radio Beacon
MLRA	Major Land Resource Area
mm	Millimeter
mmBtu	One Million British Thermal Units
MOU	Memoranda of Understanding
MOVES	Motor Vehicle Emissions Simulator
mph	Miles per Hour
MPO	Metropolitan Planning Organization
MRDS	Mineral Resource Data System
MRI	Magnetic Resonance Imaging
MSA	Metropolitan Statistical Area
MSDOT	Mississippi Department of Transportation
MSDS	Material Safety Data Sheet
MT	Metric Tonne (related to the Air Quality resource)
MT	Microwave Tower (related to Electrical Effects resource)
MW	Megawatt
MWh	megawatt hours
N_2O	Nitrogen Dioxide
N/A	Not Applicable
NAAQS	National Ambient Air Quality Standard
NAGPRA	Native American Graves Protection and Repatriation Act of 1990
NCA	Nation Climate Assessment
NCDB	National Compliance Data Base
NDB	Non-Directional Beacons
NE	Not Evaluated
NEPA	National Environmental Policy Act

NERC	North American Electric Reliability Corporation
NESC	National Electrical Safety Code
NGO	Non-Governmental Organization
NHL	National Historic Landmark
NHPA	National Historic Preservation Act
NHT	National Historic Trail
NIEHS	National Institute of Environmental Health Sciences
NLCD	National Land Cover Dataset
NO	Nitrogen oxide
NO_2	Nitrogen Dioxide
NOI	Notice of Intent
NO_x	Oxides of Nitrogen
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NRI	Nationwide Rivers Inventory
NRIS	National Register Information System
NRPB	National Radiological Protection Board
NSA	Noise Sensitive Area
NSR	New Source Review
NTSB	National Transportation Safety Board
NTSC	National Television System Committee
NWI	National Wetland Inventory
NWR	National Wildlife Refuge
O_3	Ozone
OAC	Oklahoma Administrative Code
OAS	Oklahoma Archaeological Survey
ODEQ	Oklahoma Department of Environmental Quality
ODWC	Oklahoma Department of Wildlife Conservation
OG&E	Oklahoma Gas & Electric
OHS	Oklahoma Historical Society
OKDOT	Oklahoma Department of Transportation
OKM VOR/DME	Standard Distance Measuring Equipment
OKSHPO	Oklahoma State Historic Preservation Office
ONHP	Oklahoma Natural Heritage Program
OPGW	Optical Ground Wire
ORV	Outstanding and Remarkable Values
OS	Oklahoma Statutes

OSHA	Occupational Safety and Health Administration
OWRB	Oklahoma Water Resources Board
PA	Programmatic Agreement
PCB	Polychlorinated Biphenyl
PDS	Permit Data Summary
PGA	Peak Ground Acceleration
PM	Private Land Mobile
PM_{10}	Particulate Matter Smaller than 10 Micrometers
$PM_{2.5}$	Particulate Matter Smaller than 2.5 Micrometers
PMA	Power Marketing Administration
ppb	Parts per Billion
ppm	Parts per Million
PR	Proposed Route
PRRPOA	Paradise River Resort Property Owners Association
PSCo	Public Service Company
RCRA	Resource Conservation and Recovery Act
RCRAInfo	Resource Conservation and Recovery Act Information
RFP	Request for Proposal
RLRMP	Revised Land and Resources Management Plan
rms	Root Mean Square
ROD	Record of Decision
ROI	Region of Influence
ROW	Right-of-Way
RTO	Regional Transmission Organization
RV	Recreational Vehicle
SARA	Superfund Amendments and Reauthorization Act of 1986
SE	State Endangered
SERC	SERC Reliability Corporation
SF_6	Sulfur Hexafluoride
SH	State Highway
SHPO	State Historic Preservation Officer
SIO	Scenery Integrity Objectives
SIP	State Implementation Plan
SIS	System Impact Study
SMS	Scenery Management System
SNR	Signal-to-Noise Ratio
SO_2	Sulfur Dioxide
SO_x	Oxides of Sulfur
Southwestern	Southwestern Power Administration

Units of Measure

Common units of measure and conversion factors used in this report include:

Linear Measure

1 inch = 2.54 centimeters

1 foot = 0.3048 meter

1 yard = 0.9144 meter

1 mile = 1.6 kilometers

Area Measure

1 acre = 0.4047 hectare

1 square mile = 640 acres = 259 hectares

Capacity Measure (Liquid)

1 US gallon = 4 quarts = 3.785 liter

1 cubic meter per hour = 4.403 U.S. gallons per minute

From Socioeconomics

Jobs are full-time equivalents (FTEs) for a period of one year (1 FTE = 2,080 hours)

This page intentionally left blank.

Contents

Tables

Figures Presented in Text*

*Other EIS figures presented in Appendix A.

This page intentionally left blank.

1. Introduction

In June 2010, the U.S. Department of Energy (DOE), acting through the Southwestern Power Administration (Southwestern) and the Western Area Power Administration (Western), both power marketing administrations within DOE, issued *Request for Proposals for New or Upgraded Transmission Line Projects Under Section 1222 of the Energy Policy Act of 2005* (EPAct; 75 *Federal Register* [FR] 32940; June 10, 2010). In response to the DOE request for proposals (RFP), Clean Line Energy Partners LLC of Houston, Texas, the parent company of Plains and Eastern Clean Line LLC and Plains and Eastern Clean Line Oklahoma LLC (collectively referred to as Clean Line or the Applicant in this Environmental Impact Statement [EIS]) prepared a proposal (submitted in July 2010, updated in August 2011, and supplemented in January 2015) to develop new transmission facilities to be located in Oklahoma, Arkansas, Tennessee, and possibly Texas. Figures 1.0-1 and 1.0-2 (located in Appendix A) show topographic and aerial imagery of the Project.

Prior to making a decision as to whether and under what conditions to participate in Clean Line's proposed Plains & Eastern Project (the Applicant Proposed Project), DOE must fully evaluate the Project. This EIS will inform DOE's decision by analyzing the potential environmental impacts of the Project[1]. This chapter provides an overview of DOE's purpose and need for agency action, a description of requirements under Section 1222 of the EPAct, and Clean Line's goals and objectives as they relate to the Project. This chapter also includes a description of cooperating agencies and their roles, applicable federal agency regulations, and the environmental review process including a description of the National Environmental Policy Act (NEPA) process and stakeholder and agency involvement.

Commonly Used Terms

Throughout the Plains & Eastern EIS, the following terms are used to describe different elements of the proposal being evaluated.

Applicant Proposed Project—Based on Clean Line's modified proposal to DOE,[2] the basic elements include converter stations in Oklahoma and Tennessee, alternating current (AC) interconnections at each converter station, an AC collection system, and a high-voltage direct current (HVDC) transmission line from the Oklahoma Panhandle to western Tennessee. The Applicant Proposed Project is described in detail in Sections 2.1.2 through 2.1.7.

Proposed Action—For DOE to participate, acting through the Administrator of Southwestern, in the Applicant Proposed Project in one or more of the following ways: designing, developing, constructing, operating, maintaining, or owning a new electric power transmission facility and related facilities located within certain states in which Southwestern operates, namely Oklahoma, Arkansas, and possibly Texas,[3] but not Tennessee.

Applicant Proposed Route—The single 1,000-foot-wide route alternative defined by Clean Line to connect the converter station in the Oklahoma Panhandle to the converter station in western Tennessee. The analyses of impacts are typically based on a representative 200-foot-wide right-of-way (ROW) within the 1,000-foot-wide corridor. The Applicant Proposed Route is described in detail in Section 2.4.2.

DOE Alternatives—Pursuant to NEPA, DOE has identified and analyzed potential environmental impacts for the range of reasonable alternatives in addition to the Applicant Proposed Project. These alternatives include an Arkansas converter station and alternative routes for the HVDC transmission line. In each instance, these alternatives have been discussed and evaluated with Clean Line for feasibility. The DOE Alternatives are described in detail in Section 2.4.3.

---

1 This Final EIS was revised to incorporate new information gathered since the issuance of the Draft EIS, including updated resource-specific analytical data as well as information received from commenters on the Draft EIS. Vertical bars in the margins of the pages of the Final EIS indicate where revisions, including deletions, were made.

2 In response to DOE's *Request for Proposals for New or Upgraded Transmission Line Projects under Section 1222 of the Energy Policy Act of 2005.*

3 Depending on AC collection system routes implemented (some of which are in Texas).

The Project—A broad term that generically refers to elements of the Applicant Proposed Project and/or DOE Alternatives when differentiation between the two is not necessary. The term also refers to whatever combination of project elements would be built if a decision is made by DOE to participate with Clean Line.

1.1 Department of Energy Purpose and Need

DOE is the lead federal agency for the preparation of the Plains & Eastern EIS. DOE has prepared this EIS pursuant to NEPA (42 United States Code [USC] § 4321; NEPA), the Council on Environmental Quality (CEQ) NEPA regulations (40 Code of Federal Regulations [CFR] Parts 1500 through 1508), and the DOE NEPA implementing regulations (10 CFR Part 1021). DOE's purpose and need for agency action is to implement Section 1222 of the EPAct. To that end, DOE needs to decide whether and under what conditions it would participate in the Applicant Proposed Project.

1.1.1 Section 1222 of the EPAct

Section 1222 of the EPAct, in relevant part, authorizes the Secretary of Energy, acting through and in consultation with the Administrator of Southwestern (provided the Secretary determines that certain statutory requirements have been met), to participate with other entities in designing, developing, constructing, operating, maintaining, or owning new electric power transmission facilities and related facilities located within any state in which Southwestern operates. Southwestern is one of four power marketing administrations that operate within DOE. Southwestern is authorized to market and deliver power to customers in the southwestern United States, including Arkansas, Oklahoma, and Texas, with a preference to public bodies and cooperatives.

As mentioned above, Clean Line submitted a proposal and supporting information in response to DOE's RFP on July 6, 2010. Clean Line's original proposal included two high-voltage direct current (HVDC) lines, each rated at 3,500 megawatts (MW), and which together would have had the capacity to deliver 7,000MW. Subsequently in August 2011, Clean Line modified its proposal to a single HVDC line with the capacity to deliver 3,500MW (Clean Line 2011). DOE concluded that Clean Line's modified proposal was responsive to the RFP (DOE 2012). Clean Line subsequently submitted a Part 2 Application in January 2015 (Clean Line 2015). This Part 2 Application provides additional details and information regarding the Project as requested by DOE. The statutory criteria from Section 1222 (42 USC 16421) include:

1. The proposed project
    a. is located in an area designated under section 216(a) of the Federal Power Act (16 USC §824p(a)) and will reduce congestion of electric transmission in interstate commerce, or
    b. is necessary to accommodate an actual or projected increase in demand for electric transmission capacity
2. is consistent with
    a. transmission needs identified, in a transmission expansion plan or otherwise, by the appropriate Transmission Organization (as defined in the Federal Power Act [16 USC 791a et seq.]), if any, or approved regional reliability organization, and
    b. efficient and reliable operation of the transmission grid
3. will be operated in conformance with prudent utility practice
4. will be operated by, or in conformance with the rules of, the appropriate Transmission Organization, if any, or if such an organization does not exist, regional reliability organization; and

5. will not duplicate the functions of existing transmission facilities or proposed facilities which are the subject of ongoing or approved siting and related permitting proceedings.

The decision whether to participate in a project is discretionary. In the June 2010 RFP, DOE explained that, in evaluating whether to participate in projects that have met the statutory eligibility criteria, DOE would also consider the following evaluation criteria that are not explicitly set forth in the statute:

1. Whether the project would be in the public interest
2. Whether the project would facilitate the reliable delivery of power generated by renewable resources
3. The benefits and impacts of the project in each state it traverses, including economic and environmental factors
4. The technical viability of the project, considering engineering, electrical, and geographic factors, and
5. The financial viability of the project

The purpose of the Plains & Eastern EIS is to evaluate the potential environmental impacts from the Applicant Proposed Project and the range of reasonable alternatives that also meet the purpose and need to implement Section 1222 of the EPAct and a "No Action" alternative. Potential environmental impacts are one of several factors that DOE will consider when deciding whether to participate in the Applicant Proposed Project.

The Plains & Eastern EIS analyzes the potential environmental impacts of the entire Project. This ensures that any decision by DOE or another agency is fully informed. DOE may decide to participate in any or all of the states in which Southwestern operates, namely Oklahoma, Arkansas, and Texas. However, DOE would not participate in the Project in Tennessee because that state is outside Southwestern's operational area. Other agencies, federal or state, may have jurisdiction over parts of the Project that are located in Tennessee. Some of these agencies could include, but not be limited to, Tennessee Valley Authority (TVA), U.S. Army Corps of Engineers (USACE), and Tennessee state agencies.

In addition to the NEPA process, on April 28, 2015, DOE published a notice in the *Federal Register* (80 FR 23520) requesting public comment on Clean Line's complete Section 1222 application. The initial public comment period was set to expire on June 12, 2015. In response to public and Congressional requests, DOE extended the public comment period through July 13, 2015. The notice stated, "Prior to making a determination whether or not to participate in the proposed Project, DOE, in consultation with Southwestern, must evaluate the proposed Project for compliance with section 1222 of EPAct, the criteria in the 2010 RFP, and NEPA." In addition to this public review, DOE is conducting due diligence on other factors related to the statutory criteria identified in Section 1222. DOE's review will include making all required statutory findings and will consider all criteria listed in Section 1222 of EPAct as well as all factors included in DOE's 2010 RFP. In the *Federal Register* notice dated April 28, 2015, DOE requested comments on whether the proposed Project meets the statutory criteria and the factors identified within the 2010 RFP.

1.2 Cooperating Agencies

DOE is the lead agency for the preparation of the Plains & Eastern EIS. As lead agency, DOE retains overall responsibility for the NEPA process, including the Draft and Final EIS and DOE's Record of Decision (ROD), if any. DOE's responsibilities include determining the purpose and need for DOE's agency action, identifying for analysis the range of reasonable alternatives to its Proposed Action, identifying potential environmental impacts of the Proposed

Action and reasonable alternatives, identifying its preferred alternative, and determining appropriate mitigation measures.

DOE is also the lead agency for consultation required under Section 106 of the National Historic Preservation Act (NHPA), 54 USC § 306108. DOE is using the NEPA process and documentation required for the Plains & Eastern EIS to comply with Section 106 of the NHPA in lieu of the procedures set forth in Sections 800.3 through 800.6 of the NHPA. This approach is consistent with the recommendations set forth in the NHPA implementing regulations that Section 106 compliance should be coordinated with actions taken to meet NEPA requirements (36 CFR 800.8(a)(1)). Additional information regarding compliance with Section 106 of the NHPA is provided in Section 3.9.

In addition to DOE acting as the lead agency for the Plains & Eastern EIS, several other agencies are participating as cooperating agencies as described in 40 CFR 1501.6. These cooperating agencies have also participated, along with other federal and state agencies, in routing and siting activities related to their jurisdiction, authority, or expertise (Section 1.6). Appendix B contains copies of primary correspondence between DOE and these agencies.

The cooperating agencies for the Plains & Eastern EIS are identified in Table 1.2-1.

Table 1.2-1:
Plains & Eastern EIS Cooperating Agencies

Cooperating Agencies
Bureau of Indian Affairs (BIA)
Natural Resources Conservation Service (NRCS)
Tennessee Valley Authority (TVA)
U.S. Army Corps of Engineers (USACE)
U.S. Environmental Protection Agency (EPA) Regions 4 and 6
U.S. Fish and Wildlife Service (USFWS)

Also, DOE has invited certain federal, state, Indian Tribes or Nations, and local agencies to consult under Section 106 of the NHPA in accordance with 36 CFR 800.2(c).

The following sections provide information regarding each cooperating agency. The sections include a description of the agency and its responsibilities, the basis for participation as a cooperating agency, and the extent to which the agency will rely on the Plains & Eastern EIS to fulfill its obligations under NEPA or related laws.

1.2.1 Bureau of Indian Affairs

The BIA is a bureau within the Department of the Interior responsible for the administration and management of land held in trust for American Indians and federally recognized Tribes. The BIA is recognized to have jurisdiction by law over Rights-of-Way over Indian Lands (25 CFR Part 169).

The BIA will, to the extent permitted by law, rely on the environmental analyses and Section 106 consultation developed through this NEPA process and resulting Plains & Eastern EIS to fulfill its obligations under NEPA and Section 106 of the NHPA for any action, permit, or approval by the BIA for the Project.

1.2.2 Natural Resources Conservation Service

NRCS is a federal agency within the Department of Agriculture whose mission is to provide national leadership in the conservation of soil, water, and related natural resources. The NRCS provides balanced technical assistance and cooperative conservation programs to landowners and land managers throughout the United States. NRCS is recognized to have jurisdiction by law and/or has special expertise in the following areas:

- Farmland Protection Policy Act (7 USC § 4201 et seq.; 7 CFR Part 658)
- Watershed Protection and Flood Prevention Act (16 USC §§ 1001–1009; Public Law 83–566)
- Agricultural Conservation Easement Program (Subtitle D of the Agricultural Act of 2014; 128 Stat. 649, Public Law 113-79)
- Healthy Forests Restoration Act of 2003 (16 USC § 6501 et seq., Public Law 108–148)
- Federal Agriculture Improvement and Reform Act of 1996 (110 Stat. 888–1197, Public Law 104–127)

The NRCS will, to the extent permitted by law, rely on the environmental analyses developed through this NEPA process and resulting Plains & Eastern EIS to fulfill its obligations under NEPA for any action, permit or approval by the NRCS for the Project.

1.2.3 Tennessee Valley Authority

TVA is a federally owned corporation that provides electricity to about 9 million people in parts of seven southeastern states. TVA is a cooperating agency in the preparation of the Plains & Eastern EIS and is recognized to have jurisdiction by law by virtue of the approvals that would need to be obtained from TVA before interconnecting the Project to the transmission system TVA operates in the Tennessee Valley region. TVA has extensive experience in the planning, construction, and operation of electrical transmission lines and substations. As a federal agency, TVA is also recognized as having special expertise in assessing, under NEPA, the potential environmental impacts of federal projects undertaken in the Tennessee Valley region, including electricity transmission systems and related facilities.

TVA will, to the extent permitted by law, rely on the environmental analyses and Section 106 consultation developed through this NEPA process and resulting Plains & Eastern EIS to fulfill its obligations under NEPA and Section 106 of the NHPA for any action, permit, or approval by TVA for the Project.

TVA's purpose and need for agency action is to respond to Clean Line's request to interconnect the Project to the TVA transmission system. In response to the interconnection request, TVA conducted studies that indicate certain upgrades are needed to the TVA transmission system to maintain system reliability while transmitting the power injected by the Project. TVA anticipates tiering from this EIS in completing its NEPA review to assess the potential environmental impacts of these upgrades.

1.2.4 U.S. Army Corps of Engineers

The USACE is a federal agency within the Department of Defense. The USACE is a cooperating agency in the preparation of the Plains & Eastern EIS and is recognized to have jurisdiction by law and/or has special expertise in the following areas:

- Section 404 of the Clean Water Act (33 USC § 1344)

- Section 10 of the Rivers and Harbors Appropriation Act of 1899 (33 USC § 403)
- Modification to existing USACE projects (33 USC § 408)

Authorization from the USACE is required for features of the Project that cross over, through, or under navigable waters as defined under Section 10 of the Rivers and Harbors Appropriation Act of 1899. Authorization from the USACE is also required for any activity that would result in discharges of dredged or fill material into waters of the United States as defined in Section 404 of the Clean Water Act. If granted, the USACE authorization would be issued in the form of a permit verification.

In addition to responsibilities identified above, 33 USC § 408 provides the authority to USACE to evaluate and approve proposed modifications and activities on and near existing federally constructed projects, which includes levees, navigation channels, flood channels, and harbors. Additionally, work performed within 1,500 feet of Mississippi River levees has the potential to adversely affect the ability of the levees to perform as intended. Any excavation or subgrade construction within 1,500 feet of a levee would require coordination with the USACE to ensure no negative impact to the level of flood risk reduction provided by the levee occurred.

Permits and permit verifications would be necessary from the USACE for portions of the Project (including areas within the state of Tennessee). As a cooperating agency, the USACE will review the route alternatives contained in the Plains & Eastern EIS. The USACE may consider the routing alternatives in Tennessee as presented in this EIS when making its permit decisions and will use the analysis contained in this EIS to inform all of its permit decisions for the Project. The USACE could, to the extent permitted by law, rely on the environmental analyses developed through this NEPA process and resulting EIS to fulfill its obligations under NEPA for any action, permit, or approval by the USACE for the Project.

1.2.5 U.S. Environmental Protection Agency

EPA is a federal agency that was created in 1970 for the purpose of protecting human health and the environment. EPA has ten regional offices, each of which is responsible for execution of their program. Region 4 (Southeast) includes the state of Tennessee. Region 6 (South-Central) includes the other states potentially involved in the Project (Arkansas, Oklahoma, and Texas). The EPA (Regions 4 and 6) is a cooperating agency in the preparation of the Plains & Eastern EIS and is recognized to have jurisdiction by law and/or has special expertise in the following areas:

- Environmental laws
- Executive Orders dealing with environmental review of actions
- NEPA assessment and procedures

In addition, under Section 309 of the Clean Air Act, the EPA is required to review and publicly comment on the environmental effects of major federal actions, including actions that are the subject of EIS documents. If the EPA determines that the action is environmentally unsatisfactory (per the Section 309 criteria), it is required by Section 309 to refer the matter to the CEQ.

1.2.6 U.S. Fish and Wildlife Service

USFWS is a bureau within the Department of the Interior whose mission is to conserve, protect, and enhance fish, wildlife, and plants and their natural habitats for the continuing benefit of the American people. USFWS is a cooperating agency in the preparation of the Plains & Eastern EIS and is recognized to have jurisdiction by law and/or has special expertise in the following areas:

- Endangered Species Act (16 USC § 1531 et seq.)
- Migratory Bird Treaty Act (16 USC § 703 et seq.)
- Bald and Golden Eagle Protection Act (16 USC § 668 et seq.)
- The National Wildlife Refuge System Administration Act (16 USC § 668dd–68ee)
- Executive Order 13186 and DOE and USFWS Memorandum of Understanding (DOE and USFWS 2013)

The USFWS will, to the extent permitted by law, rely on the environmental analyses developed through this NEPA process and resulting Plains & Eastern EIS to fulfill its obligations under NEPA for any action, permit, or approval by the USFWS for the Project.

In March 2015, DOE, Southwestern, and TVA requested the initiation of formal consultation and conference with the USFWS under Section 7(a)(2) of the Endangered Species Act (DOE 2015) and submitted a Biological Assessment regarding the Project and its potential effects on listed species and designated critical habitat. The Biological Assessment and addendum have been included as Appendix O of this EIS. The Biological Opinion, to be issued by the USFWS prior to the issuance of the ROD, may identify additional protective measures to avoid or minimize impacts to special status species.

1.3 Other Federal Agency Involvement

This section describes the potential roles and responsibilities of additional federal agencies other than those identified above as cooperating agencies. Additionally, Appendix C presents an overview of potential federal and state permits and consultation that could be required for construction of the Project.

1.3.1 Advisory Council on Historic Preservation

The Advisory Council on Historic Preservation (ACHP), in accordance with 36 CFR 800.2(b), issues regulations to implement Section 106 of the NHPA, and provides guidance, advises, and generally oversees operation of the Section 106 process. Section 106 of the NHPA requires federal agencies to consider effects of federal undertakings on historic properties. Historic properties include those on the National Register of Historic Places (NRHP) or that meet the criteria for the National Register (ACHP 2013). DOE informed the ACHP and the State Historic Preservation Officers (SHPOs) of Oklahoma, Texas, Arkansas, and Tennessee by letter of DOE's intent to use the NEPA process and documentation required for the Plains & Eastern EIS to comply with Section 106 of NHPA in lieu of the procedures set forth in Sections 800.3 through 800.6 of the NHPA. The ACHP has been consulting with DOE on various topics, including the potential programmatic agreement as part of the Section 106 consultation.

1.3.2 National Park Service

The National Park Service (NPS) is a bureau of the Department of the Interior and would be responsible for issuing ROW permits if the Project crosses land managed by the NPS per 16 USC § 79. Portions of the congressionally designated Trail of Tears National Historic Trail are under the managing jurisdiction of the NPS. The Project route alternatives would cross segments of the Trail; however, neither the Applicant Proposed Route nor the DOE alternative routes cross any portions managed by the NPS. DOE has provided the NPS with the location data for each of the route alternatives. The NPS is also participating as a consulting party under Section 106.

The NPS has administrative responsibilities for the Trail of Tears National Historic Trail under the Secretary of the Interior, pursuant to the National Trails System Act of 1968, as amended. Further, the NPS has responsibilities for the Route 66 Preservation Program under Public Law 106–45, enacted in 1999.

1.3.3 U.S. Department of Transportation, Federal Highway Administration

The Federal Highway Administration (FHWA) is an agency within the U.S. Department of Transportation (DOT) that would be responsible for issuing encroachment permits if the Project crosses federally funded highways.

1.3.4 U.S. Forest Service

The U.S. Forest Service (USFS) is a federal agency within the Department of Agriculture that manages Ozark-St. Francis National Forests (Forests). A Revised Land and Resources Management Plan (RLRMP) for the Forests was developed in 2005 with public input that provides direction for its management (USFS 2005). An HVDC alternative route (HVDC Alternative Route 4-B), a portion of which would cross the Ozark National Forest, was proposed as a result of public scoping comments and analyzed in the Plains & Eastern EIS. DOE has consulted with the USFS regarding this alternative route.

1.4 Clean Line's Goals and Objectives

According to Clean Line's proposal prepared in response to the DOE *Request for Proposals for New or Upgraded Transmission Line Projects under Section 1222 of the Energy Policy Act of 2005* (submitted in July 2010, modified in August 2011, and supplemented in January 2015), Clean Line proposes to develop new transmission facilities to be located in Oklahoma, Arkansas, Tennessee, and possibly Texas. According to Clean Line's proposal, "The Plains and Eastern Clean Line is necessary to accommodate the actual and projected increase in demand for additional electric transmission capacity to deliver renewable energy from western SPP to load centers in the southeastern United States." Further, Clean Line's stated objectives for development of the Applicant Proposed Project include:

- Improving public access to renewable energy at a competitive cost by facilitating the transfer of available wind energy in the Oklahoma and Texas Panhandle regions to areas with increasing demands
- Providing an efficient and reliable interconnection between the Southwest Power Pool (SPP) and TVA that facilitates the delivery of 3,500MW of wind generated electricity and is consistent with applicable transmission system plans
- Assisting in satisfying the growing customer demand for renewable energy
- Providing safe, efficient and reliable transmission infrastructure consistent with prudent utility practice

1.5 National Environmental Policy Act

Major federal actions that may significantly affect the quality of the human environment require preparation of an EIS to comply with NEPA. NEPA requires that all federal agencies consider the potential environmental impacts of their proposed actions. Under NEPA, the term environment encompasses both the physical environment (e.g., air, water, geography, geology) and the human environment (e.g., health and safety, jobs, housing, schools, transportation, cultural resources).

1.5.1 NEPA Process

The CEQ established NEPA regulations for all federal agencies, including procedures for preparing EIS documents (40 CFR Parts 1500 through 1508). Individual agencies, including DOE, have established their own implementing procedures to supplement and use in conjunction with these requirements (DOE's implementing regulations are found at 10 CFR Part 1021). The major steps in the NEPA process for preparing an EIS are issuing a Notice of Intent (NOI) to prepare an EIS; gathering input on the scope of the EIS from federal, state, and local agencies, Tribal governments, the public, and other stakeholders; preparing the Draft EIS; receiving public comments on the Draft EIS; preparing a Final EIS, including responses to comments received on the Draft EIS; and issuing a ROD. Each of these steps is discussed below and Figure 1.5-1 illustrates the process.

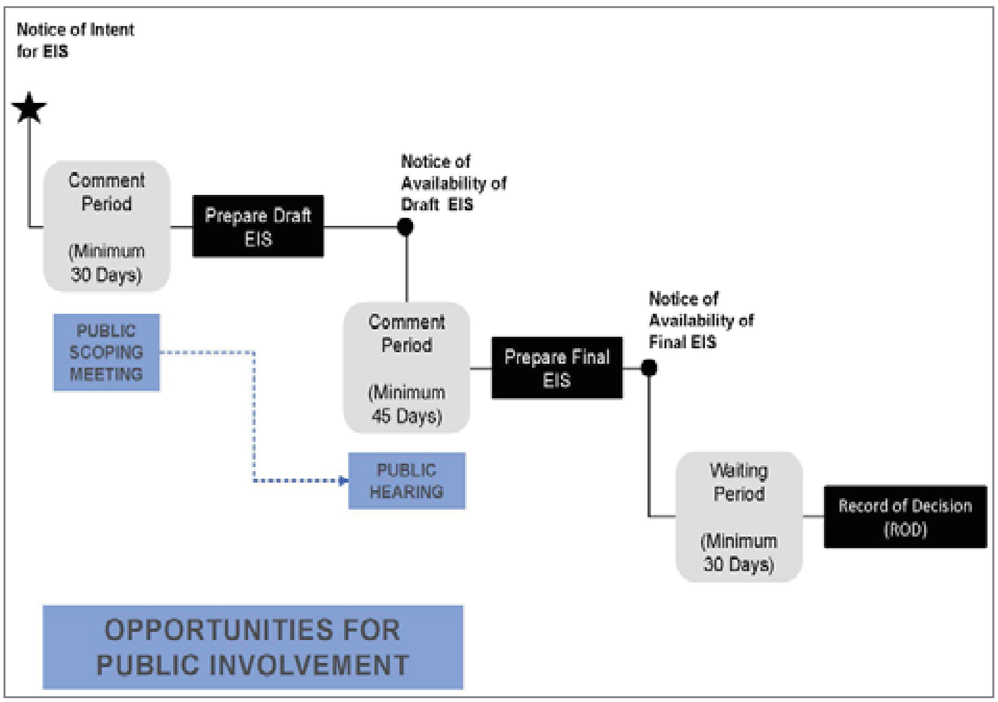


Figure 1.5-1: The EIS Process

1.5.2 Public Scoping

The public scoping period for the Project began with DOE's publication of the NOI on December 21, 2012. The NOI is included in Appendix D. The public scoping period continued for ninety days through March 21, 2013. DOE held thirteen public scoping meetings in communities along the proposed and alternative routes and five interagency meetings during the scoping period. The purpose of scoping was for DOE to request and receive comments on the scope of the EIS and alternatives from the public, agencies, tribes, and other interested parties. At the public and agency scoping meetings, DOE presented large-scale maps (42 inches by 60 inches) of the potential project area to gather input on the potential transmission line routing. These maps are shown in Appendix E of the DOE Alternatives Development Report (DOE 2013). (The DOE Alternatives Development Report is discussed in more detail in Section

2.3 of the Plains & Eastern EIS.) The Native American Tribes and federal, state, and local agencies contacted during public scoping are addressed in Section 1.6.

DOE received 664 scoping comment documents; many of which included multiple scoping comments. DOE reviewed all scoping comments and prepared a Scoping Summary Report (Appendix E). Comments pertaining to potential Project locations were categorized and compiled by location in a spreadsheet shown in Appendix F of the DOE Alternatives Development Report (DOE 2013). Issues that were identified during scoping are categorized by environmental resource area and presented in Table 1.5-1.

Table 1.5-1:
Issues Identified through Scoping

Resource or Issue Area and Issues to be Analyzed	Location in EIS
Accidents, Intentional Destructive Acts, and Hazards (including air space)	
Analyze impacts of aircraft operating in the area of the transmission lines, specifically associated with aerial application of pesticides and fertilizers (Segment L-3, Jackson and Poinsett counties, Arkansas).[1]	Sections 3.8 and 3.16
Avoid locating the line in areas near personal airstrips and small airports.	Sections 3.8 and 3.16
Consider impacts of tornadoes, fire, earthquake, snow, and ice storms. Discuss the liability and responsibility to maintain the line and ROW in the event of an accident caused by such events.	Section 3.8
Agriculture	
Analyze effects of Project on agricultural operations, water management systems (e.g., surface water reservoirs, underground oil and gas pipelines, and tail-water recovery systems), irrigation and/or drainage systems (specifically the use of two center pivot irrigation systems), removal/damage of acreage, seeding, impacts on planting and harvesting, crop production, and aerial applications of fertilizer, insecticide, and herbicide.	Section 3.2
Analyze potential impacts of Project on precision-graded rice and farm fields (Regions 5, 6, and 7).[1]	Section 3.2
Describe and consider impacts to rice production and indirect impacts on migrating waterfowl that rely on rice producing lands for feeding and winter habitat.	Sections 3.2 and 3.20
Analyze how loss of land may reduce area for grazing and hay production.	Section 3.2
Air Quality and Climate Change	
Analyze the impacts on air quality and climate change once the Project is completed. Compare and contrast these impacts with the impacts of various other resources (renewable and non-renewable) that could be used to produce and transmit power.	Section 3.3
Consider impacts on climate change associated with destruction of trees.	Section 3.3
Alternatives—General	
Opposition to the Project being built across areas/states that will receive no benefit from it, specifically Arkansas and Oklahoma; Project should be built in the areas that will receive the electricity needed/produced.	Section 2.4
Update and revise location of gas pipelines and electric transmission lines, including new Oklahoma Gas & Electric (OG&E) transmission lines.	Figures 1.0-1 and 1.0-2 in Appendix A
Identify locations of oil/gas wells within proximity to route corridors.	Section 3.6, Figure 3.6-6 (located in Appendix A)
Route along field/property lines and avoid bisecting properties and fields.	Section 2.3 and Appendix G
Identify additional/missing homes on maps showing the network of potential routes.	Figures 1.0-1 and 1.0-2 in Appendix A
Identify location of springs used to water livestock and farms.	Figures 1.0-1 and 1.0-2 in Appendix A
Follow ROWs (highways, interstates, other lines/oil and gas pipelines/utilities).	Appendix G
Bury the proposed transmission line.	Section 2.4

Table 1.5-1:
Issues Identified through Scoping

Resource or Issue Area and Issues to be Analyzed	Location in EIS
Consider other alternatives such as hydroelectric (dam), nuclear, solar, or Atlantic seaboard-based wind farms.	Section 2.4
Avoid populated areas.	Appendix G
Avoid routes that cross cemeteries.	Appendix G
Place line on government/public lands.	Appendix G
Avoid National Audubon Society Important Bird Areas.	Section 3.20
Avoid conservation areas on public and private lands.	Appendix G
Avoid public lands.	Appendix G
Commenters requested implementation timeline, Gantt charts detailing resources and critical path, and information about phone lines in Pope County, Arkansas.	Appendix F (Section 3.2 and Appendix C)
Commenters requested information about cost of project and the cost to federal government.	Section 3.13
Commenters requested information about use of solar panels with HVDC for better efficiency and production of electricity.	Section 2.4
Connected Actions	
Analyze impacts of wind farms that will be constructed in conjunction with the Project.	Section 2.5, Chapters 3 and 4
Address responsibility for removal of turbines and towers in the event the Project is terminated at some point in the future.	Chapter 3
Cultural, Historic, and Archaeological Resources	
Analyze impacts to cultural, historical, and archaeological resources, including Native American relics and artifacts (Segments K and L), burial sites; family cemeteries (Segment C and M-5); historic sites, including Butterfield Trail Stage Route, the Trail of Tears, and area battlefields, and routes connecting to those sites (Segment G); Sheridan's Roost; Sequoyah Home Museum and other Cherokee heritage sites; and other cultural activities and sites along the proposed route.[1]	Section 3.9
Consider impacts on cultural values of landowners and residents of remote areas, including the impact on future generations who may wish to reside on or farm their families' ancestral properties.	Section 3.9
Analyze impacts to "Centennial" farms and trees in Oklahoma.	Section 3.9
Cumulative Impacts	
Analyze cumulative impacts of wind farms associated with the Project.	Chapter 4
Discuss impacts of potential future projects that may be located near the Project.	Chapter 4
Analyze cumulative impacts on agriculture, wildlife, aesthetic and scenic values, and the economy and the culture of areas that would be impacted by the Project.	Chapter 4
Address cumulative impacts of past, current, or future, local, state, and/or federal projects.	Chapter 4
Address impacts of the construction of Interstate 69 in and around Munford, Tennessee (Segment M-4).[1]	Chapter 4
Electric and Magnetic Fields	
Analyze health impacts of high-voltage transmission lines to humans, livestock, and plants.	Section 3.4
Address impacts of electric and magnetic fields (EMF) on Global Positioning System (GPS), cell phones, medical devices, television, and internet.	Section 3.4
Discuss potential for stray voltage and how structures are grounded.	Section 3.4
Environmental Justice	
Consider environmental justice implications in the use of private land for private gain, specifically percentage of landowners that rely on income from the land that could be devalued by construction of the transmission line.	Sections 3.5 and 3.13
Geology and Soils (including minerals)	
Analyze impacts of construction equipment and installation of towers and power lines on erosion, scouring, silting, (Segment G).[1]	Section 3.6

Table 1.5-1:
Issues Identified through Scoping

Resource or Issue Area and Issues to be Analyzed	Location in EIS
Address erosion control activities on the ROW, specifically in hilly areas where removal of trees will cause impacts on Federal Scenic Waterways.	Section 3.6
Analyze impacts of Project to rice production/irrigated agriculture, specifically clay hardpan. Consider that soil structure is crucial to these activities and damage to hardpan will cause loss of topsoil and loss of productivity.	Section 3.2
Consider features such as rough terrain, buffalo wallows, fault lines (Mulberry Fault), and steep-sided hills.	Section 3.6
Human Health and Safety	
Analyze impacts of high-voltage transmission lines on health of humans, especially the young and elderly, as well as livestock (Segments C, F-8, G-3, K, L, and M-4).[1]	Section 3.4
Discuss health impacts of high-voltage transmission lines on GPS, pacemakers, farm equipment, defibrillators, neurostimulators, and medical equipment.	Section 3.4
Analyze potential for the Project to cause faulty GPS signals that may cause GPS-guided aircraft and or farm equipment to collide with structures and wires erected.	Section 3.4
Address health impacts of the Project resulting from grass/wild fires, structures or towers that fail, and electrocution due to downed lines.	Section 3.4
Analyze impacts on water quality of a drinking water supply (Segment G-3, under the EPA and Arkansas Department of Health's Source Water Protection Program).[1]	Section 3.15
Land Acquisition and Land Rights	
Describe the potential use of eminent domain or other land easements to obtain private property.	Section 2.1.3
Discuss how ROW access may invite trespassing on private property.	Appendix F (EPM GE-8)
Describe how construction and maintenance debris will be removed from private property.	Appendix F (Section 3.2.8)
Analyze how the Project may negatively impact the ability for small oil/gas producers to lease property for oil and natural gas exploration and production.	Section 3.6
Discuss whether access to lands would also provide access to mineral rights below the surface for fracking.	Sections 2.6 through 2.11
Evaluate utilizing existing levee system, easements, or ROWs.	Section 2.3
Land Use	
Discuss impacts on future oil and gas drilling activities	Section 3.6
Discuss the restrictions the Project will place on future land use (public and private) and cultivation/development.	Section 3.10
Discuss possibility that Project may impair or delay conservation efforts and agreements, impacts to status of federally designated areas, including Blueway (water trail), scenic byway, and wildlife refuge designations.	Sections 3.12 and 3.15
Mitigation	
Consider mitigation needs in areas where wetland mitigation banks do not exist.	Section 3.19
Address use of best management practices (BMPs[2]) for construction to mitigate impacts to wildlife habitat, including sensitive species and species of concern.	Sections 3.14 and 3.20
Discuss plans to prevent soil erosion during and after construction, including responsibility for long-term effects of erosion, sediment in streams, and duration of responsibility.	Section 3.6
NEPA Process	
The NEPA process should be held in abeyance until there is a full and fair hearing on the merits of Clean Line's application [under Section 1222].	Section 1.1
Individuals received notification of scoping meetings with too short notice or after meetings in their area had been held.	Appendix E
Requests for extension of scoping period.	Appendix E
Continue the level of public involvement during public hearings on Draft EIS. Commenter suggested that Clean Line has been very open with level of information and interaction with public.	Appendix E

Table 1.5-1:
Issues Identified through Scoping

Resource or Issue Area and Issues to be Analyzed	Location in EIS
Commenters expressed dissatisfaction with lack of communication about the Project and the quality of the maps at the scoping meetings and on the EIS website.	Appendix E
Address concerns that Northern route (Segment M-4) was announced during scoping period.[1]	Appendix E
Comments should have been recorded during scoping meetings.	Appendix E
Petitions	
A petition was submitted by residents of Cedarville, Arkansas, and Crawford County, Arkansas, who are against the power transmission line coming through the county (Segment G). Four hundred eleven people signed the petition. Specific comments were identified in the petition and were included in the summaries for the following topics discussed above: route-specific alternatives, socioeconomic, agriculture, and cultural, historical, and archaeological resources.[1]	Appendix E
Purpose and Need	
The federal government should not be involved in the Project, because the Project would benefit a private corporation.	Chapter 1
Recreation	
Analyze impacts on recreational uses including fishing, hunting, hiking, camping, canoeing (Lake Poinsett; Poinsett County, Arkansas; Segment K-1 Jackson County, Arkansas).[1]	Section 3.12
Consider impacts on recreational areas, including national and state parks and forests.	Section 3.12
Consider disturbance of recreational activities such as hang-gliding or riding all-terrain vehicles on private lands.	Section 3.12
Avoid crossings of resources that are Scenic Byways, Extraordinary Resource Waters, or National Blueways, in areas that may have recreational importance. [A National Blueway designation includes the entire river from its “headwaters to mouth” as well as the river’s watershed (American Rivers 2014).]	Section 3.12
Address use of easement areas for recreational activities such as hiking and camping.	Section 3.12
Socioeconomic Resources	
Evaluate and quantify expected impacts on property and land values along the route.	Section 3.13
Address compensation of land owners along the proposed ROW.	Section 3.13
Describe the economic benefits of the Project to the residents and state of Arkansas.	Section 3.13
Analyze the direct and indirect economic impacts of the proposed route, including to industries such as agriculture, tourism, rice farmers, duck hunting operations (Segments L, L-2, and L-4), and timber farmers.[1]	Section 3.13
Analyze impacts of short and long-term employment associated with the Project.	Section 3.13
Discuss the impacts of the Project on plans for future development and mineral exploration opportunities.	Section 3.13
Discuss how much the Project will cost the state of Tennessee.	Section 3.13
Discuss the impacts of the Project on smaller communities within the Project area that may not be able to absorb the influx of population.	Section 3.13
Traffic and Noise	
Analyze noise emitted by power lines.	Sections 3.4 and 3.11
Consider impacts of noise caused by ROW crews, including the possibility for extended work hours.	Section 3.11
Consider impacts of increased traffic from construction and maintenance, including increase in dangerous conditions and damage to roads.	Sections 3.11 and 3.16
Address road improvements that will be made before, and after, construction of the Project (Segment H; Woodward, Oklahoma).[1]	Section 3.16, Chapter 4
Vegetation	
Identify and address use of BMPs[2] to minimize disturbance to natural resources, including ground cover, hay production, pecan groves, and sensitive plants along the entire route.	Sections 3.2, 3.10, and 3.17

Table 1.5-1:
Issues Identified through Scoping

Resource or Issue Area and Issues to be Analyzed	Location in EIS
Address potential impacts that removal of vegetation would have on impaired water bodies, specifically related to filtering of pollutants.	Sections 3.15 and 3.17
Describe impacts of Project on significant grassland habitat in central Oklahoma (Segment F-8).[1]	Section 3.17
Discuss how vegetation will be managed along the ROW, specifically the use of chemicals and ability of landowners to manage vegetation as they desire (i.e., without the use of herbicides and defoliants).	Sections 3.8 and 3.17
Visual and Aesthetic	
Quantify and evaluate the visual impacts of the Project, including on scenic vistas.	Section 3.18
Describe the impacts to property owners' views that may be impacted by the proposed route.	Section 3.18
Avoid crossings/routes in Arkansas in areas that negatively impact scenic sections of Extraordinary Resource Waters; high quality fisheries; Arkansas Water trails; Arkansas Heritage Trails; and National Blueways; and National Scenic Byways.	Section 3.18
Analyze how the visual impacts of the Project may have negative effects on tourism and recreational activities.	Section 3.18
Discuss design aspects of the Project, including tower structures and distance between towers.	Section 3.18
Discuss impacts created by light pollution.	Section 3.18
Waste Management	
No scoping comments were received in this category.	
Water Resources	
Analyze impacts to water resources including water quality, pollutant sources, load allocations associated with drinking water standards, drinking water sources, wells, springs, wetlands, alluvial aquifers, rivers, streams, creeks, and lakes.	Section 3.15
Discuss impacts to floodplains.	Section 3.19
Discuss impacts to several sensitive, designated, and navigable resources being crossed or in the vicinity of the Project (Segments J, L-4, L-5, and M-5).[1]	Sections 3.15 and 3.19
Discuss impacts to aquifers, specifically in Jackson and Poinsett counties where alluvial aquifer begins at 15 feet below the surface.	Section 3.15
Discuss mitigation measures to protect underground water and water wells.	Section 3.15
Wildlife (including fish and critical habitat)	
Discuss potential for the Project to cause fragmentation of wildlife habitat, including to significant grassland habitat in central Oklahoma.	Sections 3.14 and 3.20
Address the impact to threatened and endangered species, and their habitat, found along the proposed routes, including mitigation and plans to avoid sensitive species.	Section 3.14
Analyze impacts of the Project on migratory bird habitat and flyways (including Mississippi Flyway).	Sections 3.14 and 3.20
Discuss impacts of Project on migrating birds.	Sections 3.14 and 3.20
Proposed routes should avoid lands recognized by the National Audubon Society as Important Bird Areas.	Section 3.20
The route that includes Cedarville, Arkansas, will impact the Ozark Mountains habitat currently protected by a partnership with the U.S. Geological Survey and the Arkansas Natural Heritage Commission.	Sections 1.5 and 2.5
Discuss impacts to old growth forests and the American burying beetle (Segment J).[1]	Sections 3.4 and 4.3
Describe potential impacts to the Cache River National Wildlife Refuge.	Sections 3.10, 3.12, 3.18, 3.20
Discuss impacts to the lesser prairie-chicken.	Sections 3.14 and 4.3

1 Segment identifications are based on the segment letters and numbers for the network of potential routes provided during public scoping (See Appendix E of the Alternatives Development Report (DOE 2013) for more information).

2 Best management practices (BMPs), as used in this table, is a general term used in scoping comments and does not reflect the same meaning as used in the balance of the Final EIS.

Several comments received during the scoping period identified the lack of benefits from the Applicant Proposed Project to residents in Arkansas (e.g., ability to accept increased amounts of renewable energy, tax revenues from property and ad valorum taxes associated with new facilities, and increased number of jobs). As a result of these scoping comments, DOE requested that Clean Line evaluate the feasibility of an alternative that would add a converter station in Arkansas in order to facilitate the delivery of up to 500MW of electricity to the state. The DOE Alternatives evaluated in the Plains & Eastern EIS include a converter station alternative in Arkansas. The details of this converter station alternative are presented in Chapter 2 (Sections 2.1.2.1 and 2.4.3.1).

The development of route alternatives considered the numerous scoping comments on the topic of transmission line routing. The details of the route selection process are provided in Sections 2.3 and 2.4 of the Plains & Eastern EIS and in the DOE Alternatives Development Report (DOE 2013).

1.5.3 Draft Environmental Impact Statement

The Draft EIS analyzed and compared the potential environmental impacts of the Applicant Proposed Project, the range of reasonable alternatives, and the "No Action" alternative. DOE considered all scoping comments received as well as information collected during consultations with state and federal agencies and Tribal governments in the preparation of the Draft EIS. The Draft EIS provided information on the methodologies and assumptions used for the analyses and identified environmental protection measures (EPMs) and BMPs that could prevent or minimize the potential environmental impacts of the Project. CEQ NEPA regulations require that a Draft EIS identify the agency's preferred alternative or alternatives, if one or more exists (see Section 2.14).

EPA published a Notice of Availability in the *Federal Register* (79 FR 78088) announcing the comment period for the Draft EIS. DOE published a separate Notice of Availability for the Draft EIS in the *Federal Register* (79 FR 75132), which included the locations, dates, and times of the public hearings regarding the Draft EIS and identified the methods for submitting comments during the 90-day public comment period. This information was also posted on the Project's EIS website (http://www.plainsandeasterneis.com).

The 90-day public comment period for the Draft EIS began on December 19, 2014, and was scheduled to end on March 19, 2015 (79 FR 78079). On February 12, 2015, DOE announced in the *Federal Register* that it was extending the comment period until April 20, 2015 (80 FR 7850). DOE considered comments submitted after the close of the comment period to the extent practicable.

During the comment period, DOE held 15 public hearings in the following locations: Woodward, Oklahoma; Guymon, Oklahoma; Beaver, Oklahoma; Perryton, Texas; Muskogee, Oklahoma; Cushing, Oklahoma; Stillwater, Oklahoma; Enid, Oklahoma; Newport, Arkansas; Searcy, Arkansas; Marked Tree, Arkansas; Millington, Tennessee; Russellville, Arkansas; Fort Smith, Arkansas; and Morrilton, Arkansas. There were 1,400 people signed in at the 15 meetings for an average sign-in attendance of 93 individuals. Attendance at the meetings ranged from 34 to 273 individuals who signed the registration sheet. Approximately 270 commenters spoke at the 15 public hearings.

Approximately 950 comment documents were received from individuals, interested groups, Tribal governments, and federal, state, and local agencies during the public comment period on the Draft EIS. This total includes a single copy of documents that were received as part of 50 e-mail and letter campaigns (i.e., identical letters signed and submitted by more than one commenter). The total number of campaign documents was approximately 1,700 emails or letters. The comment documents consisted of emails or electronic submittals, hand-ins at the public hearings, campaigns or petitions, comments received through the U.S. mail, and hearing transcripts. The comments contained within these comment documents have been addressed in the Comment Response Document (Appendix Q). Late comments have been considered to the extent practicable. The primary topics raised include, but are not limited to: easement acquisition and property rights, routing issues, and potential health effects associated with electromagnetic fields.

1.5.4 Final Environmental Impact Statement

DOE has prepared this Final EIS, which addresses public comments received on the Draft EIS and includes new information not available at the time of the Draft EIS (e.g., Biological Assessment and draft Programmatic Agreement developed by certain tribes, SHPOs, DOE, and ACHP to address potential adverse effects to historic properties under Section 106 of the NHPA). The environmental analyses have been updated or revised to address the public comments and the introduction of the route variations of the Applicant Proposed Route (see Section 2.4.2). The Final EIS identifies DOE's preferred alternative in Section 2.14. EPA will publish a Notice of Availability of the Final EIS in the *Federal Register*.

1.5.5 Record of Decision

The ROD is the formal agency decision document for the EIS process. DOE's ROD would announce and explain DOE's decision pursuant to Section 1222 of the EPAct of 2005 on whether and under what conditions to participate in the Project and describe any conditions, such as mitigation commitments, that would need to be met. DOE may issue a ROD no sooner than 30 days after EPA's Notice of Availability of the Final EIS is published in the *Federal Register*. The identification of a preferred alternative in an EIS (Section 2.14) does not guarantee that such an alternative will be the alternative selected in DOE's ROD. Rather, identification of the preferred alternative serves to notify the public which alternative DOE currently favors.

1.6 Consultation and Coordination with Federal, State, and Local Governments and Indian Tribes

In addition to the cooperating agencies identified in Section 1.2, DOE contacted Native American Tribes and Nations and federal, state, and local agencies during the DOE EIS scoping process and, in some instances, during the development of the EIS. The agencies and Tribes and Nations that DOE contacted during EIS scoping are listed in Tables 1.6-1 and 1.6-2, respectively, in alphabetical order.

Table 1.6-1:
Agencies Contacted during Scoping

Agency	Agency
Advisory Council on Historic Preservation	Oklahoma Office of the Secretary of Energy
Arkansas Department of Environmental Quality	Oklahoma Tourism and Recreation Department
Arkansas Farm Service Agency	Oklahoma Turnpike Authority
Arkansas Game and Fish Commission	Oklahoma Water Resources Board
Arkansas Governor Beebe's Chief of Staff	St. Francis Levee District, Arkansas
Arkansas Highway and Transportation Department	Tennessee Department of Environment and Conservation
Arkansas Historic Preservation Program	Tennessee Department of Environment and Conservation, Division of Water Resources
Arkansas Natural Heritage Commission	Tennessee Department of Environment and Conservation, Natural Areas Program

Table 1.6-1:
Agencies Contacted during Scoping

Agency	Agency
Arkansas Parks and Tourism	Tennessee Department of Environment and Conservation, Natural Heritage Inventory Program
Arkansas Riverbed Authority	Tennessee Department of Transportation
Bureau of Indian Affairs (Cherokee Nation, Eastern Oklahoma Region, Horton Agency, Pawnee Nation, Southern Plains Region)	Tennessee Historical Commission
Farm Service Agency (Arkansas, Oklahoma, Tennessee)	Tennessee Office of the Governor
Federal Highway Administration (Arkansas, Oklahoma, Tennessee)	Tennessee Valley Authority
Natural Resources Conservation Service (Arkansas, Oklahoma, Tennessee; Eastern Programs Division, Washington, DC)	Tennessee Wildlife Resources Agency
Oklahoma Biological Survey	U.S. Army Corps of Engineers (Little Rock, Memphis, and Tulsa Districts; U.S. Army Corps of Engineers Regulatory Office-Oklahoma)
Oklahoma Conservation Commission	U.S. Coast Guard Tennessee
Oklahoma Department of Agriculture, Food, and Forestry	U.S. Department of Agriculture
Oklahoma Department of Environmental Quality	U.S. Environmental Protection Agency (Regions 4 and 6)
Oklahoma Department of Transportation (Ada and Oklahoma City, Oklahoma)	U.S. Fish and Wildlife Service (Ecological Services Offices in Arkansas, Oklahoma, Tennessee); Central Arkansas National Wildlife Refuge
Oklahoma Department of Wildlife Conservation	Vance Air Force Base Oklahoma
Oklahoma Historical Society State Historic Preservation Office	

Table 1.6-2:
Tribes Contacted during Scoping

Tribe	Tribe
Absentee-Shawnee Tribe of Indians of Oklahoma	Kiowa Indian Tribe of Oklahoma
Alabama Quassarte Tribal Town	Modoc Tribe of Oklahoma
Apache Tribe of Oklahoma	Quapaw Tribe of Oklahoma
Caddo Nation of Oklahoma	Sac & Fox Nation, Oklahoma
Cherokee Nation	Santee Sioux Nation, Nebraska
Cherokee Nation (Real Estate Service)	Seneca-Cayuga Nation
Choctaw Nation of Oklahoma	Cheyenne and Arapaho Tribes
Comanche Nation, Oklahoma	The Muscogee (Creek) Nation—Eastern Oklahoma Region
Delaware Nation, Oklahoma	The Osage Nation
Delaware Tribe of Indians	Thlopthlocco Tribal Town
Eastern Band of Cherokee Indians	Tonkawa Tribe of Indians of Oklahoma
Iowa Tribe of Oklahoma	United Keetoowah Band of Cherokee Indians in Oklahoma
Kaw Nation, Oklahoma	Wichita and Affiliated Tribes, Oklahoma
Kialegee Tribal Town	

As part of these communications, DOE invited the federal and state agencies and Tribes that may attach religious and cultural significance to historic properties that may be affected by the Project to participate, as related to their authority or expertise, in the routing process for the HVDC transmission. DOE sent maps and information regarding potential routes to agencies and these Tribes for review and input during the development of the routing alternatives. Details of each agency and Tribal involvement in the routing process are included in the Alternatives Development Report (DOE 2013).

Indian Tribes and Nations that have agreed to be consulting parties in the Section 106 process are the Absentee-Shawnee Tribe of Indians of Oklahoma, the Cherokee Nation, the Chickasaw Nation, the Choctaw Nation of Oklahoma, the Iowa Tribe of Oklahoma, the Muscogee (Creek) Nation, the Osage Nation, the Quapaw Tribe of Oklahoma, the Sac and Fox Nation, the Thlopthlocco Tribal Town, the United Keetoowah Band of Cherokee Indians in Oklahoma, and the Wichita and Affiliated Tribes (Appendix P). DOE intends to execute the PA prior to issuance of the ROD or otherwise comply with procedures set forth in 36 CFR Part 800.

1.7 Organization of the Final EIS

This EIS examines the potential environmental impacts of the Applicant Proposed Project, the DOE Action Alternatives, and a No Action Alternative, and as explained in Section 3.1, addresses 19 environmental resources.

The EIS is organized into eight chapters with supporting appendices. Chapter 1 describes DOE's purpose and need for agency action, cooperating agency and federal government involvement, Clean Line's objectives, NEPA requirements, and consultation efforts with federal, state, and local governments and Tribes. Chapter 2 includes a description of the Project, alternatives considered, and potential connected actions, and provides a summary of the potential environmental impacts by resource area. Chapter 3 describes the affected environment and potential environmental impacts of the Project. Chapter 4 describes the potential cumulative impacts of the Project. Chapter 5 provides the list of preparers of the EIS. Chapter 6 provides the references used in the preparation of the EIS. Chapter 7 contains a glossary of terms, and Chapter 8 contains an index. Supporting information to the EIS is provided in 17 appendices as listed in Table 1.7-1. The appendices in the Draft EIS were labeled sequentially in the order in which they were cited in the document. These labels have not been changed for the Final EIS, even though new appendices have been added (Appendices M–Q).

Table 1.7-1:
List of Appendices to the EIS

Appendix	Title
Appendix A	Figures
Appendix B	Primary Correspondence between DOE and Federal Agencies
Appendix C	Potential Federal and State Permits and Consultation Required for the Project
Appendix D	Federal Notices
Appendix E	Scoping Summary Report
Appendix F	Project Description
Appendix G	Draft EIS Route Development Process
Appendix H	Construction Emission Calculations
Appendix I	Electrical Effects—Field Calculations
Appendix J	Arkansas Delta Agricultural Economic Impact Study
Appendix K	Visual Contrast Rating Worksheets and Visual Simulations
Appendix L	Reptiles and Amphibians, Mammals, Fish, and Aquatic Invertebrates Potentially Occurring Within the ROI[1]
Appendix M	Route Variations
Appendix N	Floodplain Statement of Findings

Table 1.7-1:
List of Appendices to the EIS

Appendix	Title
Appendix O	Biological Assessment and Addendum
Appendix P	Draft Programmatic Agreement
Appendix Q	Comment Response Document

1 ROI (Region of Influence): To examine the potential impacts of the Project components, the EIS examines the area potentially affected by the Applicant Proposed Project and the DOE Alternatives. The EIS defines the area potentially affected by the Project as the ROI. A description of the ROI is provided in Section 3.1. The ROI may be expanded or modified on a resource specific basis where appropriate as described in each resource section.

This page intentionally left blank.

Contents

Tables

Figures Presented in Appendix A

2. Project Description and Alternatives

2.1 Project Overview

The Applicant Proposed Project would include an overhead ±600 kilovolt (kV) HVDC electric transmission system and associated facilities with the capacity to deliver approximately 3,500MW primarily from renewable energy generation facilities in the Oklahoma and Texas Panhandle regions to load-serving entities in the Mid-South and Southeast United States via an interconnection with TVA in Tennessee. One of the DOE Alternatives (as described in Section 2.4.3) would increase the capacity of the proposed transmission system and facilities by 500MW (to 4,000MW) to facilitate delivery of electricity to the grid in Arkansas. A description of the Applicant Proposed Project's major facilities and improvements is included in Section 2.1.2. Further details and information for each of the Applicant Proposed Project's major facilities, construction procedures, and environmental protection measures (EPMs) are included in Appendix F.

Commonly Used Terms

Throughout the Plains & Eastern EIS, the following terms are used to describe different elements of the proposal being evaluated.

Applicant Proposed Project—Based on Clean Line's modified proposal to DOE,[1] the basic elements include converter stations in Oklahoma and Tennessee, AC interconnections at each converter station, an AC collection system, and an HVDC transmission line from the Oklahoma Panhandle to western Tennessee. The Applicant Proposed Project is described in detail in Sections 2.1.2 through 2.1.7.

Proposed Action—For DOE to participate, acting through the Administrator of Southwestern, in the Applicant Proposed Project in one or more of the following ways: designing, developing, constructing, operating, maintaining, or owning a new electric power transmission facility and related facilities located within certain states in which Southwestern operates, namely Oklahoma, Arkansas, and possibly Texas,[2] but not Tennessee.

Applicant Proposed Route—The single 1,000-foot-wide route alternative defined by Clean Line to connect the converter station in the Oklahoma Panhandle to the converter station in western Tennessee. The analyses of impacts are typically based on a representative 200-foot-wide right-of-way (ROW) within the 1,000-foot-wide corridor. The Applicant Proposed Route is defined in detail in Section 2.4.2.

DOE Alternatives—Pursuant to NEPA, DOE has identified and analyzed potential environmental impacts for the range of reasonable alternatives in addition to the Applicant Proposed Project. These alternatives include an Arkansas converter station and alternative routes for the HVDC transmission line. In each instance, these alternatives have been discussed and evaluated with Clean Line for feasibility. The DOE Alternatives are described in detail in Section 2.4.3.

The Project—A broad term that generically refers to elements of the Applicant Proposed Project and/or DOE Alternatives when differentiation between the two is not necessary. The term also refers to whatever combination of project elements would be built if a decision is made by DOE to participate with Clean Line.

2.1.1 DOE Proposed Action

DOE's Proposed Action is to participate, acting through the Administrator of Southwestern, in the Applicant Proposed Project in one or more of the following ways: designing, developing, constructing, operating, maintaining, or owning a

1 In response to DOE's *Request for Proposals for New or Upgraded Transmission Line Projects under Section 1222 of the Energy Policy Act of 2005.*

2 Depending on AC collection system routes implemented (some of which are in Texas).

new electric power transmission facility and related facilities located within certain states in which Southwestern operates, namely Oklahoma, Arkansas, and possibly Texas.

2.1.2 Applicant Proposed Project Description

The Applicant Proposed Project would include an overhead ±600kV HVDC electric transmission system and associated facilities with the capacity to deliver approximately 3,500MW primarily from renewable energy generation facilities in the Oklahoma and Texas Panhandle regions to load-serving entities in the Mid-South and Southeast United States via an interconnection with TVA in Tennessee.

Major facilities associated with the Applicant Proposed Project consist of converter stations in Oklahoma and Tennessee, an approximate 720-mile, ±600kV HVDC transmission line, an AC collection system, and access roads. The following sections summarize the Applicant Proposed Project's major facilities and improvements.

2.1.2.1 Converter Stations and Other Terminal Facilities

The Applicant Proposed Project includes two AC/ DC converter stations, one at each end of the transmission line. The Applicant proposes to locate a converter station in Texas County, Oklahoma, and a converter station in Shelby County, Tennessee. At each converter station, an AC interconnection to the existing grid would be required. These interconnections would include:

- One double-circuit 345kV AC transmission line connecting to the future Xcel Energy/Southwestern Public Service Co. Optima Substation in Oklahoma
- 500kV AC ties connecting to the TVA Shelby Substation in Tennessee

An additional converter station and associated interconnection facilities in Arkansas are also being evaluated as part of the DOE Alternatives. Information on this alternative is provided in Section 2.4.3.

2.1.2.1.1 Elements Common to the Converter Stations

Some elements are common to all of the converter stations, regardless of location. These elements are described in this section. Elements that are unique to a specific converter station are discussed in Sections 2.1.2.1.2 and 2.1.2.1.3. A converter station would be similar to a typical AC substation, but with additional equipment to convert between AC and DC. Ancillary facilities such as communications equipment and cooling equipment would be required at each converter station. Each converter station would include:

- DC switchyard
- DC smoothing reactors
- DC filters
- Valve hall(s) (which contain the power electronics for converting AC to DC and vice versa)
- Ancillary building(s) (containing control and protection equipment, cooling, etc.)
- AC switchyard
- AC filter banks
- AC circuit breakers and disconnect switches
- Transformers

A typical converter station may require 45 to 60 acres. The AC switchyard would occupy the largest area of the electrical facility within the converter station footprint. There could be up to two buildings (valve halls) to house the power electronic equipment used in AC/DC conversion, each approximately 275 feet long by 80 feet wide. Valve halls protect the converter equipment from ambient conditions and impede the audible noise generated by the equipment. The valve halls could be 60 to 85 feet tall. Additionally, smaller buildings would house the control room, control and protection equipment, auxiliaries, and cooling equipment. Other electrical equipment may be required within the AC portion of the switchyard. Transformers would be located adjacent to the valve hall(s) and surrounded on two sides with concrete fire walls. In addition to preventing a fire in one transformer from spreading to adjacent ones, the walls would also impede audible noise generated by the transformers. The Applicant would utilize a 10- to 20-acre laydown area during construction and post construction as parking and for locating warehousing facilities within the fenced converter station if needed. Figure 2.1-1 (located in Appendix A) shows a typical converter station layout. Tables 2.1-1 and 2.1-2 provide the typical facility dimensions and anticipated land requirements for converter stations during construction and operations and maintenance.

Figure 2.1-2 (located in Appendix A) depicts the potential siting areas under consideration for the converter stations and interconnection facilities for the Project. Figures 2.1-3 and 2.1-4 (located in Appendix A) depict the converter station siting area locations in Oklahoma and Tennessee, respectively.

Typical structures for AC Interconnection include lattice structures and tubular pole structures and their respective dimensions are summarized in Tables 2.1-1 and 2.1-2. The typical pole structures for AC interconnection are depicted on Figures 2.1-5 through 2.1-10 (located in Appendix A).

2.1.2.1.2 Oklahoma Converter Station and Associated Facilities

In addition to the common features described in Section 2.1.2.1.1, the Oklahoma Converter Station would also include the features/facilities as described below. Table 2.1-1 summarizes the facilities, dimensions, and land requirements for the Oklahoma converter station.

The western terminus of the Project would interconnect to the existing transmission system operated by the Southwest Power Pool (SPP) in Texas County, Oklahoma. To facilitate this interconnection, Xcel Energy/Southwestern Public Service Company would construct a new 345kV substation called Optima. A double-circuit 345kV transmission line up to 3 miles in length would be needed to interconnect the proposed converter station with the Optima Substation. The Applicant would use lattice and/or tubular pole structures to support the transmission line.

The double circuit 345kV AC line would consist of an arrangement of three electrical phases per circuit. Each phase would have a two-conductor bundle (two subconductors) in a vertical configuration with approximately 18 to 24 inches of separation between the subconductors. Each conductor would be an approximate 1- to 1.5-inch-diameter aluminum conductor with a steel reinforced core, or a very similar configuration. The exact height of each structure and required vertical clearances would be governed by topography and safety requirements. The Applicant would design minimum conductor height above the terrain, assuming no clearance buffers, per Rule 232D of the 2012 edition of the National Electrical Safety Code (NESC), which requires 25 feet of clearance above general areas and areas with vehicular traffic (for a 345kV AC line). The NESC provides for minimum distances between the conductors and the ground, crossing points of other lines, the transmission support structure, and other conductors on the same structure. The NESC also provides minimum working clearances for personnel during energized operations and maintenance activities (IEEE 2011).

Table 2.1-1:
Oklahoma Converter Station and Associated Facilities Dimensions and Land Requirements

Facility	Construction Dimensions[1]	Operation Dimensions[1]
Converter Station	45 to 60 acres of land would be required for the station, plus an additional 5 to 10 acres for construction.	45 to 60 acres of land would be required for the station; approximately 45 acres would be fenced.
Converter Station Access Roads	All weather access roads 20 feet wide x less than 1 mile long would be required. Construction of the access roads may disturb an area up to 35 feet wide.	20-foot-wide paved roadways.
ROW	One 345kV ROW; 150–200 feet wide x 3 miles long.	One 345kV ROW: 150–200 feet wide x 3 miles long.
345kV—Lattice Structures	Structure assembly area: 150 feet wide (ROW width) x 150 feet long (within ROW) 5 to 7 structures per mile. 3 miles x 6 structures per mile = 18 structures for 345kV AC.	Structural footprint 28 feet x 28 feet (typical for lattice structures) 75 to 180 feet tall; 5 to 7 structures per mile.
345kV—Tubular Pole Structures	Structure assembly area 150 feet wide (ROW width) x 150 feet long (within ROW); 5 to 7 structures per mile.	Structural footprint 7 feet x 7 feet (typical for tubular pole structures) 75 to 180 feet tall; 5 to 7 structures per mile.
AC Interconnection Point	Inside the Xcel Energy/Southwestern Public Service Co., substation that is planned to be built in the future (identified by transmission planning studies as Optima).	Inside the Xcel Energy/Southwestern Public Service Co. substation that is planned to be built in the future (identified by transmission planning studies as Optima).

1 Final design and/or dimensions may differ from typical dimensions expressed here.

2.1.2.1.3 Tennessee Converter Station and Associated Facilities

In addition to the common features described in Section 2.1.2.1.1, the Tennessee converter station would also include the following features/facilities. Table 2.1-2 summarizes the facilities, dimensions, and land requirements for the Tennessee converter station. Based on preliminary designs and studies, this converter station would have a nominal capacity of 3,500MW.

The proposed eastern converter station would interconnect to the existing transmission system operated by TVA at the existing TVA 500kV Shelby Substation, located in Shelby County, Tennessee. Based on TVA's final Interconnection System Impact Study (SIS), TVA would need to make substation and transmission upgrades to accommodate interconnection of the Project to the transmission system in Tennessee. The substation upgrades (also referred to as direct assignment facilities) include additional bays, breakers, switches, line relays, and interchange meters, which would be installed within the Shelby Substation. Network upgrades to the TVA transmission system are described in more detail in Section 2.5.2 and are addressed as connected actions in this EIS.

The 500kV AC ties connecting the Tennessee converter station to the existing Shelby Substation would consist of an arrangement of three electrical phases each with a three-conductor bundle (i.e., three subconductors). Final configuration and design of these interconnection facilities is ongoing as part of the TVA facilities study. Because the Tennessee Converter Station Siting Area would be located adjacent to the existing Shelby Substation (Figure 2.1-4), the 500kV AC ties are expected to be contained entirely within the converter station footprint and the Shelby Substation footprint.

Table 2.1-2:
Tennessee Converter Station and Associated Facilities Dimensions and Land Requirements

Facility	Construction Dimensions[1]	Operation Dimensions[1]
Converter Station	45 to 60 acres of land would be required, plus an additional 5 to 10 acres for construction.	45 to 60 acres of land would be required for the station; approximately 45 acres would be fenced.
Converter Station Access Roads	All weather access roads 20 feet wide x less than 1 mile long would be required. Construction of the access roads may disturb an area up to 35 feet wide.	20-foot-wide paved roadways.
AC Interconnection Point	Inside the existing Shelby Substation	Inside the existing Shelby Substation

1 Final design and/or dimensions may differ from the typical dimensions expressed here.

2.1.2.2 HVDC Transmission Line

The Applicant Proposed Project would transmit energy from the Oklahoma converter station to the Tennessee converter station via an approximate 720 mile ±600kV HVDC overhead electric transmission line. HVDC transmission technology includes the ability for bi-directional power flow, or the flow of power in either direction through the converters. Under normal operating conditions for the Project, power would flow from the wind farms (directly connected to the Oklahoma converter station via the AC collection system) in an eastward direction with power injection in Arkansas (under a DOE alternative) and Tennessee. Because of its unique characteristics as a direct current interconnection, system operators in each of the three states could utilize the Project to help stabilize the regional electric grids by changing the direction of power flow within seconds if necessary. In these rare conditions, power could be injected from the Project to the western SPP in Oklahoma. The power for injection into the Oklahoma grid could come from either of two sources: (1) power generated from the wind farms connected through the AC collection system, or (2) power from the Arkansas or Tennessee electrical grids temporarily flowing westward into Oklahoma.

As part of its Applicant Proposed Project, Clean Line proposed one route for the HVDC transmission line. As required by NEPA, DOE has identified and analyzed other reasonable alternative routes. To simplify and organize the analysis of impacts from the HVDC transmission line, DOE has divided the 720-mile-long transmission line into seven sequential regions, numbered Region 1 to Region 7, and describes impacts from the Applicant Proposed Project by region. All HVDC alternatives, including the Applicant Proposed Route, considered for development and analyzed as part of this EIS are described in Section 2.4 and in the Alternatives Development Report (DOE 2013). As a result of public comments on the Draft EIS, DOE and Clean Line have developed 23 route variations for the Applicant Proposed Route. In all but one instance, Clean Line concluded that the route variations were technically feasible and expressed support for DOE's adoption of these route variations to replace the Applicant Proposed Route that was evaluated in the Draft EIS. DOE has evaluated these route variations both individually and collectively and has concluded that they do not constitute substantial changes in the Proposed Action or significant new circumstances or information relevant to environmental concerns. These route variations are described by region in Sections 2.4.2.1 through 2.4.2.7.

The Applicant would complete final design for the HVDC transmission line after a final route has been identified and subsequent detailed engineering studies and ROW acquisition activities have been completed. The final design and location of the transmission line would be consistent with the project description and analysis contained in this Final EIS. If future deviations from the 1,000-foot-wide corridor analyzed in this Final EIS become necessary, DOE would evaluate those deviations in accordance with DOE's NEPA implementing regulations at 10 CFR 1021.314 to determine whether additional environmental analysis is required.

The regions potentially affected by the HVDC Applicant Proposed Route (and the counties included in each region) are listed in Table 2.1-3. Figures 2.1-17a though 2.1-17f in Appendix A present an illustration of the Project (Applicant Proposed Route and DOE alternative routes). HVDC transmission facilities, which are described in detail in Appendix F, include:

- ROW easements for the transmission line, with a typical width of approximately 150 to 200 feet
- Tubular and lattice steel structures used to support the transmission line
- Electrical conductor (transmission line) and metallic return
- Communications/control and protection facilities (optical ground wire [OPGW], static wire, and fiber optic regeneration sites)

Table 2.1-3:
Counties Potentially Affected by the Applicant Proposed Route

Feature	Length (Miles)	State	Counties
Region 1 (Oklahoma Panhandle)	115.9	Oklahoma	Texas, Beaver, Harper, and Woodward
Region 2 (Oklahoma Central Great Plains)	106.3	Oklahoma	Woodward, Major, and Garfield
Region 3 (Oklahoma Cross Timbers)	162.6	Oklahoma	Garfield, Kingfisher, Logan, Payne, Lincoln, Creek, Okmulgee, and Muskogee
Region 4 (Arkansas River Valley)	126.4	Oklahoma and Arkansas	Muskogee and Sequoyah counties, Oklahoma, and Crawford, Franklin, Johnson, and Pope counties, Arkansas
Region 5 (Central Arkansas)	113.8	Arkansas	Pope, Conway, Van Buren, Cleburne, White, and Jackson
Region 6 (Cache River, Crowley's Ridge Area, and St. Francis Channel)	55.1	Arkansas	Jackson, Cross, and Poinsett
Region 7 (Arkansas Mississippi River Delta and Tennessee)	42.8	Arkansas and Tennessee	Poinsett and Mississippi counties, Arkansas, and Tipton and Shelby counties, Tennessee
Total Length of the Applicant Proposed Route	722.9		

1 These lengths reflect the route variations to the Applicant Proposed Route.

2.1.2.2.1 Right-of-Way

Construction and operations of the HVDC transmission line would require ROW easements, which would typically be 150 to 200 feet wide. The analyses of impacts in Chapter 3 are based on a representative 200-foot-wide ROW within a 1,000-foot-wide corridor. The final transmission line ROW could be located anywhere within the 1,000-foot-widecorridor identified in this Final EIS. The final location would be determined following the completion of the NEPA process, engineering design, and ROW acquisition activities. Determination of this final location is referred to as micrositing. The easement acquisition process is described in Section 2.1.3. Figure 2.1-18 (located in Appendix A) depicts the ROW requirements for the HVDC transmission line.

The width of easements is related to the required clearance distances for the conductors, which are dictated by the NESC. They are directly related to the structure height, span length, and terrain. The width of an easement would be wider than typical where tall structures, longer spans, or terrain demands greater horizontal clearance to maintain safe clearances. To date, the Applicant has identified two locations where the easement would be significantly wider than the typical 150 to 200 feet. These include the Arkansas River and the Mississippi River crossings, where the easement could be as wide as 200 to 550 feet. Preliminary engineering indicates that the easement widths in these two locations are likely to be near the middle of this range.

Section 2.1.3 provides information relating to the acquisition of ROW easements and Section 2.1.5.1 describes restrictions on other uses within the ROW during operations and maintenance.

2.1.2.2.2 Structures

The structures used to support the HVDC transmission line would be constructed using a mix of either tubular (monopole) or lattice steel and would typically range in height from 120 to 200 feet. Preliminary engineering indicates that most structures would be less than 160 feet when lattice structures are used and would tend to be less than 140 feet when monopole structures are used. Structure heights, span lengths, and vertical clearance would be determined in accordance with the NESC, the Applicant's design criteria, terrain and land use, and applicable standards and laws. The Applicant may use taller structures in circumstances where additional clearances and/or longer spans are required. The dimensions and land requirements of typical lattice and monopole structures are summarized in Table 2.1-4 and depicted in Figures 2.1-19 through 2.1-21 (located in Appendix A). In addition to typical structures, there would be limited use of lattice crossing structures (presently planned for the crossing of the Mississippi River and the Arkansas River). These crossing structures would be constructed of lattice steel and could approach 350 feet in height at the Mississippi River crossing and 200 to 250 feet in height at the Arkansas River crossing (up to 200 feet on the western bank and up to 250 feet on the eastern bank) in order to maintain necessary clearance over the navigable channels. There could also be limited use of guyed structures, either tubular or lattice steel.

Table 2.1-4:
HVDC Transmission Line Facility Dimensions and Land Requirements

Facility	Construction Dimensions[1]	Operation Dimensions[1]
ROW	200 feet wide x approximately 720 miles long.	200 feet wide x approximately 720 miles long.
Lattice Structures	Structure assembly area 200 feet wide (ROW width) x 200 feet long (within ROW), 4 to 6 areas per mile (one for each structure).	Structural footprint 28 feet x 28 feet (typical); 120 to 200 feet tall, 4 to 6 structures per mile.
Monopole Structures	Structure assembly area 200 feet wide (ROW width) x 200 feet long (within ROW), 5 to 7 areas per mile (one for each structure).	Structural footprint 7 feet x 7 feet (typical); 120 to 160 feet tall, 5 to 7 structures per mile.
Guyed Structures	Structure assembly area 200 feet wide x 300 feet long with the ROW as necessary in limited situations.	Structural footprint 7 feet x 7 feet typical (does not include guy wire[s]), 120 to 200 feet tall, as necessary in limited situations.
Lattice Crossing Structures	Structure assembly area 200 to 550 feet wide x 300 feet long as necessary in limited situations (e.g., Mississippi River and Arkansas River crossings), assumed within the 1,000-foot-wide corridor.	Structural footprint 64 feet x 64 feet (350-foot-tall version) 200 to 350 feet tall as necessary in limited situations.
Fiber Optic Regeneration Sites	100 feet wide x 100 feet long with one site every 180 to 200 miles (720 miles/1 site every 180 miles = approximately 4 sites), typically outside the ROW (but within 500 feet) and within the 1,000-foot-wide corridor.	100 feet wide x 100 feet long, 75 feet wide x 75-foot-long fenced area, control building 12 x 32 feet and 9 feet tall and within the fenced area, permanent access road to the fenced area, power supply to control building, backup power generator and fuel supply.

1 Final design and/or dimensions may differ from typical dimensions expressed here.

The span length for a transmission line is measured along the centerline between structures. For perspective, a structure spacing of six structures per mile would result in an average span length of 880 feet. At the Arkansas River, preliminary engineering indicates that the span length would be approximately 2,000 feet. At the Mississippi River, preliminary engineering indicates that the span length would be approximately 3,300 feet. These preliminary estimates are subject to change based on final engineering and site conditions (e.g., soil, structural, or geotechnical constraints).

The Applicant would select structure types at locations along the Project ROW based on these and other factors: land use, engineering efficiency, and existing facilities. Generally, the Applicant expects to use lattice structures for longer spans in open and wooded terrain and tubular (monopole) steel structures for spans that are shorter in length. The Applicant anticipates using guyed structures only in open grass or shrub terrain.

The Applicant would use either galvanized or weathering steel structures. Pier foundations, screw piles, caissons, concrete footings, guying, or other appropriate foundations would support the structures based on engineering considerations, cost, and land use. Structures could be directly embedded if loading and soil conditions at a specific site allow for direct burial. The structure footprint would vary by structure type as provided in Table 2.1-4.

The Applicant would complete final design for the HVDC transmission line after a final route has been chosen and subsequent detailed engineering studies and ROW acquisition activities have been completed. The final design and location of the transmission line would be consistent with the project description and analysis contained in this Final EIS. If future deviations from the 1,000-foot-wide corridor analyzed in this Final EIS become necessary, DOE would evaluate those deviations in accordance with DOE's NEPA implementing regulations at 10 CFR 1021.314 to determine whether additional environmental analysis is required. Drawings of the guyed structures are included as Figures 2.1-22 through 2.1-24 (located in Appendix A). A lattice crossing structure is shown in Figure 2.1-25 (located in Appendix A).

Further information and details regarding the HVDC transmission line including conductor types, metallic return, optical ground wire, static wire, communication facilities, and fiber optic regeneration sites are included in Appendix F.

2.1.2.3 AC Collection System

In addition to the HVDC transmission line, the Applicant Proposed Project would also include construction and operations and maintenance of AC collection system transmission lines to collect energy from generation resources in the Oklahoma and Texas Panhandle regions. The collection system would consist of four to six AC transmission lines up to 345kV from the Oklahoma converter station to points in the Oklahoma and Texas Panhandle regions to facilitate efficient interconnection of wind energy generation. Components of the AC collection system include:

- ROW easements for the transmission line, with a typical width of 150 to 200 feet
- Tubular or lattice steel structures used to support the transmission line
- Electrical conductor
- Communications/control and protection facilities (optical ground wire (OPGW), static wire, and fiber optic regeneration sites)

The Applicant expects that the points of interconnection from generation facilities would be located in the Oklahoma Panhandle and the Texas Panhandle, within approximately 40 miles of the Oklahoma converter station. The Applicant based the 40-mile radius on preliminary studies of engineering constraints and wind resource data, industry knowledge, and economic feasibility. Wind energy generation facilities (wind farms) would connect to the AC collection system by way of a number of possible configurations. These configurations could range in size from a direct tap, a bus ring, or even a small substation (about 2 to 5 acres in size) with transformer and switching equipment. The type and size of these AC connections is unknown at this time; the final design of these facilities would depend on a number of factors including their location, the number of connections, and the nameplate capacity and voltage of generation facilities.

Figures 2.1-17a and 2.1-26 (in Appendix A) depict the siting area for the AC collection system in the Oklahoma and Texas Panhandle regions. This EIS refers to possible locations of the AC collector lines as the AC collection system routes. These routes do not represent alternatives for DOE selection. Rather, future development of AC transmission lines within these possible routes would be driven by the locations of wind farms that may be constructed in the future to connect to the Project. Of the 13 possible routes identified, the Applicant anticipates that only 4 to 6 of these routes would be developed (Clean Line 2014b). The counties crossed by the AC collection system routes are provided in Table 2.1-5. Table 2.1-6 provides the typical facility dimensions and land requirements for construction and operations and maintenance of the AC collection facilities.

Table 2.1-5:
Counties Potentially Crossed by the AC Collection System Routes

Route	Length (Miles)	State	Counties
E-1	29.0	Oklahoma	Texas and Beaver
E-2	40.0	Oklahoma	Texas and Beaver
E-3	40.1	Oklahoma	Texas and Beaver
NE-1	29.9	Oklahoma	Texas
NE-2	26.2	Oklahoma	Texas
NW-1	51.9	Oklahoma	Texas and Cimarron
NW-2	56.0	Oklahoma	Texas and Cimarron
SE-1	40.2	Oklahoma	Texas
		Texas	Hansford and Ochiltree
SE-2	13.3	Oklahoma	Texas
		Texas	Hansford
SE-3	49.0	Oklahoma	Texas and Beaver
		Texas	Ochiltree
SW-1	13.3	Oklahoma	Texas
		Texas	Hansford
SW-2	37.0	Oklahoma	Texas
		Texas	Hansford and Sherman
W-1	20.8	Oklahoma	Texas

Table 2.1-6:
AC Collection System Facility Dimensions and Land Requirements

Facility	Construction Dimensions[1, 2]	Operation Dimensions[1, 2]
ROW	Four to six 345kV ROWs each: 150–200 feet wide x extending to the points of interconnection within approximately 40 miles of the converter station, (assumes 300 miles of 345kV for the AC collection system on the western end of the Project).	Four to six 345kV ROWs each: 150–200 feet wide x extending up to 40 miles from the converter station
345kV—Lattice Structures	Structure assembly area 150 feet wide (ROW width) x 150 feet long (within ROW), 5 to 7 structures per mile.	Structural footprint 28 feet x 28 feet (typical for lattice structures) 75 to 180 feet tall, 5 to 7 structures per mile.
345kV—Tubular Pole Structures	Structure assembly area 150 feet wide (ROW width) x 150 feet long (within ROW), 5 to 7 structures per mile, (300 x 6 structures per mile = 1,800 total structures for 345kV AC, it is assumed that half [900] would be monopole).	Structural footprint 7 feet x 7 feet (typical for tubular pole structures), 75 to 180 feet tall, 5 to 7 structures per mile.
345kV H-Frame Structures	Structure assembly area 150 feet wide (ROW width) x 150 feet long (within ROW), 5 to 7 structures per mile.	Structural footprint two poles spaced 25 feet apart each with a 7 feet x 7 feet footprint (typical for H-frame structures) 75 to 180 feet tall, 5 to 7 structures per mile.
Fiber Optic Regeneration Site	100 feet wide x 100 feet long (outside the ROW), approximately 6 sites required, outside the ROW and near the ROW (within 750 feet) but not necessarily abutting the ROW.	100 feet wide x 100 feet wide, 75 feet wide x 75-foot-long fenced area, control building 12 x 32 feet and 9 feet tall, within the fenced area, permanent access road to the fenced area, power supply to control building, backup power generator and fuel supply

1 Final design and/or dimensions may differ from typical dimensions expressed here.
2 The AC collection system transmission lines may not consist of a straight line from the converter station to the wind farms and therefore could be longer than 40 miles.

2.1.2.3.1 Right-of-Way

ROW easements for the AC transmission lines, with a typical width of approximately 150 to 200 feet, would be required. The final AC collection line ROWs could be located anywhere within the 2-mile-wide corridors identified in this Final EIS. The final location would be determined following the completion of the NEPA process, engineering design, and ROW acquisition activities. The ROW requirements for the AC transmission line are depicted on Figure 2.1-27 (located in Appendix A). Restrictions on other uses within the ROW during operations and maintenance are described in Section 2.1.5.1. Section 2.1.3 provides information relating to the acquisition of ROW easements.

2.1.2.3.2 Structures

The structures used to support the AC transmission lines would be constructed of either tubular (monopole) or lattice steel and would generally range in height from 75 to 180 feet. The Applicant would determine structure heights, span lengths, and vertical clearance in accordance with the NESC, the Applicant's design criteria, terrain and land use, and all applicable standards and laws. The Applicant may use taller structures in circumstances where additional clearances and/or longer spans are required based on engineering review.

The Applicant would construct the structures of either galvanized or weathering steel. Pier foundations, screw piles, caissons, concrete footings, guying, or other appropriate foundations would support the structures based on engineering considerations, cost, and land use. Structures could be directly embedded if loadings and soil conditions at a specific site allow for direct burial. The structural footprint would vary by structure type as described in Table 2.1-6 and depicted in Figures 2.1-5 through 2.1-10 (located in Appendix A).

Further information and details regarding the analytical assumptions for the AC collection system including conductor types, metallic return, optical ground wire, static wire, communication facilities, and fiber optic regeneration sites are included in Appendix F.

2.1.2.4 Access Roads

Access roads would be necessary for the Project during both construction and operation. The Applicant intends to maximize the use of existing public and private roads to the extent practicable, improve existing private roads where they are insufficient, and build new roads where existing roads are not available. During construction, use of existing and new roads would be required to access transmission ROWs, structure locations, fiber optic regeneration sites, and temporary construction areas during construction. During operations and maintenance, roads would be used for access to transmission ROWs (for vegetation management and movement of maintenance equipment), structure locations, and fiber optic regeneration sites. The Applicant does not anticipate the need for a new permanent access road along the entire length of transmission line ROWs and would locate access roads between structures in active agricultural areas along fence lines or field lines where practicable to minimize impacts. The Applicant has no plans for improvements to public roads (e.g., highways, state roads, or county roads). The Applicant plans to repair existing private roads before and after construction. Paving of roads would be limited to approach aprons at intersections with existing paved roads and all-weather access roads to converter stations, unless otherwise required by jurisdictional authorities.

Site conditions, engineering design, construction requirements, EPMs, and relevant permits would govern the specific locations of proposed new access roads. The Applicant's road construction standards would comply with the applicable jurisdictions' requirements.

The road types, definitions and the typical access road dimensions during construction and operations and maintenance are included in Table 2.1-7. Typical access roads are depicted on Figure 2.1-28 (located in Appendix A).

As described in Section 2.4 of Appendix F, the Applicant estimated access road miles for the HVDC transmission line (Table 2.1-8) based on preliminary engineering and access planning conducted in 2014. Preliminary engineering and access planning was conducted using assumed structure parameters from preliminary design, assumed span lengths, assumed conductor parameters from preliminary design, LiDAR (light detecting and ranging) data and aerial imagery from the Applicant Proposed Route. Estimated access road miles for the AC collection system and AC interconnection transmission lines (Table 2.1-9) were not based on preliminary engineering nor access planning, but are extrapolations based on quantities of line-miles. The details of this extrapolation are described in Appendix F. The estimated length (by road type within each region) for access roads associated with HVDC lines (which includes those associated with the fiber optic regeneration sites) is provided in Table 2.1-8. The estimated length for access roads associated with AC transmission lines (which includes those associated with the fiber optic regeneration sites) is provided by road type within each state in Table 2.1-9. The Applicant would use existing public roads during construction and operations and maintenance of the Project to the extent practicable, and has no plans for improvements to public roads.

Table 2.1-7:
Access Roads Dimensions and Land Requirements

Road Type	Definition	Construction Dimensions[1]	Operation Dimensions[1]
Existing Roads			
Existing Roads with No Improvements or Repairs (Public or Private Roads)	Existing roads with no improvements or repairs include public roads maintained by local or state jurisdictions. Private roads that can support construction traffic with no improvements or repairs are also included in this category.	Existing roads that require no improvements or repairs would support construction of the Project as is. No road construction or ground disturbance expected.	Existing roads with no improvements or repairs are suitable for operations as is.
Existing Roads that May Need Repairs (Private Roads)	Existing roads that may need repairs include most dirt and unimproved two-track roads on private land (not publically maintained roads), which are generally in a condition that supports construction traffic with repairs in some spots. No improvements to public roads are planned for construction. Examples of repairs would include grading to remove potholes or surface ruts over short distances. In many cases, grading would include reshaping the surface to promote drainage from the travel surface. In some cases, it may be necessary to replenish and re-grade gravel-surfacing material.	Typically, 14-foot-wide travel surface at straight sections and 16 to 20 feet wide at corners. Construction disturbance would typically include a total corridor up to 35 feet wide for these roads in limited areas where repairs are needed. It is assumed that the new disturbance width would be reduced by the width of the existing road (e.g., 35-foot-wide construction corridor – 16-foot-wide existing road = 19-foot-wide new disturbance). In areas with steep side slopes (greater than 15%), the construction disturbance corridor may be up to 50 feet wide.	Repairs to existing roads will be left in place to facilitate access during Project operations and maintenance.
Existing Roads that Need Improvements (Private Roads)	Existing roads that need improvements include private roads along which modifications to alignment, structural improvements, or drainage improvements would be required before they could be used for construction and/or operations and maintenance of the Project. These roads could not support construction traffic without significant upgrades. Examples include private roads that traverse numerous drainages, exhibit severe rutting, or have sharp switchbacks. Structural improvements typically involve excavation and replacement of unstable roadbed with structural embankment fill over geotextile and gravel surfacing.	Typically, 14-foot-wide travel surface at straight sections and 16 to 20 feet wide at corners. Construction disturbance would typically include a total corridor up to 35 feet wide for these roads. It is assumed that the new disturbance width would be reduced by the width of the existing road (e.g., 35-foot-wide construction corridor – 16-foot-wide existing road = 19-foot-wide new disturbance). In areas with steep side slopes (greater than 15%), the construction disturbance corridor may be up to 50 feet wide.	Improvements to existing roads will be left in place to facilitate access during Project operations and maintenance.

Table 2.1-7:
Access Roads Dimensions and Land Requirements

Road Type	Definition	Construction Dimensions[1]	Operation Dimensions[1]
New Roads			
New Overland Travel Roads (no improvements needed) (Private Roads)	Overland-travel roads include routes that are created by direct vehicle travel over low-growth vegetation and do not require clearing or grading. Existing low-growth vegetation would be maintained where practicable. These roads require no preparation prior to use by vehicles and equipment.	Typically, 14-foot-wide travel surface at straight sections and 16 to 20 feet wide at corners. There would be no clearing or grading for these roads. Construction traffic would occur over an area 14–20 feet wide.	The Applicant estimates that 75% of construction roads would be re-used for operations and maintenance access. The remaining 25% would be abandoned and terrain would be restored to the extent practicable.
New Overland Travel Roads with Clearing (Private Roads)	New overland travel roads with clearing include overland travel routes that require clearing and minor grading using heavy machinery to remove larger vegetation or other obstructions in some locations to ensure safe vehicle operation and access.	Typically, 14-foot-wide travel surface at straight sections and 16 to 20 feet wide at corners. Construction disturbance would typically include a total corridor up to 35 feet wide for these roads. In areas with steep side slopes (greater than 15%), the construction disturbance corridor may be up to 50 feet wide.	The Applicant estimates that 90% of construction roads would be re-used for operations and maintenance access. The remaining 10% would be abandoned and terrain would be restored to the extent practicable.
New Bladed Roads (Private Roads)	New bladed roads may be constructed to access structure locations or temporary work areas in steep or uneven terrain. Bladed roads are generally used on side slopes greater than 8% and are shaped to provide drainage. New bladed roads are typically un-surfaced unless required by the applicable jurisdiction, where soil and moisture conditions contribute to surface erosion or rutting.	Construction disturbance for these roads would typically be 35 feet wide (for 90% of the new bladed roads used for the Project). In areas with steep side slopes (greater than 15%), construction disturbance may be up to 50 feet wide. (It is assumed that less than 10% of new bladed roads for the Project would be up to 50 feet wide.)	The Applicant estimates that 90% of construction roads would be re-used for operations and maintenance access. The remaining 10% would be abandoned and terrain would be restored to the extent practicable.
New Temporary Matted or Aggregate Roads (Private Roads)	New matted or aggregate roads are temporary driving surfaces used to access structures or temporary work areas in soft, wet conditions. These would include a timber or composite temporary mat or aggregate underlain by geotextile fabric.	Construction disturbance would typically include a total corridor up to 35 feet wide for these roads.	No roads of this type would be retained for operations and maintenance access.

1 Final design and/or dimensions may differ from typical dimensions expressed here.

Table 2.1-8:
Estimated Access Road Miles by Road Type for HVDC Transmission Lines (by region)

Road Type	1	2	3	4	5	6	7	Totals
Existing Roads that May Need Repairs (miles)	80.5	21.5	42.9	58.3	46.3	32.7	19.4	301.7
Existing Roads that Need Improvements (miles)	2.3	4.5	21.9	20.9	23.6	37.6	14.7	125.6
New Overland Travel Roads (miles)	26.4	44.2	49.4	37.7	1.5	0.3	2.3	161.9
New Overland Travel Roads with Clearing (miles)	20.6	24.3	40.2	19.6	27.6	0.5	3.9	136.9
New Bladed Roads (miles)	3.5	14.9	33.9	41.7	58.6	11.9	4.6	169.1
New Temporary Matted or Aggregate Roads	0	0	0	0	0	21.5	14.1	35.7
Totals (miles)	133.4	109.5	188.4	178.2	157.6	104.6	59.1	930.8
Total Disturbance (acres)	190.7	291.5	500.6	420.6	445.0	240.8	140.6	2,229.8
Road Miles In ROW (percentage)	62	87	71	59	63	51	58	83
Road Miles Outside ROW (percentage)	38	13	29	41	37	49	42	17
Inside ROW (acres)	115.6	267.0	407.6	319.5	366.7	176.7	100.0	1,753.1
Outside ROW (acres)	75.1	24.4	93.0	101.0	78.3	64.2	40.6	476.8

Table 2.1-9:
Estimated Access Road Miles by Road Type for AC Transmission Lines (by state)

Road Type[1]	OK/TX[2]	AR	TN	Totals
Existing Roads that Need Improvements (miles)	4	1	0	5
Existing Roads that May Need Repairs (miles)	145	2	0	147
New Overland Travel Roads (miles)	48	0	0	48
New Overland Travel Roads with Clearing (miles)	38	1	0	39
New Bladed Roads (miles)	7	4	1	12
New Temporary Matted or Aggregate Roads	0	1	0	1
Totals (miles)	243	9	1	253
Total Disturbance (acres)	639.3	28.9	4.4	672.6
Road Miles In ROW (percentage)	85	78	85	
Road Miles Outside ROW (percentage)	15	22	15	
Inside ROW (acres)	543.4	22.6	3.8	
Outside ROW (acres)	95.9	6.4	0.7	

1 AC transmission lines include those proposed for AC interconnection at the converter stations and those proposed for the AC collection system.
2 The column for access road miles represents both Oklahoma and Texas and is not further segregated since the locations of the actual AC transmission lines for the AC collector system are not yet known and would be determined based on the locations of future wind farms.

2.1.3 Easements and Property Rights

Prior to construction, the Applicant or DOE, if it elects to participate in the Project, would acquire property interests from owners of land along the path of the Project. These interests could take the form of a temporary easement to allow for access roads and storage yards that will be needed during construction. They could also take the form of longer term easements or fee estates (i.e., full ownership), for siting transmission line structures, converter stations, and other facilities. The acquisition of these property interests would not in themselves result in any environmental impacts. Any potential environmental impacts to these property interests would be associated with the land use and activities that would occur within the ROW, which are evaluated in this EIS.

Any property interests in land needed for the Project would be acquired through a negotiated sale or eminent domain proceedings, where the land owners would be compensated for their property interests. According to the Applicant's expressed intent, the first step would be for the Applicant to offer compensation to landowners in exchange for easements or other property interests needed for the Project. If the Applicant is unable to acquire the necessary property interests from a landowner through a negotiated agreement, DOE may choose to acquire those property interests through a negotiated agreement for compensation. Where a negotiated agreement is not possible, DOE, acting through Southwestern, may in appropriate circumstances exercise the federal government's eminent domain authority to acquire the interests. Consistent with the Constitution of the United States and other applicable law, the landowner would be paid just compensation for the real estate interest. Real estate acquisition by federal entities, such as DOE, is governed by the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646) (42 USC 4601 et seq.). DOE must also comply with 49 CFR Part 24, Subpart B, "Real Property Acquisition," the government-wide regulation that implements Public Law 91-646.

2.1.4 Proposed Project Construction

This section provides an overview for typical construction activities associated with different elements of the Project. A detailed description of construction of the converter stations, HVDC and AC transmission lines, AC collection system, and access roads is provided in Appendix F. Appendix F also provides estimates of the construction workforce, crew types (based on construction activities), crew numbers, average daily production rates per crew, construction equipment, local traffic from construction, and local vs. non-local workers.

The Applicant would implement the EPMs listed in Appendix F to avoid or minimize potential impacts from construction of the Project. Construction activities described in Appendix F would incorporate and be subject to the EPMs as well as measures/requirements imposed as part of federal or state permits and authorizations. The implementation and monitoring of these EPMs are discussed in Section 3.1 of the Plains & Eastern EIS.

The construction of a typical converter station would include:

- Land surveying and staking
- Pre-construction surveys for biological and cultural resources
- Clearing and grubbing, grading, and construction of all-weather access roads
- Fencing
- Compaction and foundation installation
- Installation of underground electrical raceways and grounds
- Steel-structure erection and area lighting
- Installation of insulators, bus bar, and high-voltage equipment
- Installation of control and protection equipment
- Placement of final crushed-rock surface
- Installation of security systems, including cameras
- Testing and electrical energization

The construction of a typical converter station would begin with survey work, geotechnical sample drillings, and soil resistivity measurements. The site-development work would include grubbing and reshaping the general grade to form a relatively flat working surface. This effort also would include the construction of all-weather access roads. The Applicant would erect a chain-link fence (8 to 10 feet tall) around the perimeter of the station to prevent unauthorized personnel from accessing the construction and staging areas. The perimeter fence would be a permanent safety feature to prevent the public from accessing the station. The Applicant would compact the excavated and fill areas to the required densities to allow structural foundation installations. Following the foundation installation, underground electrical raceways and copper ground-grid installation would take place, followed by steel-structure erection and area lighting. The steel-structure erection would overlap the installation of the insulators and bus bar as well as the installation of the various high voltage apparatus (typical of an electrical substation). The installation of the high voltage transformers would require special high-capacity cranes and crews (as recommended by the manufacturer) to be mobilized for the unloading, setting-into-place, and final assembly of the transformers. Construction of a single converter station is estimated to take 32 months. The construction personnel peak is estimated to be 242 workers, and the average over the construction duration is estimated to be 138 workers.

Construction activities for the HVDC and AC transmission lines would typically include the following activities:

- Preparation of multi-use construction yards
- Pre-construction surveys for biological and cultural resources
- Preparation of the ROW
- Clearing and grading
- Foundation excavation and installation
- Structure assembly and erection
- Conductor stringing
- Grounding
- Cleanup and site restoration

Figure 2.1-29 located in Appendix A illustrates these activities and the typical transmission construction sequence.

The duration of construction is expected to be approximately 36 to 42 months for the entire Project, including the time from initiation of clearing and grading through cleanup and restoration. The actual construction duration would depend on a number of factors such as weather and availability of labor. The Applicant would most likely divide the construction of the HVDC transmission line into several segments with multiple contractors working concurrently on different portions of the route to accomplish the Project's construction schedule and to maintain effective management of construction activities and allocation of resources. For the purposes of estimating resource needs for construction, the Applicant has assumed that the HVDC transmission line would be divided into five construction segments of approximately 140 miles in length. The Applicant would construct the four to six AC collection lines that would range in length from 13 to 56 miles, depending on the routes required (based on the location of future wind farms) (see Table 2.1-5). The construction crews would complete each of the individual activities required for construction along each segment in assembly line fashion (see Figure 2.1-29 in Appendix A and Appendix F). Construction may be active on any or all segments at any given time and activities may occur in parallel with other segments or staggered.

The Applicant expects that the duration of construction for either a single HVDC segment or the complete AC collection system would be approximately 24 months from mobilization of equipment to site restoration. The construction personnel peak for the AC collection system would be approximately 428 workers, and the average over the construction duration of the AC collection system would be approximately 305 workers. The construction personnel peak in any HVDC segment would be approximately 290 workers and the average over the construction duration of one HVDC segment would be 207 workers. The peak would occur when the structure setting operations begin, while several other operations are occurring at the same time. The size, number, and average daily production of each crew type are included in Appendix F, along with an estimate of construction workforce over time. The Applicant would stage construction on each segment of the HVDC transmission line and the AC collection system from multi-use construction yards located at regular intervals (approximately every 25 miles) along the route.

Project-wide, the workforce would reach a peak of approximately 2,431 workers. The average workforce across the Applicant Proposed Project would be approximately 1,260 people during an assumed 36-month construction duration.

2.1.4.1 Temporary Construction Areas

Temporary construction areas would be required to support construction. Temporary multi-use construction yards and fly yards (landing areas for helicopters used during construction) would be used for staging construction personnel and equipment, and for storage of materials to support construction activities. Tensioning or pulling sites and wire-splicing sites (described in more detail below) would also be staged at 2- to 3-mile intervals along the Project ROW. Typically (with the exception of tensioning or pulling sites addressed below), temporary construction areas would be outside the ROW. These areas would be sited at regular intervals and at convenient distances (described below) from the facilities being constructed for the Project.

2.1.4.1.1 Tensioning or Pulling Sites

Tensioning or pulling sites are temporary construction areas located adjacent to certain structures. These sites contain the stringing equipment required to pull conductor through a series of structures or tension conductor that has already been pulled such that the required conductor sag between structures is achieved. Because the stringing equipment needs to be located a sufficient distance away from structures during pulling or tensioning, these sites can extend up to 650 feet from the base of a structure. Tensioning or pulling sites would typically be approximately 2 to 3 miles apart to accommodate the maximum distance of a single conductor pull. Land requirements for typical tensioning or pulling sites (listed in Appendix F) would be either entirely within the ROW or partially outside the ROW, depending on the structure’s turning angle and type (e.g., mid-span or deadend). Where the transmission line turns, the tensioning or pulling sites may extend outside the ROW to maintain a straight line with the ground wire and conductor being pulled as shown in Figure 2.1-30 (located in Appendix A). Based on the Applicant’s preliminary engineering, approximately 755 pulling or tensioning sites would be required for the HVDC transmission line. Approximately 230 acres outside the ROW would be required for these tensioning or pulling sites. Approximately 200 pulling or tensioning sites would be required for the AC collection system. Approximately 64 acres outside the ROW would be required for these AC collection system tensioning or pulling sites.

2.1.4.1.2 Multi-use Construction Yards

Multi-use construction yards would be used primarily for staging of construction personnel and equipment and for material storage to support construction activities (Figure 2.1-31 in Appendix A). The Applicant would locate multi-use construction yards outside the ROW and typically at intervals of approximately 25 miles. Additionally, they would be located within approximately 10 miles of the ROW or Project facility. Typical multi-use construction yards would be approximately 25 acres in size, fenced, and access-controlled.

The Applicant may arrange individual multi-use construction yards differently, but typical sites would include areas designated for a field office, crew parking, sanitation, waste management, fueling, equipment wash, material storage, equipment storage, and fly yard. The Applicant would base fuel trucks, maintenance trucks, and construction crews in multi-use construction yards. The Applicant would store any fuel, lubricants, antifreeze, detergents, paints, solvents, and/or other chemicals used during construction at the multi-use construction yards consistent with standard practices and relevant permits.

To the extent practicable, the Applicant has committed to employ site-selection criteria to determine preferred locations for the multi-use construction yards; exceptions are noted below. The site-selection criteria for both temporary multi-use construction yards and fly yards include:

- The Applicant would prefer site multi-use construction yards on previously disturbed, privately owned parcels (e.g., vacant industrial yards, commercial lots) or on other such suitable parcels.
- Sites would be located in a manner to minimize conflict with nearby and adjacent land uses.
- Sites would have good access to public roads.
- Sites would be relatively flat.
- Sites would be selected for their relative ease of restoration.

Portable concrete batch plants would be located within multi-use construction yards where needed. Concrete would be required for construction of foundations for transmission structures, foundations for transformers and electrical equipment at converter stations, and foundations at fiber optic regeneration sites. Concrete would be delivered to structure sites and ancillary facilities in concrete trucks with a capacity of up to 10 cubic yards. The Applicant would obtain concrete from commercial ready-mix concrete producers to the extent practicable. In locations where haul times exceed 45 minutes (a haul distance of approximately 25 to 30 miles), concrete would be dispensed from portable concrete batch plants located within a multi-use construction yard. Based on preliminary review of commercial ready-mix plants in proximity to the Project, the Applicant may require up to four temporary batch plants for the HVDC transmission line and two for the AC collection system (where the haul distance may exceed 25 to 30 miles).

2.1.4.1.3 Fly Yards

The Applicant would use helicopters for conductor stringing operations and/or for transport and erection of structure sections during construction. The Applicant would locate helicopter landing areas (fly yards) at approximately 5-mile intervals along the ROW. Approximately 20 percent of fly yards would be collocated within multi-use construction yards. All other fly yards would be located near the ROW. Typical fly yards would be approximately 5 acres or less in size.

The Applicant may arrange individual fly yards differently, but typical sites would include areas designated for helicopter landing, crew parking, sanitation, waste management, refueling, and temporary material staging. Fly yards would be operated and maintained consistent with standard practices and relevant permits. To the extent practicable, the Applicant would employ the same site selection criteria for fly yards as provided in Section 2.1.4.1.2 for multi-use construction yards.

2.1.4.1.4 Wire Splicing Sites

Typically, wire-splicing sites would be located within the ROW. Conductors and shield wires (wires) are strung into their supporting structures over a length of two reels. The wire from the two reels would be mechanically joined at the wire ends with a temporary steel wire-gripping sleeve (stringing sock) which would pass through the stringing blocks. After the wire is strung and secured, the stringing sock would be replaced with a compression splice connector. The splice connector installation would occur at the wire splicing site. Typical wire splicing sites include a wire splicing truck and a line truck to facilitate installation.

2.1.4.1.5 Fiber Optic Cable Regeneration Sites

As a data signal passes through fiber optic cable, it degrades with distance. This data signal must be regenerated or amplified every 180 to 200 miles at fiber optic regeneration sites. The facilities and land requirements for a regeneration site are shown in Figure 2.1-32 (located in Appendix A). Fiber optic cable would be buried using the two basic methods of direct burial installation: trenching and plowing. Trenching involves digging a trench, placing the cable in the trench, and backfilling with native soils. Trenches are often dug with backhoes using narrow buckets (18 inches wide or less) to a depth of approximately 42 inches and are visually inspected for rocks or debris that could potentially damage the cable. In some instances, conduit is laid in the trench and the cable pulled through the conduit. Plowing involves a cable-laying plow designed to simultaneously excavate a ditch and lay the cable. Native soil would be used to backfill the trench.

2.1.5 Operations and Maintenance

All transmission lines would be inspected regularly or as necessary using fixed-wing aircraft, helicopters, ground vehicles, all-terrain vehicles, and/or personnel on foot. The frequency of inspections and maintenance would be meet or exceed standards, such as those specified by the NESC and North American Electric Reliability Corporation (NERC). Applicable federal, state, and local permits would be obtained prior to conducting maintenance. Maintenance activities for facilities would be similar to activities during construction but generally smaller in scale and more localized.

The ROW would be maintained during operations and maintenance in accordance with a Project-specific Transmission Vegetation Management Plan that would be developed by the Applicant, consistent with rules developed by NERC. A wire zone (Figures 2.1-18 and 2.1-27 located in Appendix A) typically consists of low-growing grasses, legumes, herbs, crops, ferns, and shrubs where the conductor is 50 feet or less from the ground to prevent accidental grounding contact with conductors. A border zone (i.e., to the edge of the ROW) is managed to consist of tall shrubs or short trees (up to 25 feet in height at maturity), grasses, and other low-growing vegetation. In most areas, accepted standard utility practices consistent with the Transmission Vegetation Management Plan, such as tree-trimming, tree removal, and/or brush removal, would be utilized to maintain vegetation within the ROW. In addition, vegetation clearing practices may vary based on dominant plant communities.

The Applicant expects that operations and maintenance of the Project would require 72 to 87 full-time workers. This would include up to 15 workers at each of the converter stations and 42 workers in Oklahoma and Arkansas for the HVDC transmission line.

2.1.5.1 Permitted Uses within the Right-of-Way

Land uses compatible with reliability and safety requirements for HVDC and AC facilities would be permitted in and adjacent to the ROW. Existing land uses such as agriculture and grazing, vehicle and pedestrian access, recreation uses, and pre-existing compatible land uses are generally permitted. Incompatible land uses within the ROW include construction and maintenance of inhabited dwellings and any use requiring changes in surface elevation that affect electrical clearances of existing or planned facilities.

Good utility practice, NERC rules, and the planned design, maintenance, and operations of the line were used to develop height restrictions of activities within the ROW that would maintain the minimum clearance requirements as determined from the NESC. Once a route has been established, the Applicant would review the route for non-standard activities that may require adjustments to minimum clearances.

Limitations on land uses would be described in the easement agreements; these limitations could be modified in the easement based on site-specific conditions and/or coordination with landowners. For example, limitations on uses within the ROW could include the following:

- A prohibition on placing a building or structure within the ROW
- Restrictions on timber or the height of orchard trees within the ROW
- Restrictions on grading and land re-contouring within the ROW that would change the ground surface elevation within the ROW such that required electrical clearances are no longer maintained
- Restrictions and/or required coordination for the construction of future facilities such as fences and/or irrigation lines within the ROW
- Restrictions on access for safety considerations where maintenance activities are being performed

Restrictions on land use within the ROW would be determined based on site-specific conditions and/or in coordination with landowners. These are not blanket limitations or restrictions that would apply to every parcel associated with the Project. For example, the Applicant recognizes that agricultural areas are graded, contoured, and ditched as part of routine agricultural practices. These types of routine practices are compatible with the reliability of the HVDC and AC facilities and would not be restricted. Similarly, the Applicant has no intent to displace or prohibit livestock grazing in pastures overlapped by the ROW during construction, operations or maintenance, unless otherwise desired by the landowner. The Applicant anticipates that livestock would continue grazing during the construction and operations and maintenance phases of the Project.

To illustrate the typical activities, restrictions, and temporal nature of construction, the Applicant has developed the *Example of Typical Construction Activities on Agricultural Property* (included in Appendix F), which describes a typical construction sequence that could occur on a single parcel.

Construction EPMs (further described in Section 2.1.7) would be implemented and carried forward into the operations and maintenance phase. For example, the Applicant would work with landowners to develop compensation for lost crop value caused by operations and maintenance activities. To avoid the potential of operations and maintenance activities resulting in loss of or injuries to livestock, the Applicant would continue to coordinate with landowners regarding access controls (e.g., cattle guards, fences, gates).

2.1.5.2 Safety and Reliability

Safety and reliability of the transmission system are primary concerns. The Project would be designed to meet or exceed applicable criteria and requirements outlined by organizations such as the Federal Energy Regulatory Commission (FERC), NERC, NESC, SPP, TVA, the American Society of Civil Engineers, and other applicable federal, state, or local requirements. Safety measures would meet or exceed applicable occupational safety and health standards. The transmission line would be protected with circuit interruption equipment (circuit breakers, disconnects, etc.). If the conductor were to fail, power would be automatically removed from the line. Lightning protection would be provided by overhead ground wires. Electrical equipment and fencing at the converter stations and substations would be grounded. Vegetation management would occur to minimize potential hazards; trees would be trimmed or removed to prevent accidental grounding contact.

As is done with typical transmission line operations, the Applicant would turn over functional control of the Project to a Regional Transmission Organization (RTO)/Independent System Operation (ISO) or an RTO-like entity. For the Project, this could include SPP, TVA, or a third party. Functional control of a facility means that the RTO ensures the Applicant's tariff is administered transparently. In addition, a NERC compliance program would be established and maintained either by the Applicant or by a third party to which the compliance requirements are delegated. Coordination agreements—also known as seams agreements—would be negotiated and executed with all interconnection parties. Balancing area functions would be performed by the Applicant or a third party acting as the Transmission Operator on behalf of the Applicant.

2.1.6 Decommissioning

Decommissioning could occur at the end of the useful life and if the facilities were no longer required. However, a transmission system lifetime can exceed 80 years with proper maintenance. At the end of the service life of the Project, assuming that the facilities were not upgraded or otherwise kept in service, conductors, insulators, and structures could be dismantled and removed. The converter stations and regeneration stations, if not needed for other existing transmission line projects, could also be dismantled and removed. The station structures would be disassembled and either used at another station or sold for scrap. Access roads that have a sole purpose of providing maintenance crews access to the transmission lines could be decommissioned following removal of the structures and lines, or could be decommissioned with the lines in service if determined to no longer be necessary. The Applicant would consult with landowners to assess whether access roads may be serving a purpose for landowners, at which point in time, the Applicant may elect to leave the access roads in place. A Decommissioning Plan would be developed prior to decommissioning and would follow applicable governing requirements at that time.

2.1.7 Environmental Protection Measures

For the purpose of all analyses for the EIS, it is assumed that the Applicant would conduct each phase of the Project in compliance with applicable federal, state and local laws, regulations and permits related to construction, operations and maintenance and decommissioning of the Project. Appendix C presents an overview of potential federal and state permits and consultation that could be required for construction of the Project. Local permits and approvals could also be required for the Project.

The Applicant has developed general and resource-specific EPMs to avoid or minimize effects to environmental resources during construction, operations and maintenance, and/or decommissioning of the Project. The Applicant would identify certain areas as "environmentally sensitive" and implement relevant EPMs to avoid and/or minimize adverse effects on these identified areas to the extent practicable. Environmentally sensitive areas may include wetlands, certain water bodies, cultural resources, and wildlife habitat. The general EPMs (General Measures GE-1 through GE-31) are designed to minimize environmental impacts across multiple resources. Other General Measures EPMs address avian mortality, vegetation management, herbicide use, transportation, road maintenance, hazardous materials, and other topics of concern. The resource-specific EPMs include measures to protect land use; soils and agriculture; fish, vegetation, and wildlife; and waters, wetlands, and floodplains. The complete list of EPMs is presented in Appendix F. The EPMs would be made binding through the ROD and terms of Participation Agreements between DOE and the Applicant. The EPMs would be implemented through a combination of environmental-related plans; compliance with federal, state, and local environmental regulations; and permitting requirements. The specific environmental-related plans that the Applicant has identified and described in Appendix F include:

- Transportation and Traffic Management Plan
- Blasting Plan
- Restoration Plan
- Spill Prevention, Control and Countermeasures Plan
- Stormwater Pollution Prevention Plan
- Transmission Vegetation Management Plan
- Avian Protection Plan
- Construction Security Plan
- Cultural Resources Management Planning Documents including Historic Properties Treatment Plan and Unanticipated Discoveries Plan

2.2 Transmission System Planning Processes

2.2.1 System Planning, Interconnections and Reliability

This section explains the processes applicable to the Applicant’s requests for interconnections to the existing electrical grid, including the study and assessment of the upgrades and improvements needed for such interconnections. The details of the interconnections are provided in Sections 2.1.2.1.2, 2.1.2.1.3, and 2.4.3.1 for Oklahoma, Tennessee, and Arkansas, respectively. These interconnections are an integral part of the Project. The details of any required upgrades to the transmission systems in these states are provided in Section 2.5.2. These upgrades are being evaluated as connected actions. The Applicant’s execution of interconnection agreements (which establish the basic terms and conditions of the interconnection but neither commit Clean Line to build the project nor to identify a specific route) with the two regional transmission organizations and TVA would neither have adverse environmental impacts nor limit the choice of reasonable alternatives.

2.2.1.1 Oklahoma/SPS/SPP Interconnection

Clean Line requested a Point of Interconnection in Oklahoma at the 345kV Hitchland Substation. This substation is owned by Southwestern Public Service (SPS), a subsidiary of Xcel Energy and member of the SPP RTO. This interconnection would be necessary to enable the AC to DC conversion process within the Oklahoma converter station. The interconnection between the proposed Oklahoma converter station and the SPS system would be controlled to a nominal value of zero megawatts.

For Clean Line to interconnect to the SPS system, a series of studies must be performed to review the potential interconnection and identify any upgrades to existing facilities or additions of new facilities to allow a reliable interconnection. SPS has completed a facilities study of the requested interconnection to the SPS 345kV system. Based on the SPS analysis, a new substation would be necessary to accommodate the interconnection due to space constraints at the existing Hitchland 345kV substation. To alleviate these space constraints, SPS has proposed a new substation nearby, tentatively named “Optima.” The interconnection of the Oklahoma converter station to the new substation would be facilitated by a new, approximately 3-mile-long double-circuit 345 kV transmission line. Clean Line’s selected HVDC vendor will incorporate the facilities study results into its study work on the final converter station design. This final study work will identify specific technology solutions such as reactive power requirements and filter design that would be included in the final converter station design. In the future, Clean Line anticipates that it would enter into an interconnection agreement with SPS and SPP for the Project.

For the purpose of ensuring integration of the Project into the SPP transmission planning process, and to ensure that the interconnection of the Project would not affect the security or reliability of the SPP system, Clean Line contracted Siemens PTI to conduct steady-state and dynamic power system studies to comply with SPP planning requirements under SPP Criteria 3.5. Clean Line and Siemens PTI presented the results of these studies to the SPP Transmission Working Group and SPP staff for review. Excel Engineering, an external consultant hired by SPP, reviewed the results and confirmed that Siemens PTI’s studies were complete and correct. In November 2012, the SPP Transmission Working Group found that Clean Line’s reliability study was “consistent with SPP planning processes and as having met [the Project’s] coordinated planning requirements under SPP Criteria.” The SPP Transmission Working Group indicated that Clean Line may need to update the study after selection of a vendor for the Project. These updates would ensure that the final design of the HVDC converter station complies with criteria set forth in the final interconnection agreement.

2.2.1.2 Arkansas/Entergy/MISO Interconnection

In response to comments received during the public scoping process, an intermediate converter station in Arkansas is being considered as a DOE Alternative (see Section 2.4.3.1). An AC interconnection would be required to deliver power from the intermediate converter station to the existing transmission system owned by Entergy Arkansas, a subsidiary of Entergy Corporation. Entergy Arkansas is part of the Mid-Continent Independent System Operator (MISO) system. Clean Line submitted the interconnection request to MISO in November 2013. Under MISO rules, interconnection requests involve three parties: the system operator (MISO), the transmission owner (Entergy Arkansas), and the interconnecting customer (Clean Line).

Clean Line began the interconnection process in Arkansas by requesting interconnection service from Entergy Arkansas for up to 500MW along the existing Arkansas Nuclear One-Pleasant Hill 500kV transmission line. Clean Line identified and proposed an AC interconnection consisting of a new 500kV transmission line connecting the proposed intermediate converter station to a new substation along the Arkansas Nuclear One-Pleasant Hill 500kV transmission line. Clean Line selected the Arkansas Nuclear One-Pleasant Hill 500kV Point of Interconnection to accommodate a 500MW injection. MISO performed a feasibility study of the request and delivered results to Clean Line in February 2014. The purpose of this feasibility study was to identify the cost to Clean Line to enter into the Definitive Planning Phase, which consists of several steps that include a system impact study and an interconnection facilities study. These studies would begin to identify the upgrades required to MISO’s system, if any, and the next steps for Clean Line to proceed with the Project.

In April 2015, MISO began the Definitive Planning Phase. The interconnection SIS and facilities study are anticipated to take six months in total to complete. Following completion of the Definitive Planning Phase process, Clean Line would enter into an interconnection agreement with Entergy Arkansas and MISO.

2.2.1.3 Tennessee Valley Authority Interconnection Process

Clean Line requested interconnection service in Tennessee at the TVA Shelby 500kV substation for interconnection of up to 3,500MW of power. To place this level of power injection in perspective, it is slightly higher than the generating capacity of TVA's three-unit Browns Ferry Nuclear Plant, and is described by Clean Line as capable of supplying electricity for over a million homes. Clean Line originally requested interconnection in late 2009, at which time TVA performed feasibility studies on the following three potential options: 500kV Shelby Substation, a combination of the TVA Cordova 500kV and Weakley 500kV substations, and a new substation that would have connected the Shelby–Lagoon Creek and Cordova–Haywood 500kV transmission lines. Based on studies of these options, Clean Line pursued interconnection at the Shelby Substation.

The final interconnection SIS, completed in March 2014, identified direct assignment facilities and network upgrades associated with the Project. Direct assignment facilities included additional bays, breakers, switches, line relays, and interchange meters to be installed within the Shelby Substation before interconnecting the Project. Direct assignment facilities are required to be constructed and in operations to facilitate the physical interconnection of the Project and are therefore analyzed as part of the Project. The ROI (defined in Section 3.1.1) for direct assignment facilities would occur within the Shelby Substation.

Network upgrade projects are those that TVA identified that would allow injection of up to 3,500MW to the TVA transmission system. Per TVA, some network upgrades may be constructed after initial energization of the interconnection. The interconnection SIS identified scenarios that would be resolved by 30 network upgrades, including upratings, reconductoring, and terminal upgrades on 27 existing 161kV system elements and 3 existing 500kV system elements. The interconnection SIS also identified certain reliability scenarios that would be resolved by a new 500kV transmission line and associated substation upgrades. Following good utility practice, in accordance with a final interconnection agreement, and depending on the results of a facilities study, Clean Line may be asked to operate the Project in a way that restricts its full delivery capacity under some limited scenarios until completion of certain network upgrade projects. It should be noted that the ROI for the direct assignment facilities would occur within the Tennessee Converter Station Siting Area. The ROI for the network upgrades, and in particular TVA's future 500kV transmission line, cannot be fully determined at this time. Additional details regarding these system upgrades are presented in Section 2.5.2.

The next step in the interconnection process is the performance of a facilities study in which TVA will determine the detailed designs, costs, and projected schedules for the identified direct assignment facilities and network upgrade projects. The facilities study, which is currently underway, will include a transient stability analysis, which could identify additional network upgrades. TVA anticipates the facilities study work will be complete in 2016. Following completion of the facilities study, Clean Line would negotiate an interconnection agreement with TVA.

In addition, given the regional connection of the Shelby Substation to nearby transmission systems operated by other parties, TVA identified the need for two Affected System Impact Studies (ASIS) to evaluate any impacts from the injection of up to 3,500MW into the electric grid. Memphis Light, Gas and Water completed the first ASIS, which showed the need for two wavetraps (terminal equipment) at an existing 161kV substation. MISO conducted the second ASIS, showing no need for modifications to its system to accommodate the Project's TVA interconnection.

Prior to providing service as a wholesale interstate electric transmission utility in the state of Tennessee, Clean Line must obtain a certificate of public convenience and necessity (CCN) from the Tennessee Regulatory Authority (TRA) for the Project (Tennessee Code Annotated 65-4-201 and 208). Clean Line submitted an application for the CCN in April 2014 (Clean Line 2014a). To obtain the CCN, Clean Line must show that it has the managerial, technical, and financial ability to operate as a utility within the state of Tennessee, and Clean Line must also show that granting a CCN for the construction of the portion of the Project in Tennessee would serve the public interest. In January 2015, the TRA granted without restriction Clean Line's Petition for a CCN to construct and operate electric transmission facilities in the state of Tennessee (TRA 2015).

2.3 Route and Alternative Development

This section briefly describes the process used to identify the proposed locations for each of the Applicant Proposed Project components and alternative routes for the HVDC transmission line. DOE independently reviewed and verified the Applicant-supplied information (per 40 CFR 1506.5[a]).

2.3.1 HVDC Route Development

Clean Line employed a multi-disciplinary team of professionals (referred to as the Clean Line Routing Team) to undertake the route identification process for the HVDC transmission line. Clean Line used a multi-stage approach to develop guidelines and criteria and to apply these guidelines and criteria to identify corridors and refine them. At each stage, Clean Line incorporated public stakeholder input on the development of criteria and the identification of corridors and routes. The Clean Line Routing Team began by identifying potential interconnection locations at the western and eastern endpoints of the Project (DOE 2013). Using these endpoints, the Clean Line Routing Team conducted a route development process that used progressively more detailed and restrictive siting criteria. Through this process, Clean Line identified the proposed converter station siting areas, the Applicant Proposed Route, and route alternatives for the HVDC transmission line.

The Clean Line Routing Team considered and utilized guidelines and criteria consistent with transmission line siting principles used by federal entities such as the Rural Utilities Service, Western, and Bonneville Power Administration. These principles included identification of opportunity areas (e.g., existing linear corridors, areas of land consistent with or compatible with linear utilities, etc.) and sensitive resources that limited or conflicted with transmission line development (e.g., residences, schools, USFWS-designated critical habitat under the Endangered Species Act, etc.).

The Clean Line Routing Team applied general and technical guidelines intended to avoid conflicts with existing resources, developed areas, and existing incompatible infrastructure; maximize opportunities for paralleling existing compatible infrastructure; and consider land use and other factors. Clean Line's siting criteria focused on avoiding environmentally sensitive areas irrespective of underlying land ownership. Clean Line's technical guidelines included considerations related to design and engineering of the transmission line. Details regarding the route development process described in the DOE Alternatives Development Report (DOE 2013) are provided in Appendix G of this EIS.

During the public comment process on the Draft EIS, DOE received numerous comments requesting or recommending re-routing of the Applicant Proposed Route for a variety of reasons. DOE did not receive specific route variation requests for any of the HVDC alternative routes. The process used to develop the route variations is described in Appendix M. DOE and Clean Line have developed 23 route variations for the Applicant Proposed Route. These route variations are described in detail in Sections 2.4.2.1 through 2.4.2.7. The potential environmental impacts of these route variations are addressed for each resource area in Chapter 3. These route variations have been included on the maps depicting the HVDC transmission line routes (Figures 2.1-17a through 2.1-17f in Appendix A).

2.3.2 Converter Station Siting

The following section discusses the process that the Clean Line Routing Team used to identify each of the converter station siting areas in the Applicant Proposed Project. An additional converter station in Arkansas also is being evaluated as part of the DOE Alternatives. Information on this alternative is provided in Section 2.4.3.

2.3.2.1 Oklahoma Converter Station

The Clean Line Routing Team identified a western endpoint in Oklahoma based on its evaluation of wind resources, the existing high-voltage transmission system, land use, and environmental sensitivities. Clean Line began the identification process for the western converter station by studying a broad region of northwestern Oklahoma. Clean Line narrowed the study area by considering criteria such as wind resources, available AC transmission interconnection, regional land use compatibility, and environmental sensitivities. Clean Line identified the proposed western converter station siting area based on three primary factors: (1) proximity to a large area of concentrated high capacity factor wind resources; (2) proximity to a point on the existing or planned AC transmission system that would support the interconnection; and (3) proximity to large areas of land uses compatible with wind farm development and which are known to be relatively low in environmental sensitivities. Clean Line concluded that the Oklahoma Converter Station Siting Area best met these criteria.

2.3.2.2 Tennessee Converter Station

The Clean Line Routing Team identified an eastern endpoint in Tennessee based on its evaluation of existing transmission facilities capable of reliable interconnection and delivery of up to 3,500MW of energy to points in Tennessee and elsewhere in the Mid-South and Southeast, the level of potential upgrades required to accommodate the Project, historical transmission congestion, market access, land use, and environmental considerations. Clean Line began the identification process for the eastern converter station by studying a broad geographic region from central Arkansas to western Tennessee. Clean Line concluded that the Tennessee Converter Station Siting Area best met their site selection criteria.

2.4 Alternatives

In the Plains & Eastern EIS, DOE analyzes the potential environmental impacts of the Proposed Action, the range of reasonable alternatives, and a No Action Alternative. In addition, DOE describes below other alternatives to the Proposed Action identified during the EIS scoping process that DOE considered but eliminated from detailed analysis.

This EIS analyzes the potential environmental impacts of the entire Project. This ensures that any decision by DOE or another agency is fully informed. DOE may decide to participate in any or all of the states in which Southwestern operates, namely Oklahoma, Arkansas, and Texas. However, DOE would not participate in the Project in Tennessee because that state is outside Southwestern’s operational area. Other agencies, federal or state, may have jurisdiction over parts of the Project that are located in Tennessee. Some of these agencies could include, but not be limited to, TVA, USACE, and Tennessee state agencies.

2.4.1 No Action Alternative

This Plains & Eastern EIS analyzes a No Action Alternative, under which DOE would not participate with the Applicant in the Applicant Proposed Project or DOE Alternatives. Under the No Action Alternative, DOE assumes for analytical purposes that the Project would not proceed and none of the potential environmental effects associated with the Project would occur.

2.4.2 Applicant Proposed Route

As identified in Section 2.1.2.2, the Applicant has proposed a specific route for the HVDC transmission line from the Oklahoma Panhandle Region to interconnect with TVA's electrical system in western Tennessee. For purposes of analysis, the Applicant Proposed Route is described below in terms of seven regions, which were based on geographic similarities and common node points along the route (where the Applicant Proposed Route and HVDC alternative routes converge). Within each region, the Applicant Proposed Route is divided into links. These links represent sections of the Applicant Proposed Route between points where alternative routes intersect with it. The alternative routes (described in Section 2.4.3.2) diverge from the Applicant Proposed Route and provide an alternative to the corresponding links of the Applicant Proposed Route. The links are labeled on the figures of the Applicant Proposed Route (Figures 2.1-17a through 2.1-17f located in Appendix A).

In some regions the Applicant Proposed Route is outside the 1-mile-wide route corridors presented at the public scoping meetings (referred to as the Network of Potential Routes). Areas where this occurs are described below for each region. Details regarding the route development process are described in the DOE Alternatives Development Report (DOE 2013) and are summarized in Appendix G of this EIS.

As identified in Section 2.3.1, DOE and Clean Line have developed several route variations to the Draft EIS Applicant Proposed Route to respond to comments on the Draft EIS. In all but one instance, DOE adopted these route variations, and the route variations are now part of the Applicant Proposed Route (they replace the Applicant Proposed Route that was evaluated in the Draft EIS). In one instance (Region 4, Applicant Proposed Route Link 3, Variation 2), DOE retained the original Applicant Proposed Route, and analyzed the variation as an alternative route in that area (see Section 2.4.2.4).

2.4.2.1 Region 1 (Oklahoma Panhandle)

Region 1 includes primarily grassland/herbaceous land cover. Region 1 begins at the converter station site in Texas County, Oklahoma, and continues east through Texas, Beaver, Harper, and Woodward counties in Oklahoma approximately 116 miles to the area north of Woodward, Oklahoma. The Applicant Proposed Route in Region 1 would parallel the existing Xcel/OG&E Woodward-to-Hitchland 345kV transmission line for the majority of its length. The Region 1 Applicant Proposed Route is shown on Figure 2.1-17a (located in Appendix A).

The AC collection system is located within Region 1 and within a 40-mile radius centered on the Oklahoma Converter Station Siting Area. To facilitate efficient interconnection of wind generation, it is expected that four to six AC collection transmission lines of up to 345kV from the Oklahoma converter station to points in the Oklahoma and Texas Panhandle regions would be constructed. The Clean Line Routing Team developed thirteen 2-mile-wide AC collection system route corridors between the Oklahoma Converter Station Siting Area and wind development zones. DOE, however, will not be making decisions on the locations on these transmission lines; their location will be driven by future wind development. The AC collection system routes analyzed as part of the Applicant Proposed Project are as follows:

- E-1 parallels section lines, a natural gas transmission pipeline, and the Guymon to Beaver 115-kV electrical transmission line for the majority of its length.
- E-2 parallels the Applicant Proposed Route (HVDC) and the OG&E/Xcel Energy Hitchland to Woodward 345kV transmission line for the majority of its length.
- E-3 parallels section lines, roads, and a natural gas transmission pipeline to the extent practicable.
- SE-1 parallels the Applicant Proposed Route (HVDC), the OG&E/Xcel Energy Hitchland to Woodward 345kV transmission line, section lines and county roads to the extent practicable.
- SE-2 parallels the Finney to Hitchland 345kV electrical transmission line and the Texas County to Spearman 115kV electrical transmission line to the extent practicable.
- SE-3 parallels the Applicant Proposed Route (HVDC), the OG&E/Xcel Energy Hitchland to Woodward 345kV transmission line, section lines and county roads to the extent practicable.
- SW-1 parallels the Finney to Hitchland 345kV electrical transmission line, the Hitchland to Porter 345kV electrical transmission line to the extent practicable.
- SW-2 parallels section lines, the Texas County to Moore County 115kV electrical transmission line for the majority of its length.
- W-1 parallels sections lines and county roads to the extent practicable.
- NW-1 parallels section lines, the Texas County to Moore County 115kV electrical transmission line, county roads, and U.S. Highway 412 to the extent practicable.
- NW-2 parallels sections lines and county roads to the extent practicable.
- NE-1 parallels county roads and section lines to the extent practicable.
- NE-2 parallels section lines, the Finney to Hitchland 345kV electrical transmission line, county roads, and Oklahoma State Route 94 to the extent practicable.

The AC collection system route corridors are shown on Figures 2.1-17a and 2.1-26 (located in Appendix A).

No route variations are analyzed for the Applicant Proposed Route in Region 1.

2.4.2.2 Region 2 (Oklahoma Central Great Plains)

Region 2 includes primarily grassland/herbaceous and cultivated crop land covers. Region 2 begins north of Woodward, Oklahoma, and continues southeast through Woodward, Major, and Garfield counties in Oklahoma, for approximately 106 miles to end approximately 16 miles southeast of Enid, Oklahoma. Attributes of the Applicant Proposed Route in Region 2 include:

- The Applicant Proposed Route parallels Western Farmers Electric Cooperative’s existing 115kV transmission line, U.S. Route 60, section lines and parcel boundaries, and county roads to the extent practicable.
- A portion of the Applicant Proposed Route is outside the 1-mile-wide area of Link D-2 of the Network of Potential Routes presented at the public scoping meetings. The Clean Line Routing Team sited the Applicant Proposed Route outside the Network of Potential Routes in this area to avoid several center-pivot irrigation systems that were identified during scoping.

The Region 2 Applicant Proposed Route and route variations are shown on Figure 2.1-17b in Appendix A.

Two route variations are analyzed that replace previous links of the Applicant Proposed Route in Region 2. The details of these variations are presented in Appendix M, which includes a detailed map of the variations and the corresponding link of the original Applicant Proposed Route that they would replace:

- Link 1, Variation 1. The location is in Woodward County, approximately 6 miles east of Woodward, Oklahoma. Clean Line developed the variation in response to public comments by the affected landowner. The variation would shift the Applicant Proposed Route to the northeast by about 2,500 feet and would transfer potential impacts from cultivated land to existing pasture land. The variation is about 0.07 mile (370 feet) longer than, and would replace approximately 2.3 miles of, the original Applicant Proposed Route.
- Link 2, Variation 2. The location is in Major County, starting approximately 3.5 miles south of Fairview, Oklahoma. Clean Line developed the variation in response to comments from several landowners to avoid impacts to agricultural operations and increase the distance from several homes. The variation would shift the Applicant Proposed Route south by about 1,100 feet near the quarter-section line that parallels many of their parcels. The variation is about 0.02 mile (100 feet) longer than, and would replace approximately 9.7 miles of, the original Applicant Proposed Route.

2.4.2.3 Region 3 (Oklahoma Cross Timbers)

Region 3 includes primarily grassland/herbaceous, deciduous forest, and pasture/hay land covers. Region 3 begins southeast of Enid, Oklahoma, and continues southeast through Garfield, Kingfisher, Logan, Payne, Lincoln, Creek, Okmulgee, and Muskogee counties in Oklahoma for approximately 162 miles and ends north of Webbers Falls, Oklahoma, at the Arkansas River. The eastern portion of Region 3 from Stillwater to the region’s terminal point on the eastern end has more residential development than the other portions of Region 3. Attributes of the Applicant Proposed Route in Region 3 include:

- The Applicant Proposed Route parallels OG&E’s Cottonwood Creek-to-Enid 138kV transmission line, section lines, county roads, parcel boundaries, gas pipeline, the KAMO Electric Cooperative, Inc. Stillwater-to-Ramsey 115kV transmission line, KAMO Electric Cooperative, Inc. Stillwater-to-Cushing 69kV transmission line, OG&E’s Muskogee to Pittsburgh 345kV transmission line, Public Service Company (PSCo)-OK’s Bristow to Silver City 161kV transmission line, and OG&E’s Cushing to Bristow 138kV transmission line, and the OG&E’s Beggs-to-Pecan Creek 138kV transmission line for the majority of its length.
- Portions of the Applicant Proposed Route are outside the 1-mile-wide area of Link F-7 of the Network of Potential Routes presented at the public scoping meetings. The Clean Line Routing Team sited the Applicant Proposed Route outside the Network of Potential Routes in response to scoping comments that identified additional residential areas and residences.

The Region 3 Applicant Proposed Route and route variations are shown on Figure2.1-17c in Appendix A.

Five route variations are analyzed that replace previous links of the Applicant Proposed Route in Region 3. The details of these variations are presented in Appendix M, which includes a detailed map of the variations and the corresponding link of the original Applicant Proposed Route that they would replace:

- Link 1, Variation 2. The location is in Payne County, starting approximately 7 miles east of Mulhall, Oklahoma, and about 10 miles southwest of Stillwater. Clean Line developed the variation in response to comments from several landowners to avoid impacts to no-till cropland and to shift the Applicant Proposed Route to cross pastureland. The variation would shift the route north by about 2,400 feet to parallel the half-section line. The variation is about 0.41 mile longer than, and would replace approximately 3.3 miles of, the original Applicant Proposed Route.
- Links 1 and 2, Variation 1. The location is in Payne County, approximately 5 miles south of Stillwater, Oklahoma. Clean Line developed the variation in response to comments from several landowners to avoid recently built homes and two new residential subdivisions. The route variation would generally be about 1,900 feet south of the original Applicant Proposed Route to avoid these homes. The variation is about 0.02 mile (160 feet) longer than, and would replace approximately 2.8 miles of, the original Applicant Proposed Route.
- Link 4, Variation 1. The location is in Lincoln County, approximately 3 miles south-southwest of Cushing, Oklahoma. Clean Line developed the variation in response to comments concerning an operating quarry. The route variation would avoid the quarry to the west. The variation is about 0.08 mile (420 feet) longer than, and would replace approximately 0.92 mile of, the original Applicant Proposed Route.
- Link 4, Variation 2. The location is in Creek County, approximately 6 miles north-northwest of Bristow, Oklahoma. Clean Line developed the variation in response to comments concerning a new house under construction within the ROW. The route variation would avoid the home. The variation is about 0.05 mile (260 feet) longer than, and would replace approximately 1.23 miles of, the original Applicant Proposed Route.
- Link 5, Variation 2. The location is in Muskogee County, approximately 6 miles southwest of Muskogee, Oklahoma. Clean Line developed the variation in response to comments concerning an existing house that was not identified in the initial routing process. The route variation would avoid the home. The variation is about 0.08 mile (420 feet) shorter than, and would replace approximately 2.5 miles of, the original Applicant Proposed Route.

2.4.2.4 Region 4 (Arkansas River Valley)

Region 4 includes primarily pasture/hay and deciduous forest land covers. Region 4 begins north of Webbers Falls in Muskogee County, in Oklahoma and continues east though Muskogee and Sequoyah counties in Oklahoma and Crawford, Franklin, Johnson, and Pope counties in Arkansas for approximately 127 miles and ends north of Russellville, Arkansas. Attributes of the Applicant Proposed Route in Region 4 include:

- The Applicant Proposed Route parallels several existing transmission lines across the Arkansas River. The Applicant Proposed Route continues into Arkansas parallel to OG&E's Muskogee-to-Fort Smith 345kV transmission, Southwestern's Gore-to-Alma 161kV transmission line, Interstate-40, Southwestern's Alma-to-Dardanelle 161kV transmission line, county roads, and parcel lines to the extent practicable.
- The Applicant Proposed Route includes the Lee Creek Variation, which refers to a route variation near the Oklahoma-Arkansas state line. It was developed by Clean Line prior to evaluation in the Draft EIS to address concerns expressed regarding avoidance of a buffer zone around the Lee Creek Reservoir. It begins in Sequoyah County, Oklahoma, at a point approximately 1.9 miles west of the state line, where it proceeds east-northeast for approximately 2 miles, then east-southeast, ending in Crawford County, Arkansas, approximately 1.5 miles east of the state line, where it rejoins the Applicant Proposed Route.
- Portions of the Applicant Proposed Route are outside the 1-mile-wide area of Links H-I and H-5 of the Network of Potential Routes presented at the public scoping meetings. The Applicant Proposed Route was sited outside

the Network of Potential Routes in this area to avoid residences and agricultural structures identified in comments submitted to DOE during scoping.

The Region 4 Applicant Proposed Route and route variations are shown on Figure 2.1-17d in Appendix A.

Six route variations are analyzed in Region 4. The details of these variations are presented in Appendix M, which includes a detailed map of the variations and the corresponding link of the original Applicant Proposed Route that they are associated with. DOE has not adopted Link 3, Variation 2, to replace the corresponding link of the original Applicant Proposed Route, but has analyzed this variation as an alternative route in that area. The other variations would replace the corresponding link of the original Applicant Proposed Route.

- Link 3, Variation 1. The location is in Sequoyah County, approximately 3.5 miles northeast of Sallisaw, Oklahoma. Clean Line developed the variation in response to a landowner comment regarding impacts to their home. The variation would shift the Applicant Proposed Route north to parallel the property line, avoid the home, and avoid a newly identified cemetery. The variation is essentially the same length as, and would replace, the original Applicant Proposed Route.
- Link 3, Variation 2. The location is in Sequoyah County, starting approximately 1 mile northeast of Vian, Oklahoma, and ending approximately 3.3 miles northwest of Sallisaw. The variation was proposed in response to landowner comments regarding potential impacts to their commercial operations, ranching, Deer Management Assistance Program area, airstrips, and residence. The variation would shift the route north approximately 0.8 to 1.4 miles. The variation is essentially the same length as the corresponding link of the Applicant Proposed Route. This route variation differs from others that have been presented in the Final EIS in that it does not replace the Applicant Proposed Route; the variation referred to as Applicant Proposed Route Link 3, Variation 2, is being considered as a variation (potential alternative) to the Applicant Proposed Route (similarly to the Lee Creek Variation, it is also in Region 4, Link 3).
- Link 3, Variation 3. The location is in Crawford County, Arkansas, approximately 6 miles northwest of Van Buren, Arkansas, near the eastern end of the Lee Creek Variation. Clean Line developed the variation in response to landowner comments that provided confirmed information about a January 2015 discovery of federally protected (endangered) Ozark big-eared bats in two winter cave hibernacula near the Lee Creek Reservoir within the ROI for the Applicant Proposed Route. The variation would shift the Applicant Proposed Route north by approximately 0.75 mile and would resolve engineering constraints associated with complex terrain and proximity to recreational trails, Teardrop Falls, and locations of existing residences as well as reduce the amount of forested land and Ozark big-eared bat occurrence area crossed. The variation is about 0.25 mile (1,320 feet) shorter than, and would replace approximately 3.5 miles of, the original Applicant Proposed Route.
- Link 6, Variation 1. The location is in Crawford County and approximately 3 miles north of Van Buren, Arkansas. Clean Line developed the variation in response to landowner comments regarding a new home planned for construction as well as two newly constructed homes located directly adjacent to the Applicant Proposed Route. The variation would shift the Applicant Proposed Route to the south approximately 500 feet, parallel parcel boundaries, and avoid the proposed site for this home and increase the distance from the two newly constructed homes in the area. The variation is about 0.03 mile (160 feet) longer than, and would replace approximately 1.05 miles of, the original Applicant Proposed Route.
- Link 6, Variation 2. The location is in Crawford County and approximately 4 miles east of Alma, Arkansas, and 3.5 miles west of Mulberry, Arkansas. Clean Line developed the variation in response to landowner comments that the Applicant Proposed Route would cross the northwestern corner of a parcel subject to a NRCS Wetlands

Reserve Program (WRP) easement. The variation would shift the Applicant Proposed Route to the northwest approximately 500 feet to avoid crossing the parcel subject to the WRP easement. The variation is about 0.03 mile (160 feet) longer than, and would replace approximately 2.43 miles of, the original Applicant Proposed Route.

- Link 6, Variation 3. The location is in Crawford County and approximately 3 miles north of Van Buren, Arkansas, immediately east of Applicant Proposed Route Link 6, Variation 1. Clean Line developed the variation in response to landowner comments expressing concern about the proximity of the Applicant Proposed Route to a residence and complex terrain. The variation would adjust the route by about 500 feet from the original Applicant Proposed Route to avoid residences and the difficult terrain. The variation is about 0.1 mile (530 feet) shorter than, and would replace approximately 1.9 miles of, the original Applicant Proposed Route.
- Link 9, Variation 1. The location is in Pope County and approximately 8 miles east of Hagarville, Arkansas, where two bridges on Arkansas Highway 164 span Big Piney Creek. Clean Line developed the variation in response to landowner comments expressing concern about the proximity of the Applicant Proposed Route to a residence, a campground, and complex terrain. The variation would shift the Applicant Proposed Route from the western side to the eastern side of the existing Southwestern transmission line. This variation would avoid the home identified by the landowner, move the line away from the campground, and eliminate potential engineering challenges associated with both Arkansas Highway 164 bridges. The variation would maintain a parallel alignment to the existing SWPA transmission line. The variation is the same length as and would replace approximately 3.12 miles of, the original Applicant Proposed Route.

2.4.2.5 Region 5 (Central Arkansas)

Region 5 includes primarily pasture/hay, deciduous forest, and evergreen forest land covers. Region 5 begins north of Russellville, in Pope County, Arkansas, and continues east for 113 miles through Pope, Conway, Van Buren, Faulkner, Cleburne, White, and Jackson counties in Arkansas, and ends southwest of Newport, Arkansas. The Applicant Proposed Route in Region 5 parallels parcel boundaries and section lines, Entergy Arkansas Inc.'s Independence-to-Genpower Keo 500kV transmission line, the Cleburne County 69kV transmission line, and a natural gas transmission pipeline to the extent practicable.

The Region 5 Applicant Proposed Route and route variations are shown on Figure 2.1-17e in Appendix A.

Five route variations are analyzed that replace previous links of the Applicant Proposed Route in Region 5. The details of these variations are presented in Appendix M, which includes a detailed map of the variations and the corresponding link of the original Applicant Proposed Route that they would replace:

- Link 1, Variation 2. The location is in Pope County and approximately 3 miles north of Dover, Arkansas. Clean Line developed the variation in response to landowner comments expressing concern about the proximity of the Applicant Proposed Route to a previously undetected residence. The variation would shift the Applicant Proposed Route to the south by about 1,800 feet to avoid the previously undetected residence and other residences. The variation is about 0.14 mile (740 feet) longer than, and would replace approximately 2.01 miles of, the original Applicant Proposed Route.
- Link 2, Variation 2. The location is in Pope County and approximately 2 miles east of Caglesville, Arkansas. Clean Line developed the variation in response to landowner comments expressing concern about the impact of the Applicant Proposed Route on their timber production. The variation would shift the Applicant Proposed Route to the west by between 0.7 mile and 1 mile (3,700–5,280 feet) feet to follow property lines. The variation is about

0.21 mile (1,100 feet) longer than, and would replace approximately 2.51 miles of, the original Applicant Proposed Route.

- Links 2 and 3, Variation 1. The location is in Pope County and approximately 1.5 miles southeast of Applicant Proposed Route Link 2, Variation 2 (as described above). Clean Line developed the variation as a result of a previously undetected residence in the representative ROW and in response to landowner comments. The variation would shift the Applicant Proposed Route to the west and south by less than 1,000 feet to avoid the residence and to reduce the number of affected landowners. The variation is about 0.11 mile (580 feet) longer than, and would replace approximately 2 miles of, the original Applicant Proposed Route.
- Links 3 and 4, Variation 2. The location is in Van Buren County and approximately 2.4 miles east of Damascus, Arkansas. Clean Line developed the variation in response to landowner comments about an existing homestead structure and the identification of conservation easements, which are part of streambank mitigation site along Cadron Creek. The variation would shift the Applicant Proposed Route north by about 0.25 mile (1,320 feet) to avoid the homestead site and to minimize impacts to streambank resources protected by existing conservation easements. The variation is about 0.06 mile (320 feet) shorter than, and would replace approximately 4.28 miles of, the original Applicant Proposed Route.
- Link 7, Variation 1. The location is in White County and approximately 8.4 miles northeast of Letona, Arkansas. Clean Line developed the variation in response to landowner comments concerning a previously undetected house near the Applicant Proposed Route. The route variation would avoid the home. The variation is about 0.2 mile (1,060 feet) longer than, and would replace approximately 1.27 miles of, the original Applicant Proposed Route.

2.4.2.6 Region 6 (Cache River, Crowley's Ridge Area, and St. Francis Channel)

With the exception of the Crowley's Ridge area, Region 6 primarily includes cultivated crop land covers. Region 6 begins southwest of Newport in Jackson County, Arkansas, and continues northeast through Jackson, Cross, and Poinsett counties in Arkansas, for approximately 55 miles and ends south of Marked Tree, Arkansas. Crowley's Ridge consists mostly of hardwood forest. Attributes of the Applicant Proposed Route in Region 6 include:

- The Applicant Proposed Route parallels the Entergy Arkansas Inc.'s Fisher-to-Cherry Valley 161kV transmission line, the St. Francis Levee, parcel boundaries, and county roads to the extent practicable.
- Portions of the Applicant Proposed Route in Region 6 are outside the 1-mile-wide area of Links L-3, L-4, and L-5 of the Network of Potential Routes presented at the public scoping meetings for the EIS. These deviations outside the Network of Potential Routes resulted from aligning the Applicant Proposed Route to follow an existing electrical transmission line into Cross County, Arkansas, to follow the Spoil Bank Central Canal within the St Francis Oak Donnick Floodway, and to avoid private airfields and aerial applicator operations in Poinsett County, Arkansas.

The Region 6 Applicant Proposed Route and a route variation are shown on Figure 2.1-17f in Appendix A.

- Link 2, Variation 1, is presented in detail in Appendix M. The location is in Jackson County and approximately 8 miles southeast of Newport, Arkansas. Clean Line developed the variation in response to tenant farmer comments concerning potential interference with agricultural operations. The route variation would minimize these potential impacts. The variation is about 0.61 mile (3,220 feet) longer than, and would replace approximately 2 miles of, the original Applicant Proposed Route.

2.4.2.7 Region 7 (Arkansas Mississippi River Delta and Tennessee)

Region 7 includes primarily cultivated crop land covers. Region 7 begins south of Marked Tree, in Poinsett County, Arkansas, and continues east and southeast through Poinsett and Mississippi counties in Arkansas, across the Mississippi River and into Tipton and Shelby counties in Tennessee, for approximately 43 miles, ending near the Tipton-Shelby county line south of Tipton, Tennessee. Attributes of the Applicant Proposed Route in Region 7 include:

- The Applicant Proposed Route parallels Entergy Arkansas Inc.'s Marked Tree to Marion 161kV electrical transmission line, county roads, section lines, and parcel boundaries to the extent practicable.
- Portions of the Applicant Proposed Route are outside the 1-mile-wide area of Links M-2 and M-5 of the Network of Potential Routes presented at the public scoping meetings for the EIS. In Link M-2, the Clean Line Routing Team identified a route that more closely follows Entergy Arkansas Inc.'s Marked Tree-to-Marion 161kV electric transmission line. In Link M-5, the Clean Line Routing Team identified a route that more closely followed field lines and parcel boundaries and that avoided residential areas identified during aerial reconnaissance.

The Region 7 Applicant Proposed Route and route variations are shown on Figure 2.1-17f in Appendix A.

Three route variations are analyzed that replace previous links of the Applicant Proposed Route in Region 7. The details of these variations are presented in Appendix M, which includes a detailed map of the variations and the corresponding link of the original Applicant Proposed Route that they would replace:

- Link 1, Variation 1. The location is in Mississippi County and approximately 1.8 miles west of Frenchman's Bayou, Arkansas. Clean Line developed the variation in response to comments concerning potential interference with agricultural operations. The route variation would minimize these potential impacts by following property boundaries. The variation is about 0.23 mile (1,200 feet) longer than, and would replace approximately 0.69 mile of, the original Applicant Proposed Route.
- Link 1, Variation 2. The location is in Mississippi and Tipton counties and approximately 4.2 miles southeast of Joiner, Arkansas. Clean Line developed the variation in response to landowner comments concerning potential interference with agricultural operations. The route variation would minimize these potential impacts. The variation is about 0.37 mile (1,950 feet) shorter than, and would replace approximately 4.38 miles of, the original Applicant Proposed Route.
- Link 5, Variation 1. The location is in Shelby and Tipton counties, Tennessee, and approximately 0.2 mile west of the Tennessee Converter Station Siting Area. Clean Line developed the variation in response to landowner feedback and based on new information, including the location of a proposed home site and planned residential area that was not identified during route development. The variation would avoid the proposed home site and addresses landowner concerns about the planned residential area. The variation is about 0.03 mile (160 feet) longer than, and would replace approximately 1.23 miles of, the representative ROW of the original Applicant Proposed Route. This variation does not result in a change of the Applicant Proposed Route 1,000-foot-wide corridor analyzed in the Draft EIS. This was identified as a variation so that DOE's analyses of the representative ROW would be consistent with Clean Line's application for a CCN with the Tennessee Regulatory Authority. The

CCN application includes the same ROW as depicted on these maps with no change to the Applicant Proposed Route 1,000-foot-wide corridor.

2.4.3 DOE Alternatives

The DOE Alternatives evaluated in this EIS include an intermediate AC/DC converter station in Arkansas and HVDC alternative routes in each region. The regions potentially affected by the alternatives (and the counties within each region) are provided in Table 2.4-1 and are shown in Figures 2.1-17a through 2.1-17f (located in Appendix A). The Arkansas Converter Station Alternative is discussed in Section 2.4.3.1. The HVDC alternative routes are described in Section 2.4.3.2. As identified previously in Section 2.4.2, the Applicant Proposed Route is divided into links, within each region. These links represent sections of the Applicant Proposed Route between points where alternative routes intersect with it. The alternative routes diverge from the Applicant Proposed Route and provide an alternative to the corresponding links of the Applicant Proposed Route. Table 2.4-1 includes information about the links of the Applicant Proposed Route to illustrate their relationship to the alternative routes.

Table 2.4-1:
Counties Potentially Affected by DOE Alternatives

Feature	Length (Miles)	State	Counties
Converter Station			
Arkansas Converter Station Alternative	N/A	Arkansas	Pope
Arkansas AC Interconnection	6.0	Arkansas	Pope
HVDC Alternative Routes			
Region 1 (Oklahoma Panhandle)			
Link 1 of the Applicant Proposed Route (no corresponding Alternative Route)	1.91	Oklahoma	Texas
Alternative Route 1-A	123.3	Oklahoma	Texas, Beaver, Harper, and Woodward
Corresponding Links (2, 3, 4, 5) of the Applicant Proposed Route	114.0	Oklahoma	Texas, Beaver, Harper, and Woodward
Alternative Route 1-B	52.1	Oklahoma	Texas and Beaver
Corresponding Links (2, 3) of the Applicant Proposed Route	54.0	Oklahoma	Texas and Beaver
Alternative Route 1-C	52.2	Oklahoma	Texas and Beaver
Corresponding Links (2, 3) of the Applicant Proposed Route	54.0	Oklahoma	Texas and Beaver
Alternative Route 1-D	33.6	Oklahoma	Beaver and Harper
Corresponding Links (3, 4) of the Applicant Proposed Route	33.7	Oklahoma	Beaver and Harper
Region 2 (Oklahoma Central Great Plains)			
Link 1 of the Applicant Proposed Route (no corresponding Alternative Route)	20.32	Oklahoma	Woodward
Alternative Route 2-A	57.3	Oklahoma	Woodward and Major
Corresponding Link (2) of the Applicant Proposed Route	54.5	Oklahoma	Woodward and Major
Alternative Route 2-B	29.9	Oklahoma	Major and Garfield
Corresponding Link (3) of the Applicant Proposed Route	31.3	Oklahoma	Major and Garfield
Region 3 (Oklahoma Cross Timbers)			
Alternative Route 3-A	37.7	Oklahoma	Garfield, Logan, and Payne
Corresponding Link (1) of the Applicant Proposed Route	40.1	Oklahoma	Garfield, Kingfisher, Logan, and Payne
Alternative Route 3-B	47.9	Oklahoma	Garfield, Logan, and Payne

Table 2.4-1:
Counties Potentially Affected by DOE Alternatives

Feature	Length (Miles)	State	Counties
Corresponding Links (1, 2, 3) of the Applicant Proposed Route	50.1	Oklahoma	Garfield, Kingfisher, Logan, and Payne
Alternative Route 3-C	121.9	Oklahoma	Payne, Lincoln, Creek, Okmulgee, and Muskogee
Corresponding Links (3, 4, 5, 6) of the Applicant Proposed Route	118.7	Oklahoma	Payne, Lincoln, Creek, Okmulgee, and Muskogee
Alternative Route 3-D	39.4	Oklahoma	Muskogee
Corresponding Links (5, 6) of the Applicant Proposed Route	35.2	Oklahoma	Muskogee
Alternative Route 3-E	8.5	Oklahoma	Muskogee
Corresponding Link (6) of the Applicant Proposed Route	7.8	Oklahoma	Muskogee
Region 4 (Arkansas River Valley)			
Link 1 of the Applicant Proposed Route (no corresponding Alternative Route)	8.31	Oklahoma	Muskogee
Alternative Route 4-A	58.6	Oklahoma and Arkansas	Sequoyah County, Oklahoma, and Crawford and Franklin counties, Arkansas
Corresponding Links (3, 4, 5, 6) of the Applicant Proposed Route	60.6	Oklahoma and Arkansas	Sequoyah County, Oklahoma, and Crawford and Franklin counties, Arkansas
Alternative Route 4-B	78.9	Oklahoma and Arkansas	Sequoyah County, Oklahoma, and Crawford and Franklin counties, Arkansas
Corresponding Links (2, 3, 4, 5, 6, 7, 8) of the Applicant Proposed Route	80.0	Oklahoma and Arkansas	Sequoyah County, Oklahoma, and Crawford and Franklin counties, Arkansas
Alternative Route 4-C	3.4	Arkansas	Crawford
Corresponding Link (5) of the Applicant Proposed Route	2.2	Arkansas	Crawford
Alternative Route 4-D	25.4	Arkansas	Crawford and Franklin
Corresponding Links (4, 5, 6) of the Applicant Proposed Route	25.3	Arkansas	Crawford and Franklin
Alternative Route 4-E	36.9	Arkansas	Franklin, Johnson, and Pope
Corresponding Links (8, 9) of the Applicant Proposed Route	38.9	Arkansas	Franklin, Johnson, and Pope
Region 5 (Central Arkansas)			
Alternative Route 5-A	12.7	Arkansas	Pope
Corresponding Link (1) of the Applicant Proposed Route	12.3	Arkansas	Pope
Link 2 of the Applicant Proposed Route (no corresponding Alternative Route)	6.45	Arkansas	Pope
Alternative Route 5-B	71.2	Arkansas	Pope, Conway, Faulkner, White
Corresponding Links (3, 4, 5, 6) of the Applicant Proposed Route	67.4	Arkansas	Pope, Conway, Van Buren, Cleburne and White
Alternative Route 5-C	9.2	Arkansas	White
Corresponding Links (6, 7) of the Applicant Proposed Route	9.6	Arkansas	White
Alternative Route 5-D	21.7	Arkansas	White and Jackson
Corresponding Link (9) of the Applicant Proposed Route	20.5	Arkansas	White and Jackson
Link 8 of the Applicant Proposed Route (no corresponding Alternative Route)	1.61	Arkansas	White
Alternative Route 5-E	36.4	Arkansas	Van Buren, Faulkner, and White
Corresponding Links (4, 5, 6) of the Applicant Proposed Route	33.3	Arkansas	Van Buren, Cleburne, and White
Alternative Route 5-F	22.4	Arkansas	Cleburne and White

Table 2.4-1:
Counties Potentially Affected by DOE Alternatives

Feature	Length (Miles)	State	Counties
Corresponding Links (5, 6) of the Applicant Proposed Route	18.8	Arkansas	Cleburne and White
Region 6 (Cache River, Crowley's Ridge Area, and St. Francis Channel)			
Link 1 of the Applicant Proposed Route (no corresponding Alternative Route)	6.12	Arkansas	Jackson
Alternative Route 6-A	16.2	Arkansas	Jackson and Poinsett
Corresponding Links (2, 3, 4) of the Applicant Proposed Route	17.7	Arkansas	Jackson and Poinsett
Alternative Route 6-B	14.1	Arkansas	Jackson and Poinsett
Corresponding Link (3) of the Applicant Proposed Route	9.7	Arkansas	Jackson and Poinsett
Link 5 of the Applicant Proposed Route (no corresponding Alternative Route)	1.87	Arkansas	Poinsett
Alternative Route 6-C	23.2	Arkansas	Poinsett
Corresponding Links (6, 7) of the Applicant Proposed Route	24.9	Arkansas	Poinsett and Cross
Alternative Route 6-D	9.2	Arkansas	Cross and Poinsett
Corresponding Link (7) of the Applicant Proposed Route	8.6	Arkansas	Cross and Poinsett
Link 8 of the Applicant Proposed Route (no corresponding Alternative Route)	3.91	Arkansas	Poinsett
Region 7 (Arkansas Mississippi River Delta and Tennessee)			
Alternative Route 7-A	43.2	Arkansas and Tennessee	Poinsett and Mississippi counties, Arkansas, and Tipton County, Tennessee
Corresponding Link (1) of the Proposed Route	28.7	Arkansas and Tennessee	Poinsett and Mississippi counties, Arkansas, and Tipton County, Tennessee
Link 2 of the Applicant Proposed Route (no corresponding Alternative Route)	1.08	Tennessee	Tipton
Alternative Route 7-B	8.6	Tennessee	Tipton and Shelby
Corresponding Links (3, 4) of the Applicant Proposed Route	8.3	Tennessee	Tipton and Shelby
Alternative Route 7-C	23.8	Tennessee	Tipton and Shelby
Corresponding Links (3, 4, 5) of the Applicant Proposed Route	13.2	Tennessee	Tipton and Shelby
Alternative Route 7-D	6.2	Tennessee	Tipton and Shelby
Corresponding Links (4, 5) of the Applicant Proposed Route	6.6	Tennessee	Tipton and Shelby

2.4.3.1 Arkansas Converter Station

During the scoping period, DOE received comments from stakeholders in Arkansas who were concerned that the state would endure impacts from the Project without receiving any of the benefits (e.g., ability to accept increased amounts of renewable energy, tax revenues from property and ad valorum taxes associated with new facilities, and increased number of jobs). Based on these comments, DOE requested that Clean Line evaluate the feasibility of an alternative that would add a converter station in Arkansas. The Arkansas converter station would be an intermediate converter station; it would not replace the Oklahoma or Tennessee converter stations. Based on Clean Line's feasibility evaluation and ongoing considerations since issuance of the Draft EIS, an Arkansas converter station could be sited in Pope County, Arkansas. This alternative converter station would be similar to the Oklahoma and Tennessee converter stations, except that it would likely require a smaller land area, encompassing approximately 20 to 35 acres, and contain a smaller valve hall (approximately 175 feet long by 75 feet wide). The facility dimensions and land requirements are summarized in Table 2.4-2. Based on preliminary design and studies, it would be capable of interconnecting 500MW. With the implementation of this alternative, the delivery capability of the Project would be increased to 4,000MW.

Figure 2.1-17e (located in Appendix A) depicts the Arkansas converter station siting area.

The AC interconnection for the Arkansas converter station would include an approximate 5-mile 500kV AC transmission line (the interconnection requirements are discussed in Section 2.2.1) to an interconnection point along the existing Arkansas Nuclear One-Pleasant Hill 500kV AC transmission line by way of a direct tap or small switchyard. An additional 5 acres would be required during construction of the converter station and 500kV AC interconnection for materials staging and equipment storage. The interconnection would also include a new substation at the point where the 500kV AC interconnection line taps the existing Arkansas Nuclear One-Pleasant Hill 500kV line. The footprint of this substation is estimated to be between 25 and 35 acres, with an additional 5 acres for temporary materials staging and equipment storage. The design and layout of the interconnection facilities are dependent on the results of ongoing interconnection and engineering studies (see Section 2.2.1). Tensioning or pulling sites, wire-splicing sites, and multi-use construction yards would all occur within the AC interconnection siting area.

The 500kV AC interconnection line would consist of an arrangement of three electrical phases each with a three-conductor bundle (i.e., three subconductors) in a triangle configuration about 18 to 24 inches on each side. Each conductor would be an approximate 1- to 2-inch-diameter aluminum conductor with a steel reinforced core, or a very similar configuration. The Applicant would design minimum conductor height above the terrain, assuming no clearance buffers, per Rule 232D of the NESC, Edition 2012, requiring 29 feet of clearance for general areas and areas with vehicular traffic (for a 500kV AC line).

Table 2.4-2:
Arkansas Converter Station Alternative and Associated Facilities Dimensions and Land Requirements

Facility	Construction Dimensions[1]	Operation Dimensions[1]
Arkansas Converter Station Alternative-Pope County, Arkansas	20 to 35 acres of land would be required, plus an additional 5 to 10 acres for construction.	20 to 35 acres of land would be required for the station; approximately 20 acres would be fenced.
Arkansas Converter Station Access Road	All weather access roads 20 feet wide by less than 1 mile long would be required. Construction of the access roads may disturb an area up to 35 feet wide.	20-foot-wide paved roadways.
ROW	One 500kV ROW 150–200 feet wide x 5 miles long.	One 500kV ROW 150–200 feet wide x approximately 5 miles long.
500kV—Lattice Structures	Structure assembly area, 150 feet wide (ROW width) x 150 feet long (within ROW), 5 to 7 structures per mile.	Structural footprint 28 feet x 28 feet (typical for lattice structures) 75 to 180 feet tall, 5 to 7 structures per mile.
500kV—Tubular Pole Structures	Structure assembly area, 150 feet wide (ROW width) x 150 feet long (within ROW), 5 to 7 structures per mile.	Structural footprint 7 feet x 7 feet (typical for tubular pole structures), 75 to 180 feet tall, 5 to 7 structures per mile.
AC Interconnection Point	500kV AC: a 25- to 35-acre site where the alternative AC transmission line would interconnect with an existing 500kV transmission line. An additional 5 acres would be required during construction.	The 25- to 35-acre site would be fenced. Permanent access road to the fenced area. Power supply to fenced area.

1 Final design and/or dimensions may differ from typical dimensions expressed here.

2.4.3.2 HVDC Alternative Routes

DOE developed alternative routes as described in Section 2.3.1. These alternatives were discussed and evaluated with Clean Line for feasibility. Eventual selection of a route alignment for the HVDC transmission line could either follow the Applicant Proposed Route for the entire length or could bypass specific links of the Applicant Proposed Route by selecting specific alternative routes.

As discussed in Section 2.4.2.1 through 2.4.2.7, DOE and Clean Line developed 23 route variations to respond to public comments on the Applicant Proposed Route. These route variations caused shifts in the Applicant Proposed Route. There were four instances where the change in the Applicant Proposed Route caused a discontinuity with the linkage between the Applicant Proposed Route and the HVDC alternative routes. As a result of the route variations, DOE and Clean Line developed "route adjustments" to reestablish the continuity between the Applicant Proposed Route and the HVDC alternative routes. DOE has adopted these route adjustments into the applicable HVDC alternative routes. These occur in Regions 3, 5, and 6 and are discussed further below.

Descriptions of ROW easements, structure types, and access for the HVDC alternative routes would be the same as described in Sections 2.1.2.2.1, 2.1.2.2.2, and 2.1.2.4. Construction practices for the HVDC alternative routes or Arkansas converter station alternative would be the same as described in Section 2.1.4. Impacts of these alternatives could nonetheless vary due to differences in affected environment and the scale of the alternatives compared to the Applicant Proposed Project. The impacts that are relevant and material to the comparison of alternatives to the Applicant Proposed Project are described in Chapter 3 and summarized in Section 2.6.

2.4.3.2.1 Region 1 (Oklahoma Panhandle)

DOE and Clean Line identified four HVDC alternative routes for Region 1. The Region 1 HVDC alternative routes are shown on Figure 2.1-17a in Appendix A:

- 1-A parallels county roads and section lines for the majority of its length and parallels existing transmission lines for some short distances.
- 1-B parallels section lines for the majority of its length.
- 1-C is made up of portions of HVDC Alternative Routes 1-A and 1-B.
- 1-D follows sections lines for the majority of its length.

2.4.3.2.2 Region 2 (Oklahoma Central Great Plains)

DOE and Clean Line identified two HVDC alternative routes for Region 2. The Region 2 HVDC alternative routes are shown on Figure 2.1-17b in Appendix A:

- 2-A parallels OG&E's Woodward-to-Cleo's Corner 345kV electrical transmission line and the Cimarron River floodplain for the majority of its length.
- 2-B parallels section lines and parcel boundaries and OG&E's Cottonwood Creek-to-Enid 138kV transmission line for the majority of its length.

A portion of Proposed Alternative Route 2-B is outside the 1-mile-wide area of Link D-1 of the Network of Potential Routes presented at the public scoping meetings. HVDC Alternative Route 2-B is outside the Network of Potential

Routes in this area to avoid a private airstrip identified through review of Federal Aviation Administration (FAA) data and aerial imagery.

Additionally, there is only one route option in the western portion of Region 2 because the city of Woodward, the city of Moreland, Boiling Springs State Park, potentially high value lesser prairie-chicken habitat and rough terrain limit the potential opportunities for other route alternatives.

2.4.3.2.3 Region 3 (Oklahoma Cross Timbers)

DOE and Clean Line identified five HVDC alternative routes for Region 3. The Region 3 HVDC alternative routes are shown on Figure 2.1-17c in Appendix A:

- 3-A parallels county roads and parcel boundaries to the extent practicable.
- 3-B parallels parcel boundaries, section lines, and the KAMO Electric Cooperative, Inc. Stillwater-to-Cushing 69kV transmission line to the extent practicable.
- 3-C parallels OG&E's Cushing-to-Bristow 138kV transmission line, roads, section lines and property boundaries to the extent practicable.
- 3-D begins northwest of Boynton and joins HVDC Alternative Route 3-C approximately 1 mile to the southeast.
- 3-E begins north of Warner, Oklahoma.

Portions of HVDC Alternative Routes 3-C and 3-D are outside the 1-mile-wide area of Link F-8 of the Network of Potential Routes presented at the public scoping meetings. HVDC Alternative Routes 3-C and 3-D are sited outside the Network of Potential Routes in response to comments by the Oklahoma Department of Wildlife Conservation (ODWC) regarding the presence of federal grassland conservation easements and potential high-value greater prairie-chicken habitat.

Applicant Proposed Route Links 1 and 2, Variation 1, shifted the Applicant Proposed Route south in the same area that HVDC Alternative Route 3-A would have joined the Applicant Proposed Route. As a result, Clean Line developed a route adjustment that brings HVDC Alternative Route 3-A due south to connect with the modified Applicant Proposed Route. The route adjustment would shorten the length of HVDC Alternative Route 3-A by 0.16 miles (850 feet). The adjustment is illustrated on Figure 2.1-17c in Appendix A.

2.4.3.2.4 Region 4 (Arkansas River Valley)

DOE and Clean Line identified five HVDC alternative routes for Region 4. The Region 4 HVDC alternative routes are shown on Figure 2.1-17d in Appendix A:

- 4-A parallels parcel boundaries and the Nicut-to-Brushy Switching Station 69kV transmission line in Crawford County, Arkansas, to the extent practicable.
- 4-B is located partially within the Ozark National Forest in Crawford County, Arkansas.
- 4-C is a short route that parallels parcel lines to the extent practicable in the Van Buren, Arkansas area.
- 4-D is an alternative in the areas of Cedarville, Van Buren, and Mulberry, Arkansas.
- 4-E parallels parcel boundaries and the Dardanelle-to-Ozark 161kV transmission line to the extent practicable.

Portions of HVDC Alternative Route 4-A are outside the 1-mile-wide area of Links G-2 and G-5 of the Network of Potential Routes presented at the public scoping meetings to avoid residences and a municipality (Cedarville, Arkansas).

Portions of HVDC Alternative Route 4-B are outside the 1-mile-wide area of Links G-2 and G-6 of the Network of Potential Routes presented at the public scoping meetings. Alternative Route 4-B was sited outside the Network of Potential Routes in this area to avoid residences and a municipality (Cedarville, Arkansas) and to respond to comments received during scoping that requested an alternative route through the Ozark National Forest. As presented in Section 2.14, DOE has identified HVDC Alternative Route 4-B as a non-preferred alternative.

Portions of HVDC Alternative Route 4-C are outside the 1-mile-wide area of Link G-4 of the Network of Potential Routes presented at the public scoping meetings for the EIS. Alternative Route 4-C was sited outside the Network of Potential Routes in response to comments received by DOE during the EIS scoping period regarding the residential area north of Van Buren.

Portions of HVDC Alternative Route 4-D are outside the 1-mile-wide area of Link G-5 of the Network of Potential Routes presented at the public scoping meetings for the EIS to avoid residences. These residences were identified in comments submitted to DOE during the EIS scoping period and through comments received by Clean Line during Clean Line's stakeholder meetings.

2.4.3.2.5 Region 5 (Central Arkansas)

DOE and Clean Line identified six HVDC alternative routes for Region 5. The Region 5 HVDC alternative routes are shown on Figure 2.1-17e in Appendix A:

- 5-A is a short alternative that provides a route north of Dover, Arkansas.
- 5-B parallels an existing natural gas transmission pipeline, electrical transmission lines, parcel boundaries, and the Entergy Arkansas, Inc.'s Independence-to-Genpower Keo 500kV transmission line to the extent practicable.
- 5-C is a short alternative that provides a route northeast of Letona, Arkansas.
- 5-D parallels the Entergy Arkansas, Inc.'s Independence-to-Genpower Keo 500kV transmission line, parcel boundaries, and natural gas transmission pipelines to the extent practicable.
- 5-E parallels existing transmission lines to the extent practicable through Faulkner County, Arkansas.
- 5-F provides an alternative to the south of Letona, Arkansas.

Applicant Proposed Route Links 2 and 3, Variation 1, shifted the Applicant Proposed Route southwest in the same area that HVDC Alternative Route 5-B would have joined the Applicant Proposed Route. As a result, DOE and Clean Line developed a route adjustment that brings the northwestern end of HVDC Alternative Route 5-B south and west to connect with the Applicant Proposed Route variation. The route adjustment would shorten the length of HVDC Alternative Route 5-B by 0.12 mile (630 feet). The route adjustment is illustrated on Figure 2.1-17e in Appendix A.

Applicant Proposed Links 3 and 4, Variation 2, shifted the Applicant Proposed Route north in the same area that HVDC Alternative Route 5-E would have joined the Applicant Proposed Route. As a result, DOE and Clean Line developed a route adjustment that brings the northwestern node of Alternative Route 5-E east to connect with the Applicant Proposed Route variation. There would be no effect on the length of HVDC Alternative Route 5-E from the route adjustment. The adjustment is illustrated on Figure 2.1-17e in Appendix A.

2.4.3.2.6 Region 6 (Cache River, Crowley's Ridge Area, and St. Francis Channel)

DOE and Clean Line identified four HVDC alternative routes for Region 6. The Region 6 HVDC alternative routes are shown on Figure 2.1-17f in Appendix A:

- 6-A parallels parcel boundaries and roads to the extent practicable to provide a southern alternative river crossing location for the Cache River.
- 6-B parallels parcel boundaries, State Route 14, and existing transmission lines to provide a northern alternative river crossing location for the Cache River.
- 6-C parallels parcel boundaries and local roads to the extent practicable to provide alternative crossing of Crowley's Ridge and the St. Francis-Oak Donnick Floodway.
- 6-D is a short alternative that parallels a levee to the extent practicable to provide an alternative crossing location for the St. Francis-Oak Donnick Floodway.

Portions of HVDC Alternative Route 6-A are outside the 1-mile-wide area of Link L-4 of the Network of Potential Routes presented at the public scoping meetings. HVDC Alternative Route 6-A was sited outside the Network of Potential Routes in this area to follow parcel lines and traverse less forested wetlands.

Portions of HVDC Alternative Route 6-B are outside the 1-mile-wide area of Links L-2 and L-3 of the Network of Potential Routes presented at the public scoping meetings. HVDC Alternative Route 6-B was sited outside the Network of Potential Routes in this area to follow an existing electrical transmission line south of Amagon, Arkansas, and to avoid private airfields, aerial spraying, and agricultural operations in Poinsett County.

Applicant Proposed Route Link 2, Variation 1, changed the Applicant Proposed Route from an angled, northeast run to a northerly run with two 90-degree turns in the same area that HVDC Alternative Route 6-A would have joined the Applicant Proposed Route. As a result, DOE and Clean Line developed a route adjustment that brings the western node of HVDC Alternative Route 6-A east to connect with the Applicant Proposed Route variation. The route adjustment would shorten the length of Alternative Route 6-A by 0.62 mile (3,270 feet). The adjustment is illustrated on Figure 2.1-17f in Appendix A.

2.4.3.2.7 Region 7 (Arkansas Mississippi River Delta and Tennessee)

The Project includes elements (transmission line routes and facilities and the converter station and interconnections) in Tennessee. The EIS includes an impacts and alternatives analysis of all Project components; including those located in Tennessee. As explained in Section 1.1.1, DOE's participation in the Project would be limited to states in which Southwestern operates; namely Oklahoma, Arkansas, and possibly Texas, but not Tennessee.

DOE and Clean Line identified four HVDC alternative routes for Region 7. The Region 7 HVDC alternative routes are shown on Figure 2.1-17f in Appendix A:

- 7-A parallels existing canals, county roads, section lines, parcel boundaries, and field lines to the extent practicable to provide an alternative Mississippi River crossing location to the north. 7-A also parallels TVA's Shelby-to-Sans Souci 500kV transmission line.
- 7-B parallels property lines and local roads to provide an alternative in Tipton County, Tennessee.

- 7-C parallels local roads and TVA's Covington-to-Northeast Gate 161kV transmission line and provides a southern route into the converter station.
- 7-D parallels TVA's Shelby-to-Sans Souci 500kV electrical transmission line and provides a northern route into the converter station.

Portions of HVDC Alternative Route 7-A are outside the 1-mile-wide area of Link M-1 of the Network of Potential Routes presented at the public scoping meetings. HVDC Alternative Route 7-A was sited outside the Network of Potential Routes in this area to avoid a center pivot irrigation system and a perpendicular crossing of an airfield.

Portions of HVDC Alternative Route 7-B are outside the 1-mile-wide area of Link M-5 of the Network of Potential Routes presented at public scoping meetings. This alternative was sited outside the Network of Potential Routes in this area in response to scoping comments that requested the analysis of routes that were south of Millington, Tennessee.

Portions of HVDC Alternative Route 7-C are outside the 1-mile-wide area of Link M-5 of the Network of Potential Routes presented at the public scoping meetings. This alternative was sited outside the Network of Potential Routes in this area in response to comments that requested the analysis of routes south of the Millington Regional Airport that also would avoid Munford, Tipton, and Atoka.

HVDC Alternative HVDC Route 7-D is outside the Network of Potential Routes presented at public scoping meetings. This alternative was sited outside the Network of Potential Routes in this area in response to comments expressing concerns about the existing and planned airspace north of the Millington Regional Airport; this alternative is a greater distance from the airport than the Applicant Proposed Route and follows the TVA Shelby-to-Sans Souci 500kV existing transmission line for portions of its length.

2.4.4 Alternatives Considered but Eliminated from Detailed Analysis

DOE considered several additional potential alternatives, in part based on public scoping comments, but eliminated them from detailed analysis as discussed below.

2.4.4.1 Alternative Transmission Line Routes

During the iterative planning and siting process for the transmission line, a number of route alternatives were proposed and studied. These alternatives were evaluated for their feasibility and ultimately eliminated from further study and consideration based on route-specific factors and public scoping comments. Route alternatives that were studied and eliminated and the rationales for their elimination are discussed in the DOE Alternatives Development Report (DOE 2013). Excerpts from the DOE Alternatives Development Report (including the main body of the report and select appendices; including the Tier IV Routing Study) are provided in Appendix G of this EIS.

Additional route alternatives (with varying degrees of detail) were provided as public comments on the Draft EIS. DOE applied routing criteria in evaluating each request and recommendation for a route variation, including technical feasibility, potential impacts, and location relative to the 1,000-foot-wide corridor and representative ROW analyzed in the Draft EIS. After completing these evaluations, DOE chose to carry forward 23 of the recommended changes to the Applicant Proposed Route in the Final EIS. In one case, DOE chose to carry forward both the route variation and the original corresponding segment of the Applicant Proposed Route for analysis in the Final EIS. DOE dismissed other recommendations because they were not feasible, would result in potentially more adverse effects, or any overall reduction in potential environmental impacts was negligible. For example, DOE dismissed two route variations proposed in public comments from further consideration for Region 5, Link 9 because both variations would be closer to residences than the original Applicant Proposed Route. One of the route variations would be located in more areas of potential occurrence of the Indiana bat than the original Applicant Proposed Route. The other route variation would have potential greater impacts to wetlands compared with the original Applicant Proposed Route. The rationale for dismissal of individual routing requests is documented in Appendix Q.

2.4.4.2 Underground HVDC Transmission Line

During public scoping and in comments received on the Draft EIS, some commenters suggested that the HVDC transmission line be installed underground for either the entire length or for discrete segments to minimize visual impacts associated with construction and operations and maintenance. Based on the analysis below, DOE concluded that undergrounding the Project (all or portions thereof) is not a reasonable alternative and has eliminated it from further analysis.

HVDC technology and the voltage of 600kV were identified for the Project to meet the objective of delivering 3,500–4,000MW of renewable energy at a competitive cost and meet the objectives and criteria of Section 1222 of the EPAct. To date, underground electric transmission cable technology is not commercially available at the very high voltage and capacity levels (i.e., ±600kV and 3,500MW to 4,000MW) planned for the Project. HVDC transmission at ±600kV exhibits electrical characteristics that minimize electrical losses over long distances. If the line voltage for the Project were reduced, the Project would not deliver the planned capacity in Tennessee. The highest rated proposed cable system in the world at ±600kV is the Western Link Project in the United Kingdom, with a capacity of 2,200MW, and a distance of about 260 miles (418km). This submarine project is under construction and, at present, is expected to be in operation in 2016. The Western Link Project represents the limits of the application of current, commercially available cable technology to an undergrounding option.

Comments received on the Draft EIS mentioned the following projects:

- Murray Link Project in Australia—Capacity of 220MW at ±150kV, length: 112 miles (ABB 2015b)
- Champlain Hudson Power Express Project at the U.S.–Canadian border—Capacity of 1,000MW at ±300–320kV, length: 364 miles (DOE 2014a)
- Northeast Energy Link (proposed) in Maine and Massachusetts—Capacity of 1,100MW at ±320kV, length: 230 miles (Northeast Energy Link 2015)
- ABB HVDC underground cables—ABB reports the voltage limit is up to ±320kV (ABB 2015a)

Additionally, the Northern Pass Project is a proposed 187-mile transmission line project from Quebec to New Hampshire. Northern Pass has proposed that approximately 153 miles of the transmission would be a ± 300kV HVDC transmission line, including a total of approximately 60 miles of underground transmission. One of the alternatives evaluated for the Northern Pass Project included undergrounding the full length of the line, albeit at only 1,000MW (DOE 2014b).

None of these projects is comparable to the Plains & Eastern Project in terms of capacity, voltage and length. As a result, they do not provide evidence of the feasibility of undergrounding the Project.

Only one cable project is currently under construction (Western Link, which will connect Scotland and England) that has voltage levels of ±600kV (Siemens 2015). This project involves a submarine, rather than underground, installation using mass impregnated cable technology. Even if the cable were capable of transmitting greater than its present maximum rated capability of 2,200MW, the physical characteristics of ±600kV cable render its use infeasible on land. These characteristics include:

- Cable diameter of 5 inches
- Cable length per spool of approximately 3,400 feet
- Weight per spool of over 66 tons

These characteristics would present unreasonable barriers to constructing the Plains and Eastern Project underground. The transportation and material handling of cable spools of such weight and complexity result in many restrictions and challenges during construction, including:

- Because the maximum current rating of available cable will not deliver 4,000MW, each electrical pole would require at least two cables (for a total of at least four cables for the bi-pole configuration). Such conductors would be significantly physically larger than the conductor planned for the Project (requiring a 5-inch-diameter conductor on approximately 4,500 spools weighing 66 tons each) and could not be directly buried. Such conductors must be mechanically protected using a buried duct bank, conduit, or tunnel. Frequent access points would require abovegrade structures to allow for splicing, monitoring, and maintenance. The delivery of these spools to the construction sites, some of which are remote, would require heavy-haul trucks and could result in significant impacts for the construction of access roads and traffic. These requirements make the application of mass impregnated cables for undergrounding highly impractical—and likely impossible.
- Burying cables also would result in significant environmental impacts resulting from open trenching, horizontal directional drilling, and blasting (where necessary).
- Depending on the soil characteristics (conductivity and heat resistance), cooling stations, transition vaults, and splice vaults would be required. For example, the proposed Champlain Hudson Power Express Project requires multiple cooling stations, transition vaults, and splice vaults to make possible the burial of the terrestrial portions of that project. In the case of the Champlain Hudson Power Express Project, transition and splice vaults are precast reinforced concrete facilities that can typically measure 35 feet long by 9 feet wide and 8 feet deep. The Champlain Hudson Power Express Project is expected to require an estimated 400 splices for approximately 134 miles of terrestrial cable (DOE 2014a).
- Because four cables would be required for the bi-pole configuration, the Plains and Eastern Project could require more than 8,600 splices. In addition, cooling stations included an aboveground building measuring approximately 8 feet by 8 feet by 16 feet would be necessary. A cooling station would consist of a chiller unit and pumping system used to circulate chilled water (DOE 2014a).

The time, materials handling, and potential environmental impact of burying (including possible need for cooling stations and need for multiple transition stations) make the risks of undergrounding the Plains and Eastern Project extremely high and, even if successful, would not achieve the objectives of the Project. Ultimately, as was stated earlier in this section, underground electric transmission cable technology is not commercially available at the very high voltage and capacity levels (i.e., ±600kV and 3,500MW to 4,000MW) planned for the Project.

While there is research underway for underground high-voltage transmission cable technology that could conceivably be applied to the voltage and capacity levels of the Project, this research has yet to produce commercially available, proven technology, and DOE does not foresee that such technology will become available within the time frame for construction of the Project. Because such technology is not available, the costs for implementing underground HVDC technology of the voltage and capacity proposed for the Project are unknown.

In summary, based on current information, even if such technology were to become available, other constraints would make it infeasible to install a conductor (i.e., the transmission line) of this voltage and capacity underground. Such conductors cannot be directly buried. They must be mechanically protected by being installed within a buried duct bank, conduit, or tunnel. Frequent access points would be required from the surface into these duct banks, conduits, or tunnels to allow for splicing, monitoring, and maintenance. Heat dissipation from the underground conductors would be a significant challenge to the installation. Also, the large insulation requirements would result in extreme weights for an underground conductor relative to an overhead conductor, so only short segments could be installed at any one time, significantly increasing the cost and time required for completing the construction. The diagnosis and repair of outages could be time-consuming, which would affect emergency response times, could result in additional ground disturbance and excavation to locate and repair the problems.

2.4.4.3 Local Generation and Distribution

During public scoping, commenters suggested utilizing distributed generation as an alternative to the Applicant Proposed Project. Distributed generation involves the use of small-scale power generation technologies that are usually installed at or near the location to the load being served by the generated power. Distributed generation does not require long-range transmission lines. Distributed generation systems range in size from approximately 5 kilowatts to 10MW, in contrast to utility-scale generation that ranges from 10MW to more than 1,000MW per site. Examples of distributed generation resource technologies include residential and roof-top photovoltaic, energy storage devices, microturbines, and fuel cells.

This alternative was eliminated from further analysis because Section 1222 of the EPAct does not authorize the Secretary of Energy to participate with other entities in distributed generation, and the alternative does not meet the DOE-issued RFP for new or upgraded transmission projects. As such, the alternative would not meet the purpose and need for agency action because distributed generation as studied by DOE does not meet the utility-scale generation required. DOE has determined that distributed generation would not meet the need of utility-scale generation and would still require the Project to meet the needs of the agency's goal. DOE has established policies and programs related to distributed generation (see http://www.energy.gov/eere/slsc/renewable-energy-distributed-generation-policies-and-programs).

2.4.4.4 Energy Conservation Programs

During public scoping, commenters suggested energy conservation programs as an alternative to the Applicant Proposed Project. Commenters suggested that mandatory conservation and demand response programs be used to eliminate the need for more generation and transmission. This alternative would include regulated energy use at the consumer level to decrease the overall energy demand. This alternative was eliminated from detailed consideration because Section 1222 of the EPAct does not authorize the Secretary of Energy to participate with other entities in energy conservation programs. As such, the alternative would not meet the purpose and need for agency action because energy conservation programs, as studied by DOE, would not meet the utility-scale generation required.

DOE has determined that energy conservation programs would not meet the need of utility-scale generation and would still require the Project to meet the needs of the agency's goal. DOE has established policies and programs related to energy conservation programs (see: http://www.energy.gov/eere/efficiency).

2.5 Connected Actions

Connected actions are those that are "closely related" to the proposal. Actions are considered connected if they automatically trigger other actions which may require environmental impact statements, cannot or will not proceed unless other actions have been taken previously or simultaneously, or are interdependent parts of a larger action and depend on the larger action for their justification (40 CFR 1508.25). Connected actions are analyzed together with the Applicant Proposed Project and DOE Alternatives in this EIS.

2.5.1 Wind Energy Generation

The construction and operations and maintenance of reasonably foreseeable wind power facilities are evaluated as connected actions in the Plains & Eastern EIS. Wind power facilities that would interconnect with the Project are anticipated to be located in parts of the Oklahoma Panhandle and Texas Panhandle within an approximate 40-mile radius of the western converter station. As identified in Section 2.1.2.3, the Applicant based the 40-mile radius assumption on preliminary studies of engineering constraints and wind resource data, industry knowledge, and economic feasibility. The Applicant anticipates that these wind energy generators will be the primary customers using the transmission capacity of the Plains & Eastern transmission line. To achieve full utilization of the 3,500MW delivery capacity of the Applicant Proposed Project, the Applicant anticipates actual wind farm build-out to be approximately 4,000MW. With the addition of the Arkansas converter station alternative, the Applicant anticipates the delivery capacity of the Project to increase to 4,000MW, and associated wind farm build-out to be approximately 4,550MW (Clean Line 2014b). The Oklahoma Panhandle region contains an excellent wind resource (DOE 2011). An analysis of the wind resource in Oklahoma's Panhandle region by the National Renewable Energy Laboratory shows that large areas of wind resources with average annual wind speeds greater than 8 meters/second are prevalent in that part of the state (NREL 2011).

Neither the Applicant nor DOE knows the exact location of wind power facilities that would be connected to the Project. However, it is reasonably foreseeable that future wind farms would be located in a reasonable proximity to the Project's Oklahoma converter station and in areas with high wind resource potential and suitable land use(s). This EIS provides an analysis of potential impacts from wind development within an area of an approximate 40-mile radius of the Oklahoma converter station. Clean Line identified 12 Wind Development Zones (WDZs) in its *Wind Generation Technical Report* (Clean Line 2014b) based on available wind resources and existing land uses within the 40-mile radius. Table 2.5-1 presents the size and potential maximum generation capacity for each WDZ analyzed in this EIS for potential wind energy generation. Figures 2.1-2 and 2.1-17a in Appendix A provide illustrations of the WDZs in relation to the locations of the various Project components.

Table 2.5-1:
Size and Potential Maximum Generation Capacity of Wind Development Zones

WDZ	Approximate Total Size (acres)	Potentially Suitable Areas for Wind Development (acres)	Approximate Maximum Wind Development (megawatts)
A	109,000	101,000	800
B	125,000	108,000	900
C	160,000	123,000	1,000

Table 2.5-1:
Size and Potential Maximum Generation Capacity of Wind Development Zones

WDZ	Approximate Total Size (acres)	Potentially Suitable Areas for Wind Development (acres)	Approximate Maximum Wind Development (megawatts)
D	69,000	43,000	300
E	47,000	43,000	300
F	112,000	82,000	700
G	186,000	159,000	1,300
H	116,000	67,000	500
I	105,000	85,000	700
J	92,000	44,000	400
K	92,000	84,000	700
L	165,000	144,000	1,200

Where construction and operations and maintenance of individual wind power facilities require permits or authorizations, site-specific environmental review, possibly including NEPA review, may be conducted prior to the construction and operations and maintenance of individual wind farm projects.

2.5.2 Related Substation and Transmission Upgrades

In addition to the transmission lines and related facilities analyzed as part of the Project, the EIS also analyzes facility additions and upgrades to existing third-party transmission systems that would be required to enable the Project to transmit power. The additions and upgrades in Oklahoma and Tennessee are evaluated as connected actions in the EIS.

Oklahoma

The Applicant Proposed Project includes construction and operations and maintenance of a converter station in Texas County, Oklahoma. The Oklahoma converter station would be interconnected to the existing transmission system. This interconnection is necessary to enable the AC to DC conversion process within the Oklahoma converter station. The interconnection between the proposed Oklahoma converter station and the SPS system would be controlled to a nominal value of zero (0) MW; meaning that there would be no net energy exchange. Based on the SPS analysis, a new substation would be necessary to accommodate the interconnection due to space constraints at the existing 345kV Hitchland Substation. To alleviate these space constraints, SPS has proposed a new substation nearby, tentatively named “Optima.” This new substation, which represents the connected action, would be located within a few miles of the Oklahoma converter station in Texas County, Oklahoma, within the area identified on Figure 2.1-3 in Appendix A as the AC Interconnection Siting Area. Additional background and details are provided in Section 2.2.1.1.

Arkansas

A DOE Alternative would include construction and operations and maintenance of an intermediate converter station in Arkansas to enable injection and delivery of up to 500MW of power into the Arkansas electrical grid. Clean Line selected the Arkansas Nuclear One-Pleasant Hill 500kV Point of Interconnection in an attempt to avoid the need for additional upgrades to the surrounding transmission system and to accommodate a 500MW injection. MISO performed a feasibility study of the request and delivered results to Clean Line in February 2014. The purpose of this feasibility study was to identify the cost to Clean Line to enter into the Definitive Planning Phase, which consists of several steps that include a system impact study and an interconnection facilities study. These studies would begin to identify the upgrades required to MISO's system, if any, and the next steps for Clean Line to proceed with the Project. If, in the future, network upgrades were identified, they would likely be similar to those discussed for TVA below.

Tennessee

The Applicant Proposed Project includes construction and operations and maintenance of a converter station in Shelby County, Tennessee to enable injection of up to 3500MW of power into the Shelby Substation. As described in Section 2.2.1.3, TVA completed its Interconnection SIS to determine whether any upgrades (or modifications) to its transmission system would be necessary to protect grid reliability while accommodating Clean Line's request for interconnection at 3500MW. The upgrades within Shelby Substation (also referred to as direct assignment facilities) are analyzed in this EIS as part of the Applicant Proposed Project.

TVA's Interconnection SIS has identified the following connected actions as necessary to enable the injection of 3500MW from the Plains & Eastern Clean Line: (a) upgrades to existing infrastructure and (b) construction of a new 500kV AC transmission line, approximately 37 miles long, in western Tennessee, including necessary modifications to existing substations on the terminal ends of the new line. Upgrades to existing infrastructure would include upgrading terminal equipment at three existing 500kV substations and six existing 161kV substations; making appropriate upgrades to increase heights on 16 existing 161kV transmission lines to increase line ratings; and replacing the conductors on eight existing 161kV transmission lines. Most upgrades to existing transmission lines would occur in central and western Tennessee.

TVA's Interconnection SIS estimates that completion of all network upgrades would take 8 years to complete after TVA completes the facilities study. TVA anticipates tiering from this EIS when completing its review of potential environmental impacts of the upgrades as required by NEPA. TVA would evaluate both upgrades to existing infrastructure and construction of a new 500kV transmission line under their NEPA procedures. It is likely that upgrades to existing infrastructure would fall under categories of actions that are expected to result in few, if any, environmental impacts. TVA would likely evaluate potential impacts associated with a new 500kV AC transmission line under a separate NEPA review once the location and design have been identified. For these reasons, and because specific route information regarding the new transmission line and the specific locations for many of the upgrades to existing transmission lines is not available, these actions are not analyzed in detail in this EIS, but are discussed qualitatively in the connected action section in Chapter 3 for each resource.

TVA 500kV transmission lines are typically constructed on ROWs at least 175 feet in width and with self-supporting galvanized laced-steel structures between 85 and 125 feet tall. The distance between structures, which varies with terrain, is typically about 1,000 feet. Final structure heights, conductor span length, and conductor vertical clearance would be determined in accordance with the NESC. The electrical conductors would consist of three sets of three cables bundled in a triangular configuration, suspended beneath the structure crossarms by paired insulators arranged in a "V" shape. Ground wires, which may carry communication circuits, would be placed on the two highest points of the structures to provide lightning protection. Tower foundations are normally a laced-steel grillage, one per leg, buried in the earth. ROW easement acquisition and construction and operations and maintenance methods would generally be similar to those described for transmission lines in Sections 2.1.3, 2.1.4, and 2.1.5.

The total length of multiple existing transmission lines that could require some degree of upgrade is approximately 350 miles; most of these lines are located in central and western Tennessee. However, the upgrades would likely not be necessary along the full length of each line; i.e., the total length of existing transmission lines requiring modification would be less than 350 miles. The detailed identification of the necessary upgrades to each transmission line and construction of a new transmission line (as discussed above) is the subject of an interconnection facilities study, which should be completed in 2016. More detail regarding the typical upgrade activities is provided below.

This EIS assumes that impacts to resources would not occur where the existing terminal equipment at substations would be upgraded; these existing substations are assumed to have permanent access roads that would be used for upgrades, and upgrade activities would not increase the overall footprints of disturbance. The EIS evaluates the following likely upgrades to existing transmission lines:

1. Removing physical objects that interfere with line clearance
2. Replacing and/or modifying existing structures to increase clearance
3. Installing intermediate structures
4. Replacing the existing conductor with another that can accommodate higher power flows
5. Modifying the existing conductor to increase ground clearance
6. Adding fill rock or dirt around the base of existing structures
7. Working with the local power companies to modify their lines where they cross under TVA's lines

The various modification/upgrade activities are described in more detail below.

Typical modifications to existing conductors, installations of intermediate structures, additions of structure extensions, or replacements of existing structures are performed with standard transmission line construction and maintenance equipment such as crane trucks, bulldozers, bucket or boom trucks, and forklifts. Disturbance is usually limited to an approximate 100-foot radius around a transmission line structure.

Modifications to existing conductors include: conductor slides, cuts, and/or installation of floating deadends to increase ground clearance by increasing the height of conductor where it sags to its minimum clearance, or "belly," between structures. A slide involves relocating the conductor clamp on the adjacent structure a certain distance toward the area of concern (i.e., "sliding" the clamp). A cut involves cutting the conductor, removing a small piece of it, and then splicing the conductor ends back together. A floating deadend shortens the vertical (or "suspension") insulator string that attaches a conductor to a "suspension" (or "tangent") structure to raise the height of its conductor. A suspension structure is one that is designed to provide primarily vertical support for a conductor, but not to take the full tension of the conductor, which would require that the structure also provide significant horizontal support.

If the existing conductor is not rated to carry the new electrical load required for the transmission line, the conductor must be replaced. Reels of replacement conductor are delivered to various staging areas along the transmission line ROW and temporary H-frame clearance poles are installed at road crossings to reduce interference with traffic. Bucket trucks are utilized for worker access to the insulators supporting the conductors. Pulleys are attached to the insulators at the conductor clamp points. The new conductor is connected to the old conductor and pulled down the line through the pulleys. A bulldozer and specialized tensioning equipment is used to pull conductors to the proper tension. Workers then clamp the wires to the insulators and remove the pulleys. The length of continuous conductor wire replaced in a single "pull" varies and is limited to a maximum of 5 miles. Pull point locations depend on the type of structures supporting the conductor as well as the length of conductor being installed. Pull points are typically located along the most accessible path on the ROW (adjacent to road crossings or existing access roads). The area of disturbance at each pull point typically ranges from 200 to 300 feet along the line ROW.

Rock or soil "surcharge" is sometimes added to the base of a transmission structure when height and/or loading modifications are made to the structure. These modifications can create uplift on the structure foundation, therefore requiring the surcharge to maintain structure stability, particularly during inclement weather conditions or high conductor loading. The surcharge is typically delivered to structures by dump trucks and placed around the structure base using tracked equipment. Ground disturbance is typically limited to the immediate vicinity of the structure.

Transmission line upgrade activities are planned in a manner to maximize the use of existing access roads and to avoid non-essential stream crossings and activities in wetlands. Other sensitive environmental resources are also avoided to the extent practicable. Where necessary, standard erosion control measures such as the installation of silt fences are implemented. After the completion of the activity, the disturbed area is revegetated using native or non-invasive, low-growing plant species in appropriate areas. Areas such as pastures, agricultural fields, and lawns are restored to their former condition.

2.6 Summary of Impacts by Resource

The impacts analyzed in Chapter 3 of this EIS are summarized in Tables 2.6-1, 2.6-2, and 2.6-3. Table 2.6-1 provides a summary of potential environmental impacts from construction and operations of the proposed converter stations, including the Arkansas Converter Station Alternative Siting Area and AC interconnection. Table 2.6-2 provides a summary of the potential environmental impacts of construction and operations of the AC collection system. These impacts are provided as a range of impacts that could occur among the thirteen different AC collection system routes. Table 2.6-3 provides a summary of the potential environmental impacts of construction and operations of the HVDC transmission line, including any specific difference in impacts between the Applicant Proposed Route and the HVDC alternative routes. Unless specifically identified, potential impacts would be expected to be similar for the Applicant Proposed Route and the HVDC alternative routes.

Chapter 3 also provides the potential environmental impacts for each resource area that could occur from decommissioning of the Project components. Generally, the impacts of decommissioning the Project would be similar to those presented for construction. The Applicant would follow the same general and resource-specific EPMs during decommissioning that would be implemented during construction. In addition, the Applicant would develop a Decommissioning Plan prior to any decommissioning actions for review and approval by the applicable state and federal agencies.

Impacts are presented for the following resource categories: Agriculture; Air Quality and Climate Change; Electrical Environment; Environmental Justice; Geology, Paleontology, Minerals, and Soils; Groundwater; Health, Safety, and Intentional Destructive Acts; Historic and Cultural Resources; Land Use; Noise; Recreation; Socioeconomics; Special Status Wildlife and Fish, Aquatic Invertebrate, and Amphibian Species; Surface Water; Transportation; Vegetation Communities and Special Status Plant Species; Visual Resources; Wetlands, Floodplains, and Riparian Areas; and Wildlife and Fish.

Impacts in the table are presented in terms of direct, indirect, temporary, short-term, long-term, and permanent impacts for each resource area. Direct impacts occur at the same time and place as the Project. Indirect impacts are effects that may occur later in time, or further away from the Project, but are still reasonably foreseeable. Impacts are also characterized by time frame: temporary, short-term, long-term, or permanent. Temporary impacts would occur during construction, with the resource returning to preconstruction conditions once construction is complete. Short-term impacts would continue beyond the completion of construction and last from 2 to 5 years, depending on the resource affected. Long-term impacts would last beyond 5 years and could extend for the life of the Project; these impacts pertain to resources requiring longer recovery periods to return to preconstruction conditions. Permanent impacts are those that would be expected to continue even after decommissioning of the Project.

Table 2.6-1:
Summary of Potential Environmental Impacts—Converter Stations and AC Interconnections

RESOURCE	IMPACT
AGRICULTURAL RESOURCES	
Oklahoma Converter Station and AC Interconnection Siting Areas	Construction The Oklahoma converter station would be located on undeveloped rangeland; approximately 95% of the land cover in the siting area is grassland/herbaceous. Construction of the converter station would convert 45 to 60 acres of rangeland to a utility land use. During construction, an additional 5 to 10 acres would be used as temporary laydown areas for equipment. An additional 4.24 acres of rangeland would be converted to access roads (2.42 acres long term, 1.82 acres temporary). The Oklahoma AC interconnection would be approximately 3 miles long. The agricultural land cover in the representative ROW is currently composed of 58 acres of grasslands. Work in the ROW would include assembly of transmission structures, wire splicing, and tensioning or pulling. Outside the ROW, two additional tensioning or pulling sites would be required. A 25-acre multi-use construction yard space required for the Oklahoma AC interconnection would be shared with that of the HVDC line. During construction, assembly areas for the pole structures (either lattice or tubular structures) would be required, as would wire splicing sites and tensioning or pulling sites. Within the 65.5-acre ROW, an assembly area of 150 feet wide by 150 feet long for each structure would be required. Assuming five to seven structures per mile, the assembly areas would take up to 10.7 acres within the ROW. Approximately two wire splicing sites, each 100 feet by 100 feet (0.2 acre), would be used within the ROW during construction. Approximately four tensioning or pulling sites, 150 feet wide by 600 feet long, also would be required within the ROW, although it is estimated that 1 acre of the total will be located outside the ROW (2.0 acres each, minus 1 acre, for a total of 7 acres). Tensioning or pulling sites would be located partially outside the ROW at locations where the line turns more than 8 degrees. These sites are estimated at 1 acre. A total of approximately 74 acres would be required for the Oklahoma Converter Station (including access roads) and approximately 19 acres would be required for the Oklahoma AC interconnection during construction. Construction may affect livestock control and distribution if a gate is left open or a fence is damaged. Vehicular access during construction would increase the likelihood of livestock injury or death from collisions. Access controls (e.g., cattle guards, fences, gates) would be installed, maintained, repaired, replaced, or restored as required by regulation, road authority, or as agreed to by landowner (EPM GE-8). Operations and Maintenance Once construction has been completed, only the 45- to 60-acre converter station, the AC interconnection pole structures, and a 20-foot-wide paved access road would remain; all other temporary construction areas would be returned to their previous use, primarily rangeland. Approximately 45 acres would be fenced. Within the AC interconnection ROW (200 feet wide), only the transmission structures would remain with a total footprint of up to less than 1 acre. All other land in the ROW could be returned to previous land uses, primarily grazing. Roads not otherwise needed for maintenance and operations would be restored to preconstruction conditions.
Tennessee Converter Station and AC Interconnection Siting Areas	Construction The land cover in the Tennessee Converter Station Siting Area is approximately 50.7% agricultural land cover (30.6 percent pasture/hay and 20.1 percent cultivated crops). No center-pivot irrigation or other irrigation infrastructure is known to occur. Although the exact location has not yet been determined, construction of this converter station would convert 45 to 60 acres of currently undeveloped land to a utility land use. During construction, an additional 5 to 10

Table 2.6-1:
Summary of Potential Environmental Impacts—Converter Stations and AC Interconnections

RESOURCE	IMPACT
	acres would be used as temporary laydown areas for equipment. An additional 4.24 acres of rangeland would be converted to access roads (2.42 acres long term, 1.82 acres temporary). The Tennessee AC interconnection would be located entirely within the converter station siting area and entirely contained within the converter station footprint and the Shelby Substation footprint. All tensioning or pulling for ties between the Shelby Substation and Tennessee converter station (if necessary) would be contained within the footprint of both stations. No temporary construction areas would be needed, and the multi-use construction yard for the Tennessee AC interconnection would share construction yard space with the Tennessee converter station and would be contained within the footprint of the converter station. Construction may affect livestock control and distribution if a gate is left open or a fence is damaged. Vehicular access during construction would increase the likelihood of livestock injury or death from collisions. Access controls (e.g., cattle guards, fences, gates) would be installed, maintained, repaired, replaced, or restored as required by regulation, road authority, or as agreed to by landowner (EPM GE-8). Approximately 74 acres would be required for the Tennessee converter station (including access road) during construction; it is anticipated that any temporary construction areas would be contained within the footprint of the Tennessee Converter Station and the Shelby Substation. Operations and Maintenance Once construction has been completed, only the 45- to 60-acre converter station, the AC interconnection, and 20-foot-wide paved access road would remain; all other temporary construction areas would be returned to their previous use, primarily cultivated crops and pasture/hay. Approximately 45 acres would be fenced.
Arkansas Converter Station Alternative and AC Interconnection Siting Areas	Construction The land cover in the Arkansas Converter Station Alternative Siting Area is composed of approximately 96 acres (26.7%) pasture/hay and approximately 16 acres (4.5%) grassland/herbaceous land cover. The Arkansas AC interconnection would be approximately 5 miles long, and during construction, approximately 146.5 acres of currently primarily pasture/hay land cover would be temporarily converted to a utility use. Construction of the converter station and AC interconnection would directly affect livestock grazing by temporarily reducing forage in up to approximately 661.6 acres of land. If any crop land is in the construction area, crops grown in these areas would be lost and crops in adjacent areas may have reduced yields if there are disturbances to irrigation structures or in aerial spraying. The Applicant would avoid or minimize adverse effects to surface and subsurface irrigation and drainage systems (e.g., tiles). Operations and Maintenance Once construction has been completed, only the 20- to 35-acre converter station and 20-foot-wide paved access road would remain; all other temporary construction areas would be returned to their previous use, primarily rangeland. Approximately 35 acres would be fenced. A 25–35-acre site where the alternative AC transmission line would interconnect with the existing 500kV transmission line would also remain as a utility use. Although most of this land is not currently used for agricultural purposes, up to 72.2% is used as pasture/hay and 0.3% is grassland/herbaceous. If any of these lands are used for long-term structures, they would be removed from agricultural use until decommissioning. Within the Arkansas AC interconnection (150– 200 feet wide by 5 miles long), only the transmission structures and most access roads would remain. Roads not otherwise needed for maintenance and operations would be restored to preconstruction conditions.
AIR QUALITY AND CLIMATE CHANGE	
All Converter Stations and AC Interconnections	Construction Emissions for constructing each of the converter stations and AC interconnections are estimated to be approximately the same because the converter station sizes and construction processes are similar. While there would be minor temporary impacts on air quality in the vicinity of ongoing construction activities, emissions would be below National Ambient Air Quality Standards for all emissions. Operations and Maintenance The converter stations and AC interconnection would emit negligible air pollutants. Standard operations and maintenance of the converter stations and AC interconnection would not emit air pollutants, but maintenance activities would emit small amounts of pollutants associated with combustion of fossil fuels for worker vehicles and equipment.

Table 2.6-1:
Summary of Potential Environmental Impacts—Converter Stations and AC Interconnections

RESOURCE	IMPACT
ELECTRICAL ENVIRONMENT	
All Converter Stations	Construction There would be no electrical effects associated with construction of the converter stations, because these facilities would not be energized during construction. Electrical facilities need to be energized to create electrical effects such as electric and magnetic fields, audible noise, and radio and television interference. Operations and Maintenance For the converter stations, the dominant sources of electrical effects would be the AC interconnections. Some types of substation and switching station equipment can potentially be a source of electrical effects (e.g., power transformers can produce audible noise; converter equipment can produce radio noise, etc.). These effects can be reduced or eliminated by the use of filtering equipment, sound walls, and other methods, so the dominant sources of electrical effects are associated with the overhead transmission lines.
All AC Interconnections	Construction No electrical effects would be associated with construction of AC interconnections because these facilities would not be energized during construction. Oklahoma Converter Station AC Interconnection For the Oklahoma converter station AC interconnection, calculated AC electric fields would be below public guidelines at the ROW edges. However, for one of the three possible configurations (i.e., the double circuit Danube configuration), calculated electric fields at the ROW edge are above guidelines for workers with implanted medical devices. A variety of electronic devices are known to affect the operation of pacemakers and other implanted medical devices. Transmission lines have not been reported as a significant source to produce functional disturbances to these devices. The consequences of brief reversible pacemaker malfunction are mostly benign (typically the implanted device will resume a normal mode of operation if the patient moves away from the source of the interference). An exception would be an individual who has a sensitive pacer and depends on it completely for maintaining all cardiac rhythms. For such an individual, a malfunction that compromised pacemaker output or prevented the unit from reverting to the fixed pacing mode, even brief periods of interference, could be life-threatening. The precise coincidence of events (i.e., pacer model, field characteristics, biological need for full function pacing, and occupation involving work under transmission lines) would generally appear to be a rare event. Since no loading would be present, no AC magnetic field would be generated as a result of the transmission line. Calculated audible noise would be below the public guideline at the ROW edges for two of three possible configuration types (the other configuration type—double circuit monopole— is slightly higher than the public guideline). Calculated radio noise would below guidelines at which reception quality may be less than satisfactory during fair but not rainy weather conditions. While it is difficult to determine whether the TV noise level produced by a transmission line would cause unacceptable interference, new digital broadcast system technology would provide better coverage and less sensitivity to transmission line noise than analog television signals. Maximum ozone levels would be far below the EPA standard. Tennessee Converter Station AC Interconnection For the Tennessee converter station AC interconnection, transmission lines would be located entirely within the converter station and the adjacent Shelby Substation site. Therefore, most electrical effects would be limited to within these electrical stations. Arkansas Converter Station Alternative AC Interconnection For the Arkansas converter station AC interconnection, calculated AC electric fields would be below public guidelines at the ROW edges. However, for the lattice configuration, calculated electric fields within the ROW would be slightly above the transmission line ROW guidelines. For all configurations, calculated electric fields would exceed the American Conference of Governmental Industrial Hygienists (ACGIH) guideline for workers with implanted medical devices within the ROW and at most ROW edges. Calculated AC magnetic fields would be below public guidelines at the ROW edges for both configurations, as well as within the ROW for workers with implanted medical devices. Calculated audible noise would be at or above public guidelines at the ROW edges for both configurations. Calculated radio noise would be below Federal Communications Commission and Institute of

Table 2.6-1:
Summary of Potential Environmental Impacts—Converter Stations and AC Interconnections

RESOURCE	IMPACT
	Electrical and Electronic Engineers exposure guidelines during fair but not rainy weather conditions. While it is difficult to determine whether the TV noise level produced by a transmission line would cause unacceptable interference, new digital broadcast system technology should provide better coverage and less sensitivity to transmission line noise than analog television signals. Maximum ozone levels would be far below the EPA standard.
ENVIRONMENTAL JUSTICE	
All Converter Stations	Construction/Operations and Maintenance There would be no impacts to areas where no minority or low-income populations were identified. For areas where minority and/or low-income populations were identified, it is expected that any impacts would affect all populations equally.
GEOLOGY, PALEONTOLOGY, SOILS, AND MINERALS	
Oklahoma Converter Station and AC Interconnection Siting Areas	Construction Subsidence from karst is a possible geologic hazard of concern within the Oklahoma Converter Station Siting Area. Implementation of EPMs and appropriate engineering design, including geotechnical investigations, would avoid or minimize the potential impacts from karst. No known fossil bed sites were identified in the Oklahoma Converter Station Siting Area. About 40% of the siting area is located in the shallow bedrock, so grading and excavation activities could cause direct impacts to paleontological resources if fossils are at or near the ground surface in rock outcrops and/or areas of shallow bedrock. Designated Farmland. Eight% (73 acres) of the Oklahoma AC interconnection siting area consists of prime farmland. Depending on the specific siting of the AC interconnection line within this area, impacts could include exposing prime farmland to conditions of increased erosion potential, and soils with high compaction potential would be susceptible to compaction from construction vehicles and equipment. Either impact could result in a decrease in the productivity of such soils and a loss of fertile topsoil. Soil Limitations. All of the soils within the Oklahoma Converter Station and AC Interconnection Siting Areas would be susceptible to compaction and have moderate to high wind erosion potential. Bedrock or other restrictive layers are encountered within 60 inches of the ground surface in 42% of the Oklahoma converter station siting area and in 50% of the AC interconnection representative ROW. Soil Contamination. No areas of potential soil contamination were identified; therefore, no construction-related impacts are anticipated. Operations and Maintenance Impacts from geological hazards or to mineral resources are not anticipated because the area is located in an area of low seismic risk, soil liquefaction risk is expected to be low, and no mineral resources are located within the siting areas. Operation and maintenance of the converter station would have long-term impacts (lack of access to potential mineral resources) to a 45-acre fenced area and a conservative estimate of 2.4 acres associated with a new paved access road. Transmission structures would impact a conservative estimate of 0.4 acre.
Tennessee Converter Station and AC Interconnection Siting Areas	Construction The Tennessee converter station and AC interconnection would be constructed to withstand probable seismic events in the moderate to high seismic hazard zones. Soils within the Tennessee Converter Station Siting Area have high liquefaction potential, which could contribute to unstable conditions and potential structural damage during seismic events. Appropriate placement and design of Project components following completion of geologic/geotechnical investigations during engineering design would minimize risks related to soil liquefaction. The Applicant would implement EPMs to minimize the direct effects of landslides in this area of moderate susceptibility and low incidence. About 30% of the siting area is located in shallow bedrock, and blasting may be required. Impacts would be minimized by appropriate engineering design and through implementation of the Blasting Plan. Designated Farmland. Sixty-two percent (459 acres) of the siting area consists of designated farmland. Depending on the specific siting of the converter station and AC interconnection line within this area, impacts could include exposing prime farmland to conditions of increased erosion potential, and soils with high compaction potential would be susceptible to compaction from construction vehicles and equipment. Either impact could result

Table 2.6-1:
Summary of Potential Environmental Impacts—Converter Stations and AC Interconnections

RESOURCE	IMPACT
	in a decrease in the productivity of such soils and a loss of fertile topsoil. Soil Limitations. Soils susceptible to compaction and water erosion dominate the Tennessee siting area. The siting area includes 77 acres (10%) of land with steep slopes and 161 acres (22%) of land with hydric soils. Depending on the specific siting of the converter station, these areas could be avoided or impacted during construction activities. Construction could expose erosion-prone soils to conditions of increased erosion potential; and soils with high compaction potential would be susceptible to compaction from construction vehicles and equipment. Soil Contamination. One National Pollutant Discharge Elimination System (NPDES) site and one Toxics Release Inventory (TRI) site were identified in the siting area. The NPDES site indicates a stone and gravel operation where a permit was granted in 2008 for the discharge of stormwater. The TRI site is the 500kV Shelby Substation. These sites indicate a records inventory and do not raise a concern at this time in regards to areas of soil contamination. Operations and Maintenance The Project components would be operated and maintained in an area of moderate to high seismic hazard, and expected ground motions from an earthquake would be moderate to high. The Project components would be constructed to withstand probable seismic events and constructed in accordance with applicable federal and state regulations to prevent accidents and to ensure adequate protection for the public and the Project. Soils within the siting areas have high liquefaction potential. Geotechnical investigations would be completed in these areas during engineering design. Soils within the siting areas have high liquefaction potential. Geotechnical investigations would be completed in these areas during engineering design. The placement of Project components would be governed in part by site conditions, construction requirements, and EPMs, which would minimize risks related to soil liquefaction. Operations and maintenance would have long-term and impacts (lack of access to potential mineral resources) to a 45-acre fenced area and a conservative estimate of 2.4 acres would be associated with a new paved access road.
Arkansas Converter Station Alternative and AC Interconnection Siting Areas	Construction The converter station and AC interconnection would be located in an area of low to moderate seismic hazard, and one active surface fault that traverses the siting area. Nine percent of soils within the Arkansas Converter Station Siting Area have high liquefaction potential and about 47% of the soils within the AC interconnection have high liquefaction potential. To reduce impacts from seismic hazard and liquefaction, the Applicant would implement the same measures as described for the Tennessee Converter Station and AC Interconnection Siting Areas. The areas have moderate susceptibility and low incidence with respect to landslides. Potential landslide impacts would be reduced or mitigated using the same techniques as described for the Tennessee Converter Station and AC Interconnection Siting Areas. Impacts from blasting would be minimized by following provisions of the Blasting Plan, and the Applicant would train personnel in the practices, techniques, and protocols required by federal and state regulations and applicable permits to protect potential paleontological resources from grading and excavation activities. Shale gas play is located within the converter station and AC interconnection Siting Areas; three oil and gas wells were identified within the converter station Siting Area. EPMs LU-1, GE-29, and LU-4 would be implemented to minimize potential impacts to mineral resources from construction. Designated Farmland. The converter station siting area is located within 192 acres of designated farmland. The converter station would require 20 to 35 acres of land. The AC interconnection representative ROW includes 662 acres, all of which is designated farmland. Depending on the specific siting of the converter station and AC interconnect line within these areas, impacts could include exposing designated farmland to conditions of increased erosion potential, and soils with high compaction potential would be susceptible to compaction from construction vehicles and equipment. Either impact could result in a decrease in the productivity of such soils and a loss of fertile topsoil. Soil Limitations. Fifteen percent of the Arkansas Converter Station Alternative Siting Area is within lands with steep slopes (15 to 30 %). Soils with moderate to high wind and water erosion potential compose 47 and 27%, respectively, of siting area. Bedrock or other restrictive layers are encountered within 60 inches of the ground surface for 79% of the siting area. None of the AC Interconnection representative ROW is within lands with steep slopes (15 to 30%). Soils with moderate to high wind and water erosion potential compose 24 and 50%, respectively, of the AC interconnection representative ROW. Bedrock or other restrictive layers are encountered within 60 inches of the ground surface for

Table 2.6-1:
Summary of Potential Environmental Impacts—Converter Stations and AC Interconnections

RESOURCE	IMPACT
	62% of the AC interconnection representative ROW. Soil Contamination. Two sites were identified in the Arkansas Converter Station Alternative AC Interconnection Siting Area. Both sites are NPDES sites. Implementation of EPMs would minimize potential contamination of soils. Operations and Maintenance The area has moderate susceptibility and low incidence with respect to landslides. The Project components would be in an area of low to moderate seismic hazard. The soils within the siting areas have high liquefaction potential. Impacts from seismic hazards and liquefaction would be minimized utilizing the same measures as described for the Tennessee Converter Station Siting Area and AC Interconnection Siting Area. Impacts to mineral resources are not expected from operations. The converter station site would take 20 to 35 acres of designated farmland out of production. The AC transmission line ROW is estimated to temporarily impact 662 acres of designated farmland. Transmission line structures are conservatively estimated to permanently impact 0.6 acres of land.
GROUNDWATER	
All converter station siting areas	Construction Common impacts from all converter stations include (1) potential for contamination from spills or leaks of fuels and lubricants, (2) small and short-term changes in infiltration rates in areas of land disturbance, (3) minor impacts to water availability from water demands, and (4) potential damage to wells and associated piping systems in construction areas.
Oklahoma Converter Station and AC Interconnection Siting Areas	Oklahoma Converter Station No groundwaters of special interest are underneath the Oklahoma Converter Station Siting Area or the associated AC interconnection. No wells or wellhead protection area are located within the station siting area and a single industrial well, which would likely be avoided, is within the ROW of the AC interconnection. Construction would not include work below the water table. Water needed to support construction would likely come from groundwater. Water demand would not be expected to have an impact on the availability of groundwater for other uses. Operations and Maintenance No impacts on groundwater are expected.
Tennessee Converter Station and AC Interconnection Siting Areas	Construction The converter station and the AC interconnection line would not be located in an area with designations of special interest. No wellhead protection area or wells occur within the siting areas. Water to support construction would be expected to come from groundwater. Construction of the converter station might not encounter groundwater. Operations and Maintenance No impacts on groundwater are expected.
Arkansas Converter Station Alternative and AC Interconnection Siting Areas	Construction The Arkansas converter station alternative and AC interconnection siting areas would be located over an area that has no principal aquifer. No wellhead protection area or wells are present in the siting areas. Water to support construction would likely not come from groundwater because surface water is the predominant source of water in Pope County. Construction actions could possibly encounter groundwater. Operations and Maintenance No impacts on groundwater are expected.
HEALTH, SAFETY, AND INTENTIONAL DESTRUCTIVE ACTS	
All Project Components	Construction/Operations and Maintenance The Project would introduce hazards that could affect worker and public health and safety. Natural events, external events or accidents (e.g., aircraft mishaps or fires) or intentional destructive acts or mischief could impact such infrastructure and have related effects on the health and safety of construction workers and the public. The Project would involve the transportation and handling of hazardous materials. The implementation of EPMs associated with management of hazardous materials would keep risks to a minimum.

Table 2.6-1:
Summary of Potential Environmental Impacts—Converter Stations and AC Interconnections

RESOURCE	IMPACT
HISTORIC AND CULTURAL RESOURCES	
Oklahoma Converter Station and AC Interconnection Siting Areas	Construction The Oklahoma Converter Station and AC Interconnection Siting Areas contain no previously recorded archaeological sites or other historic properties. Cultural resources surveys would be performed prior to construction of the Project to ascertain whether any unrecorded eligible properties for listing on the NRHP are present and to assess the possible impacts of construction on such resources if present. DOE establishes the timing and protocols for cultural resources surveys in the draft Programmatic Agreement (PA), developed through consultation with State Historic Preservation Offices (SHPOs), Indian Tribes, federal agencies, and Clean Line. DOE intends to execute the PA before issuing the ROD or otherwise comply with procedures set forth in 36 CFR Part 800. Operations and Maintenance No impacts have been identified.
Tennessee Converter Station and AC Interconnection Siting Areas	Construction Same as Oklahoma Converter Station and AC Interconnection Siting Areas (row above). Operations and Maintenance No impacts have been identified.
Arkansas Converter Station Alternative and AC Interconnection Siting Areas	Construction The Arkansas Converter Station Alternative and AC Interconnection Siting Areas evaluated in the Draft EIS (roughly 20,000 acres) contain 23 previously recorded archaeological sites, including 2 that have been recommended as eligible for the National Register of Historic Places (NRHP) and 21 that have no eligibility recommendation. There are also three previously recorded historic buildings, none of which has been evaluated for NRHP eligibility. The number of previously recorded cultural resources suggested a moderate to high sensitivity for the presence of sites that might have been affected by the area evaluated in the Draft EIS. The smaller Arkansas Converter Station Alternative and AC Interconnection Siting Areas evaluated in this Final EIS would have the potential to impact a much smaller subset of these historic and cultural resources. Cultural resources surveys would be performed prior to construction of the Project to ascertain whether any historic or cultural properties eligible for listing on the NRHP are present in the affected areas and to assess the possible impacts of construction on such resources if present. DOE establishes the timing and protocols for cultural resources surveys in the draft PA developed through consultation with State Historic Preservation Offices (SHPOs), Indian Tribes, federal agencies, and Clean Line. Operations and Maintenance No impacts have been identified.
LAND USE	
Oklahoma Converter Station and AC Interconnection Siting Areas	Construction The Oklahoma converter station would be located on undeveloped rangeland; approximately 95% of the land cover in the siting area is grassland/herbaceous. Construction of this converter station would convert 45 to 60 acres of rangeland to a utility land use. The Oklahoma AC interconnection would be approximately 3 miles long and would temporarily convert approximately 66 acres of primarily undeveloped rangeland to a utility land use. Operations and Maintenance After construction is complete, only the 45- to 60-acre converter station and 20-foot-wide paved access road would remain; all other temporary construction areas would be returned to their previous use, primarily rangeland. Approximately 45 acres would be fenced. Within the 3-mile-long AC interconnection ROW, only the transmission structures would remain. All other land in the ROW could return to previous land uses, primarily grazing. Access roads that are not needed for operations and maintenance of the Project would be restored.
Tennessee Converter Station and AC Interconnection	Construction The land cover in the Tennessee Converter Station Siting Area is approximately 33 percent deciduous forest, 31 percent pasture/hay, 20% cultivated crops, and 12% woody wetlands. No existing structures are known to occur. Although the exact location within the 218-acre siting area has not yet been determined, construction of this

Table 2.6-1:
Summary of Potential Environmental Impacts—Converter Stations and AC Interconnections

RESOURCE	IMPACT
Siting Areas	converter station would convert 45 to 60 acres of this land to a utility land use. Operations and Maintenance After construction is complete, only the 45- to 60-acre converter station, the AC interconnection, and 20-foot-wide paved access road would remain; all other temporary construction areas would be returned to their previous use, primarily cultivated crops and pasture/hay. Approximately 45 acres would be fenced. Access roads that are not needed for operations and maintenance of the Project would be restored.
Arkansas Converter Station Alternative	Construction The land cover in the Arkansas Converter Station Alternative Siting Area consists primarily of deciduous forest (32.8 percent), pasture/hay (26.7 percent), evergreen forest (21.9 percent), and mixed forest (10.0 percent). Although the exact location of the converter station has not yet been determined, construction of this converter station would convert 20 to 35 acres of undeveloped land to a utility land use. The Arkansas Converter Station Alternative AC Interconnection Siting Area is approximately 1,000 feet wide and the permanent ROW would be 150 to 200 feet wide and approximately 5 miles long with a total acreage of approximately 661.6 acres. During construction, approximately 477.7 acres of primarily pasture/hay land cover would be temporarily converted to industrial utility land use. Operations and Maintenance After construction is complete, only the 20- to 35-acre converter station and 20-foot-wide paved access road would remain; all other temporary construction areas would be returned to their previous use, primarily rangeland. Approximately 35 acres would be fenced. A 25- to 35-acre site where the alternative AC transmission line would interconnect with the existing 500kV transmission line would also remain as a utility land use. Within the 5-mile-long Arkansas AC interconnection ROW, only the transmission structures would remain. Access would be restricted during the performance of maintenance activities. Access roads that are not needed for operations and maintenance of the Project would be restored.
NOISE	
Oklahoma Converter Station and AC Interconnection Siting Areas	Construction Noise levels associated with individual pieces of equipment at 50 feet away would generally range between 55 and 85 dBA maximum sound level (L_{max}). Maximum instantaneous construction noise levels would range from 91 to 95 dBA equivalent sound level (L_{eq}) at 50 feet from any work site. No noise sensitive areas would be located within DOT noise threshold distances, so no exceedances of the DOT guidelines are expected. Operations and Maintenance The predicted sound level at the nearest noise sensitive area would be below the EPA environmental noise guidelines.
Tennessee Converter Station and AC Interconnection Siting Areas	Same as Oklahoma Converter Station and AC Interconnection Siting Areas (row above).
Arkansas Converter Station Alternative and AC Interconnection Siting Areas	Construction Same as Oklahoma Converter Station and AC Interconnection Siting Areas (row above). Operations and Maintenance The predicted sound level at the nearest noise sensitive area would be below the EPA environmental noise guidelines. Six noise sensitive areas (NSAs) would be located within 659 feet of the Arkansas interconnection line, which corresponds to the threshold distance to the 55 dBA L_{dn} EPA guideline threshold for the 500kV single circuit AC transmission line, assuming operating conditions that would generate the highest noise emissions. These six NSAs may experience adverse noise impacts, which are in excess of the EPA guideline threshold. However, impacts would be less under different weather conditions or if the transmission line is located at an altitude less than 3,000 feet.
RECREATION	
Oklahoma Converter Station and AC	Construction No impacts to any recreation resources are expected because there are no recreational resources in these areas.

Table 2.6-1:
Summary of Potential Environmental Impacts—Converter Stations and AC Interconnections

RESOURCE	IMPACT
Interconnection Siting Areas	Operations and Maintenance No impacts expected.
Tennessee Converter Station	Construction No impacts to any recreation resources are expected because there are no recreational resources in these areas. Operations and Maintenance No impacts expected.
Arkansas Converter Station Alternative	Construction Impacts to recreation resources are not expected from construction of the Arkansas converter station and AC interconnection siting areas because no recreational resources are within in these areas. Operations and Maintenance Impacts to recreation resources are not expected from operations and maintenance of the Arkansas converter station and AC interconnection because no recreational resources are within in the siting areas.
SOCIOECONOMICS	
Oklahoma Converter Station and AC Interconnection Siting Areas	Construction Population and community service impacts would be minor, short term, and temporary. Economic condition impacts would be positive, minor, short term, and temporary. Construction of the converter station is expected to cost approximately $250 million and employ an average of 138 workers over a 32-month construction period, resulting in estimated total employee earnings of $16.2 million. Impacts have the potential to be more substantial in Region 1, where housing resources are more limited, if construction is concurrent with construction of the HVDC transmission line and AC collection system; this potential shortage would be further exacerbated if Project construction coincides with construction of wind projects. Tax revenue impacts would be positive, short term, and temporary from sales, use, and lodging taxes. Operations and Maintenance Operations and maintenance of each of the converter stations is expected to support up to 15 workers, with total estimated annual earnings of approximately $1 million. Annual ad valorem or property tax revenues expected to be generated by the Oklahoma converter station in the first year of operation would range from $3.2 million to $4.6 million. Thereafter, ad valorem taxes would be paid annually based on an annual assessment by the responsible taxing agency.
Tennessee Converter Station and AC Interconnection Siting Areas	Construction Population and community service impacts would be minor, short term, and temporary. Economic conditions impacts would be positive, minor, short term, and temporary. Construction of the converter station is expected to cost approximately $250 million and employ an average of 138 workers over a 32-month construction period, resulting in estimated total employee earnings of $16.2 million. Tax revenue impacts would be positive, short term, and temporary from sales, use, and lodging taxes. Operations and Maintenance Operations and maintenance of each of the converter stations is expected to support up to 15 workers, with total estimated annual earnings of approximately $1 million. Clean Line has entered into a payment-in-lieu of taxes (or "PILOT") arrangement with the Economic Development Growth Engine Industrial Development Board of the City of Memphis and Shelby County for the Tennessee converter station (see Section 3.13.6.2.7.1.2).
Arkansas Converter Station Alternative and AC Interconnection Siting Areas	Construction Same as for Tennessee converter station. Operations and Maintenance Operations and maintenance of each of the converter stations is expected to support up to 15 workers, with total estimated annual earnings of approximately $1 million. Operations and maintenance of the Arkansas converter station would generate annual property or ad valorem tax revenues in Pope County. The Arkansas converter station would result in estimated annual ad valorem or property tax revenues of about $0.9 million in its first year of operation. Thereafter, ad valorem taxes would be paid annually based on an annual assessment by the responsible taxing agency.

Table 2.6-1:
Summary of Potential Environmental Impacts—Converter Stations and AC Interconnections

RESOURCE	IMPACT
SPECIAL STATUS WILDLIFE AND FISH, AQUATIC INVERTEBRATE, AND AMPHIBIAN SPECIES	
Oklahoma Converter Station and AC Interconnection Siting Areas	Construction No mortality impacts to any of the special status species are expected. Construction would disturb approximately 45 to 60 acres of grasslands and croplands at the Oklahoma converter station and associated AC interconnection. The habitat loss is unlikely to have substantial long-term direct impacts to special status wildlife populations in the area. No direct or indirect impacts to special status fish, aquatic invertebrate, and amphibian species or their habitat would occur because no waterbodies are located within the footprint of the converter station. Operations and Maintenance Because the converter station area would be a developed site with approximately 45 acres fenced, the routine presence of staff would not have any impacts to any special status wildlife species. The expected risk of collision mortality from the AC interconnection line to avian species is low. No direct or indirect impacts to special status fish, aquatic invertebrate, and amphibian species or their habitat would occur because no waterbodies are located within the footprint of the converter station.
Tennessee Converter Station and AC Interconnection Siting Areas	Construction No mortality impacts are expected to either the northern long-eared bat or Indiana bat. Potential impacts are expected to be very limited because the siting area is largely croplands and pasture land. No loss of bat habitat is expected so long as construction does not require removal of any potential roost trees that may occur in forested areas. The only special status fish or aquatic invertebrate species identified near the converter station include the pallid sturgeon (federally endangered) and blue sucker (state threatened), which occur within the Mississippi River. Although the Mississippi River is more than 10 miles from the siting area, construction activities could impact tributaries draining into the Mississippi River. If the converter station is built adjacent to Big Creek or Bull Branch. Construction activities could introduce sediment, herbicides, and/or fuel and lubricants into the aquatic system that could travel to the Mississippi River. Operations and Maintenance No impacts to either the northern long-eared bat or Indiana bat are expected. If the converter station is built adjacent to Big Creek or Bull Branch, riparian clearing maintenance, road maintenance activities, and facilities operations could result in increased risk of chemical spills and contamination and increased sedimentation that could travel to the Mississippi River.
Arkansas Converter Station Alternative and AC Interconnection Siting Areas	Construction The siting areas contain about 55% forested habitat that could potentially be used by the Indiana bat and northern long-eared bat for summer-roosting and foraging. The occurrence and use of forested habitat by the northern long-eared bat and Indiana bat, and possibly by the Ozark big-eared bat and gray bat as foraging, within the Project ROI is likely restricted to the spring through fall. To the extent that construction of the converter station and associated AC interconnection transmission lines avoids forested areas, impacts to bat habitat (i.e., removal of roost trees or temporary disturbance of roost sites) would be minimized or avoided. No bald eagle nesting or winter roost sites are known to exist within the siting areas, but any potential sites would be identified prior to construction and appropriate measures would be implemented to avoid potential impact to nests or winter roosts. No direct impacts to special status fish, aquatic invertebrate, and amphibian species or their habitat because no waterbodies are located within the footprint of the construction area or along the interconnection area. Operations and Maintenance No impacts to any of the special status bat species are expected from operations and maintenance of the facility. The vegetation in the ROW underneath the AC transmission lines would be maintained in a low stature to prevent interference with electrical conductors. Any trees removed during construction would not be allowed to regrow, including any trees that had been used as bat roost trees. The transmission lines could pose a risk to wintering bald eagles in the region, although there is no suitable habitat within the siting area that would attract eagles from surrounding wintering areas, so the potential risk of collisions with the transmission lines is considered low. No direct or indirect impacts to special status fish, aquatic invertebrate, and amphibian species or their habitat would occur because no major waterbodies are located within the footprint of the construction area or along the interconnection area.

Table 2.6-1:
Summary of Potential Environmental Impacts—Converter Stations and AC Interconnections

RESOURCE	IMPACT
SURFACE WATER	
Common impacts to all converter station and AC interconnection siting areas	Common impacts include (1) potential for runoff and receiving water contamination from spills or leaks of fuels and lubricants, (2) changes in runoff rates in areas of land disturbance, (3) possible disturbance of drainage features, including intermittent or perennial streams, from construction of facilities and access roads; and (4) impacts to water availability from water demands.
Oklahoma Converter Station and AC Interconnection Siting Areas	Construction Limited surface water features consisting of 1.6 miles of intermittent stream beds, no perennial streams, and no major waterbodies are present in the siting areas. The length of intermittent streams within the representative 200-foot-wide ROW for the AC interconnection is 0.2 mile. Water needed to support construction would likely not come from surface water. Operations and Maintenance No impacts on surface water are expected.
Tennessee Converter Station and AC Interconnection Siting Areas	Construction Limited surface water features consisting of a few drainage features, including 0.21 mile of perennial streams, 1.5 miles of intermittent streams, and no major or other waterbodies are present within the siting areas. Water needed to support the construction would likely not come from surface water. Operations and Maintenance No impacts on surface water are expected.
Arkansas Converter Station Alternative and AC Interconnection Siting Areas	Construction The converter station siting area includes no perennial streams, 0.63 mile of intermittent streams, no major waterbodies, and 2.6 acres of reservoirs, lakes, and ponds. The 200-foot-wide representative ROW for the AC interconnection would encompass 0.16 mile of perennial streams, 1.49 miles of intermittent streams, and 1.66 acres of reservoirs, lakes, and ponds. The Applicant would avoid surface waters to the extent practicable in selecting the ultimate construction site for the station. Water to support construction of the converter station and interconnection would likely come from surface water; which is expected to be obtained from a municipal provider. Operations and Maintenance No impacts on surface water are expected.
TRANSPORTATION	
Oklahoma Converter Station and AC Interconnection Siting Areas	Construction No decrease in level of service is expected for any roadway segments in the siting areas. No railroads are located in the siting areas. No impacts to airports, airstrips, or navigation aids are expected. Operations and Maintenance Negligible impacts to transportation.
Tennessee Converter Station and AC Interconnection Siting Areas	Construction Conservative modeling of construction traffic predicts a potential decrease in the level of service from A to B (9 segments) and from B to C (5 segments) for segments of the multiple roadways. Decreases from levels of service LOS-C to LOS-D are predicted for six segments of the some local roadways centered in the area of Munford, Atoka, and Millington, Tennessee. The decrease from LOS-C to LOS-D is only a one-level drop in operation level and would be minimally noticeable to motorists. The scenario that peak traffic would be distributed entirely to the roadway segments with resulting decreases to LOS-D is a bounding scenario; actual impacts to these roadway segments are expected to be less than predicted. No railroads are located within the siting area. Equipment and buildings associated with the converter station are expected to be less than 85 feet in height; these would not affect nearby airports. Operations and Maintenance Negligible impacts to transportation.

Table 2.6-1:
Summary of Potential Environmental Impacts—Converter Stations and AC Interconnections

RESOURCE	IMPACT
Arkansas Converter Station Alternative and AC Interconnection Siting Areas	Construction Construction traffic could result in decreases in the level of service from LSO-A to LOS-B for segments of the multiple roadways. All roadways would continue to operate an acceptable LOS-C or better in the converter station siting area. No railroads, airports, airstrips, or navigation aids would be affected. Operations and Maintenance Negligible impacts to transportation.
VEGETATION COMMUNITIES	
Common impacts to all converter station and AC interconnection siting areas	Construction may cause the direct impact of vegetation removal and the indirect impacts of reduction of plant vigor from mechanical damage, fragmentation, and the introduction of invasive species. Operations and maintenance of the Project would result in the continued absence of vegetation from the footprint of the facilities for the life of the Project. Operations and maintenance of the AC transmission lines for the interconnections would impact vegetation directly through mowing and pruning in the ROW and indirectly through herbicide applications that may impact non-target plant species.
Oklahoma Converter Station and AC Interconnection Siting Areas	Construction The dominant vegetation for the siting area is grassland and herbaceous cover (605 acres). Forty-five to 60 acres of land would be cleared and graded for the station facility footprint, plus an additional 5 to 10 acres of land for the overall construction. Vegetation would not be allowed to grow on these 45–60 acres for the life of the Project and during construction of the Project for the additional 5–10 acres. Clearing and grading activities for the access road would cause removal of approximately 4 acres of vegetation for the life of the Project. A maximum 200-foot-wide by 3-mile-long interconnection ROW would result in approximately 66 acres of long-term impacts, including the initial clearing of the existing vegetation. The footprint of the transmission line support structures would require less than 1 acre of long-term impact to vegetation. Operations and Maintenance Vegetation removed during the construction of the converter station or access road would not be replaced during the operations phase of the Project. Vegetation within the ROW of the AC interconnection would be maintained during the operations and maintenance phase of the Project. The projected acreage of vegetation to maintain in the AC interconnection ROW is 66 acres.
Tennessee Converter Station and AC Interconnection Siting Areas	Construction The dominant vegetation for the siting area for the Tennessee converter station includes cultivated crop lands (394 acres) and pasture/hay (195 acres). Forty-five to 60 acres of land would be cleared and graded for the station facility footprint. Vegetation would not be allowed to grow on these 45-60 acres for the life of the Project and during construction of the Project for the additional 5–10 acres. Clearing and grading activities for the access road would cause the removal of approximately 4 acres of vegetation for the life of the Project. Operations and Maintenance Vegetation removed during the construction of the converter station or access road would not be replaced during the operations and maintenance phase of the Project.
Arkansas Converter Station Alternative and AC Interconnection Siting Areas	Construction The dominant land cover type is deciduous forest (71 acres), followed by pasture/hay lands (67 acres), and cultivated crops (44 acres). There are also 12 acres of woody wetlands within the overall siting area. Twenty to 35 acres of land would be cleared and graded for the station facility footprint. Vegetation would not be allowed to grow on these 20–35 acres for the life of the Project. Clearing and grading activities for the road would cause removal of approximately 4 acres of vegetation for the life of the Project. The following impacts would be expected: • Transmission line ROW: A maximum 200 foot-wide by 5-mile-long ROW would impact 121 acres of vegetation. • Lattice or monopole structures: Approximately 1 acre of vegetation removal. • Tubular pole structures: Less than 1 acre of vegetation removal. • AC Interconnection Siting Area: A 25-35-acre site would be required for the interconnection to an existing

Table 2.6-1:
Summary of Potential Environmental Impacts—Converter Stations and AC Interconnections

RESOURCE	IMPACT
	500kV transmission line. An additional 5-acre area would be required during construction, resulting in a potential for 40 total acres of impact. The interconnection site is mostly grassland with some forested areas. Operations and Maintenance Vegetation removed during the construction of the converter station or access road would not be replaced during the operations phase of the Project. Vegetation within the ROW of the AC interconnection would be maintained during the operations and maintenance phase of the Project. The projected acreage of vegetation to maintain in the ROW is 121 acres. Vegetation removed for the interconnection site would not be replaced except for about 5 acres required only during construction.
VISUAL RESOURCES	
Oklahoma Converter Station and AC Interconnection Siting Areas	Construction Short-term visual intrusion of construction vehicles, equipment, materials, and a work force in staging areas, and final converter station location. Vehicles, heavy equipment, structure components, ancillary facility components and materials, and workers would be visible during construction and would create short-term and local contrast within the areas of the ROW for the AC interconnection. Lighting of construction yards and work areas would create temporary visual impacts to night skies. Affected viewers would be aware of the temporary nature of the Project construction impacts, which should decrease their concern about the impact. Operations and Maintenance Facilities would contrast with the rural landscape and be visible on the horizon from large distances; however, the area is already impacted by numerous vertical structures such as wind turbines and existing transmission lines. There are no notable visual resources, so visual concern is low. Overall visual impacts would be low due to existing modification to the landscape and low number of sensitive viewers.
Tennessee Converter Station and AC Interconnection Siting Areas	Construction Same as described for the Oklahoma converter station. Operations and Maintenance Two key observation points were identified for the siting area. Depending on the observation point, the Project would result in moderate or strong contrast and moderate-high visual impacts.
Arkansas Converter Station Alternative and AC Interconnection Siting Areas	Construction Short-term visual intrusion of construction vehicles, equipment, materials, and a work force in staging areas, and final converter station location. Vehicles, heavy equipment, structure components, and workers would be visible during converter station construction and modification, access and spur road clearing and grading, structure erection, and cleanup and restoration. Affected viewers would be aware of the temporary nature of the Project construction impacts, which should decrease their concern about the impact. Operations and Maintenance The surrounding landscape of the siting area is primarily rural and agricultural and other than rural residences, does not contain a high number of sensitive resources that would be impacted. When visible in the foreground, the facilities associated with the converter station would result in high contrast on the rural landscape, but given low numbers of sensitive viewers in the area, it would have an overall low-moderate impact.
WETLANDS, FLOODPLAINS, AND RIPARIAN AREAS	
Oklahoma Converter Station and AC Interconnection Siting Areas	Construction The Oklahoma Converter Station and AC Interconnection Siting Areas are dominated by grassland/herbaceous vegetation (605 acres). No wetland resources or 100-year floodplains were identified within the siting areas. Potential impacts to riparian areas are unlikely. Less than 2 miles of intermittent stream beds, no perennial streams, and no major waterbodies are present within the siting areas. Operations and Maintenance No impacts to wetlands, floodplains, or riparian areas are expected.

Table 2.6-1:
Summary of Potential Environmental Impacts—Converter Stations and AC Interconnections

RESOURCE	IMPACT
Tennessee Converter Station and AC Interconnection Siting Areas	Construction The Tennessee Converter Station and AC Interconnection Siting Areas include approximately 2.7 acres of palustrine forested wetlands. The construction effort would avoid wetlands and waters of the United States to the extent practicable. Where impacts appear unavoidable, those wetland sites would receive a formal wetland delineation and appropriate consultation with the USACE. No 100-year floodplains occur with the siting area. Only 1.5 miles of intermittent and 0.2 mile of perennial streams, and no major waterbodies are present within the siting area. Potential impacts to riparian areas are unlikely. Operations and Maintenance If wetlands and riparian areas can be avoided during construction activity, then they should also be avoided during all operations and maintenance activities.
Arkansas Converter Station Alternative and AC Interconnection Siting Areas	Construction The Arkansas Converter Station Alternative Siting Area includes 0.6 mile of intermittent streams, 43.8 acres of floodplains, and 2.6 acres of surface waterbodies (ponds/lakes). The converter station would ultimately only disturb approximately 20–35 acres of land and it is very unlikely that these 20–35 acres would be focused on the wetland resources documented within the siting area. The construction effort should avoid wetlands and waters of the United States to the extent practicable. The Arkansas AC Interconnection Siting Area is approximately 1,000 feet wide and the permanent ROW would be 150 to 200 feet wide and approximately 5 miles long with a total acreage of approximately 661.6 acres. The ROW includes 1.5 miles of intermittent streams, 0.2 mile of perennial streams, 463.8 acres of floodplains, and 1.7 acres of other surface waterbodies (ponds/lakes). Operations and Maintenance Wetlands, floodplains and riparian areas associated with perennial streams have all been documented within the siting area, but ultimately only 20-35 acres of land would be disturbed. Therefore, these resources would likely be avoided during siting and would thus incur no impacts during operations and routine maintenance.
WILDLIFE AND FISH	
Oklahoma Converter Station and AC Interconnection Siting Areas	Construction Wildlife species would be exposed to Project-related mortality or injury. Grasslands and croplands are capable of restoring to pre-disturbance levels in a short timeframe (defined as less than 5 years). As a result, the majority of Project-related impacts to grasslands and croplands habitats would be short term in nature (i.e., those areas would restore to pre-construction conditions within 5 years or less) However, some permanent loss of grassland and croplands habitats would also occur as a result of the Project’s permanent footprint. The grassland and cropland habitats found within the Oklahoma Converter Station and AC Interconnection Siting Areas are relatively common throughout the ROI; therefore, disturbance of 45–60 acres would not result in a significant impact to local wildlife. No perennial streams and no major waterbodies are located within the siting area. Coldwater Creek, a perennial stream, is within 1 mile of the siting area. Increased sedimentation is not likely to affect Coldwater Creek; however, if construction occurs near established intermittent waterways, there is potential for sediment to travel downstream and cause potential impacts to fish and aquatic invertebrate species. Operations and Maintenance Operation and maintenance activities would result in long-term impacts to the habitats. Some permanent loss of habitat would occur as a result of the Project’s permanent footprint (i.e., some areas would be encompassed permanently by Project structures such as the converter station, transmission line structures, access roads, etc.).The permanent loss of habitat is unlikely to have substantial long-term impacts to wildlife populations in the area because the type of habitats affected are common in the region and found elsewhere in the vicinity of the Project ROI. Operation and maintenance activities would not result in long-term impacts to fish and aquatic species because no major waterbodies or perennial streams are within the siting area, and downslope streams are approximately 1 mile away.

Table 2.6-1:
Summary of Potential Environmental Impacts—Converter Stations and AC Interconnections

RESOURCE	IMPACT
Tennessee Converter Station and AC Interconnection Siting Areas	Construction Croplands and pasture/hay lands are the dominant habitat types found in the siting areas. However, hardwood forests and riparian areas are also present. Croplands and pasture lands are capable of restoring to pre-disturbance levels in a short timeframe (defined as less than 5 years). As a result, the majority of Project-related impacts to these areas would be short-term in nature. However, some permanent loss of habitats would still occur as a result of the Project's permanent footprint. Furthermore, because forests and riparian areas are also present, these types of habitats could also be potentially impacted as well. Forested and riparian areas could take decades to restore to pre-construction conditions if they are disturbed or cleared. There are no major waterbodies or streams located within the siting area. The Tennessee Converter Station Siting Area and AC Interconnection Siting Area borders Big Creek, a perennial stream, listed as impaired in 2010 for aquatic resources (fish, shellfish, and wildlife values). Impacts fish and aquatic species would likely be less if the facilities were located within the croplands and pasture/hay lands, and greater if they were located in forested areas due to the effects of long-term habitat loss from vegetation clearing, the extensive time necessary for forests to regenerate to pre-disturbance conditions and provide sediment retention, shade, and cover, and the impacts associated with edge effects in forested habitats that do not provide sedimentation retention, shade, and cover. Operations and Maintenance Operation and maintenance activities would result in long-term impacts to the habitats. Some permanent loss of habitat would occur as a result of the Project's permanent footprint (i.e., some areas would be encompassed permanently by Project structures such as the converter station, transmission line structures, access roads, etc.). The permanent loss of habitat is unlikely to have substantial long-term impacts to wildlife populations in the area because the type of habitats affected are common in the region and found elsewhere in the vicinity of the Project ROI. However, species that are near or at carrying capacity may experience a reduction in population size due to this permanent loss of potential feeding and breeding A perennial stream flows adjacent and downslope along the western side of the siting areas. Additionally, a perennial stream flows through the middle of the siting area. Placement of roads and structures that could result in increased sedimentation from operations and maintenance activities could result in long-term direct and indirect impacts to fish and aquatic invertebrate species or their habitat.
Arkansas Converter Station Alternative and AC Interconnection Siting Areas	Construction The siting area contains a variety of habitats that range from forested areas to pasture lands. The Project could result in long-term impacts to wildlife habitats (due to the timeframes necessary for these forests areas to restore to pre-construction conditions). Because the pasture/hay fields that could potentially be impacted are capable of restoring to pre-disturbance levels in a short timeframe (defined as less than 5 years), most impacts to these types of habitats would be short-term in nature. However, some long-term loss of pasture/hay field habitats would still occur as a result of the Project's footprint. Impacts to wildlife would likely be less if the facilities were located within the pasture lands, and would be greater if they were located in forested areas due to the effects of long-term habitat loss, the extensive time necessary for forests to regenerate to pre-disturbance conditions, and the impacts associated with edge effects in forested habitats. Construction would not likely result in any direct impacts to fish and aquatic invertebrate species or their habitat because no waterbodies are located within the siting area. Indirect construction impacts should be minimal. However, if either siting area is upslope of any waterbodies, there is a potential for runoff to enter the waterway, causing potential indirect impacts to fish and aquatic invertebrate species. Operations and Maintenance The permanent loss of habitat is unlikely to have substantial long-term impacts to wildlife populations in the area because the type of habitats affected are common in the region and found elsewhere in the vicinity of the Project ROI. Direct impacts to fish and aquatic invertebrate species or their habitat are not expected because no waterbodies are located within the footprint of the interconnection area.

Table 2.6-2:
Summary of Potential Environmental Impacts—AC Collection System

RESOURCE	IMPACT
Agricultural Resources	Construction Cultivated crops would be directly affected by removal of vegetation and potential removal of agricultural structures such as irrigation systems, barns, and silos. Agricultural production may be temporarily diminished. The Applicant would avoid or minimize adverse effects to surface and subsurface irrigation and drainage systems (e.g., tiles). Potential impacts to cultivated crops would vary based on the design and location of the proposed transmission line structures and access roads relative to existing agricultural operations. During construction, 325 to 1,365 acres of primarily grassland and cultivated crops would be disturbed depending on which AC collection system route is constructed. Construction of the AC collection system would directly affect livestock grazing by temporarily reducing forage for livestock within areas of grassland/herbaceous and pasture land cover. Construction may affect livestock control and distribution if a gate is left open or a fence is damaged. Vehicular access during construction would increase the likelihood of livestock injury or death from collisions. Construction and operations and maintenance of the proposed transmission lines could affect the economic value of livestock production in the representative ROW by increasing ranchers' costs and decreasing available forage. The Project could affect net earnings from livestock production in the following ways: • Decreased forage from land taken out of production • Increased management costs associated with controlling additional noxious and invasive vegetation species introduced by Project construction equipment • Increased management costs associated with moving livestock around Project-related structures and easements if a landowner wishes to move livestock during the construction period Operations and Maintenance Potential impacts to cultivated crops would vary based on the design and location of the AC collection system structures and access roads relative to existing agricultural operations. Long-term disturbance would result in 1.8 to 7.8 acres of primarily grassland/herbaceous and cultivated crops depending on which AC collection system route is constructed. Most agricultural activities such as livestock grazing and cultivating crops could be returned to the ROW upon the completion of construction.
Air Quality and Climate Change	Construction Construction activities would result in air quality and greenhouse gas emissions. Emissions are not anticipated to cause or significantly contribute to a violation of an applicable ambient air quality standard or contribute substantially to an existing or projected air quality violation. Operations and Maintenance There would be negligible amounts of air pollutants from maintenance activities. Operations and maintenance of the AC collection system would not emit pollutants; however, maintenance activities would emit small amounts of pollutants associated with combustion of fossil fuels for worker vehicles and equipment.
Electrical Environment	Construction No electrical effects would be associated with construction of the AC collection system because these facilities would not be energized during construction. Operations and Maintenance Calculations with respect to electrical fields, magnetic fields, audible noise, radio noise, television noise, and ozone were performed for each of the configurations and the results are as follows: • Calculated AC electric field levels at the ROW edges would be below guidelines for public exposure (established by non-regulatory organizations such as the Institute of Electrical and Electronics Engineers [IEEE] and the International Committee on Non-Ionizing Radiation Protection [ICNIRP]). Within the ROW, calculated electric field levels would be below some guidelines for transmission line ROWs, but exceed some public exposure guidelines. For the single circuit lattice structure configuration, calculated electric field levels exceed the ACGIH guideline for workers with implanted medical devices at the ROW edges if the ROW width is only 150 feet, but comply if the width is 200 feet. • Calculated magnetic field levels at the ROW edges are below guidelines for public exposure (established by non-regulatory organizations such as the IEEE and ICNIRP) and within the ROW are below the ACGIH

Table 2.6-2:
Summary of Potential Environmental Impacts—AC Collection System

RESOURCE	IMPACT
	guideline for workers with implanted medical devices. • Calculated audible noise levels at the ROW edges are below the EPA guideline for noise. • Calculated radio noise levels at 50 feet from the outside conductor comply with the IEEE threshold during fair weather conditions but are slightly above that threshold during rainy weather. • Television noise could cause interference. No interference from corona-generated noise expected for digital signals broadcast at frequencies above 1 gigahertz from satellites. • Maximum ozone levels are far below the EPA standard. • Based on an evaluation of research and guidelines recommended by various agencies, it is unlikely that the AC collection system would pose a known threat to human health. • Overall, the likelihood of annoyance to landowners by audible noise from the line or interference with AM radio or television reception is small.
Environmental Justice	Construction/Operations and Maintenance No temporary, short-term, or long-terms impacts to low-income or minority populations are anticipated.
Geology, Paleontology, Soils, and Minerals	Construction Designated Farmland. AC Collection System Route SW-1 would impact the least amount (9 acres) of designated farmland. AC Collection System Routes E-2, NW-1, NW-2, SE-1, and SE-3 would impact the greatest amount (502 to 671 acres) of designated farmland. Soil Limitations. Depending on the AC collection system routes that are implemented, construction would result in: • Disturbance of 128 to 1,125 acres of karst and 43 to 138 acres of shallow bedrock • 127 to 1,209 acres of soils with high compaction potential • 76 to 779 acres of soils with moderate to high wind erosion potential • 0 to 46 acres of soils with slopes of 15% to 30% • Temporary disturbance to soils from access roads Soil Contamination. One facility/site with known contamination was identified within the AC Collection System Route SW-2. That location would likely be avoided. Operations and Maintenance Impacts to soils generally depend on the length and area covered by the routes, which generally correlates with the amount of access roads and ROW. Other impacts depend on farmland and soil limitation parameters that might be affected. Impacts to soils would be limited to the actual transmission line structure footprints and from occasional use of the ROW for maintenance access. Impacts from access roads might expose soils to erosion and compaction. Impacts caused by new structures would be permanent during operations and maintenance and the access impacts would be temporary and minimal.
Groundwater	Construction Common impacts among the AC collection system routes include (1) potential for contamination from spills or leaks of fuels and lubricants, (2) short-term changes in infiltration rates in areas of land disturbance, (3) minor impacts to water availability from water demands (low demand as compared to availability), and (4) potential damage to wells and associated piping systems in construction areas. The deepest foundations for transmission line structures would be in the range of 15 to 30 feet below ground. Based on the typical depths to groundwater in the five counties in which the AC collection system routes would be located, it is expected that construction of foundations for transmission line structures would not reach groundwater. Five of the representative ROWs associated with AC Collection System Routes E-1, E-2, E-3, SE-1, and SE-3 would encompass 14 to 174 acres of nutrient-vulnerable groundwater, but do not cross areas with special source groundwater. The total number of wells (private domestic, public water supply, agricultural, and industrial) within the ROWs range from 0 to 8. Operations and Maintenance No impacts to groundwater.

Table 2.6-2:
Summary of Potential Environmental Impacts—AC Collection System

RESOURCE	IMPACT
Health, Safety, and Intentional Destructive Acts	Construction/Operations and Maintenance The Project would introduce hazards that could affect worker and public health and safety. Natural events, external events or accidents (e.g., aircraft mishaps or fires) or intentional destructive acts or mischief could impact such infrastructure and have related effects on the health and safety of construction workers and the public. The Project would involve the transportation and handling of hazardous materials. The implementation of EPMs associated with management of hazardous materials would keep risks to a minimum.
Historic and Cultural Resources	Construction AC Collection System Routes NE-1, NE-2, SE-1, SE-2, and SW-1 contain no previously recorded archaeological sites or other historic properties. AC Collection System Routes E-1, E-2, E-3, and SE-3 each contain one previously recorded archaeological site that has not been evaluated for NRHP eligibility. None contain previously recorded historic buildings. AC Collection System Routes NW-1 and NW-2 each contain two previously recorded archaeological sites, neither of which has been evaluated for NRHP eligibility. AC Collection System Route NW-1 contains no previously recorded historic buildings. The NRHP-listed Tracey Woodframe Grain Elevator is located in the vicinity of AC Collection System Route NW-2. AC Collection System Route SW-2 contains three previously recorded archaeological sites, none of which have been evaluated for NRHP eligibility. The route contains no previously recorded historic properties. AC Collection System Route W-1 contains two previously recorded archaeological sites, neither of which has been evaluated for NRHP eligibility. The route contains no previously recorded historic properties. A cultural resources survey within AC collection system would be performed prior to construction of the Project to assess the possible impacts of construction on such resources if present. Depending upon circumstances, such survey(s) would be conducted in accordance with the PA. Operations and Maintenance No impacts would be expected.
Land Use	Construction The majority of the impacts to land use would be temporary. Construction would temporarily prevent the use of rangeland and cultivated crops in the ROW. Depending on the AC collection system route, disturbance of primarily grassland and cultivated crops would range from 325 to 1,365 acres. There are 0 to 2 structures present in ROWs. Operations and Maintenance Assuming 300 miles of up to seven lattice structures per mile, the operational footprint of the structures would be approximately 42 acres. An additional 3 acres would be required for six fiber optic regeneration sites. It is anticipated that all existing roads and existing roads with repairs/improvements would be retained for operations and maintenance of the Project. It is estimated that approximately 75% of the new overland roads with no improvements and 90% of the new overland roads with clearing and new bladed roads would be retained for operations and maintenance access. These roads would be up to 20 feet wide. Access roads that are not needed for operations and maintenance would be restored. All other land in the ROW could return to most previous land uses if they are compatible with operations and maintenance of the Project. Some uses may be impeded in the ROW, such as using farming equipment near the pole structures or crop-dusting planes that would not be able to approach the transmission lines. Land uses that would not be permitted in the ROW include buildings or structures, changing the grading and land contours, and some restrictions and coordination for infrastructure such as fences and irrigation lines. In addition, access would be restricted during the performance of maintenance activities. All of the tensioning or pulling areas could return to existing uses once construction has been completed.

Table 2.6-2:
Summary of Potential Environmental Impacts—AC Collection System

RESOURCE	IMPACT
Noise	Construction Depending on the route, noise sensitive areas may experience short-term and temporary elevated noise levels. The only two schools within the ROI are within AC Collection System Route E-1, located within the town of Hardesty. Operations and Maintenance Operations and maintenance would include the use of trucks, lifts, or other equipment as needed on a periodic basis along the AC collection system. Depending on the route, some noise sensitive areas could experience adverse noise impacts under certain operational and weather conditions.
Recreation	Construction Construction is not expected to permanently preclude the use of or access to any existing recreation areas or activities since no recreation resources have been identified within the representative ROW for any routes. The southern boundaries of the Optima National Wildlife Refuge (NWR) and the Optima Wildlife Management Area (WMA) are located to the north of AC Collection System Route E-1. At the closest point, the Optima NWR and the Optima WMA are approximately 1,500 feet from this route, and about 1.5 miles from the Optima lake shoreline, which is within the NWR and WMA areas. The boundaries of the Schultz Lake State Park and Schultz WMA are located to the north of AC Collection System Routes SE-1, and E-2. At the closest point, the Schultz Lake State Park and Schultz WMA are approximately 0.5 mile from the route. The boundary of the Shorb WMA is located to the north of AC Collection System Routes E-2 and SE-3. At the closest point, the Shorb WMA is located 0.16 mile to the north of the routes. Long-term indirect impacts would result from vegetation clearing and structure erection and could affect recreational visitors in adjacent recreational areas due to changes in the scenic landscapes visible from Optima NWR and WMA, Schultz Lake State Park and WMA, and Shorb WMA. Operations and Maintenance No impacts to recreation resources are anticipated from operations and maintenance of any of the AC collection system routes because no recreation resources are located within the representative ROW.
Socioeconomics	Construction Population and community service impacts would be short term and temporary. Economic condition impacts would be positive, short term, and temporary. Impacts have the potential to be more substantial in Region 1, where existing housing resources are more limited, if construction is concurrent with construction of the HVDC line and Oklahoma converter station; this potential shortage would be further exacerbated if Project construction coincides with construction of wind projects. Tax revenue impacts would be short term and temporary from sales, use, and lodging taxes, ranging from $0.2 million to $2.5 million per route alternative. Operations and Maintenance Operations and maintenance are unlikely to affect regional agricultural production and employment, but could have localized impacts. Some short-term adverse impacts on residential property values (and salability) might occur on an individual basis as a result of the Project. However, these impacts would be highly variable, individualized, and are difficult to predict. Positive tax revenue impacts (less than $1 million per route) would be expected from annual ad valorem or property taxes. Ad valorem taxes would be paid annually based on an annual assessment by the responsible taxing agency.
Special Status Wildlife and Fish, Aquatic Invertebrate, and Amphibian Species	Construction Habitat loss and fragmentation of existing grassland habitat is one of the primary threats to the lesser prairie-chicken (LEPC). The highest quality LEPC habitat (based on Crucial Habitat Assessment Tool [CHAT]-1 and CHAT-2) occurs on the eastern side of the AC collection system area. To the extent that the AC transmission lines and access roads cross contiguous areas of native grasslands, construction of the AC collection system may contribute to the loss of potential LEPC habitat. These impacts could be minimized with routes that follow existing ROWs, areas of cultivated fields, and grassland areas already fragmented by other activities that are areas of low quality prairie chicken habitat. The Sprague's pipit also uses native grasslands and could be similarly affected by loss of habitat and fragmentation. Special status fish, aquatic invertebrate, and amphibian species potentially occurring within the AC collection system routes include populations of the Arkansas River shiner. The Beaver River and Palo Duro Creek, which are

Table 2.6-2:
Summary of Potential Environmental Impacts—AC Collection System

RESOURCE	IMPACT
	crossed by several routes, may provide aquatic habitat for the Arkansas River shiner. Potential direct impacts include grading, access roads, herbicide use, and handling of fuel and lubricants where the Beaver River and Palo Duro Creek would be crossed by the routes. Operations and Maintenance Potential impacts to special status wildlife species include mortalities from collisions with transmission lines and structures and possible electrocutions, disturbance impacts from routine maintenance activity, and loss of habitat by behavioral avoidance of areas surrounding vertical structures (i.e., transmission structures and lines). There is a potential risk of mortalities to whooping cranes and golden eagles from collisions with transmission lines and structures. The prairie chicken is a low flier and typically avoids areas surrounding tall structures. Routine maintenance and inspection work is unlikely to impact special status wildlife species other than a temporary displacement while work is performed. However, any avoidance of areas by the LEPC due to the potential for increased predation rates (due to consolidation of raptors and corvids along the AC collection lines) would constitute a loss of habitat. The use of both access roads and the ROW for repair and maintenance activities could result in both direct and indirect impacts to the Arkansas River shiner or its potential habitat in the Beaver River and Palo Duro Creek. The potential application of herbicides could result in indirect impacts, and to a lesser extent, direct impacts.
Surface Water	Construction Common impacts include (1) potential for runoff and receiving water contamination from spills or leaks of fuels and lubricants, (2) short-term changes in runoff rates in areas of land disturbance, (3) possible disturbance of drainage features, including intermittent or perennial streams, from construction of access roads; and (4) impacts to water availability from water demands. Depending on the route, potential impacts could occur to the following surface water resources: (1) the 200-foot-wide ROWs contain 0 to 0.51 mile of perennial streams, 0.25 to 2.91 miles of intermittent streams, 0 to 0.18 mile of major waterbodies, and 0 to 2.61 acres of reservoirs, lakes or ponds; (2) AC Collection System Route SE-3 crosses Wolf Creek, designated a Texas ecologically unique stream segment; (3) six of the routes cross impaired water segments of Beaver River or Palo Duro Creek; and (4) the depth to water table is great enough that pumping and discharge of groundwater during construction is unnecessary. Operations and Maintenance Operations and maintenance would not impact surface water.
Transportation	Construction Only minor decreases in the level of service for area public roadways in the ROI would be expected. These decreases would be temporary. Operations and Maintenance None of the routes would result in impacts to traffic, railroads, or airports/airfields.
Vegetation Communities	Construction Impacts include the initial clearing of vegetation in the ROW and the removal of vegetation in the locations of transmission line support structures. The range of potential impacts from vegetation clearing in the ROW ranges from 325 acres to 1,365 acres. There would be 1.9 acres to 7.8 acres of permanent vegetation loss at structural foundation placements. Operations and Maintenance There would be some degree of regular mowing and trimming of vegetation in any of the routes. None of the routes have forested land cover, so there would be little to no change in the structural form of the vegetation. Depending on the route, the projected acreage of vegetation to maintain in the ROW is between 325 and 1,365 acres.
Visual Resources	Construction There would be short-term visual intrusion of construction vehicles, equipment, materials, and a work force in staging areas, along access roads, and along the new transmission line ROW. Vehicles, heavy equipment, structure components, and workers would be visible during transmission line construction and modification, access and spur road clearing and grading, structure erection, conductor stringing, and cleanup and restoration. However, disturbance from construction activities would be transient and of short duration as activities progress along the transmission line route. Affected viewers would be aware of the temporary nature of Project construction impacts, which may decrease their concern to the impact. The structures and cables (transmission lines) would cause the

Table 2.6-2:
Summary of Potential Environmental Impacts—AC Collection System

RESOURCE	IMPACT
	major long-term change in scenery. Operations and Maintenance The routes are located in a sparsely populated area in a landscape that is primarily flat agricultural lands offering open panoramic views. The region does not contain a high number of sensitive viewers or sensitive resources, so impacts would be expected to be low–moderate. The routes are located in a largely open and undeveloped landscape, and the introduction of large vertical elements such as a transmission line, would have the potential to affect viewers over a large viewing area. Thirteen viewing locations were identified for the routes.
Wetlands, Floodplains, and Riparian Areas	Construction Impacts may vary from short term to long term, and potentially there may be permanent loss of wetland acreage. Potential impacts to wetlands for the various routes range from 0 acre to 20.1 acres. Potential impacts to floodplains range from 0 to 54.6 acres. Riparian areas could be associated with surface water features, which range from 0 to 0.5 mile of perennial streams, 0.3 to 2.9 miles of intermittent streams, 0 to 0.2 mile of major waterbodies, and 0 to 2.6 acres of reservoirs, lakes, and ponds. Operations and Maintenance Impacts may result from use of heavy machinery through wetlands, floodplains, and riparian areas. These impacts can cause soil compaction and mechanical damage or removal of vegetation. These impacts are anticipated to cover a range from temporary to potentially more severe and long-term/permanent. The use of vegetation management would be necessary to protect the Project infrastructure and enhance safety. However, the trimming, mowing, or removal of vegetation can cause changes to plant diversity and function in all three ecosystem types (i.e., wetlands, floodplains, and riparian areas). Vegetation maintenance in wetlands and riparian areas should be kept to a minimum. Additionally, the use of herbicides can cause few to severe impacts to vegetation in areas where they are applied.
Wildlife and Fish	Construction/Operations and Maintenance Some routes would have an elevated risk of avian collision during the migration seasons compared to the other routes, as well as a higher potential for disturbances to important wildlife areas due to these routes proximity to important wildlife areas (i.e., Optima NWR and Optima WMA). There would be no substantial difference between the other routes considered with regard to the types of wildlife impacts that would likely occur as a result of the route location and position; however, longer routes would likely have a greater impact due to the greater length and extent of areas impacted. The length of the various AC collection system routes range from 13 to 56 miles. There is potential for mortality, injury, and disturbance to fish and aquatic invertebrates, and aquatic habitat loss and modification where waterbodies (e.g., perennial, intermittent) would be crossed by routes.

1

Table 2.6-3:
Summary of Potential Environmental Impacts—HVDC Transmission Line

RESOURCE	IMPACT
Agricultural Resources	Construction Construction could affect livestock grazing by temporarily reducing forage areas in the representative ROW. Except while access to the ROW is temporarily restricted during construction, operations, and maintenance for safety reasons, livestock would not be displaced or prohibited from grazing in pastures overlapped by the ROW during construction, unless otherwise desired by the landowner. Construction activities during which restrictions to the ROW may occur are identified in the construction sequence and timeline provided in Table 3.2-10. Croplands would be directly affected by removal of vegetation and agricultural structures such as irrigation systems, barns, and silos. Agricultural production may be temporarily diminished. Potential temporary impacts to center-pivot irrigation could occur primarily in Regions 1, 2, 6, and 7. The operation of center-pivot irrigation could be limited in construction areas. During construction, access roads, temporary work areas, and other graded areas could temporarily disrupt the slope and flow patterns of water on flood-irrigated fields. Operations and Maintenance Maintenance may occasionally disrupt agricultural activities and production on a localized basis. Potential indirect impacts to agricultural production from interference with aerial applications of fertilizer, insecticide, and herbicide,

Table 2.6-3:
Summary of Potential Environmental Impacts—HVDC Transmission Line

RESOURCE	IMPACT
	could occur. Most of the land within the ROWs could return to previous uses after construction. Restrictions on land use within the ROW would be determined based on site-specific conditions and/or in coordination with landowners. These are not blanket limitations or restrictions that would apply to every parcel potentially impacted by the Project. The continued use of the ROW for routine agricultural practices such as grading and contouring and construction of ditches would be permitted and would be compatible with reliability criteria for HVDC facilities and would not be restricted. Limitations on land uses would be described in the easement agreement; these limitations could be modified in the easement based on site-specific conditions and/or coordination with landowners. Maintenance activities may cause temporary impacts within the ROW such as damage to crops.
Air Quality and Climate Change	Construction Construction-related emissions would be below thresholds for all criteria pollutants across all alternatives. Temporary construction impacts to air quality include emissions near sensitive areas such as residences or schools for short periods of time. Locations of residences and schools are shown in Figure 1.0-2 located in Appendix A of the EIS. The only two schools within the ROI are within AC Collection System Route E-1, located within the town of Hardesty. Air quality emissions would be elevated during construction, however typically Project construction would move relatively rapidly along a given ROW, with temporary impacts lasting for only a few days or weeks in a given area. Operations and Maintenance Operations and maintenance would emit negligible air pollutants associated with combustion of fossil fuels for worker vehicles and equipment.
Electrical Environment	Construction No electrical effects would be associated with construction because the transmission line would not be energized yet. Operations and Maintenance Calculated DC electric fields are below public guidelines (such as IEEE and ICNIRP) at the ROW edges. Calculated DC electric fields also conform to occupational standards within the ROW, except for the dedicated neutral return configurations. Calculated DC magnetic fields are below public guidelines (IEEE and ICNIRP) at the ROW edges for all configurations. Calculated audible noise is below the public guideline at the ROW edges for the standard monopole and both dedicated neutral return configurations (the standard lattice configuration is slightly higher than the EPA guideline at 55.2 dBA at one of the ROW edges, but calculated audible noise levels assume a 5 percent overvoltage condition at the highest line elevation of 3,000 feet). Calculated radio noise is below Federal Communications Commission and IEEE exposure guidelines. It is unlikely that the proposed HVDC transmission line would pose a known threat to human health.
Environmental Justice	Construction/Operations and Maintenance The Project would not disproportionately impact low-income or minority populations, and where the Project does cross areas with these populations, the impacts would be the same irrespective of the economic or racial demographics of the area.
Geology, Paleontology, Soils, and Minerals	Construction/Operations and Maintenance Long-term impacts from the Project include the conversion of geology, mineral resources access, and soils resources (especially farmland) to a utility use, primarily for access roads, and transmission line pole structure locations. Impacts include potential damage to Project infrastructure and equipment from seismicity, landslides, subsidence, or soil liquefaction. Blasting may be necessary in areas of shallow bedrock. Impacts to soil resources from construction activities are associated with clearing, grading, excavation, and other activities necessary for construction that could expose erosion-prone soils to conditions of increased erosion potential; and soils with high compaction potential would be susceptible to compaction from construction vehicles and equipment. Impacts to soils would also include the potential for loss of soil productivity. Inadvertent spills of fluids used during construction, such as fuel, lubricants, antifreeze, and herbicides could directly impact soils through contamination; and excavation activities during construction might uncover previously unknown areas of contaminated soils. Seismic hazards are low for the entire Project except for the eastern portion of the ROI in Region 5 and all of Regions 6 and 7 in the area of the New Madrid Seismic Zone. Areas of high to very high soil liquefaction potential are present in the Project Regions 4, 5, 6, and 7. Subsidence from karst is a possible geologic hazard of concern within Regions 1, 2, 4, and 5. Areas of high susceptibility for landslides are present in Project Regions 4, 5, and 7.

Table 2.6-3:
Summary of Potential Environmental Impacts—HVDC Transmission Line

RESOURCE	IMPACT
	The potential for impact to oil and gas operations is greatest in Regions 4 and 5. Given the ongoing development of the Fayetteville shale, numerous oil and gas wells and other related infrastructure could be present.
Groundwater	Construction Typical construction impacts include: • Potential for Groundwater Contamination—Contamination could occur as a result of the accidental release of hazardous substances, primarily fuels and lubricants, which would be used for construction equipment and be present in construction staging or storage yards. Compliance with permit requirements and implementation of EPMs, including spill prevention and response planning, would minimize the potential for groundwater contamination. • Changes to Infiltration Rates—Soils disturbed and loosened during construction could represent areas of increased precipitation infiltration, possibly increasing local groundwater recharge rates over the short term. After construction, impermeable facility surfaces would represent areas of decreased infiltration rates over the long term. The area of impermeable surfaces resulting from the Project would be small. In accordance with the Applicant's EPMs, soils not occupied by Project facilities would be returned to pre-activity conditions, therefore resulting in *de minimis* long-term impacts to infiltration rates. • Effects on Water Availability—Water demands to support the Project could come from groundwater resources (more likely in areas where total water use is typically from groundwater sources such as Regions 1, 2, 6, and 7) and result in less groundwater being available for other uses. Water demand associated with the Project is not expected to have noticeable effects on groundwater resources beyond those resulting from existing water usage. • Physical Damage to Well Systems—Well system damage could occur as a result of direct impacts from equipment traffic or during excavations, and could also occur at locations more remote from construction if blasting was used at excavation sites. The Applicant's EPMs would minimize these occurrences and require repairs of any damages and, in the case of any damage, arrange for temporary water supply, if necessary. Pre-construction planning, working with property owners to identify well system locations, and adjusting construction sites to avoid well systems are among the actions that would be taken to minimize the potential for damaging well systems. Operations and Maintenance Potential impacts to groundwater would be very minor. The quantities of hazardous materials present (primarily fuels and lubricants in maintenance vehicles and equipment) would be much less than during construction and water demands of facilities would be limited to that required to support the small number of employees.
Health, Safety, and Intentional Destructive Acts	Construction/Operations and Maintenance Construction and operational activities for large infrastructure projects, such as a transmission line and associated facilities can pose hazards that affect worker and public health and safety. In addition, natural events, external events or accidents (e.g., aircraft mishaps or fires) or intentional destructive acts or mischief could impact such infrastructure and have related effects on the health and safety of construction workers and the public. The Project may involve the transportation and handling of hazardous materials. Management (i.e., transportation, storage, handling, use, and disposal) of such hazardous materials during the construction and operations and maintenance phases would be undertaken in a manner to avoid or minimize health and safety impacts to workers and nearby members of the public. The implementation of EPMs associated with management of hazardous materials would keep risks to a minimum. The transmission lines and associated facilities could be susceptible to natural events such as extreme weather. Based on accident statistics for the construction and operational utility industries, the estimated construction workforce Project would experience 140 non-fatal recordable incidents during the assumed 36-month construction period. Using the average construction workforce of 1,260 workers, it is estimated that there would be approximately 0.4 fatalities during the 36-month construction phase. It is likely that no fatalities would occur. During the assumed 80-year operational period of the Project, the average operations workforce would experience 2.0 non-fatal recordable incidents annually. The construction and operational impacts of the HVDC alternative routes would be roughly equivalent to those of the Applicant Proposed Project.
Historic and Cultural Resources	Construction Potential impacts would be experienced primarily during construction. Potential construction impacts to belowground (archaeological) resources could occur as a result of ground disturbances at site locations. Potential Project impacts to aboveground historic and cultural resources such as buildings and structures would most likely be limited to visual

Table 2.6-3:
Summary of Potential Environmental Impacts—HVDC Transmission Line

RESOURCE	IMPACT
	alterations in the historical setting of the resource. Such alterations would be introduced through the erection of transmission structures, and stringing of conductors. Potential Project impacts to aboveground historic and cultural resources would be long-term for the life of the Project. Construction could also cause temporary impacts to historic and cultural resources through the generation of dust, noise, and vibration, but such effects would be transient in nature. DOE establishes the timing and protocols for cultural resources surveys, evaluation of resources' eligibility for the NRHP, and assessments of Project effects, and resolution of adverse effects in the draft PA developed through consultations with SHPOs, Indian Tribes, federal agencies, and Clean Line. Compliance with the PA and related plans would enable the Project to avoid, minimize, or mitigate adverse impacts to historic and cultural resources. Operations and Maintenance Additional ground disturbance impacts to archeological resources are unlikely to occur during operations and maintenance. Once built, the Project facilities are not likely to be substantially altered through routine operations and maintenance.
Land Use	Construction Land use impacts consist primarily of the conversion of existing land uses (primarily rangeland, cropland, and pasture/hay) to a utility use. Typical temporary impacts include the use of some areas for temporary work areas and loss of access to areas in or adjacent to work areas. Construction would prevent the use of rangeland and cultivated crops in the ROW in a specific location and may change the contour of the land and affect irrigation infrastructure. Yields from cropland, pasture/hay, and timberlands could potentially also be temporarily affected in the construction areas. There are 33 structures within the representative ROW for the Application Proposed Route, including 19 agricultural structures, 4 residential structures, 3 industrial structures (oil/gas infrastructure), 3 commercial structures, 2 abandoned structures, and 2 other structures (use unknown). HVDC alternative routes with fewer structures than the corresponding links of the Applicant Proposed Route include HVDC Alternative Routes 3-A (one less industrial structure), 3-B (two agricultural structures and one commercial structure compared to one residential, two agricultural, and one industrial structures), 6-C (three fewer agricultural structures), 7-A (one less other structure [use unknown]), 7-C (one less agricultural structure), and 7-D (two fewer agricultural structures). All other HVDC alternative routes contain more structures within the representative ROW than the corresponding links of the Applicant Proposed Route. These structures may have to be permanently removed if the Project features could not avoid them, although the Applicant would continue to work with affected landowners to minimize the impact of siting the ROW on their property, including micrositing to avoid residences and other structures. Region 4, Link 3, Variation 2, compared with the Applicant Proposed Route would cross 32 percent fewer land parcels, parallel a larger percentage of existing linear infrastructure, have 8 fewer residences within 500 feet of the representative ROW, and avoid one private airstrip. The U.S. Forest Service (USFS) has expressed several concerns regarding HVDC Alternative 4-B. According to the USFS, the ROW would create linear breaks in National Forest land and could adversely affect timber production. The USFS has also stated that, in places, HVDC Route Alternative 4-B would undermine the use for which the National Forest land was originally acquired, that is conservation of natural resources. Operations and Maintenance Long-term impacts from the Project include the conversion of land to a utility use, primarily for access roads and transmission line structure locations. Most of the land within the transmission ROWs could return to previous uses after construction, although uses incompatible with the operation of the transmission line, such as tall trees for timber, would be removed permanently from the ROW. Land uses that generally may not be permitted in the ROW include buildings or structures, changes to grading and land contours such that the ground surface elevation within the ROW would change and alter the required electrical clearance, and installing fences or irrigation lines without coordination with the Applicant. Maintenance activities may cause temporary impacts within the ROW such as damage to crops.
Noise	Construction Temporary impacts include elevated sound levels at noise sensitive areas such as residences or schools for short periods of time. Locations of residences and schools are shown in Figure 1.0-2 located in Appendix A of the EIS. Sound levels would be elevated during construction of the HVDC transmission lines. Operations and Maintenance Sound from operation of the HVDC transmission lines results from corona effects, which can result in audible noise. Corona noise is greatest on HVDC transmission lines when the lines are dry. There are two noise sensitive areas

Table 2.6-3:
Summary of Potential Environmental Impacts—HVDC Transmission Line

RESOURCE	IMPACT
	expected to exceed federal guidelines near the Applicant Proposed Route in Region 3.
Recreation	Construction Construction of the Project is not expected to permanently preclude the use of or access to any existing recreation areas or activities. Temporary impacts include the use of some recreational areas for temporary work areas and loss of access to recreation areas in or adjacent to work areas. Direct short-term impacts may include noise, visual disturbance, restricted access, and diminished quality of recreational impacts that are crossed by the representative ROW. The main differences in potential recreation impacts between the Applicant Proposed Route and the HVDC alternative routes occur in Regions 3, 4, and 5. The Applicant Proposed Route Link 1 in Region 3 would not cross Lake Carl Blackwell, while corresponding Alternative Routes 3-A and 3-B could impact approximately 23 acres of the lake. The Applicant Proposed Route Link 6 could potentially impact 4 acres of the Webbers Falls Lock and Dam Reservoir lands while the corresponding HVDC alternative routes in Region 3 could potentially impact 1 acre of the Webbers Falls Lock and Dam Reservoir lands. The Applicant Proposed Route in Region 4 could potentially impact 2 acres of the Ozark Lake WMA and 4 acres of the Frog Bayou WMA, while the corresponding HVDC alternative routes in Region 4 would not. Applicant Proposed Route Link 1 in Region 4 could potentially impact 17 acres of the Webbers Falls Lock and Dam Reservoir lands. There is no HVDC alternative route to this link of the Applicant Proposed Route. The Lee Creek Variation (Applicant Proposed Route in Region 4, Link 3) would cross the Nationwide Rivers Inventory segment of Lee Creek, while the Alternative Routes 4-A and 4-B would also cross the Nationwide Rivers Inventory segment of Lee Creek. HVDC Alternative Route 4-B could impact approximately 230 acres of the Ozark National Forest, while the Applicant Proposed Routes in Region 4 would only potentially impact approximately 2 acres. The Applicant Proposed Route in Region 5 could potentially impact 77 acres of the Cherokee WMA while the alternative routes in Region 5 would not. The representative ROW for HVDC Alternative Routes 6-C and 6-D does not include any natural areas or recreational land compared to the corresponding link of the Applicant Proposed Route, which includes approximately 0.5 acre of the Singer Forest Natural Area within the St. Francis Sunken Lands WMA. Operations and Maintenance Most of the land within the HVDC transmission line ROWs could return to previous uses after construction. Recreation uses would be permitted in the ROW; however; buildings or structures, and some restrictions for infrastructure such as fences would not be permitted. Maintenance activities may cause temporary impacts within the ROW such as restricted access.
Socioeconomics	Construction Construction of the Project would generate regional economic activity through Project-related expenditures on materials and supplies. The Project would also employ construction workers who would spend much of their income locally and support jobs and incomes elsewhere in the economy. Approximately 26% of the construction workforce is expected to be hired locally (i.e., workers who normally reside within daily commuting distance of their job site), with the remaining 74% temporarily relocating to communities along the ROI for the duration of their employment. There is a potential shortage of temporary housing and RV spaces in Region 1 that would be further exacerbated if the construction schedules for the Oklahoma converter station, AC collection system, and HVDC transmission line were to overlap. This availability could be further reduced by other outside activities in the ROI such as other construction projects, community-sponsored events, and hunting and other recreational activities, as well as connected actions, specifically the development of wind generation facilities and the Optima Substation. The Applicant proposes to prepare and implement a workforce housing strategy designed to minimize potential impacts to housing availability. Some short-term adverse impacts on residential property values (and marketability) might occur on an individual basis as a result of the Project. However, these impacts would be highly variable, individualized, and are difficult to predict. Minor, short-term increases in demand from construction workers and family members temporarily relocating to local communities within the ROI are not expected to affect the levels of service provided by existing law and fire personnel, health care and medical facilities, or educational facilities. Minor increases in population resulting from operations and maintenance of the Project are also not expected to affect the provision of community services. Construction of the Applicant Proposed Route would generate sales, use, and lodging tax revenues during the construction period, with an estimated 90% of total construction costs expected to be for materials subject to sales and use tax. Total estimated state sales and use tax revenues range from \$2.1 million in Tennessee to \$34.6 million in Oklahoma; the estimated total for Arkansas would be \$32.3 million. Local spending by construction workers would

Table 2.6-3:
Summary of Potential Environmental Impacts—HVDC Transmission Line

RESOURCE	IMPACT
	also generate sales and lodging tax revenues. Substituting one or more of the HVDC alternative routes for the corresponding links of the Applicant Proposed Route would not substantially affect the regional economic impact estimates. The largest net increases in the number of people who would temporarily relocate to each region, as compared to the Applicant Proposed Route, would occur in Region 1 with the addition of 16 people (HVDC Alternative Route 1-A) and in Region 7 where 14 and 19 more people could be added (HVDC Alternative Routes 7-C and 7-A, respectively). The majority of the HVDC alternative routes would not affect the peak number of school age children temporarily relocating to the affected regions. In other cases, there would be a potential increase of one to two school-age children as compared to the Applicant Proposed Route for that region. As compared to the Applicant Proposed Route, the largest differences in estimated sales and use tax revenue that would accrue to the respective state would occur in counties in Region 5 and range from a decrease of $2.75 million (-100%) in Cleburne County, Arkansas (because an HVDC alternative route would not cross the county), to an increase of $2.55 million (100%) in Faulkner County, Arkansas. Differences in estimated sales and use tax that would be paid to each county would range from a decrease of about $0.7 million in Cleburne County, Arkansas (Region 5), to an estimated increase of $0.5 million in Shelby County, Tennessee (Region 7). Operations and Maintenance Operations would have similar, but smaller regional economic benefits than construction. Operation of Project facilities would generate ad valorem or property tax revenues in the counties where they would be located. Operation-related expenditures would generate sales and use tax revenues. Estimates of annual county tax revenues in Oklahoma range from $0.1M to $2.4M. Estimates of annual county tax revenues in Arkansas range from $0.2M to $0.6M. Estimates of annual county tax revenues in Tennessee range from $0.2M to $0.3M. These estimates are for payments that would be made in the first year of operation. Thereafter, ad valorem taxes would be paid annually based on an annual assessment by the responsible taxing agency. Substituting one of more of the HVDC alternative routes for the corresponding link of the Applicant Proposed Route would not affect estimated operations and maintenance employment for the HVDC and AC transmission lines. Potential impacts to population, economic conditions, housing, and community services from operations and maintenance related to estimated operations and maintenance employment would be the same or very similar to those described above for the Applicant Proposed Route.
Special Status Wildlife and Fish, Aquatic Invertebrate, and Amphibian Species	Construction/Operations and Maintenance Impacts to special status wildlife species in Region 1 from the Applicant Proposed Route or alternative routes include potential habitat loss and fragmentation of existing habitat of LEPC habitat mapped focal areas (CHAT-1) or connectivity zone habitat (CHAT-2) HVDC Alternative Route 2-A in Region 2 is parallel to the Cimarron River for a portion of the route. This portion of the Cimarron River is known to be used by the interior least tern. Therefore construction of this alternative route could disturb habitat or individuals. HVDC Alternative Route 3-C in Region 3 has slightly more forested land than other alternative routes or the Applicant Proposed Route and therefore could potentially impact the American burying beetle. HVDC Alternative Route 4-B in Region 4 includes forested lands and is closer to the Ozark Plateau region than other alternative routes and the Applicant Proposed Route. The Ozark Plateau region contains cave hibernacula for special status bat species. Because of the amount of forested areas, there is a potential for greater mortality impacts to the American burying beetle during construction. The increase in forested land in closer proximity to areas of caves known to be or potentially used by bats increases the potential impacts (e.g., disturbances to or loss of roost trees) to the special status bat species along this route Similarly, HVDC Alternative Route 4-D also contains more forested land than other alternative routes and the Applicant Proposed Rout in Region 4. Therefore, there could be construction impacts to the American burying beetle and the special status bat species along this route. Direct construction impacts that could potentially affect special status fish, aquatic invertebrate, and amphibian species and their habitats include vegetation clearing, grading, access roads, herbicide use, and handling of fuel and lubricants at stream and river crossings. Vegetation clearing has the potential to increase sedimentation and decrease cover. Increased sedimentation can directly or indirectly suffocate, bury, or limit feeding of fish, aquatic invertebrate, and amphibian species. Grading and access roads have the potential to increase sedimentation, decrease cover, and increase runoff. Increased runoff can alter stream and river hydrology and provide a mechanism for delivery of sediment, herbicides, and fuel and lubricants to streams and rivers. Herbicide use and handling of fuel and lubricants have the potential to concentrate in body tissues of fish, amphibians, and filter-feeding mussels, which can result in

Table 2.6-3:
Summary of Potential Environmental Impacts—HVDC Transmission Line

<table>
<tr><th>RESOURCE</th><th>IMPACT</th></tr>
<tr><td></td><td>death.
During the construction phase of the Project, all general EPMs and those specific to special status fish, aquatic invertebrates, and amphibians would be implemented to avoid or minimize impacts to special status fish aquatic invertebrates, and amphibians.
For all regions except Region 2, there would be no difference in impacts between the Applicant Proposed Route and the HVDC alternative routes. For Region 2, HVDC Alternative Route 2- has more acres of waters designated by the USFWS as critical habitat for the Arkansas River shiner within the ROI than the corresponding link of the Applicant Proposed Route. Both the HVDC Alternative Route 2-A and the corresponding of the Applicant Proposed Route cross the Cimarron River at separate locations where it is USFWS designated critical habitat, but HVDC Alternative Route 2-A is within the critical habitat for more acres.
Potential impacts in the operations and maintenance phase of the HVDC transmission line would be similar to the potential impacts in the construction phase; however, impacts would be at a lesser extent than in the construction phase, but occur throughout the life of the Project. During the operations and maintenance phase, the use of both access roads and the ROW for repair and maintenance activities could result in both direct and indirect impacts to the Arkansas River shiner or its potential habitat in the Beaver River and Palo Duro Creek. In addition, the potential application of herbicides during operations and maintenance of the Project could result in indirect impacts, and to a lesser extent, direct impacts. During the operations and maintenance phase of the Project, both general EPMs and those specific to fish aquatic invertebrates, and amphibians would be implemented to avoid or minimize impacts to special status fish, aquatic invertebrates, and amphibians.</td></tr>
<tr><td>Surface Water</td><td>Construction
Typical impacts include:
Potential for Surface Water Contamination—Contamination could occur as a result of the accidental release of hazardous substances, primarily fuels and lubricants, which would be used by construction equipment and be present in construction staging or storage yards. Permit compliance and implementation of EPMs, including spill prevention and response planning, would minimize the potential for surface water contamination.
Changes to Runoff Rates—Soils disturbed and loosened during construction could represent areas of increased precipitation infiltration, possibly decreasing local runoff rates over the short term. Surfaces compacted during construction and impermeable facility surfaces remaining after construction would represent areas of increased runoff rates. The area of impermeable surfaces resulting from the Project would be small. In accordance with the Applicant's EPMs, soils not occupied by Project facilities would be returned to pre-activity conditions, therefore resulting in de minimis long-term impacts to runoff rates.
Direct Impacts or Disturbances to Surface Water or Drainage Channels—Surface waters and drainage channels would be avoided as practicable in the placement of transmission line facilities, with transmission lines spanning such features as necessary. Access roads may not always have the same means of avoidance and would be most likely to involve disturbance of drainage features. Preplanning of the crossing methods would minimize the length of the drainage feature affected and enhance the ability to maintain flow characteristics.
Effects on Water Availability—Water demands to support the Project could come from surface water resources (more likely in areas where total water use is typically from surface water sources such as Regions 4 and 5) and result in less surface water being available for other uses. The Project's water demand is not expected to have noticeable effects on surface water resources beyond those resulting from existing water usage.
There are differences in the amount of surface water used between regions and in the numbers of surface water features within the representative ROWs for each of the HVDC alternative routes. Water demands from the Project are not expected to be a concern, primarily because the highest demand would occur during the short-term construction phase and regions with low surface water availability are areas where groundwater use already dominates. The specific locations of each structure or access road have not yet been determined; therefore, the EIS does not identify which surface water features would be completely avoided or which could be affected by Project. Areas with the greatest amount of surface water in the ROW, such as Region 3 with the most perennial streams, reservoirs, lakes, and ponds, would be the most likely to have impacted surface waters.
Operations and Maintenance
Potential impacts would be minimal. The quantities of hazardous materials present (primarily fuels and lubricants in maintenance vehicles and equipment) would be much less than during construction, herbicides used to maintain ROWs and access roads would be applied in accordance with label instructions and any federal, state, and local</td></tr>
</table>

Table 2.6-3:
Summary of Potential Environmental Impacts—HVDC Transmission Line

RESOURCE	IMPACT
	regulations to minimize the potential for spreading, and water demands of facilities would be limited to that required to support the small number of employees.
Transportation	Construction Typical temporary impacts during construction include increased traffic from workers commuting to the construction sites, as well as increased traffic from the hauling of materials and equipment to the construction sites. Construction traffic also has the potential to impact bus and emergency routes for roadways near the construction areas. Temporary travel delays involving major roads (interstate highways, federal highways, and state highways) and railroads may also occur for HVDC transmission line installation at crossings. Construction activities that take place adjacent to major roadways also have the potential to cause temporary adverse impacts to traffic from vehicles entering and leaving the roadway and could involve lane closures. Roadway pavement or other infrastructure might be damaged by heavy vehicles delivering equipment and materials to construction areas. Transmission line structures and lines could become a hazard if they are located too close to airport operations or military airspace operating areas. River traffic may be controlled, in coordination with the USACE, during the short time required to span the conductor across Project construction activities have the potential to impact river traffic at the crossings of the Arkansas and Mississippi rivers. River traffic would not be impacted during Project operations and maintenance. Potential impacts to level of service and overall impacts to transportation resources are similar between the Applicant Proposed Route and the corresponding HVDC alternative routes. Although the HVDC alternative routes would have somewhat less roadway mileage within 50 feet of the route centerline than the Applicant Proposed Route (Regions 2 and 3), this would not be expected to have any noticeable consequences to transportation resources. Impacts to airports and airstrips are generally similar for the Applicant Proposed Route and the HVDC alternative routes as both would include measures to avoid these features to the extent possible. One route variation (Region 4, Link 3, Variation 2) is being considered as an alternative to the Applicant Proposed Route and would avoid impacts to a private airstrip that would potentially be impacted by the Applicant Proposed Route. Operations and Maintenance Long-term impacts are not expected because any increase in traffic during the operations and maintenance phase would be negligible. Transportation resources would be returned to previous operating conditions following construction.
Vegetation Communities	Construction Construction may cause the direct impact of vegetation removal and the indirect impacts of reduction of plant vigor from mechanical damage, fragmentation, and the introduction of invasive species. Impacts to vegetation may also vary in duration from short-term to long-term, with some impacts potentially permanent in nature. Removal of vegetation during construction may vary across the spectrum from short-term to permanent. Short-term removals and mechanical damage to vegetation may occur in areas of temporary construction access roads, construction laydown areas, and tensioning areas. It is likely that vegetation impacts in croplands would be short-term based on the seasonal replanting of these landscapes. Long-term to permanent impacts to vegetation would involve those areas of the ROW where vegetation is removed for new access roads and transmission structural foundations. Long-term impacts are also expected through those portions of the ROW with forested land cover due to the need to minimize canopy height for line safety. Long-term impacts may also result from vegetation removal in the portions of the Project ROW dominated by shortgrass prairie due to the difficulty of revegetation in drier climatic conditions. Operations and Maintenance Operation and maintenance of the Project is likely to impact vegetation directly through mowing and pruning in the ROW, and indirectly through herbicide applications that may impact non-target plant species.
Visual Resources	Construction Construction would result in the short-term visual intrusion of construction vehicles, equipment, materials, and a work force in staging areas, along access roads, and along the new transmission line ROW. Vehicles, heavy equipment, structure components, and workers would be visible during transmission line construction and modification, access and spur road clearing and grading, structure erection, conductor stringing, and cleanup and restoration. However, disturbance from construction activities would be transient and of short duration as activities progress along the transmission line route. Affected viewers would be aware of the temporary nature of Project construction impacts as well as existing structures in the area adjacent to the Project, which may decrease their concern to the impact.

Table 2.6-3:
Summary of Potential Environmental Impacts—HVDC Transmission Line

RESOURCE	IMPACT
	Operations and Maintenance Long-term impacts from the Project include the intrusion of transmission structures, access roads and cleared ROW that may introduce contrast into the surrounding landscape setting. Visual impacts during operations and maintenance vary by region. Sensitive viewers in Regions 1, 2, and 6 that are characterized primarily by flat croplands and grasslands with scattered vegetation are anticipated to have greater visibility of the Project due to long viewing distances associated with an open landscape with panoramic views. In addition, the tall vertical geometric structures of the Project components would result in strong contrast with the relatively flat landscape with the regions. Sensitive viewers in Regions 3, 4, 5 and 7 that are characterized by varying terrain ranging from gently rolling to hilly to rugged with a greater occurrence of dense wooded areas are anticipated to have shorter viewing distances. Project components are more likely to be partially to completely screened by existing terrain and/or vegetation in all distance zones.
Wetlands, Floodplains, and Riparian Areas	Construction Potential impacts would primarily occur during construction. Short-term impacts may include mechanical damage/crushing of vegetation from use of heavy machinery, compaction of soils, sedimentation and turbidity from construction activities, alteration of hydrology from access road construction and excavations for structure foundations, contamination from herbicide runoff and from accidental spills of hazardous substances. Potential impacts are similar between the Applicant Proposed Route and the corresponding HVDC alternative routes. Some differences are apparent, however. For wetland resources, all HVDC alternative routes for Regions 2 and 3 have potential to impact more wetland acreage than the corresponding Applicant Proposed Route links in those regions. For floodplain resources, all HVDC alternative routes for Regions 2 and 7 contain more floodplain acreage and greater potential for impacts within the 200-foot-wide representative ROW as compared to Applicant Proposed Route links in those regions. Finally, all the HVDC alternative routes for Regions 2 and 4, and most of the HVDC alternative routes for Region 1 (except HVDC Alternative Route 1-C), Region 3 (except HVDC Alternative Route 3-C), and Region 6 (except HVDC Alternative Route 6-A), would cross more riparian area resources and have the potential for more impact acreage than the corresponding Applicant Proposed Route links. Operations and Maintenance The potential long-term impacts may include placement of fill at foundation footprint locations or for permanent access roads, long-term conversion of forested wetlands or riparian areas to shrubby or herbaceous cover types within the ROW, changes to hydrology from construction of permanent access roads or support structures and other ancillary infrastructure, and introduction of invasive species from construction equipment.
Wildlife and Fish	Construction Potential impacts would include direct mortality or injury of individuals from vegetation clearing, collisions with vehicles, potential exposure to hazardous materials (e.g., accidental spills and pesticides), wildfires, or increased predation rates; disturbance of suitable habitats or disruption of normal behaviors; and habitat loss or degradation (both temporary and permanent loss/degradation of habitat). Potential impacts to fish and aquatic invertebrate species would include direct mortality and injury of individuals (e.g., via crushing during crossing construction, sedimentation, potential exposure to hazardous materials, blasting); disturbance from suitable aquatic habitats or disruption of normal behaviors; aquatic habitat loss or degradation (both temporary and permanent loss/degradation of aquatic habitat); and introduction of non-native aquatic plants and animals. Operations and Maintenance Potential impacts include the fragmentation of habitats; isolation of sub-populations and loss of meta-population dynamics; degradation of habitat quality due to edge effects as well as invasive plant species; consolidation of predatory avian species along the line (e.g., raptors and corvids), and ongoing mortality of individual birds due to collision and electrocution risks. The majority of the Project would pass through and impact habitat types that contain low vegetation, which would typically recover quickly and would not need to be permanently cleared or maintained during the Project's operations and maintenance (e.g., grassland and cropland habitats). However, Regions 4 and 5, as well as Regions 3 and 7 to a lesser extent, would cross through and impact forested habitats. The Project would result in the permanent conversion of these forested habitats within the ROW to grasslands and/or shrublands (i.e., habitats that contain low vegetation types). This would constitute a permanent loss of forested habitats, as well as create a permanent edge effect along the Project's ROW in forested habitats. This could change the species composition and use of these once forested

Table 2.6-3:
Summary of Potential Environmental Impacts—HVDC Transmission Line

RESOURCE	IMPACT
	areas (i.e., transitioning to an edge habitat community). Potential impacts to fish and aquatic invertebrate species include mortality and injury of individual fish and aquatic invertebrates from sedimentation and potential exposure to hazardous materials (e.g., oils, fuels, herbicides); aquatic habitat degradation and loss from the presence of crossing structures, sedimentation, and non-native aquatic plants and animals; avoidance of aquatic habitats near project structures and roads; and temporary disturbance during maintenance activities.

2.7 Summary of Best Management Practices

As identified in Section 2.1.7, the Applicant has developed and would implement EPMs, included in Appendix F, to avoid or minimize effects to environmental resources from construction, operations and maintenance, and/or decommissioning, as appropriate. This EIS assumed the implementation of the EPMs throughout the impact analysis for each resource area in Chapter 3.

In addition, some resource sections also include best management practices (BMPs). For these resources, implementation of the EPMs would not be able to completely avoid or minimize all potential adverse effects resulting from construction, operations and maintenance, and decommissioning of the Project. In those instances, the following BMPs could be implemented to further avoid or minimize potential adverse effects. Table 2.7-1 provides a summary listing of the BMPs identified by each resource area analyzed in Chapter 3 (those resource areas that did not identify any BMPs are not included in the table). The Applicant has not committed to implementing BMPs though it is possible that certain BMPs will be required through the ROD or Participation Agreements. Additional protective measures may be identified and required as part of ongoing consultation and permitting with federal, state, and local agencies.

Table 2.7-1:
Summary of Best Management Practices

RESOURCE AREA	BEST MANAGEMENT PRACTICE
Air Quality and Climate Change	• The quantity of sulfur hexafluoride (SF_6) emissions from maintenance activities (and potential leaks in equipment) would be minimized through the use of hermetically sealed equipment, leak detection programs, and sulfur hexafluoride recycling programs. To reduce the impacts associated with blowing fugitive dust and/or under windy conditions, the following BMPs have been identified: • Stabilize spoil piles and sources of fugitive dust by implementing control measures, such as covering and/or applying water or chemical/organic dust palliative where appropriate at active and inactive sites during workdays, weekends, holidays, and windy conditions. EPA (1995) lists common sources of fugitive dust as unpaved roads, agricultural tilling operations, aggregate storage piles, and heavy construction operations; all but agricultural tilling operations would apply to the Project and require appropriate control measures. • Install wind fencing and phase grading operations where appropriate, and operate water trucks for stabilization of surfaces under windy conditions. • Prevent spillage when hauling spoil material. • In active construction areas including access roads, Limit speeds of non-earth-moving equipment to 15 miles per hour. Limit speed of earth-moving equipment to 10 mph. To mitigate emissions resulting from mobile and stationary sources, the following BMPs have been identified:

Table 2.7-1:
Summary of Best Management Practices

RESOURCE AREA	BEST MANAGEMENT PRACTICE
	• Plan construction scheduling to minimize vehicle trips. • Limit idling of heavy equipment to less than 5 minutes unless needed for the safe operation of the equipment and verify through unscheduled inspections. • Maintain and tune engines per manufacturer's specifications to perform at EPA certification levels, prevent tampering of source engines (i.e., knowingly disabling an emission control system component or element of design of a certified engine so that it no longer meets the manufacturer's specifications) and conduct unscheduled inspections to ensure these measures are followed.
Geology, Paleontology, Minerals, and Soils	• If signs of contaminated soils are uncovered during construction activities, work would be stopped in the area of potentially contaminated soils until appropriate Project representatives could be consulted.
Health, Safety, and Intentional Destructive Acts	• Develop and implement a Health and Safety Plan that describes regulatory requirements, procedures, and practices for conducting activities to help ensure a safe working environment, which for purposes of health and safety measures should include: o Fire prevention, suppression, and emergency responder contact procedures o Natural disaster and severe weather reporting and contact procedures o Law enforcement contact procedures o Procedures for addressing hazardous materials spills and other mishaps • The Applicant will develop and implement a communications program. Section 3.1.2 describes the elements of this plan, which for purposes of health and safety should include: o Liaison and public outreach activities with local airports, aviation communities, aviation regulatory bodies, and aerial agricultural spraying operations o Local media and public outreach procedures for applicable hazard communication notices.
Land Use	• In existing forested areas where temporary construction areas require tree clearing, replant with appropriate tree species and/or reclaim temporary construction areas in coordination with landowners. • In addition to EPM LU-5, make reasonable efforts to avoid displacing structures on private property.
Noise	• Investigate noise complaints in accordance with the Applicant's communications program. It is likely that blasting would be required for some tower installations; however, in these cases, a detailed Blasting Plan would be developed and implemented to avoid noise impacts. Examples of measures that could be included in the Blasting Plan to minimize blasting impacts are: • Use tamping or stemming into the collars of blast holes and smooth-wall perimeter holes (stemming is defined as inserted material, such as crushed stone, sand, or any other inert objects placed in the top of the blast hole for the purpose of confining explosive charges and limiting rock movement and air-overpressure). • Use blasting mats. • Unless otherwise coordinated with landowners and adjacent landowners, plan blasting to take place only between the hours of 10:00 am and 4:00 pm, Monday through Friday. No blasting shall take place on weekends. • Notify landowners and tenants, including owners of adjacent utilities or structures, prior to blasting. • Detailed Blasting Plans would be developed for the Project based on site-specific activities and nearby conditions.
Socioeconomics	• The Applicant will prepare and implement a workforce housing strategy that would minimize potential impacts to housing availability. This strategy would consider Project component construction schedules, workforce required, and other outside influences.
Special Status Wildlife and Fish, Aquatic Invertebrate, and Amphibian Species	DOE and the Applicant have prepared a Biological Assessment (Appendix O) of potential impacts on special status species protected under the ESA as part of the Section 7 consultation between DOE and the USFWS. The Section 7 consultation review is a parallel but separate process conducted pursuant to the requirements of ESA and the applicable implementing regulations. A Biological Opinion will be issued by USFWS prior to the ROD. Through this process, additional protective measures may be identified and adopted to avoid and/or minimize impacts to special status species.

Table 2.7-1:
Summary of Best Management Practices

RESOURCE AREA	BEST MANAGEMENT PRACTICE
Transportation	• Accommodate existing and programmed, approved, and/or funded transportation projects to the extent practicable into the final Project design and coordinate with appropriate jurisdictions to avoid or minimize disruptions to trails, streets, or drainage/irrigation structures. • In identified areas of traffic impact, conflicts between the Project traffic and background traffic such as movements of normal heavy trucks (dump trucks, concrete trucks, standard size tractor-trailers or flatbeds, etc.) would be minimized by scheduling (essential deliveries only) to the extent practicable during peak traffic hours/times and scheduling remaining heavy truck trips during off-peak traffic hours/times. • To the extent practicable, staging activities and parking of equipment and vehicles would occur primarily within private ROW on private land. • Implement the communications program described in Section 3.1.2. • The Applicant would perform mitigation to address Project structures in the vicinity of private airstrips. This BMP would require conducting specific flight plan analyses to determine whether interference with private airstrips can be avoided through micrositing within the 1,000-foot-wide corridor to the extent practicable. If impacts are unavoidable, the Applicant would develop and implement mitigation measures and/or provide compensation, in coordination with landowners. The Applicant would apply similar mitigation to private airstrips where Project structures would present a hazard within a 1:20 glide slope from each end of private airfields.
Wetlands, Floodplains, and Riparian Areas	DOE, in consultation with the USACE, has identified the following BMPs: • In addition to protection of intermittent and perennial streams, ephemeral streams would also be included in the Applicant's streamside management zones. This BMP would add to EPM W-3. • Where tree removal is necessary in the ROW, this removal would be accomplished at ground level leaving root wads in place to aid in the stabilization of soils. • Limit, to the extent practicable, the amount of vegetation removed along streambanks and minimize the disruption of natural drainage patterns. • All permanent and temporary crossings of waterbodies would be suitably culverted, bridged, or otherwise designed and constructed to maintain low flows to sustain the movement of aquatic species. The crossings would also be constructed to withstand expected high flows. The crossings would not restrict or impede the passage of normal or high flows. • Excavated trenches that are to be backfilled would separate the upper 12 inches of topsoil from the rest of the excavated material. The topsoil would be used as the final backfill.
Wildlife and Fish	For general wildlife and fish populations and habitat: • All vegetation clearing would comply with both state and federal spatial and timing windows, and would not occur during the avian breeding season applicable to each respective region. • Identify, control, and minimize the spread of non-native, invasive species and noxious weeds to the extent practicable, including ensuring that in-water equipment and vehicles are cleaned between waterbodies to minimize the chance of transferring non-native species between waterbodies. This BMP would expand EPM FVW-2.

2.8 Summary of Unavoidable Adverse Impacts

2.8.1 Definition

Unavoidable adverse impacts could occur during construction, operations and maintenance, and decommissioning of the Project. These impacts would be expected after implementation of the EPMs and those BMPs that DOE includes in a ROD or participation agreement; however, in all cases, the impacts would have been minimized through implementation of these measures. The following sections provide a brief summary of the unavoidable adverse impacts that could occur for each environmental resource area as provided in Chapter 3.

2.8.2 Agricultural Resources

Unavoidable adverse impacts could occur if the Project could not avoid agricultural structures (e.g., barns, silos, and other out/accessory buildings). Yields from lands used for crops, pasture/hay, and grazing livestock would be temporarily affected in the construction areas, and land used for transmission structures, long-term access roads, and converter stations would be removed from agricultural production until the Project was decommissioned.

2.8.3 Air Quality and Climate Change

No unavoidable adverse impacts to air quality are anticipated to result from the Project.

2.8.4 Electrical Environment

Potential unavoidable adverse impacts to the electrical environment include the electrical effects (electric and magnetic fields, radio and television noise, audible noise, ozone, and air ions) associated with the operation of overhead HVDC and/or AC transmission lines. These effects are present within, and to a more limited extent outside, the transmission line ROW. Outside the ROW, calculated electrical effects for the Project are generally limited to levels that comply with associated standards and guidelines.

2.8.5 Environmental Justice

No unavoidable adverse impacts would be disproportionately borne by low-income or minority populations as a result from the Project.

2.8.6 Geology, Paleontology, Minerals, and Soils

2.8.6.1 Geology, Paleontology, and Minerals

Appropriate engineering design and adherence to applicable design standards would reduce the risk from geological hazards, but damage to Project components could occur if a rare, major geologic event such as a large magnitude earthquake or landslide occurred.

Despite EPMs and appropriate engineering design, scientifically valuable fossils may be disturbed and lost during construction activities. If this occurred, the small loss of fossil material would be offset to a degree by material that is recovered and preserved for scientific study purposes.

Mineral resources may exist below the surface within the Project ROWs and/or converter station sites, in which case some resources could be less accessible for the life of the Project. The types of mineral resources that would be more affected are near-surface mineral material deposits (e.g., common sand, gravel, and stone). Oil and gas resources would be less affected because recovery of the resources would be possible, even with a minimum stand-off of 250 feet from the edge of the route ROWs and converter station sites using a vertically installed well, without the use of directional drilling. With directional drilling such areas could be accessed at considerable distance from the Project.

2.8.6.2 Soils

Removal of vegetation during construction grading and excavation activities could result in the exposure of soils to erosion and compaction of soils susceptible to compaction. Transmission line structures and converter station sites would permanently impact agricultural soils and remove them from productivity during construction and operations and maintenance. Access roads used during construction would temporarily remove agricultural soils from productivity, and the use of unpaved access roads during all Project phases could result in the exposure of soils to erosion and compaction. There would be potential depletion of soil productivity including erosion and loss of fertile topsoil, and potential erosion of exposed areas and compaction of areas traversed by equipment and vehicles.

2.8.7 Groundwater

Although the water needed for the Project is expected to come from municipal water systems, some of that municipal water would undoubtedly come from groundwater sources, so there would be a minor reduction in groundwater available for other uses or natural features while the construction took place.

Common materials present during construction would be considered groundwater contaminants were those materials to be spilled, leaked, or otherwise released and eventually reach groundwater. The potential for groundwater contamination is minor due to the EPMs and permitting requirements; however, the potential would not be eliminated.

2.8.8 Health, Safety, and Intentional Destructive Acts

There is a statistical possibility that accidents resulting in worker injuries and possibly death could occur during implementation of the Project. The hazardous nature of the work, the complexity of the electrical system, and the size and areal extent of the Project all would contribute to a potential for worker injuries or death and would be considered unavoidable adverse impacts. These unavoidable adverse impacts could be as a result of common personnel-involved injuries (e.g., slips, trips, or falls), hazardous materials or waste accidents, aircraft incidents, fire hazards, natural events or disasters, or intentional destructive acts.

2.8.9 Historic and Cultural Resources

The Project has the potential to cause adverse impacts to historic and cultural resources in several ways. Construction could result in the loss of archaeological resources as a result of ground disturbances resulting from excavation and related actions that remove or redistribute soils and the contents of soils. The Project could also result in the loss of historic or culturally significant buildings, structures, sites, objects, or other aboveground features and properties if it is necessary to demolish, remove, or relocate them to allow construction of Project elements such as transmission towers, access roads, work and storage yards, and substations and switching stations at their locations. In addition, the Project has the potential to cause adverse impacts by altering the setting of neighboring historic and cultural resources and those spanned by the Project through the introduction of modernistic visually prominent elements, such as transmission towers, and auditory effects such as noise associated with the transmission of high voltage electrical currents and the passage of wind through transmission wires and towers. Such effects would only be adverse if the setting of the resource substantively contributes to its historical or cultural character or significance. In addition, such adverse effects tend to fall off with the distance separating Project elements from the resource and vary with local terrain and vegetation. Project-specific cultural resource surveys, which will be implemented as part of the Section 106 PA, in conjunction with micrositing, would tend to diminish the number and magnitude of such impacts.

2.8.10 Land Use

Unavoidable adverse impacts to land uses from the Project include the removal of vegetation and conversion of primarily rangeland and cultivated crops and some forested lands and developed open space to a utility use. The Applicant Proposed Route would result in the conversion of up to approximately 2,598 acres of land to utility use for the life of the Project, including 2,345 acres for access roads, 120 acres for two converter stations, 129 acres for all pole structures, and 4 acres for fiber regeneration sites.

Under the Applicant Proposed Route, 33 structures are present in the representative ROW: 4 residences, 3 commercial structures, 19 agricultural structures, 3 industrial structures, 2 abandoned structures, and 2 other structures (use unknown). These structures may have to be removed if the Project features could not avoid them, although the Applicant will continue to work with affected landowners to minimize the impact of siting the ROW on their property, including micrositing to avoid residences and other structures. Yields from cultivated crops, pasture/hay, and timberlands would be temporarily affected in the construction areas, and uses that are incompatible with the operation of the transmission line, such as tall trees for timber, would be removed from the ROW for the life of the Project. The height of orchard trees within the ROW could be restricted for the life of the Project.

Because the locations of Project access roads are not known at this time, it is possible that the access roads could be located in such a way that small areas of agricultural land would be isolated and no longer practicable to be used for farmland or grazing, resulting in a conversion of additional land from agricultural to non-agricultural use.

If DOE opts to participate in the Project and the Project included the Arkansas converter station, an additional 73 acres would be committed to utility use, including 35 acres for the converter station, 35 acres for the new substation, 2.4 acres for access roads, and 0.7 acre for 5 miles of AC interconnect structures.

2.8.11 Noise

Temporary noise impacts from construction activities would occur along the Project ROW. It is possible that EPA guidelines could be exceeded at some noise sensitive receptors from operations and maintenance of the AC and HVDC transmission lines.

2.8.12 Recreation

Unavoidable adverse impacts include the potential loss or alteration of recreational land and recreational uses of public or private lands that are located within the transmission line ROW because public access would be restricted at structure locations. Following the completion of construction, access to the HVDC transmission line ROWs would resume consistent with access prior to construction; in some cases, opening new areas within the ROW to recreational activities (e.g., hiking trails, hunting). Impacts to the setting of public recreational lands would be minimized by the EPMs, would be unavoidable and long term, but would not be permanent in recreational areas that the Project crosses.

2.8.13 Socioeconomics

No unavoidable adverse impacts to socioeconomic resources were identified.

2.8.14 Special Status Wildlife, Fish, Aquatic Invertebrate, and Amphibian Species

2.8.14.1 Special Status Terrestrial Wildlife Species

Construction and operations and maintenance of the Project could result in the mortality of some special status wildlife species if they are present in the affected areas during these Project phases. Mortalities could include potential mortalities associated with the clearing of vegetation as well as avian collisions with Project structures during operations and maintenance. Potential mortalities would be highest if vegetation clearing was conducted during the breeding season. Construction-related disturbances could result in temporary loss of some wildlife habitats through noise and visual disturbances. Potential loss of special status wildlife habitat during operations and maintenance could result from the effects of fragmentation, edge effects, and invasive plant species. ROW maintenance in forested habitats as well as the footprint of Project structures would result in a permanent loss of mature forest habitats.

2.8.14.2 Fish, Aquatic Invertebrate, and Amphibian Species

Construction and operations and maintenance of the Project could result in the mortality and injury of some special status fish, aquatic invertebrate, and amphibian species if they are present in the affected areas during construction or operations and maintenance. Construction mortalities and injuries could result from crushing during waterbody crossings with equipment, sedimentation, potential exposure to hazardous materials, and blasting. Mortalities and injuries during operations and maintenance could result from sedimentation and potential exposure to hazardous materials. Unavoidable impacts to special status fish, aquatic invertebrate, and amphibian species and their habitat include the potential loss or alteration of aquatic habitat in streams that may require culverts or vehicle crossings, potential loss or disturbance to riparian vegetation along streams on private or public lands where the ROW is parallel and adjacent to the stream, and potential short-term sedimentation effects on aquatic resources as a result of vehicular traffic causing disturbances within or adjacent to streams.

2.8.15 Surface Water

The Project would require a moderate level of water use, and some access roads would likely traverse through or over stream channels. Sediment-laden runoff from a construction site could occur and could have adverse effects on a receiving water. The construction general permit for stormwater discharges would minimize the potential for such incidents and would keep potential adverse impacts to these surface waters to a minimum.

2.8.16 Transportation

Construction-related adverse impacts to local traffic would occur on roadways where materials and equipment are hauled to the construction areas. Construction activities associated with the crossing of roadways and railroads and potential encroachment along roadway ROWs would also result in unavoidable temporary impacts to roadways and traffic.

2.8.17 Vegetation Communities and Special Status Plant Species

Unavoidable adverse impacts to vegetation and special status plant species from the Project may include the following elements:

- Removal of vegetation in the footprints of new transmission line support structures, permanent access roads, converter stations, and other associated infrastructure
- Conversion of structural types of vegetation (e.g., forest conversion to grassland or forest to low-stature shrublands)
- Changes to plant species diversity with the general trend likely to be a diminishment of vegetation species diversity in disturbed areas
- Potential lower yields in croplands that are disturbed during construction and operations and maintenance

2.8.18 Visual Resources

Unavoidable impacts include the potential loss or alteration of sensitive views from public or private lands that are located within or adjacent to (within the foreground/middleground) the transmission line ROW or adjacent to converter station siting areas.

2.8.19 Wetlands, Floodplains, and Riparian Areas

Unavoidable adverse impacts to wetlands, floodplains, and riparian areas from construction and operations and maintenance of the Project could include:

- Removal of vegetation in the footprints of new transmission line support structures, access roads, converter stations, and other associated infrastructure, some of which may be wetland vegetation, or vegetation present in floodplains or riparian zones
- Conversion of vegetation structure (e.g., floodplain/riparian forest conversion to grassland/herbaceous or shrub/scrub land cover)
- Changes to species diversity within wetlands, floodplains, and/or riparian areas
- Changes in total cover percentage in wetland, floodplain, and riparian zone vegetation.

2.8.20 Wildlife, Fish, and Aquatic Invertebrates

2.8.20.1 Wildlife

Construction and operations and maintenance of the Project would result in the death of some wildlife species. Mortalities could result from the vegetation clearing activities as well as avian collisions with Project structures during operations. These mortality events would likely be highest if vegetation clearing is conducted during the breeding season. Construction-related disturbances to habitats would also result in temporary loss of some wildlife habitats through noise and visual disturbances. Wildlife habitat also could be lost during operations and maintenance from the effects of fragmentation, edge effects, and invasive plant species. ROW maintenance in forested habitats as well as the footprint of Project structures would result in a permanent loss of habitats.

2.8.20.2 Fish and Aquatic Invertebrates

Unavoidable impacts include the potential loss or alteration of aquatic habitat in smaller streams that may require culverts or vehicle crossings, potential loss or disturbance to riparian vegetation along streams on private or public lands where the ROW is adjacent to the stream, and potential short-term sedimentation effects on aquatic resources as a result of vehicular traffic causing disturbances within or adjacent to streams.

2.9 Summary of Irreversible and Irretrievable Commitment of Resources

2.9.1 Definition

Resources are considered irreversibly committed when, once committed to the Project, the resource would continue to be committed throughout the life of the Project but would become available again following decommissioning of the Project and restoration (if necessary). Resources are considered irretrievably committed when, once used, consumed, destroyed, or degraded during construction, operations, maintenance, or decommissioning of the Project, the resource would no longer be available for use by future generations. Such resources could not be restored, replaced, or otherwise retrieved for the life of the Project or thereafter. Examples of irretrievable types of resources include permanent conversion of wetlands and playas, or loss of cultural resources, soils, wildlife, agricultural, and socioeconomic conditions. The losses are permanent. This section provides a summary of irreversible and irretrievable commitment of resources.

2.9.2 Agricultural Resources

Upon decommissioning of the Project, all land could return to previous uses. There would be no irreversible or irretrievable commitment of agricultural resources

2.9.3 Air Quality and Climate Change

No irreversible and irretrievable commitments of air quality resources are anticipated to result from the Project.

2.9.4 Electrical Environment

No irreversible and irretrievable commitment of resources associated with electrical effects is anticipated to result from the Project.

2.9.5 Environmental Justice

No irreversible and irretrievable commitments of resources associated with environmental justice are anticipated to result from the Project.

2.9.6 Geology, Paleontology, Minerals, and Soils

2.9.6.1 Geology, Paleontology, and Minerals

There would be no irreversible and irretrievable commitments of resources regarding geologic hazards. Because paleontological resources are nonrenewable, any impacts would render the resource disturbance irreversible and the integrity of the resource irretrievable.

2.9.6.2 Soils

There would be no irreversible and irretrievable commitments of soil resources provided that all transmission line concrete foundations, converter station facilities, and access roads were removed and successful reclamation was achieved as part of decommissioning the Project.

2.9.7 Groundwater

The Project would involve a commitment of groundwater resources, but at least to some extent, those resources would be replenished by cyclic seasonal recharge. The commitment of groundwater resources would be irreversible in that it would limit, in the short term, other options for use of that resource. Over time, however, the amounts of groundwater used to support construction would be expected to have a negligible effect on groundwater resources. In sum, the groundwater resource would be renewable or recoverable, so the commitment would not be considered irretrievable.

2.9.8 Health, Safety, and Intentional Destructive Acts

The health of workers and the public are important resources that must be protected. Through the implementation of safety plans, procedures, and required design elements, irreversible commitment of these resources would be kept to a minimum.

2.9.9 Historic and Cultural Resources

Historic and cultural resources are nonrenewable, and adverse direct effects to these resources generally constitute an irreversible and irretrievable commitment of resources. Any Project-related activity that results in the destruction, significant permanent alteration, removal, or relocation of a historic or cultural resource, such as the excavation of soil at an archeological site or the demolition of a building or structure within the Project ROW is irreversible and irretrievable. Some indirect adverse visual effects, such as the removal of large trees within the Project ROW, can be regarded as essentially irreversible, because they would take hundreds of years or more to be fully restored, while other visual and auditory indirect effects, such as those resulting from the presence of transmission towers and lines, persist throughout the lifespan of the Project, until Project elements are removed during decommissioning.

2.9.10 Land Use

The use of the approximately 2,598 acres for the life of the Project would be irreversible since these areas would be converted to a utility use as transmission structures, access roads, converter stations, or fiber regeneration sites. In addition, some land use restrictions may result within the ROW depending on the limitations determined for each individual landowner's lease agreement. As discussed above, it is possible that some small areas may no longer be practicable for agricultural use depending on the location of Project access roads. Once the Project has been decommissioned, all land could return to previous uses; therefore, there would be no irretrievable commitment of land use resources.

2.9.11 Noise

With the implementation of EPMs and identified BMPs to resolve potential noise impacts to noise sensitive areas, no irreversible or irretrievable commitments of resources related to noise are anticipated.

2.9.12 Recreation

All impacts related to recreational resources would cease with the end of the Project and would not be considered an irreversible or irretrievable commitment of resources.

2.9.13 Socioeconomics

No irreversible or irretrievable commitments of socioeconomic resources were identified.

2.9.14 Special Status Wildlife, Fish, Aquatic Invertebrate, and Amphibian Species

2.9.14.1 Special Status Terrestrial Wildlife Species

The potential permanent loss or alteration of established trees in mature forests in the eastern portion of the Project (in Regions 3, 4, 5, and 7) would last throughout the life of the Project; however, gradual recovery of habitat may occur once the Project is decommissioned. As the exact state of this recovery is not known (e.g., substantial changes related to climate, land-use, and/or weeds or pathogens may occur during the assumed 80-year lifespan of the Project), and mature forests are subject to long-term climatic regimes and it is reasonable to assume that some portions of the habitat for special status wildlife species in these forests would be irreversibly and irretrievably impacted.

2.9.14.2 Special Status Fish, Aquatic Invertebrate, and Amphibian Species

The potential permanent loss or alteration of aquatic habitat in smaller streams that may require road crossings would last throughout the life of the Project; however, gradual recovery of habitat may occur once the road crossing was removed. As the exact state of this recovery is not known (e.g., substantial changes related to climate, land-use, and/or watershed hydrology may occur during the assumed 80-year lifespan of the Project), and aquatic habitat is subject to long-term climatic regimes and changes in land-use and watershed hydrology, it is reasonable to assume that some portions of the aquatic habitat for special status fish, aquatic invertebrate, and amphibian species in these smaller streams would be irreversibly and irretrievably impacted.

2.9.15 Surface Water

The commitment of surface water resources would be irreversible in that it would limit, in the short term, future options for use of that resource. Over time, however, the amounts of water used to support construction would be expected to have a negligible effect on surface water resources. In other words, the surface water resource would be renewable or recoverable, so the commitment would not be considered irretrievable.

2.9.16 Transportation

As a result of the increased traffic associated with construction of the Project, a portion of the local roadway network capacity would be lost during the construction period. This loss would be irretrievable but short term. The use of non-renewable resources and resources that cannot be recycled would occur as a result of access roadway construction. The use of these resources would be irreversible.

2.9.17 Vegetation Communities and Special Status Plant Species

Both short- and long-term disturbance to vegetation would be reconciled through appropriate application of the Project's Restoration Plan. Once the Project has been decommissioned, there is potential for all of the approximately 2,598 acres of vegetation to be recovered. Therefore, it is predicted that there would be no irreversible or irretrievable commitment of vegetation resources.

2.9.18 Visual Resources

Irreversible and irretrievable commitment of visual resources are anticipated where large trees are removed in the ROW, since trees would not be replanted or would be replanted and would result in age disparities, the effects of which would be noticeable to the casual observer.

Impacts to visual resources from the introduction of structures (e.g., transmission structures and converter stations) and vegetation clearing would be irretrievable during the life of the Project. Once the Project has been decommissioned, however, visual resources could be restored; therefore, the introduction of structures would be not result in any irreversible commitment of visual resources.

2.9.19 Wetlands, Floodplains, and Riparian Areas

The potential permanent loss or alteration of wetlands, floodplains, and riparian areas would last throughout the life of the Project; however, gradual recovery of these resources is expected after decommissioning. It is reasonable to assume that some wetlands, floodplains, and riparian areas may be irreversibly and irretrievably impacted.

2.9.20 Wildlife, Fish, and Aquatic Invertebrates

2.9.20.1 Wildlife

The potential permanent loss or alteration of wildlife habitat associated with established trees in mature forests in the eastern Project area (in Regions 3, 4, 5, and 7) would last throughout the life of the Project; however, gradual recovery of habitat may occur once the Project is decommissioned. As the exact state of this recovery is not known (e.g., substantial changes related to climate, land-use, and/or weeds or pathogens may occur during the 80-year lifespan of the Project), and mature forests are subject to long-term climatic regimes, it is reasonable to assume that some portions of the wildlife habitat in these forests would be irreversibly and irretrievably impacted.

2.9.20.2 Fish and Aquatic Invertebrates

The potential permanent loss or alteration of aquatic habitat in smaller streams that may require road crossings would last throughout the life of the Project, or at least through the duration of use of the access roads; however, gradual recovery of habitat may occur once the road crossing was removed and the stream restored to original conditions. As the exact state of this recovery is not known (e.g., substantial changes related to climate, land-use, and/or watershed hydrology may occur during the 80-year lifespan of the Project), and aquatic habitat is subject to long-term climatic regimes and changes in land-use and watershed hydrology, it is reasonable to assume that some portions of the aquatic habitat for fish and aquatic invertebrate species in these smaller streams would be irreversibly and irretrievably impacted.

2.10 Summary of Relationship between Local Short-term Uses and Long-term Productivity

2.10.1 Definition

Pursuant to NEPA regulations (40 CFR 1502.16), an EIS must consider the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity. In this EIS, short-term impacts are those impacts expected to occur during construction. Long-term impacts are those impacts expected to occur for some time during operations and maintenance. Permanent impacts are those that would be expected to continue even after decommissioning of the Project. The potential impacts to the environment from all phases of the Project could be minimized through the implementation of the EPMs and BMPs identified in Appendix F and Section 2.7, respectively. The following sections provide a brief summary of the relationship between local short-term uses and long-term productivity for each environmental resource area as provided in Chapter 3.

2.10.2 Agricultural Resources

The conversion of primarily agricultural land to a utility use to construct and operate the Project would result in short-term use impacts. These direct effects would include the loss of crops pasture/hay and grazing land for livestock in the representative ROW as well as loss of agricultural structures. Other short-term and localized impacts include the disruption of access to local agricultural land uses during construction. The productivity of the soil in temporary construction areas may also be reduced due to compaction and soil erosion.

2.10.3 Air Quality and Climate Change

Emissions from construction of the Project are not predicted to impact sensitive receptors and also would not impact long-term productivity. While over the short-term emissions from construction would be higher in localized areas—

because the Project provides for development of non-fossil fuel energy sources over the long term—air quality would be improved in comparison to not building the Project.

2.10.4 Electrical Environment

No short-term uses or resource removal exist that would affect long-term productivity associated with electrical effects from the Project.

2.10.5 Environmental Justice

Because the EIS did not identify any disproportionately high and adverse impacts to low-income or minority populations, there would be no short-term or long-term impact to these populations.

2.10.6 Geology, Paleontology, Minerals, and Soils

2.10.6.1 Geology, Paleontology, and Minerals

No relationships exist between local short-term uses and long-term productivity for geological hazards. Short-term impacts associated with the exposure of any scientifically important fossils from Project activities would not adversely impact the long-term potential for discovery of potential fossil resources. Any short-term effects are not expected to cause long-term impairment to the productivity of mineral resources.

2.10.6.2 Soils

Overall site productivity is primarily a matter of revegetation/reclamation success and availability for agricultural or other uses. Impacts to short-term uses of soil resources would result from construction and operations and maintenance of the Project, while impacts to long-term productivity would depend on the success of the reclamation activities. Short-term impacts are associated with land areas directly affected by construction and operations and maintenance of the Project. Short-term impacts include the construction and use of access roads during the construction phase of the Project and the use of access roads for operations and maintenance. Other short-term impacts to soil resources could occur at the footprint areas of construction work areas, converter station sites, transmission line structures, fiber optic sites, and construction tensioning or pulling areas. These areas could all be returned to other productive uses following decommissioning. A decrease in the long-term productivity of soils would result if soils were not reclaimed to their existing quality condition including such characteristics as aeration, permeability, texture, salinity and alkalinity, microbial populations, fertility, and other physical and chemical characteristics that are accepted as beneficial to overall plant growth and establishment.

2.10.7 Groundwater

Groundwater required to support the Project would represent a new, short-term use of the resource, but would have negligible effect on its long-term productivity.

2.10.8 Health, Safety, and Intentional Destructive Acts

While there would be a short-term temporary increase in potential health and safety impacts associated with construction, long-term impacts in the region would not increase and would not affect the productivity of the region.

2.10.9 Historic and Cultural Resources

The impacts associated with short-term use of the environment for cultural resources would likely be minor because DOE has developed a PA that provides a protocol for the identification of historic and cultural resources, evaluation of their possible significance and eligibility to the NRHP, and assessment and resolution of potential Project effects, including, as appropriate and practicable, impact avoidance, minimization, where practicable, and mitigation. As part of the PA, DOE will require the Applicant to develop and implement plans and activities such as those described in Section 3.9.6.1.1 as needed. The draft PA is included in Appendix P. DOE intends to execute the PA prior to issuance of the ROD or otherwise comply with procedures set forth in 36 CFR Part 800. Long-term productivity would not be affected by short-term use of the environment for cultural resources because impacts from short-term use are expected to be minor.

2.10.10 Land Use

Local short-term use effects from the Project would result from the removal of vegetation and conversion of primarily agricultural and undeveloped land to a utility use. Other short-term and local impacts include the disruption to access to local land uses that may occur, such as agriculture, oil and gas development, and residences and businesses during construction. The Project is not expected to have any long-term impacts on land use productivity.

2.10.11 Noise

Construction noise would temporarily impact nearby noise sensitive areas; noise levels associated with operations and maintenance of the Project would not impact long-term productivity. Changes in sound level associated with the Project would not be expected to negatively impact current land use and activities.

2.10.12 Recreation

Some direct short-term impacts to resources such as noise or visual disturbance, or restricted access to the recreation area during construction, would likely diminish the quality of a recreational visit. Long-term productivity of recreational areas could potentially decrease in recreational areas that were crossed by the Project.

2.10.13 Socioeconomics

Potential short-term impacts to socioeconomic resources are not expected to outweigh the long-term benefits of the Project. In the long term, the Project would be expected to increase economic productivity through the delivery of renewable energy generated in the Oklahoma and Texas Panhandle regions to load-serving entities in the mid-south and southeast regions of the United States.

2.10.14 Special Status Wildlife, Fish, Aquatic Invertebrate, and Amphibian Species

2.10.14.1 Special Status Terrestrial Wildlife Species

The Project could result in a short-term disturbance to special status wildlife; however, these impacts should not affect the long-term productivity of populations of special status wildlife.

2.10.14.2 Special Status Fish, Aquatic Invertebrate, and Amphibian Species

The Project may result in a short-term disturbance to special status fish, aquatic invertebrate, and amphibian resources; however, these impacts would not likely affect the long-term productivity of populations of special status fish, aquatic invertebrate, and amphibian species.

2.10.15 Surface Water

Surface water required to support the Project would represent a new, short-term use of the resource, but would have negligible effect on its long-term productivity. Any alterations to streambeds required by access road construction would have short term impacts on the altered segment of stream, but over time the impacts would be expected to fade as natural flora and fauna reestablished and the impacted stream segments would be small.

2.10.16 Transportation

Construction of the Project would increase the short-term uses of the local roadway network during construction but would have no impact on long-term productivity because roadways would be returned to their original condition and travel conditions would neither improve nor deteriorate during the operational life of the Project.

2.10.17 Vegetation Communities and Special Status Plant Species

The impact of short-term uses on long-term productivity to vegetation resources would be limited to those areas where (1) structural foundations are left in place until decommissioning, or (2) instances where vegetation structure is altered from forested to herbaceous structural types. In this second specific case, the functions of wildlife habitat maintenance, biodiversity, and recreational opportunities could be diminished.

2.10.18 Visual Resources

Short-term vegetation management may impair long-term visual resources where trees or areas of thick vegetation are removed and take years to grow back.

2.10.19 Wetlands, Floodplains, and Riparian Areas

The Project would result in a short-term disturbance to wetlands, floodplains, and riparian areas; however, these impacts should not affect the long-term productivity of these resources.

2.10.20 Wildlife, Fish, and Aquatic Invertebrates

2.10.20.1 Wildlife

The Project may result in a short-term disturbance to wildlife resources; however, these impacts should not affect the long-term productivity of populations of wildlife resources.

2.10.20.2 Fish and Aquatic Invertebrates

The Project would result in a short-term disturbance to aquatic resources; however, these impacts should not affect the long-term productivity of populations of fish and other aquatic species. The short-term impact of introducing non-native invasive species would be negligible; however, over time, long-term productivity would be affected and species could be eliminated from their native habitat.

2.11 Summary of Impacts from Connected Actions

The following sections provide a characterization of the potential connected actions associated with the Project. Descriptions of these connected actions are provided in Section 2.5.

2.11.1 Wind Energy Generation

As described in Section 2.5.1, wind power facilities that would interconnect with the Project are anticipated to be located in parts of the Oklahoma Panhandle and Texas Panhandle within an approximate 40-mile radius of the western converter station. The Applicant anticipates future wind farm development to be between 4,000 and 4,550MW. Neither the Applicant nor DOE knows the exact location of wind power facilities that would be connected to the Project. The Applicant has identified 12 wind development zones (WDZs) based on available wind resources and existing land uses. The range of potential impacts connected to the Project from wind energy development within these WDZs is presented in Table 2.11-1.

Table 2.11-1:
Summary of Impacts from Wind Energy Generation

RESOURCE	POTENTIAL IMPACTS
Agricultural Resources	Construction Approximately 2% of land within a wind energy facility would be disturbed, typically primarily cropland and grasslands. As indicated in Section 3.2.6.8.1, assuming between 20 and 30% of the WDZs would be built-out, between 4,328 and 6,492 acres of primarily agricultural land would be temporarily affected during construction. Wind farm developers are typically able to microsite turbines and other facility components to avoid displacing or damaging agricultural structures such as irrigation equipment, barns, and silos. Operations and Maintenance Approximately 1% or less of the land for a wind energy facility would be affected or disturbed (converted to utility use for life of the Project). For the 12 WDZs, assuming 20 to 30% build-out, between 2,164 and 3,246 acres of primarily agricultural land would be affected for the life of the wind energy facilities. Agricultural uses may usually resume around the facility once construction has been completed.
Air Quality and Climate Change	Construction Minor temporary impacts from construction emissions and are not expected to contribute to substantially increased air pollutant concentrations. Operations and Maintenance Reduction in emissions of pollutants and greenhouse gases from the displacement of current fossil fuel power sources for electricity generation.
Electrical Environment	Construction/Operations and Maintenance None expected.
Environmental Justice	Construction/Operations and Maintenance None expected.
Geology, Paleontology, Soils, and Minerals	Construction Potential impacts to karst and to paleontological resources if shallow bedrock disturbed. Complete avoidance of karst is not possible, and the risk to wind farm components from subsidence would still exist. Impacts on mineral resources extraction during construction are anticipated to be minor. Specific locations of wind generation facilities are not known at this time and therefore specific impacts to designated farmland, soil limitation parameters, or contaminated soil cannot be determined. Based on the general characteristics of the WDZs, some affected soils may be susceptible to compaction or have moderate to high wind erosion potential. The remaining soil limitation characteristics are not prominent in the WDZs. Operations and Maintenance Due to the prevalence of karst in the area, the risk for subsidence does exist. Impacts from subsidence in karst areas can be avoided and minimized during engineering design. Impacts to mineral resource accessibility would not be expected if protective measures described for the construction phase were put in place, and the locations of

Table 2.11-1:
Summary of Impacts from Wind Energy Generation

RESOURCE	POTENTIAL IMPACTS
	the facilities would be designed to avoid mineral resources to the extent possible. Impacts to designated farmland, and soils within infrastructure footprints, including turbine footprint areas, collector lines, substations, met towers, operations and maintenance buildings, and access roads for the maintenance and operations of these facilities.
Groundwater	Construction Common impacts include (1) minor potential for contamination from spills or leaks of fuels and lubricants, (2) small and short-term changes in infiltration rates in areas of land disturbance that would not be expected to result in any noticeable changes in the area's natural groundwater recharge rates; (3) minor impacts to water availability from groundwater demands for soil compaction during road, substation, and wind turbine foundation construction and for dust suppression, and (4) potential damage to wells and associated piping systems in construction areas. Operations and Maintenance Groundwater use would be minor; (limited to personal needs of the few workers associated with maintenance of facilities and equipment) no notable sources of contaminants would be in use other than the typical fuels and lubricants found in vehicles and equipment, no soil disturbance would occur, no impacts expected.
Health, Safety, and Intentional Destructive Acts	Construction Lost-time accident and fatality risks to workers typical of large construction projects. Aircraft operations, including helicopter use, could pose collision risks. Operations and Maintenance Minor potential for rotor blade failure and ice buildup and throw from blades during freezing weather conditions. Impacts typically remaining within the wind generation facility site or transmission line ROW. Potential for shadow flicker and blade glint and glare to cause annoyance to workers and public within range of wind energy generation structures.
Historic and Cultural Resources	Construction Ground disturbance has the potential to disturb belowground historic and cultural (archaeological) resources if present. Direct effects to aboveground historical and cultural resources would be transient and limited, based on micrositing and application of EPM LU-5, and could include temporary increases in noise, vibration, and dust. The level of potential adverse impacts to cultural resources associated with wind energy generation would depend on the level of archaeological surveys conducted and the associated cultural resources BMPs and mitigation plans implemented by wind energy developers. Operations and Maintenance No additional impacts expected.
Land Use	Construction Disturbance of approximately 2% of land within an individual wind energy facility, typically primarily cropland and grasslands. Assuming between 20 and 30% of the WDZs would be built out, between 4,328 and 6,492 acres would be temporarily disturbed (2% of the 20% for the low end, 2% of the 30% for the high end.) Operations and Maintenance Approximately 1% of land within a wind energy facility is converted to utility use for life of the Project. For the 12 WDZs, assuming 20 to 30% build-out, between 2,164 and 3,246 acres would be disturbed (until decommissioning). Temporary construction acres would revert to their previous use. Only turbines, access roads, generation tie-lines (if necessary), substations, and operations and maintenance buildings would remain. Agricultural uses and oil/gas development may usually resume around the facility.
Noise	Construction Noise sensitive areas near wind energy facilities could experience temporary elevated sound levels from motorized construction equipment used for general construction. Operations and Maintenance Noise from operation of wind energy generation facilities would result from the operation of wind turbines, and maintenance of the wind energy developments. Because there are no site-specific plans for the wind energy development areas, it is not possible to analyze noise impacts for each potential wind energy generation development area. As wind development projects are established in the WDZs, each would be required to proceed through state, local, and other permitting efforts as applicable.

Table 2.11-1:
Summary of Impacts from Wind Energy Generation

RESOURCE	POTENTIAL IMPACTS
Recreation	Construction Noise, dust, and human activity, as well as vegetation clearing and turbine erection would cause short-term reduced access to, or enjoyment of, recreational areas. No recreational areas are present in WDZ-C, E, F, G, H, I, J, and K, so no impacts are expected in those WDZs. It is assumed that wind energy developers would likely site wind farms to avoid direct impacts to parks and municipalities. Operations and Maintenance Long-term impacts to recreation would typically be limited to changes in the visual characteristics of a recreational area.
Socioeconomics	Construction Construction would result in a range of estimated total (direct, indirect, and induced) jobs of between 8,762 and 9,910 in Region 1. Construction would also result in a range of estimated total (direct, indirect, and induced) earnings of between $435 million and $494 million. Temporary housing impacts could occur if wind generation construction is concurrent with construction of the Project in Region 1 because housing is more limited in this region. Estimated state sales and use tax revenues would range from $158 million to $161 million in Oklahoma and from $217 million to $223 million in Texas. For the three Oklahoma counties, estimated county sales and use tax revenues per facility would range from $0.9 million to $1.9 million for a 50MW facility and from $17.9 million to $35.7 million for a 1,000MW facility. Operations and Maintenance Operations and maintenance would result in a range of estimated total (direct, indirect, and induced) jobs of between 665 and 798. Operations and maintenance would also result in a range of estimated total (direct, indirect, and induced) earnings of between $32.9 million and $41.2 million. These annual impacts would occur each year for the operating life of the potential wind facilities. Positive tax revenue impacts would be expected from annual ad valorem or property taxes. For potentially affected counties in Oklahoma, the tax revenues for a single wind facility would range from $1.9 million (for a 50MW facility in Beaver County) to $36 million (for a 1,000MW facility in Texas County). For potentially affected Texas counties, the property tax revenues for a single wind facility would range from $4.3 million (for a 50MW facility in Hansford County) to $85.6 million (for a 1,000MW facility in Sherman County).
Special Status Wildlife and Fish, Aquatic Invertebrate, and Amphibian Species	Construction Potential impacts during wind farm development could include short-term disturbances to species (i.e., displacement in the vicinity of construction activity) during construction, loss of habitat from land disturbance, and potential mortality from vehicle collisions. Potentially suitable habitat for piping plover is limited; however, there is a potential for piping plover to occur during migration. LEPC and whooping crane may feed within the croplands and grasslands; however, the whooping crane occurrence is likely to be limited to migratory and stopover occurrences. The LEPC habitat within some zones is categorized as CHAT category 1 (i.e., focal area) suggesting that large areas of undeveloped, contiguous grassland/herbaceous land cover occur. The LEPC could be potentially impacted during construction of wind farms by clearing of grassland habitats for access roads, wind turbines, and electrical stations. Specifically, the potential for construction impacts to the LEPC and its habitat is greater in WDZ-D, -I, -J, -K, and -L. These WDZs occur in eastern Texas County and western Beaver County in Oklahoma and western Ochiltree County in Texas. Potential mortality and injury, disturbance, and aquatic habitat loss and modification impacts to the Arkansas darter and Arkansas River shiner could occur in WDZ-J and WDZ-K. Operations and Maintenance Migrant bald and golden eagles and whooping cranes could be at risk for mortality collisions with the turbines. Behavioral avoidance by LEPC of otherwise suitable habitat surrounding wind turbine towers could be possible. Specific impacts would be dependent on the eventual location of the wind energy facilities. Potential impacts to the Arkansas darter and Arkansas River shiner would be similar to those from construction.
Surface Water	Construction Common impacts include (1) potential for runoff and receiving water contamination from spills or leaks of fuels and lubricants, (2) small and short-term changes in runoff rates in areas of land disturbance, and (3) possible disturbance of drainage features, including intermittent or perennial streams, from construction of access roads. Operations and Maintenance

Table 2.11-1:
Summary of Impacts from Wind Energy Generation

RESOURCE	POTENTIAL IMPACTS
	Water use would be minor; no impacts expected. Compared to pre-wind farm conditions, long-term operations and maintenance of wind farms in any of the WDZs would only result in minor changes to stormwater runoff and drainage.
Transportation	Construction: Impacts to roads would be minor, short term and temporary, most roads have the potential for one-level decreases to level of service. Level of service would not decrease below LOS-C even in the unlikely scenario where 38 wind farms and the AC collection system are under construction within 1 year, which further supports the conclusion that impacts during construction would be minor and temporary. Although railroads, airports, airstrips, and navigational aids are located within the WDZs, impacts to these features from construction are not expected. Operations and Maintenance Low level of increased rural traffic from wind farm workers and their families. FAA lighting requirements would apply to the wind turbines. In addition, the heights of the turbines would require careful selection of specific turbine sites to avoid potential conflicts with airports and military airspace. In some cases, FAA notification requirements might be triggered.
Vegetation Communities	Construction Approximately 2% of land within any wind energy facility is assumed to be disturbed during construction, equating to approximately 6,492 acres of temporary disturbance. All of the potential wind generation areas are dominated by cropland and grassland land cover types. Temporary impacts during construction may result from increased dust entrainment that can settle on surrounding vegetation causing a reduction in photosynthetic capability of plants. It is also likely that there would be mowing or potential removal of vegetation in ROWs for generation tie-lines, access roads, and electrical collection lines that are placed underground. Long-term to permanent impacts may result to vegetation where it is removed to facilitate construction of substation facilities. Operations and Maintenance Approximately 1% of land within any given wind energy facility is anticipated to be impacted by maintenance and operations. This would equate to approximately 3,246 acres. Once construction has been completed, agricultural operations would be able to continue in most of the wind farm. Agricultural activities such as cultivating crops are generally permitted up to the wind turbine pads, so only a very minimal area of existing agricultural land would be permanently removed from production. Permanent access roads may change the configuration of fields for crops.
Visual Resources	Construction Short-term visual intrusion of construction vehicles, equipment, materials, and work force in staging areas, and final turbine location. Operations and Maintenance The tall, vertical wind turbines would be in strong contrast with the primarily horizontal lines of the surrounding landscape; therefore, higher impacts are anticipated where the wind turbines are located in the foreground and near middle ground in relation to sensitive viewers. In addition, the required FAA lighting would be visible for long distances and would likely attract attention when flashing. Most of the highly sensitive resources, such as the national grassland and recreation areas, however, would be located in the background distance zone, so impacts would not be as strong as turbines would not be a dominant feature at that distance.
Wetlands, Floodplains, and Riparian Areas	Construction The potential short-term impacts from construction activities for wind energy generation could include mechanical damage/crushing of wetland and riparian vegetation, compaction of soils, sedimentation and turbidity from construction activities adjacent to these resources, alteration of hydrology from access road construction, dewatering activities, and contamination from accidental spills of hazardous substances such as fuels and lubricants. The potential long-term impacts to wetlands, floodplains, and riparian resources could include removal of vegetation during excavations for structure foundations, electrical collection lines, or during permanent access road construction, conversion of forested wetlands and riparian areas to shrubby or herbaceous cover types within the ROW, changes to hydrology from permanent access roads construction, and the introduction of invasive species from construction equipment. Operations and Maintenance There would be a potential for impacts from contamination from accidental spills of hazardous substances such as fuels and lubricants, however, the potential would be less than during construction.

Table 2.11-1:
Summary of Impacts from Wind Energy Generation

RESOURCE	POTENTIAL IMPACTS
Wildlife and Fish	Construction Short-term impacts to wildlife resources during construction may include disturbance due to increased noise, dust, and traffic. Additionally, there is the potential for short-term indirect impacts to wildlife habitats as a result of the clearing of vegetation and soil disruption during construction. There is the potential for long-term direct habitat loss related to construction of a wind energy development as well as the potential for avian and bat mortalities resulting from collisions with wind turbines and blades. Potential localized aquatic habitat damage, sensory disturbance, and mortality/injury to fish and aquatic invertebrate species could occur at stream and water body crossings. Operations and Maintenance Operations and maintenance of wind energy developments are known to have direct impacts on some wildlife species, specifically avian and bat species, due to collisions with wind turbine blades, collisions and electrocutions associated with generation tie-lines, and barotrauma of bat species. Permanent habitat loss would occur due to the footprint of the wind energy facility for the life of that facility. Potential impacts to fish and aquatic invertebrate species similar to those during construction could occur during maintenance activities at stream and river crossings.

2.11.2 Optima Substation

The future Optima Substation is anticipated to be constructed on 160 acres of currently undeveloped land near an operating wind energy facility. The land cover of the site is primarily grassland/herbaceous. Any agricultural practices, such as grazing, that currently occur on the site would be converted to a utility use. The site would be partially contained within the Oklahoma AC Interconnection Siting Area. Therefore, impacts of this connected action would be similar, but of a smaller scale, to the impacts presented for the Oklahoma Converter Station and Interconnection Siting Areas. Impacts would occur primarily during construction of the substation because there would be few, if any environmental impacts associated with operations and maintenance of the substation.

2.11.3 TVA Upgrades

The required TVA upgrades would have impacts similar to the Project, but on a smaller scale, being restricted to an approximately 37-mile-long new 500kV AC transmission line in western Tennessee and upgrades to existing facilities in western and central Tennessee. The potential impacts of the required upgrades would be limited primarily to the construction phase with negligible impacts resulting from the operation of the upgraded facilities. The upgrades to existing facilities would be unlikely to result in any significant, adverse impacts since there would not likely be any additional land disturbance required beyond the existing footprint of those facilities. The specific impacts of the new transmission line would be subject to environmental review once specific locations are identified. TVA anticipates tiering from this EIS when completing its review of potential environmental impacts of the new transmission line and upgrades to existing facilities as required by NEPA.

2.12 Summary of Impacts from the No Action Alternative

Under the No Action Alternative, DOE would not participate with the Applicant in the Applicant Proposed Project or DOE Alternatives. DOE assumes for analytical purposes that the Project would not move forward and none of the potential environmental effects associated with the Project would occur. Therefore, the Project would not be constructed and no additional impacts would occur to any of the environmental resources analyzed.

2.13 Summary of Cumulative Impacts

The cumulative impacts analysis identified past, present, and reasonably future actions that could occur within the same time and place as the Project. This section identifies those cumulative impacts for both construction and operations and maintenance. Chapter 4, Cumulative Impacts, describes the identification of past, present, and reasonably foreseeable future actions in detail and provides an evaluation of potential cumulative impacts.

Impacts from Construction

Construction activities in the seven diverse regions of the Project could result in impacts to agricultural resources, changes to land uses, temporary land disturbance, increased traffic, increased air emissions, increased noise levels, intrusions into the visual landscape, and potential impacts to wildlife, fish, aquatic invertebrate, and amphibian species and vegetation, including special status species. Cumulatively, other construction activities occurring in the same time and vicinity would have similar impacts within each region. Other past, present, and reasonably foreseeable actions identified for the seven regions that could occur within the same time and place of the Project include electrical transmission lines, roadway and bridge enhancements, new road construction, oil or natural gas pipelines, wind farm developments, and two relatively large development projects in Region 7 (Great River Super Site and Green Meadows Development; see Table 4.2-1a in Chapter 4). Multiple activities occurring at the same time and vicinity would have greater impacts than just one action. If construction activities overlapped in the same area, then the construction-related impacts could be greater than for just the Project. However, with the exception of the converter stations, construction of the Project would not affect any one area for long (i.e., no more than a few weeks or months), so the short temporal overlap would limit cumulative impacts. The majority of the actions identified are transmission lines and road construction. Most of the road construction would occur on existing roadways, not disturbing new lands, and therefore would have only minor contributions to cumulative impacts from the Project. Overall, construction of the Project, when considered with past, present, and reasonably foreseeable actions, would result in the following cumulative impacts: short-term, temporary disturbance of active agricultural lands and operations; possible restrictions on existing land uses; temporary soil and vegetation disturbance; increased risk of localized water quality impacts (spills or sedimentation); increased traffic; increased air emissions and noise levels; potential shortages in temporary housing (in Region 1); visual disruptions from construction equipment and land disturbance; and potential impacts to wildlife, fish, aquatic invertebrate, and amphibian species and vegetation, including special status species. Fish special status species are the Arkansas darter, Arkansas River shiner, Ozark cavefish, Yellowcheek darter, and pallid sturgeon. The aquatic invertebrate special status species are spectaclecase, pink mucket, Neosho mucket, speckled pocketbook, scaleshell mussel, fat pocketbook, rabbitsfoot, snuffbox, and Curtis' pearlymussel. The special status amphibian is the Ozark hellbender.

Impacts from Operations and Maintenance

After completion of construction, the majority of the Project-related impacts would be minimized. Those that would continue or increase would include electrical environment (electric fields, magnetic fields, audible noise, and radio and television interference) and visual resources. The Project individually would not be considered a strong source of electric or magnetic fields. Other existing and proposed transmission lines that would be crossed by the Project would be an additional source of electric or magnetic fields at the location of the crossing. People are exposed to numerous sources of magnetic fields on a daily basis from sources like power lines, but also from electric devices in home and office environments. The research available on the health impacts of magnetic field exposure are not definitive, and no conclusions regarding the health impacts can be drawn based on what is presently known about the health impacts of magnetic fields. Looking at the occupational guidelines, calculated DC electric fields within the

ROW would be lower than 20 kilovolts per meter, except during infrequent operating conditions (such as when a main conductor bundle is de-energized for repair or maintenance) for either monopole or lattice structures, where they would be as high as 24.3 kilovolts per meter.

Long-term visual impacts from the Project include the intrusion of the converter station and associated structures and transmission structures, access roads, and cleared ROW that may introduce contrast into the surrounding landscape setting. The cumulative impacts would be of a similar nature in areas where additional transmission line actions have been identified (Regions 1, 2, and 3). Additionally, sensitive viewers in Regions 1, 2, and 6 that are characterized primarily by flat croplands and grasslands with scattered vegetation are anticipated to have greater visibility of the Project due to long viewing distances associated with an open landscape with panoramic views. A new planned section of Highway 71 would cross Link 6 of the Region 4 Applicant Proposed Route and near the Alma Key Observation Point. The visual impacts of the new section of Highway 71 would be cumulative over the long-term with those of the Project.

2.14 Agency Preferred Alternative

The proposed Plains & Eastern transmission line represents high-voltage transmission facilities that would make possible the development of valuable wind resources in the Oklahoma and Texas Panhandle regions by providing HVDC transmission capability to deliver 3,500–4,000MW of electricity to the Mid-South and Southeast regions of the United States (depending on selected alternatives). DOE has evaluated the Proposed Action of whether to participate under Section 1222 of the EPAct, acting through and in consultation with the Administrator of the Southwestern Power Administration (Southwestern), in the Applicant Proposed Project or DOE Alternatives in one or more of the following ways: designing, developing, constructing, operating, maintaining, or owning a new electric power transmission facility and related facilities located within certain states in which Southwestern operates, namely Oklahoma, Arkansas, and, possibly Texas. As identified throughout Chapter 2, there are several elements that make up the Project. These elements include:

- Applicant Proposed Project
  - Oklahoma Converter Station and AC Interconnection
  - Tennessee Converter Station and AC Interconnection
  - AC Collection System
  - HVDC Applicant Proposed Route (through Regions 1–7)
- DOE Alternatives
  - Arkansas Converter Station and AC Interconnection
  - HVDC alternative routes (through Regions 1–7)

CEQ regulations at 40 CFR 1502.14(e) require an agency to identify its preferred alternative in the Final EIS. While developing the Final EIS, DOE considered the alternatives analyzed in the Draft EIS, the comparison of potential impacts for each resource area, and input received on the Draft EIS. DOE has coordinated with the various cooperating agencies to determine the preferred alternative for each of the Project elements. The following paragraphs present the DOE preferred alternative for each of the Project elements and the bases for its identification. DOE's identification of a preferred alternative in an EIS does not guarantee that such an alternative will be the alternative selected in DOE's ROD. Rather, identification of the preferred alternative serves to give the public notice as to which alternative DOE currently favors. The ROD, which would be signed no earlier than 30 days after the EPA Notice of Availability for the Final EIS is published in the Federal Register, would document DOE's decision.

2.14.1 Participation in the Applicant Proposed Project

Based on the information presented in the Final EIS, DOE has identified participation as its preferred alternative.

Parallel with the NEPA process, DOE is evaluating Clean Line's application under Section 1222 of the EPAct. This non-NEPA evaluation includes, but is not limited to, evaluating the application against statutory criteria and technical and financial viability. An outcome of this evaluation could be a Participation Agreement between Clean Line and DOE, which would define under what conditions DOE would participate with Clean Line and, if applicable, would include any stipulations or requirements that resulted from this environmental review under NEPA.

2.14.1.1 Oklahoma Converter Station and AC Interconnection

The Applicant Proposed Project would require an AC/DC converter station at the western terminus of the transmission line. The Oklahoma Converter Station Siting Area is an approximate 620-acre area in Texas County, Oklahoma, within which the converter station and associated AC switchyard (45 to 70 acres total) and access road or roads would be sited. The construction and operations and maintenance of the Oklahoma converter station within this siting area is DOE's preferred alternative for a converter station at the western terminus of the transmission line.

The Oklahoma converter station would require a connection to the SPP electric grid. Clean Line has proposed a double-circuit 345kV AC transmission line up to 3 miles in length to interconnect the proposed converter station with a planned Xcel Energy/Southwest Public Service Company substation referred to as Optima. The construction and operations and maintenance of this interconnection is DOE's preferred alternative for connecting the proposed Oklahoma converter station to the existing electric grid.

2.14.1.2 Tennessee Converter Station and AC Interconnection

The Applicant Proposed Project would require an AC/DC converter station at the eastern terminus of the transmission line. The Tennessee Converter Station Siting Area is an approximate 220-acre area in Shelby County, Tennessee, within which the converter station and associated AC switchyard (45 to 70 acres total) and access road or roads would be sited. The AC interconnection would be a direct connection between the converter station and the existing Shelby Substation. Consistent with Section 1222 of the EPAct, DOE's participation in the Applicant Proposed Project or DOE Alternatives would be limited to states in which Southwestern operates, namely, Oklahoma, Arkansas, and, possibly, Texas, but not Tennessee. Consequently, DOE would not participate in the portions of the Applicant Proposed Project or DOE Alternatives that would be sited in Tennessee. As such, when making its decision on whether to participate in the Project under Section 1222, DOE would not select a particular converter station location in Tennessee. The alternatives analysis of the Project components in Tennessee may be relied upon, however, by other agencies with permitting or authorization decisions for the Project in Tennessee, including, but not limited to, TVA and USACE. Therefore, DOE does not have a preferred alternative for the Tennessee converter station and AC interconnection.

2.14.1.3 AC Collection System

Clean Line would construct between four and six AC collection transmission lines within a 40-mile radius from the Oklahoma converter station to collect energy from generation resources in the Oklahoma and Texas Panhandle regions. The collection system would consist of 345kV AC transmission lines that would extend from the converter station to future wind farms. These wind farms, which would likely be established in the WDZs evaluated in the EIS as connected actions, have not been established and their exact locations cannot be known at this time. DOE evaluated 13 possible route alternatives for these AC collection transmission lines to fully evaluate their potential environmental impacts. DOE's preferred alternative is for the Applicant to construct between four and six AC collection transmission lines within a 40-mile radius from the Oklahoma converter station; the specific locations of these transmission lines cannot be known at this time and would depend on the locations of future wind farms in this area.

2.14.1.4 Arkansas Converter Station and AC Interconnection

Based on comments received during the scoping period, DOE identified and evaluated an alternative converter station in Arkansas. The Arkansas converter station would be an intermediate converter station that would not replace either of the other converter stations in Oklahoma or Tennessee. This alternative converter station would be similar to, but smaller than, the Oklahoma and Tennessee converter stations and would allow the delivery of 500MW of power to the electric grid in Arkansas. The Arkansas Converter Station Siting Area is an approximate 360-acre area in Pope County, Arkansas, within which the converter station and associated AC switchyard (20 to 35 acres total) and access road or roads would be sited. The construction and operations and maintenance of the Arkansas converter station within this siting area is DOE's preferred alternative for an intermediate converter station.

The Arkansas converter station would require a connection to the existing electric grid in Arkansas. The interconnection would include an approximate 5-mile 500kV AC transmission line to an interconnection point along the existing Arkansas Nuclear One-Pleasant Hill 500kV AC transmission line. The interconnection would include a new substation (footprint of 25–35 acres) at the point where the 500kV AC interconnection line taps the existing Arkansas Nuclear One-Pleasant Hill 500kV line. The construction and operations and maintenance of this interconnection is DOE's preferred alternative for connecting the proposed Arkansas converter station to the existing electric grid.

2.14.1.5 HVDC Transmission Line Routes

There is no "impact-free" routing choice for a large transmission line. In some regions of the Project, where there are multiple resource conflicts, the HVDC alternative routes impact certain resources differently, and some alternative routes were included in the analysis to emphasize protection of one resource or land value over another. The information in Table 2.6-3 provides a summary of potential impacts for the HVDC transmission line by resource and highlights substantive differences between the Applicant Proposed Route, route variations, and HVDC alternative routes.

After EIS scoping and during the development of the Draft EIS, DOE and Clean Line entered into a Tier IV route development process for the Applicant Proposed Route and the HVDC alternative routes. This process, as documented in Section 2.3 and the DOE Alternatives Development Report (Appendix G), included the establishment of General and Technical guidelines to focus the evaluation of the various route alternatives. The General Guidelines were intended to minimize conflicts with existing resources, developed areas, and existing incompatible infrastructure; to maximize opportunities for paralleling existing compatible infrastructure; and to take into consideration land use and other factors affecting route identification. The General Guidelines included the following:

- Utilize existing linear corridors to the extent practicable
- Utilize areas with land uses/land cover that are consistent or compatible with linear utility uses, such as existing utility corridors and open lands, to the extent practicable
- Avoid existing residences
- Avoid nonresidential structures, including barns, garages, and commercial buildings
- Minimize interference with the use and operation of existing schools, known places of worship, and existing facilities used for cultural, historical, and recreational purposes
- Avoid cemeteries or known burial places
- Minimize adverse effects to economic activities (e.g., impacts to existing residences, businesses and developed areas)
- Minimize crossing of designated public resource lands, including, but not limited to, national and state forests and parks, large camps and other recreation lands, designated battlefields or other designated historic resources and sites, and state-owned wildlife management areas
- Minimize crossings of tribal trust lands and allotments
- Minimize the number and length of crossings of large lakes, major rivers, large wetland complexes, or other sensitive water resources
- Minimize adverse effects on protected species habitat and on other identified sensitive natural resources (e.g., forested areas, native prairies, and other areas as identified by Natural Heritage Commissions)
- Minimize visibility of transmission lines from residential areas and visually sensitive public locations (e.g., public parks, scenic routes or trails, and designated Wild and Scenic Rivers)
- Avoid areas of past environmental contamination to the extent practicable
- Minimize route length, circuitry, special design requirements, and impractical construction requirements

The Technical Guidelines were specific to the Project and were based on technical limitations related to the design, ROW requirements, or reliability concerns. The Technical Guidelines included the following:

- Minimize the crossing of transmission lines of 345kV or above
- Minimize paralleling corridors with more than one existing circuit of 345kV or above
- Maintain 200 feet of centerline-to-centerline separation when paralleling existing transmission lines of 345kV or above
- Maintain 150 feet of centerline-to-centerline separation when paralleling 138kV or lower voltage transmission lines
- Minimize turning angles in the transmission line greater than 65 degrees
- Minimize the length of the transmission line located on soils sloped more than 20 percent
- Minimize underbuild or double circuit arrangements with existing AC infrastructure

The route alternatives analyzed in the Draft EIS were identified based on these guidelines. A detailed discussion of the route development and basis for identification of the Applicant Proposed Route is included in Section 2.3.1 and Appendix G. To respond to public comments on the Draft EIS, DOE and Clean Line developed 23 route variations (as described in Sections 2.3.1 and 2.4.2.1 through 2.4.2.7). These route variations were developed with the intent of reducing land use conflicts or minimizing potential environmental impacts of the Applicant Proposed Route from the levels of impacts considered in the Draft EIS. In all but one instance, the route variations replaced their corresponding segments of the Applicant Proposed Route. This exception (Region 4, Applicant Proposed Route Link

3, Variation 2) was carried forward as an additional alternative for comparative analysis in this Final EIS with the corresponding segment of the Applicant Proposed Route.

Identification of the preferred route for the HVDC transmission line depends on two primary factors: 1) the Applicant Proposed Route evaluated in the Draft EIS was initially identified from among the initial route alternatives because it minimized potential environmental impacts (as detailed in Appendix G), and 2) the Applicant Proposed Route as analyzed in this Final EIS includes route variations that were developed to incorporate feedback from landowners with the intent of reducing land use conflicts and minimizing environmental impacts. Considering these factors, the Applicant Proposed Route (as presented in the Final EIS) is DOE's preferred route for the majority of the route from the Oklahoma converter station to the Arkansas/Tennessee border. Consistent with Section 1222 of the EPAct, DOE's participation in the Project would be limited to states in which Southwestern operates, namely, Oklahoma, Arkansas, and, possibly, Texas, but not Tennessee. Consequently, DOE would not participate in any portion of the Project that would be sited in Tennessee. As such, when making its decision on whether to participate in the Project under Section 1222, DOE would not select an HVDC route alternative in Tennessee. Outside Tennessee, the only exception to the Applicant Proposed Route, as DOE's preferred route, is DOE's identification of the route variation (Region 4, Applicant Proposed Route Link 3, Variation 2) mentioned above to be a segment of the preferred route. The basis for the identification of this route variation over the corresponding segment of the Applicant Proposed Route includes the following: 1) the route variation crosses 32 percent fewer land parcels (17 versus 25); 2) the route variation parallels more than twice the length of existing infrastructure, including transmission lines and roads (4.42 miles versus 1.85 miles); 3) the representative ROW of the route variation would be located within 500 feet of 8 fewer residences (1 versus 9); and 4) the route variation would avoid a private airstrip whose operations could be impacted by the Applicant Proposed Route.

Similarly, because DOE's preferred route is the route alternative with the lowest potential for environmental impacts when compared against the other HVDC route alternatives, it is also designated as the environmentally preferable route alternative. While the No Action Alternative would avoid the environmental impacts identified in the EIS, adoption of this alternative would not meet DOE's purpose and need as identified in Section 1.1, which is to implement Section 1222 of the EPAct of 2005.

As mentioned earlier, the identification of DOE's preferred route in this Final EIS is not a DOE decision on the overall HVDC route. DOE could select from any of the proposed route alternatives for that decision with one exception: the portion of HVDC Alternative Route 4-B that would intersect the Ozark National Forest in Crawford County, Arkansas, is considered non-preferred in the Final EIS for the following reasons:

- The portion of the route alternative would adversely affect sensitive resources by creating discontinuities (linear breaks) in National Forest land (Section 3.10.6).
- The portion of the route alternative would cross lands designated as High Scenic Integrity Objectives as identified in the USFS' Forest Plan (Section 3.18.6).
- Required ROW maintenance along a portion of the route alternative would adversely affect timber production (see Section 3.10.6).
- The portion of the route alternative would, in places, undermine the use for which the National Forest land was originally acquired, i.e., conservation of natural resources (Section 3.10.6).

- The portion of the route alternative would, in places, traverse steep rugged terrain that could present an increased safety hazard during construction and future maintenance of an HVDC transmission line (Section 3.8.5.3).
- The portion of the route alternative is close to the Ozark Plateau region, which contains cave hibernacula for special status bat species. The increase in forested land in this area increases the potential for impacts to the special status bat species (e.g., disturbances to or loss of roost trees) compared to routes that do not cross the Ozark National Forest (3.14.1.7).
- The portion of the route alternative would cross into the Ozark National Forest Important Bird Area (identified by National Audubon Society), potentially indirectly impacting wildlife species (Section 3.20.1.7.3).
- The interspersed land cover and land ownership along the portion of the route alternative suggests that a variety of land uses may occur along the ROW. As a result, a variety of wildlife species common to both deciduous forests and pasture/hay land covers may occur in this area, thereby potentially exposing more wildlife species to Project-related impacts compared to the Applicant Proposed Route (Section 3.20.1.7.3).
- To the extent that the portion of the route alternative might have the benefit of avoiding private land, that benefit is limited because this portion of the route alternative would also cross a large number of parcels of privately owned land within the National Forest boundary (Section 3.10.6). (Privately owned land, or inholdings, can occur inside the boundary of a National Forest. Inholdings result from private ownership of lands prior to the designation of the National Forest, which then end up grandfathered within the legally designated boundary.)

DOE would still be able to select other portions of HVDC Alternative Route 4-B as segments of the HVDC transmission line route if used in concert with other HVDC alternative routes in Region 4. For example, the western segment of HVDC Alternative Route-4B could be used with 4-A, or the eastern portion of HVDC Alternative Route 4-B could be used with either 4-A or 4-D.

This page intentionally left blank.

Contents

Tables

This page intentionally left blank.

3. Affected Environment and Environmental Impacts

3.1 Introduction

3.1.1 Region of Influence

The Project covers approximately 720 miles of diverse landscape and therefore is divided into seven geographic regions. These regions are discussed in Section 2.4 and were established as part of the route development and identification process and have been carried through to the environmental analysis phase of the Project so that the existing conditions and environmental impacts could be analyzed within geographic areas that have similar characteristics. Figures 2.1-17a though 2.1-17f (located in Appendix A) provide an illustration of the Project components throughout the regions. Consistent with Section 1222 of the EPAct, DOE's participation in the Project would be limited to states in which Southwestern operates; namely Oklahoma, Arkansas, and possibly Texas, but not Tennessee. Consequently, DOE will not participate in the portions of the Project that would be located in Tennessee. This EIS does, however, evaluate the environmental impacts of the Project in Tennessee.

This chapter describes the baseline environment of the areas that could be affected by the Project and analyzes the potential environmental impacts that may result from construction, operations and maintenance, and decommissioning of the Project. To examine the potential impacts of the Project components, the EIS examines the area potentially affected by the Applicant Proposed Project and the DOE Alternatives. The EIS defines the area potentially affected by the Project as the region of influence (ROI). The ROI extends beyond the physical dimensions of the HVDC and AC transmission ROWs and converter station footprints. The ROI for the Applicant Proposed Project consists of the following:

- Oklahoma Converter Station Siting Area: An approximate 620-acre area in Texas County, Oklahoma, within which the Applicant proposes to site the Oklahoma converter station and associated AC switchyard (45 to 70 acres total) and access road(s).
- Oklahoma AC Interconnection Siting Area: An approximate 870-acre corridor within which the Applicant proposes to site an AC transmission interconnection route from the Oklahoma converter station to the future Optima Substation.
- AC Collection System: Thirteen 2-mile-wide corridors in Oklahoma (Beaver, Cimarron, and Texas counties) and Texas (Hansford, Ochiltree, and Sherman counties) within which the Applicant anticipates that the AC Collection System could be sited.
- Tennessee Converter Station Siting Area: An approximate 220-acre area located in Shelby County, Tennessee, within which the Applicant proposes to site the Tennessee converter station and associated AC switchyard (45 to 70 acres total), access road(s), and the AC interconnection, which would span between the converter station and the adjacent existing Shelby Substation.
- HVDC Applicant Proposed Route: A 1,000-foot-wide corridor within which the Applicant proposes to site the ROW for the HVDC transmission line between the Oklahoma converter station and the Tennessee converter station.

The ROI for the DOE Alternatives consist of the following:

- Arkansas Converter Station Alternative Siting Area: An approximate 360-acre siting area located in Pope County, Arkansas, within which the Arkansas converter station and associated AC switchyard (25 to 45 acres total) and access road(s) could be sited.
- Arkansas AC Interconnection Siting Area: An approximate 660-acre corridor within which potential 500kV AC transmission line(s) would be sited from the Arkansas converter station to an interconnection point(s) with an existing 500kV AC transmission line. The interconnection would require a 25- to 35-acre substation near the tap with the existing Arkansas Nuclear One-Pleasant Hill 500kV AC transmission line, with another 5 acres for material staging and equipment storage.
- HVDC Alternative Routes: A series of 1,000-foot-wide corridors that DOE has proposed as alternatives to the HVDC Applicant Proposed Route within which the ROW for the HVDC transmission line could be sited.

The ROI for connected actions (described in Section 2.5) are described below:

- Wind Energy Generation ROI: Twelve Wind Development Zones (WDZs) were identified by the Applicant within approximately 40-miles of the Oklahoma Converter Station Siting Area and within parts of the Oklahoma Panhandle and Texas Panhandle These WDZs exhibit adequate wind resource and are areas within which future development of wind energy facilities would likely occur. The ROI for the 12 WDZs is approximately 1,385,000 acres in Oklahoma (Beaver, Cimarron, and Texas counties) and Texas (Hansford, Ochiltree, and Sherman counties).
- Optima Substation ROI: The future SPS Optima Substation would be constructed within approximately 160 acres of land and would be located within a few miles of the Oklahoma converter station in Texas County, Oklahoma. It would be partially located within the Oklahoma AC Interconnection Siting Area and shown on Figure 2.1-3 (located in Appendix A).
- TVA Upgrade ROI: TVA's Interconnection SIS has identified the following as necessary to accommodate the Plains & Eastern Clean Line HVDC interconnection: (a) upgrades to existing infrastructure and (b) construction of a new 500kV transmission line, approximately 37 miles long, in western Tennessee, including necessary modifications to existing substations on the terminal ends of the new line. Upgrades to existing infrastructure would include upgrading terminal equipment at three existing 500kV substations and six existing 161kV substations, making appropriate upgrades to increase heights on sixteen existing 161kV transmission lines to increase line ratings, and replacing the conductors on eight existing 161kV transmission lines (as described in Section 2.5.2). The ROI for the direct assignment facilities would occur within the Shelby Substation. The ROI for the network upgrades, and in particular TVA's future 500kV transmission line, cannot be fully determined at this time. The ROW for the 500kV transmission line would occupy about 785 acres, assuming a ROW width of 175 feet. The upgrades to existing substations are expected to take place within the current substation boundaries and the upgrades to existing transmission lines, except for potential access roads, are expected to take place within existing ROWs.

These ROIs reflect the areas of analysis for direct and indirect impacts. The ROIs defined above are the "base" or standard ROI for the analysis. These ROIs have been expanded or modified on a resource specific basis where appropriate as described in certain resource area sections below. Resources where the ROIs have been expanded or modified include Air Quality and Climate Change, Environmental Justice, Groundwater, Surface Water, Special Status Wildlife and Fish Species, Socioeconomics, Transportation, and Visual Resources. For example, the ROI for examination of socioeconomic impacts (Section 3.13) of the Project was expanded to encompass counties surrounding the Project components so that impacts on economic conditions, agriculture, housing, and community services could be evaluated.

Representative ROW within the ROI

The analyses of impacts for the HVDC Applicant Proposed Route, AC collection system, and HVDC alternative routes are based on a representative 200-foot-wide ROW (100 feet on either side of a representative centerline). Quantitative data regarding the resources that would be directly intersected by the representative 200-foot-wide ROW are used as a representative example of potential impacts from a ROW within a given ROI. The resources that could be affected by the Project vary throughout the 1,000-foot-wide corridor where the actual ROW could be located. The representative ROW does not necessarily reflect where particular resources are most or least concentrated, or an average. For example, the representative ROW avoids many homes and environmental resources, and so moving the ROW within the 1,000-foot-wide corridor could result in environmental impacts different from those described for the representative ROW.

By identifying the existing resources within a broader corridor or siting area, the analyses presented in this EIS consider the full scope of the potential impacts from siting the Project facilities anywhere within their respective siting areas or corridors. The final transmission line ROW could be located anywhere within the 1,000-foot-wide corridor identified in this Final EIS. The final location would be determined following the completion of the NEPA process, engineering design, and ROW acquisition activities. Determination of this final location is referred to as micrositing. The micrositing of a transmission line ROW and the converter stations would require detailed engineering that considers existing conditions; compliance with federal, state, and local permits and authorizations; and incorporation of all environmental protection measures (EPMs) developed by the Applicant. The potential impacts presented in this EIS would serve as one source informing the siting of the HVDC and AC transmission line ROWs and converter stations. Further, the siting of the four to six ROWs for the AC transmission lines that would be part of the AC collection system would also depend on the final locations of the wind generation projects. The specific locations of those wind farms and transmission lines to them would not be known until after completion of this EIS process (including issuance of the ROD in this agency action) and closer to the time of construction of the Project.

3.1.2 Environmental Protection Measures, Best Management Practices, and Project Plans

For the purpose of all analyses for the EIS, it is assumed that the Applicant would conduct each phase of the Project in compliance with applicable federal, state and local laws, regulations and permits related to construction, operation and decommissioning of the Project. Appendix C presents an overview of potential federal and state permits and consultation that could be required for construction of the Project. Local permits and approvals may also be required for the Project.

The Project evaluated in this EIS and described in detail in Chapter 2 incorporates EPMs developed (and that would be implemented) by the Applicant to avoid or minimize potential adverse effects resulting from construction, operations and maintenance, and decommissioning of the Project. The EPMs, listed in Appendix F, are part of the Project. Applicable EPMs are referenced in each resource section and are repeated exactly as they are stated in Appendix F. Implementation of the EPMs is assumed throughout the impact analysis for this EIS.

In some resource sections, DOE has included best management practices (BMPs) that could further avoid or minimize potential adverse impacts. For these resource areas, implementation of the EPMs would not be adequate to avoid or minimize all potential adverse effects resulting from construction, operations and maintenance, and decommissioning of the Project.

Environmental-related project plans are also listed in Appendix F. These plans would be developed and implemented by Clean Line to avoid or minimize effects to environmental resources from construction, operations and maintenance, and/or decommissioning, as appropriate. These plans include: Transportation and Traffic Management Plan; Blasting Plan; Restoration Plan; SPCCP; SWPPP; Transmission Vegetation Management Plan (TVMP); Avian Protection Plan; a Construction Security Plan; and various cultural management planning documents. In addition, Clean Line has developed elements of a communications program, elements of which could be implemented as appropriate during the construction and/or operations and maintenance phases of the Project. The initial elements of a communications program include:

- Clean Line will review and respond to all concerns and complaints from the public.
- Clean Line will publish methods for public input through various forms of media including newspaper advertisements, online social media, email or direct correspondence.
- Clean Line will establish a toll-free hotline, mailing address, email address, and an online comment submission form to receive direct input.

Should DOE decide to participate in the Project, the EPMs would be included in the ROD as part of the project and also by one or more participation agreements. In addition, the ROD or other binding federal document may include conditions of approval (e.g., BMPs or mitigation measures) imposed by DOE or other agencies that have a decision to make or a consultation responsibility (e.g., TVA, USACE, USFWS) regarding the Project. The participation agreement(s) between the Applicant and DOE would require a monitoring plan to ensure implementation of some or all such conditions of approval.

3.1.3 Impact Analyses

Impacts to each resource are discussed in terms of direct, indirect, temporary, short-term, long-term, and permanent impacts in the sections that follow. Direct impacts occur at the same time and place as the Project. Indirect impacts are effects that may occur later in time, or further away from the Project, but are still reasonably foreseeable. Impacts are also characterized by time frame: temporary, short-term, long-term, or permanent. Temporary impacts would occur during construction, with the resource returning to preconstruction conditions once construction is complete. Short-term impacts would continue beyond the completion of construction and last from 2 to 5 years, depending on the resource affected. Long-term impacts would last beyond 5 years and could extend for the life of the Project; these impacts pertain to resources requiring longer recovery periods to return to preconstruction conditions. Permanent impacts are those that would be expected to continue even after decommissioning of the Project.

3.1.4 Chapter 3 Roadmap

3.1.4.1 Organization

Each of the following sections in this chapter is organized alphabetically by the resource sections as listed in Table 3.1-1.

Table 3.1-1:
Chapter 3 Organization

Section Number	Resource
3.2	Agricultural Resources
3.3	Air Quality and Climate Change
3.4	Electrical Environment
3.5	Environmental Justice
3.6	Geology, Paleontology, Minerals, and Soils
3.7	Groundwater
3.8	Health, Safety, and Intentional Destructive Acts
3.9	Historical and Cultural Resources
3.10	Land Use
3.11	Noise
3.12	Recreation
3.13	Socioeconomics
3.14	Special Status Wildlife and Fish, Aquatic Invertebrate, and Amphibian Species
3.15	Surface Water
3.16	Transportation
3.17	Vegetation Communities and Special Status Plant Species
3.18	Visual Resources
3.19	Wetlands, Floodplains, and Riparian Areas
3.20	Wildlife, Fish, and Aquatic Invertebrates

Specific headings within each resource section include the following:

- Affected Environment
  - Regulatory background
  - Data sources
  - Region of influence
  - Affected environment by geographic region (Region 1–Region 7)
- Impacts
  - Methodology
  - Impacts associated with the Applicant Proposed Project
  - Impacts associated with the DOE Alternatives
  - Best management practices
  - Unavoidable adverse impacts
  - Irreversible and irretrievable commitment of resources
  - Relationship between local short-term uses and long-term productivity
  - Impacts from connected actions

As a result of public comments on the Draft EIS, DOE and Clean Line have developed 23 route variations for the Applicant Proposed Route. In all but one instance, Clean Line concluded that the route variations were technically feasible and expressed support for DOE's adoption of these route variations to replace the Applicant Proposed Route that was evaluated in the Draft EIS. DOE has evaluated these route variations both individually and collectively and has concluded that they do not constitute substantial changes in the Proposed Action or significant new circumstances or information relevant to environmental concerns. These route variations are described by region in Sections 2.4.2.1 through 2.4.2.7. Each route variation is described by region within the affected environment section for each resource section in Chapter 3. Potential impacts are also described for each route variation within the impacts section for each resource section in Chapter 3.

A reference CD has been provided for the reader to ensure easy access to certain reference documents used to develop this EIS. Included on the CD are the following reference documents:

- The *Alternatives Development* Report (DOE 2013), which describes the routing process that DOE and Clean Line followed to develop the Applicant Proposed Route and the DOE Alternatives evaluated in this EIS
- Resource-specific technical reports developed by Clean Line of existing environmental conditions in the ROI
- PDF files of reference works consulted during the development of this EIS that are not available on the Internet and not protected by copyright laws

3.1.4.2 Definitions

Each section contains a discussion of unavoidable adverse impacts, irreversible and irretrievable commitment of resources, and relationship between short-term uses and long-term productivity. Unavoidable adverse impacts are caused by or resulting from the Project that are adverse and cannot be avoided with implementation of EPMs, recommended BMPs, and mitigation measures.

An “irreversible commitment of resources” occurs when, once committed to the Project, the resource would continue to be committed throughout the life of the Project but would become available again following decommissioning of the Project and restoration (if necessary). An "irretrievable commitment of resources" occurs when, once used, consumed, destroyed or degraded during construction, operation, maintenance, or decommissioning of the Project, the resource would no longer be available for use by future generations. Such resources could not be restored, replaced, or otherwise retrieved for the life of the Project or thereafter. Examples of irretrievable types of resources include permanent conversion of wetlands and playas, or loss of cultural resources, soils, wildlife, agricultural, and socioeconomic conditions. The losses are permanent.

Pursuant to NEPA regulations (40 CFR 1502.16), an EIS must consider the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity. In this EIS, short-term impacts are those impacts expected to occur during construction. Long-term impacts are those impacts expected to last beyond 5 years and could extend for the life of the Project. Permanent impacts are those that would be expected to continue even after decommissioning of the Project.

Finally, it should be noted that there are several supporting tables that summarize characteristics associated with the affected environment and environmental impacts. Values presented in the supporting tables to this chapter for acres, mileages, and percentages have been rounded to the nearest 0.1, and values between 0 and less than 0.1 were typically rounded to 0 and 0.1, respectively. Because the numbers have been rounded, summation of the values in the table may not always be exact.

Contents

Tables

Figures Presented in Appendix A

3.2 Agricultural Resources

3.2.1 Regulatory Background

Land use laws, regulations, and standards relevant to agricultural resources in the ROI are summarized in Table 3.2-1. Permits that may apply to the Project are described in Appendix C.

Table 3.2-1:
Land Use Laws, Regulations, and Standards Relevant to Agricultural Resources

Statute/Regulation	Agency	Applicability to the Project
Federal		
U.S. Department of Agriculture (USDA) Conservation Program	USDA	The USDA is authorized to provide monetary and technical support to private landowners who reserve agricultural lands for protection of wildlife, wildlife habitat, and wetlands. Contracts are made with landowners to set aside acreage for the reserve programs. These programs include the Conservation Reserve Program (CRP), administered by the Farm Service Agency (FSA), and the Grassland Reserve Program (GRP) and the Wetlands Reserve Program (WRP), both administered by the NRCS. The CRP is administered by the FSA, with the NRCS providing technical land eligibility determinations, conservation planning, and practice implementation. The FSA does not distribute the location of CRP lands without written authorization from landowners, although the number of acres enrolled in CRP in 2007 is available and presented in Tables 3.2-2 through 3.2-9.
Farmland Protection Policy Act	USDA Natural Resources Conservation Service	See Section 3.6 for further information regarding the Farmland Protection Policy Act (FPPA).

3.2.2 Data Sources

Information on cultivated crops was obtained from the USDA National Agricultural Statistics Service CropScape Map (GIS Data Source: NASS 2013). Flood control project dam locations were identified only within Oklahoma and were provided by NRCS (GIS Data Source: NRCS 2005).Section 3.10.2 provides further detail for the land cover and structure data sources that were used.

3.2.3 Region of Influence

For agricultural resources, the ROI for the Project and connected actions is the same as described in Section 3.1.1.

3.2.4 Affected Environment

The affected environment includes the agricultural practices for the ROI in Regions 1 through 7 as described below. Section 3.6 provides further discussion on the designation of prime or unique farmland and farmland of statewide importance, and Section 3.10 provides the percentage and acreage of cultivated crops for each region.

Agriculture is the predominant land use in the ROI in Regions 1 through 7. In Regions 1, 2, and 3, grassland/pasture is the primary type of agriculture. In Regions 4 and 5, pasture/hay is the primary type of agriculture, whereas cultivated crops are more prevalent in Regions 6 and 7 (Figure 3.2-1 located in Appendix A). Agricultural structures found in the ROI in Regions 1 through 7 include concentrated animal feeding operations, barns, and silos, which are distributed throughout the ROI in each region. Center-pivot, mechanically irrigated, and precision-graded fields are also found in the ROI in Regions 1 through 7. Additionally, USDA-constructed dams are located within the ROI of Regions 3 and 4 (GIS Data Source: NRCS 2005). These dams were constructed primarily for flood control.

The market values for agriculture, crops, and livestock are provided in further detail in Section 3.13. Additionally, Section 3.13 provides information on agriculture for the counties that are within the ROI, based on data from the Agricultural Census (USDA 2014a).

Several route variations to the Applicant Proposed Route in Regions 2-7 were developed in response to public comments on the Draft EIS and are described in Appendix M and summarized in Sections 2.4.2.1–2.4.2.7. Comparisons in affected environment between the Applicant Proposed Route and the route variations by Project region, including accompanying HVDC alternative route adjustments, are provided below. The variations are presented graphically in Exhibit 1 of Appendix M.

3.2.5 Regional Description

3.2.5.1 Region 1

Region 1 is referred to as the Oklahoma Panhandle Region and includes the Applicant Proposed Route and HVDC Alternative Routes I-A through I-D, as well as the Oklahoma converter station, AC interconnection, and AC collection system routes. The ROI in Region 1 traverses through five counties in Oklahoma, Beaver, Cimarron, Harper, Texas, and Woodward. The majority land use is agriculture, which includes center-pivot irrigation and pasture/hay and is interspersed with well fields. Winter wheat is the primary crop (GIS Data Source: NASS 2013). Major cultivated crops represented within the AC collection system routes, which include winter wheat, pasture/hay, corn, sorghum, cotton, and alfalfa, are shown in Figure 3.2-1a in Appendix A. Table 3.2-2 summarizes the agricultural land use profiles for the ROI in Region 1, including the number of acres actively enrolled in the CRP in from 1996 through the end of June 2015 (FSA 2014a, 2014b). Agriculture is one of the major industries in the region; the market values for agriculture, crops, and livestock are provided below.

Table 3.2-2:
ROI Profile of Agriculture—Region 1

County	State	Percent of Land Area as Farm	Acres Enrolled in CRP	Market Value of Agriculture Products Sold	Market Value of Crops Sold	Market Value of Livestock and Product Sold
Texas	Oklahoma	99%	183,637.7	$1,013,921,000	$151,942,000	$861,980,000
Beaver	Oklahoma	96%	113,708.8	$186,990,000	$32,994,000	$153,996,000
Cimarron	Oklahoma	79%	117,177.3	$376,658,000	$65,716,000	$310,943,000
Harper	Oklahoma	93%	56,115.9	$148,726,000	$13,933,000	$134,793,000
Hansford	Texas	96%	18,244.7	$783,207,000	$110,704,000	$672,503,000
Ochiltree	Texas	93%	30,812.7	$424,605,000	62,118,000	362,487,000
Sherman	Texas	99%	89,429.2	$590,356,000	$129,479,000	$460,877,000

Source: USDA (2014c, 2014e), FSA (2014a, 2014b)

Within the ROI for the Applicant Proposed Route and the HVDC alternative routes, there are 122 agricultural structures. Within the ROI for the Oklahoma Converter Station Siting Area and the representative Oklahoma AC interconnection, there are no agricultural structures. Within the 13 AC collection system routes are 1,662 agricultural structures.

No route variations were proposed in Region 1.

3.2.5.2 Region 2

Region 2 is referred to as the Oklahoma Central Great Plains Region and includes the Applicant Proposed Route and HVDC Alternative Routes 2-A and 2-B. The ROI in Region 2 traverses Woodward, Major, and Garfield counties in Oklahoma. The majority land use is rangeland and cultivated crops and includes some regions considered to be the wheat belt of Oklahoma. Major cultivated crops represented in the area, such as alfalfa, winter wheat, sorghum, corn, and canola are grown in the ROI in this region (GIS Data Source: NASS 2013) and are shown in Figure 3.2-1b in Appendix A. Table 3.2-3 summarizes the agricultural land use profiles for the ROI in Region 2, including the number of acres actively enrolled in the CRP from 1996 through the end of June 2015 (FSA 2014a).

Table 3.2-3:
ROI Profile of Agriculture—Region 2

County	State	Percent of Land Area as Farm	Acres Enrolled in CRP	Market Value of Agriculture Products Sold	Market Value of Crops Sold	Market Value of Livestock and Product Sold
Woodward	Oklahoma	90%	15,643	$116,493,000	$15,665,000	$100,828,000
Major	Oklahoma	88%	11,766.4	$105,404,000	$41,325,000	$64,079,000
Garfield	Oklahoma	98%	4,790.8	$151,786,000	$93,745,000	$58,041,000

Source: USDA (2014c), FSA (2014a)

Fifty-six agricultural structures are present within the ROI for the Applicant Proposed Route and the HVDC alternative routes.

Two route variations to the Applicant Proposed Route were developed in Region 2 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.2. The variations are illustrated on Exhibit 1 in Appendix M. These variations represent minor adjustments to the Applicant Proposed Route. The agricultural land cover within the ROI is consistent with that described above for both Link 1, Variation 1, and Link 2, Variation 2.

3.2.5.3 Region 3

Region 3 is referred to as the Oklahoma Cross Timbers Region and includes the Applicant Proposed Route and HVDC Alternative Routes 3-A through 3-E. The ROI in Region 3 traverses Garfield, Kingfisher, Logan, Payne, Lincoln, Creek, Okmulgee, and Muskogee counties in Oklahoma. The majority land use is rangeland and cultivated crops and includes areas considered to be the wheat belt of Oklahoma. Major cultivated crops represented in the area, such as alfalfa, winter wheat, sorghum, rye, and canola are grown in the ROI in this region as shown in Figure 3.2-1c in Appendix A (GIS Data Source: NASS 2013). Table 3.2-4 summarizes the agricultural land use profiles for the ROI in Region 3, including the number of acres actively enrolled in the CRP from 1996 through the end of June 2015 (FSA 2014a).

Within the ROI for the Applicant Proposed Route and the HVDC alternative routes, there are 281 agricultural structures.

Table 3.2-4:
ROI Profile of Agriculture—Region 3

County	State	Percent of Land Area as Farm	Acres Enrolled in CRP	Market Value of Agriculture Products Sold	Market Value of Crops Sold	Market Value of Livestock and Product Sold
Kingfisher	Oklahoma	98%	2,570.5	$161,825,000	$63,461,000	$98,365,000
Logan	Oklahoma	76%	1,591.5	$43,985,000	$20,751,000	$23,234,000
Payne	Oklahoma	80%	0	$34,056,000	$9,009,000	$25,046,000
Lincoln	Oklahoma	73%	274.6	$38,730,000	$10,371,000	$28,359,000
Creek	Oklahoma	56%	0	$23,524,000	$4,474,000	$19,050,000
Okmulgee	Oklahoma	67%	0	$27,139,000	$7,519,000	$19,619,000
Muskogee	Oklahoma	65%	0	$50,557,000	$21,398,000	$29,159,000

Source: USDA (2014c), FSA (2014a)

Five route variations to the Applicant Proposed Route were developed in Region 3 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.3. The variations include Link 1, Variation 2; Links 1 and 2, Variation 1; Link 4, Variation 1; Link 4, Variation 2, and Link 5, Variation 2, and they are illustrated in Exhibit 1 in Appendix M. One route adjustment in this region was made for HVDC Alternative Route 3-A to maintain an end-to-end route with the Links 1 and 2 variations. This adjustment is also illustrated in Exhibit 1 in Appendix M. These variations represent minor changes to the Applicant Proposed Route. All of the route variations generally cross the same acreage of agricultural land cover when compared with the ROI in Region 3.

3.2.5.4 Region 4

Region 4 is referred to as the Arkansas River Valley Region and includes the Applicant Proposed Route and HVDC Alternative Routes 4-A through 4-E as well as the Lee Creek Variation. The ROI in Region 4 traverses Muskogee and Sequoyah counties in Oklahoma and Crawford, Franklin, Johnson, and Pope counties in Arkansas. The majority of land uses is pasture/hay. Major cultivated crops represented in the area, such as winter wheat, soybeans, rice, corn, and sorghum are grown in the ROI in this region and are shown in Figure 3.2-1d in Appendix A (GIS Data Source: NASS 2013). Table 3.2-5 summarizes the agricultural land use profiles for the ROI in Region 4, including the number of acres actively enrolled in the CRP from 1996 through the end of June 2015 (FSA 2014a, FSA 2015a).

Table 3.2-5:
ROI Profile of Agriculture—Region 4

County	State	Percent of Land Area as Farm	Acres Enrolled in CRP	Market Value of Agriculture Products Sold	Market Value of Crops Sold	Market Value of Livestock and Product Sold
Sequoyah	Oklahoma	47%	0	$55,485,000	$12,763,000	$42,721,000
Crawford	Arkansas	32%	721.9	$67,408,000	$22,542,000	$44,866,000
Franklin	Arkansas	40%	369.2	$158,178,000	$4,267,000	$153,911,000
Johnson	Arkansas	27%	63.1	$141,042,000	$4,335,000	$136,706,000

Source: USDA (2014b, 2014c), FSA (2014a, 2015a)

Within the ROI for the HVDC Applicant Proposed Route, the Lee Creek Variation, and the HVDC alternative routes, there are 436 agricultural structures. Table 3.10-8 in Section 3.10 provides agricultural land cover within the Lee Creek Variation in the Region 4 ROI. The Lee Creek Variation contains 5.8 percent grasslands/herbaceous land.

Seven route variations to the Applicant Proposed Route were developed in Region 4 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.4. The variations are illustrated in Exhibit 1 in Appendix M. These variations represent minor adjustments to the Applicant Proposed Route. Link 3, Variation 1, would parallel parcel boundaries but otherwise generally has the same amount of agricultural land cover as the original Applicant Proposed Route Link 3. Link 3, Variation 2, generally has the same amount of agricultural land cover as the original Applicant Proposed Route Link 3, and Link 3, Variation 3, generally has the same amount of agricultural land cover as the original Applicant Proposed Route Link 3. Link 6, Variation 1, generally has the same amount of agricultural land cover as the original Applicant Proposed Route Link 6 but would parallel parcel boundaries. Link 6, Variation 2, would avoid a WRP easement but otherwise generally has the same amount of agricultural land cover as the original Applicant Proposed Route Link 6. Link 6, Variation 3, and Link 9, Variation 1, generally each have the same amount of agricultural land cover as the original Applicant Proposed Route Links 6 and 9.

3.2.5.5 Region 5

Region 5 is referred to as the Central Arkansas Region and includes the Applicant Proposed Route and HVDC Alternative Routes 5-A through 5-F. The ROI in Region 5 traverses Pope, Conway, Van Buren, Cleburne, White, and Jackson counties in Arkansas. The majority land uses include pasture/hay and cultivated crops. Approximately 4.5 percent of the ROI in Region 5 consists of cultivated crops. Section 3.10 presents detailed information on the land cover for the Project. Major cultivated crops represented in the area, such as winter wheat, soybeans, rice, and corn are grown in the ROI in this region and are shown in Figure 3.2-1e in Appendix A (GIS Data Source: NASS 2013). Table 3.2-6 summarizes the agricultural land use profiles for the ROI in Region 5. Within the ROI for the Applicant Proposed Route, the HVDC alternative routes, the Arkansas Converter Station Siting Area, the AC Interconnection Siting Area, and new substation are 218 agricultural structures. Table 3.2-6 summarizes the agricultural land use profiles for the ROI in Region 5, including the number of acres actively enrolled in the CRP from 1996 through the end of June 2015 (FSA 2015a).

Table 3.2-6:
ROI Profile of Agriculture—Region 5

County	State	Percent of Land Area as Farm	Acres Enrolled in CRP	Market Value of Agriculture Products Sold	Market Value of Crops Sold	Market Value of Livestock and Product Sold
Pope	Arkansas	29%	1,946.1	$150,102,000	$10,396,000	$139,706,000
Conway	Arkansas	53%	192	$133,581,000	10,926,000	$122,655,000
Van Buren	Arkansas	27%	0	$19,947,000	$1,067,000	$18,880,0000
Cleburne	Arkansas	42%	130.2	$47,871,000	$1,195,000	$46,675,000
Faulkner	Arkansas	43%	1,709.9	$26,257,000	$10,067,000	$16,190,000
White	Arkansas	53%	19,220.6	$100,373,000	$39,106,000	$61,267,000
Jackson	Arkansas	75%	9,960.4	$215,265,000	$196,405,000	$18,861,000

Source: USDA (2014b), FSA (2015a)

Five route variations to the Applicant Proposed Route were developed in Region 5 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.5. The variations are illustrated in Exhibit 1 in Appendix M. These variations represent minor adjustments to the Applicant Proposed Route. Link 1, Variation 2, has generally the same amount of agricultural land cover as the original Applicant Proposed Route Link 1. Link 2, Variation 2, crosses less pasture/hay than the ROI for the original Applicant Proposed Route Link 2. Links 2 and 3, Variation 1, has generally the same amount of agricultural land cover as the original Applicant Proposed Route Links 2 and 3. Additionally, a route adjustment was made for HVDC Alternative Route 5-B to maintain an end-to-end route with Links 2 and 3, Variation 1. Links 3 and 4, Variation 2, more closely parallels parcel boundaries than the original Applicant Proposed Route Links 3 and 4; a route adjustment was made for HVDC Alternative Route 5-E to maintain an end-to-end route with this proposed variation. Link 7, Variation 1, generally has the same amount of agricultural land as Link 7 of the original Applicant Proposed Route.

3.2.5.6 Region 6

Region 6 is referred to as the Cache River and Crowley's Ridge Region and includes the Applicant Proposed Route and HVDC Alternative Routes 6-A through 6-D. The majority of the land (from 70 to 80 percent of the land area) in the counties crossed by the ROI for Region 6 (Cross, and Poinsett Counties in Arkansas) is used for agriculture. See Table 3.13-9 and Table 3.2-7 for further information. The majority of the agricultural land in theses counties is irrigated cropland. Groundwater is the source for most irrigation water used in these counties. Common irrigation systems in these areas include furrow and flood systems, with overhead sprinkler (center-pivot) irrigation also present, but to a lesser extent (see Appendix H). Major cultivated crops represented in the area, such as winter wheat, soybeans, rice, and corn are grown in the ROI in this region and are shown in Figure 3.2-1f in Appendix A (GIS Data Source: NASS 2013). Rice grown in Arkansas is 100 percent irrigated. Corn requires timely irrigation to maximize its yield potential and is almost entirely irrigated in the region. The majority of cotton and soybean acres are also irrigated in the three counties crossed by the ROI in Region 6 (see Appendix H). Table 3.2-7 summarizes the agricultural land use profiles for the ROI in Region 6, including the number of acres actively enrolled in the CRP from 1996 through the end of June 2015 (FSA 2015a). Within the ROI for the Applicant Proposed Route and the HVDC alternative routes are 40 agricultural structures.

Table 3.2-7:
ROI Profile of Agriculture—Region 6

County	State	Percent of Land Area as Farm	Acres Enrolled in CRP	Market Value of Agriculture Products Sold	Market Value of Crops Sold	Market Value of Livestock and Product Sold
Cross	Arkansas	70%	11,167.3	$215,016,000	$214,685,000	$331,000
Poinsett	Arkansas	79%	2,824.5	$287,420,000	$286,746,000	$674,000

Source: USDA (2014b), FSA (2015a)

One route variation was developed to the Applicant Proposed Route in Region 6 in response to public comments on the Draft EIS. The route variation is described in Appendix M and summarized in Section 2.4.2.6. The variation is illustrated in Exhibit 1 in Appendix M. This variation represents minor adjustments to the Applicant Proposed Route. Link 2, Variation 1, generally has the same amount of agricultural land cover as the ROI for Link 2 of the original Applicant Proposed Route. Additionally, a route adjustment was made for HVDC Alternative Route 6-A to maintain an end-to-end route with the Applicant Proposed Route Link 2, Variation 1.

3.2.5.7 Region 7

Region 7 is referred to as the Arkansas Mississippi River Delta and Tennessee Region and includes the Applicant Proposed Route and HVDC Alternative Routes 7-A through 7-D. The ROI in Region 7 traverses Poinsett and Mississippi counties in Arkansas and Tipton and Shelby counties in Tennessee. The irrigated agriculture overview presented above for Jackson, Cross, and Poinsett counties in Region 6 also apply to the Arkansas counties crossed by the ROI for Region 7. Major cultivated crops represented in the area, such as corn, soybeans, winter wheat, and cotton are grown in the ROI in this region and are shown in Figure 3.2-1f in Appendix A (GIS Data Source: NASS 2013). Extensive cultivated crops have replaced the historical wetlands. Table 3.2-8 summarizes the agricultural land use profiles for the ROI in Region 6, including the number of acres actively enrolled from 1996 through the end of June 2015 (FSA 2015a, 2015b). There are also approximately 17 acres of WRP land in the ROI. Within the ROI for the Applicant Proposed Route, the HVDC alternative routes, and the Tennessee Converter Station Siting Area are 73 agricultural structures.

Table 3.2-8:
ROI Profile of Agriculture—Region 7

County[1]	State	Percent of Land Area as Farm	Acres Enrolled in CRP	Market Value of Agriculture Products Sold	Market Value of Crops Sold	Market Value of Livestock and Product Sold
Mississippi	Arkansas	81%	1,241.3	$314,647,000	$314,464,000	$183,000
Shelby	Tennessee	16%	1,637.4	$31,806,000	$29,977,000	$1,829,000
Tipton	Tennessee	58%	228	$32,027,000	34,344,000	2,683,000

1 The respective route alternatives do not go through the same counties as listed in the table above.
Source: USDA (2014b, 2014d), FSA (2015a, 2015b)

Three route variations to the Applicant Proposed Route were developed in Region 7 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.7. The variations are illustrated in Exhibit 1 in Appendix M. Applicant Proposed Route Link 1, Variation 1; Link 1, Variation 2; and Link 5, Variation 1, each generally has the same amount of agricultural land cover as the ROI for the original Applicant Proposed Route.

3.2.5.8 Connected Actions

3.2.5.8.1 Wind Energy Generation

Land cover in the WDZs is primarily cultivated crops and grassland/herbaceous. The land cover in each WDZ is summarized in Section 3.10. Existing agricultural land uses in the WDZs include irrigated and dry cultivated crops and feedlots. Agricultural structures in the WDZs include barns and silos. Additionally, rural residences are scattered on large parcels of land and generally surrounded by agricultural land uses.

Table 3.2-9 summarizes the agricultural land use profiles for the WDZs. Agriculture is one of the major industries in the counties where the WDZs are located; the market values for agriculture, crops, and livestock are provided in Table 3.2-9. Section 3.13 describes socioeconomic impacts in detail.

Table 3.10-12 presents the land cover in each respective WDZ. The number of acres enrolled in CRP in 2007 is available and presented in the table below (USDA 2014a).

Table 3.2-9:
ROI Profile of Agriculture—WDZ Analysis in Oklahoma and Texas

County	State	Percent of Land Area as Farm	Acres Enrolled in CRP	Market Value of Agriculture Products Sold	Market Value of Crops Sold	Market Value of Livestock and Product Sold
Beaver	Oklahoma	96%	113,708.8	$186,990,000	$32,994,000	$153,996,000
Cimarron	Oklahoma	79%	117,177.3	$376,658,000	$65,716,000	$310,943,000
Texas	Oklahoma	99%	183,637.7	$1,013,921,000	$151,942,000	$861,980,000
Hansford	Texas	96%	18,244.7	$783,207,000	$110,704,000	$672,503,000
Ochiltree	Texas	93%	30,802.7	$424,605,000	62,118,000	362,487,000
Sherman	Texas	99%	89,429.2	$590,356,000	$129,479,000	$460,877,000

1 Withheld to avoid disclosing data for individual farms.

Source: USDA (2014a), FSA (2014a, 2014b)

3.2.5.8.1.1 WDZ-A

The predominant land cover in WDZ-A is approximately 60.3 percent cultivated crops. Additionally, the agricultural land cover is 26.1 percent grassland/herbaceous and 0 percent pasture/hay.

3.2.5.8.1.2 WDZ-B

The predominant land cover in WDZ-B is 53.2 percent cultivated crops. Additionally, the agricultural land cover is 37.8 percent grassland/herbaceous and 0 percent pasture/hay. Central-pivot irrigation is found throughout the WDZ.

3.2.5.8.1.3 WDZ-C

The predominant land cover in WDZ-C is 52.8 percent grassland/herbaceous; the agricultural land cover is 38.8 percent cultivated crops and 0 percent is pasture/hay.

Center-pivot irrigation is found throughout the WDZ and a concentrated animal feeding operation is located in the western portion of the WDZ southeast of Stratford, Texas.

3.2.5.8.1.4 WDZ-D

The predominant land cover in WDZ-D is 69.3 percent grass and/herbaceous; the agricultural land cover is up to 17.8 percent cultivated crops and 0 percent is pasture/hay. Transmission lines and center-pivot irrigation are present in the northern and southern portions of the WDZ.

3.2.5.8.1.5 WDZ-E

The predominant land cover in WDZ-E is 57.0 percent cultivated crops; the agricultural land cover is 31.9 percent grassland/herbaceous and 0 percent is pasture/hay.

3.2.5.8.1.6 WDZ-F

The predominant land cover in WDZ-F is 67.0 percent grassland/herbaceous; the agricultural land cover is up to 25.4 percent cultivated crops and 0 percent is pasture/hay. Center-pivot irrigation is found throughout the WDZ.

3.2.5.8.1.7 WDZ-G

The predominant land cover in WDZ-G is 53.0 percent grassland/herbaceous; the agricultural land cover is up to 40.5 percent cultivated crops and 0 percent is pasture/hay. A few parcels with central-pivot irrigation are located in the northern portion of the WDZ.

3.2.5.8.1.8 WDZ-H

The predominant land cover in WDZ-H is 81.5 percent grassland/herbaceous; the agricultural land cover is 12.9 percent cultivated crops and 0 percent is pasture/hay. A few parcels have center-pivot irrigation.

3.2.5.8.1.9 WDZ-I

The predominant land cover in WDZ-I is 61.1 percent cultivated crops; the agricultural land cover is 23.8 percent is grassland/herbaceous and 0 percent is pasture/hay.

Center-pivot irrigation is found primarily in the central portion of the WDZ. Concentrated animal feeding operations are also found in the WDZ.

3.2.5.8.1.10 WDZ-J

The predominant land cover in WDZ-J is 73.6 percent grassland/herbaceous; the agricultural land cover is 12.9 percent cultivated crops and 0 percent is pasture/hay.

Some central-pivot irrigation structures are present in the central portion of the WDZ.

3.2.5.8.1.11 WDZ-K

The agricultural land cover in WDZ-K is 46.5 percent cultivated crops; the agricultural land cover is 42.2 percent grassland/herbaceous and 0 percent is pasture/hay. Existing infrastructure includes transmission lines and some scattered center-pivot irrigation.

3.2.5.8.1.12 WDZ-L

The predominant land cover in WDZ-L is 55.2 percent cultivated crops; the agricultural land cover is 28.4 percent grassland/herbaceous and 0 percent is pasture/hay. Center-pivot irrigation is found throughout the WDZ.

3.2.5.8.2 Optima Substation

The land cover in the future Optima substation location is primarily grassland/herbaceous. There are no structures or existing infrastructure on the 160-acre site, although there are roads and an operating wind farm nearby. Cultivated crops are located south of the Optima substation, while grassland/herbaceous is the predominant agricultural land cover that surrounds the Optima substation.

3.2.5.8.3 TVA Upgrades

The ROI for the direct assignment facilities (which are included in the Applicant Proposed Project) would occur within the Tennessee Converter Station Siting Area and more specifically within the Shelby Substation. The ROI for the network upgrades, and in particular TVA's future 500kV transmission line, cannot be fully determined at this time. The new 500kV line would be constructed in western Tennessee, where agricultural lands are common and cultivated crops, grassland/herbaceous, and pasture/hay are dominant land covers. The upgrades to existing facilities would mostly be in western and central Tennessee. Upgrades to existing infrastructure would include upgrading terminal equipment at three existing 500kV substations and six existing 161kV substations, making appropriate upgrades to increase heights on 16 existing 161kV transmission lines to increase line ratings, and replacing the conductors on eight existing 161kV transmission lines. Where possible, general impacts associated with the required TVA upgrades are discussed qualitatively as described below.

3.2.6 Impacts to Agricultural Resources

The majority of the land crossed by the Project is used for agriculture, including grassland/herbaceous, cultivated crops, and pasture/hay. The analysis includes the potential for direct impacts to agricultural land from construction of the Project as well as on agricultural structures such as barns or storage silos. Potential indirect impacts to agricultural production to adjacent land and from impacts to aerial applications of fertilizer, insecticide, and herbicide and socioeconomic impacts to farmers and ranchers as a result of the impacts to the agricultural land are also discussed.

Impacts to agricultural structures are discussed in Sections 3.2.6.2 and 3.2.6.3.

3.2.6.1 Methodology

To identify potential impacts to agriculture that may result from construction and operations and maintenance of the Project, the analysis of the HVDC transmission line route alternatives, the Oklahoma and Arkansas AC interconnection lines, the Tennessee, Oklahoma, and Arkansas converter stations, and the high voltage AC collection line in Oklahoma was based on a desktop review of existing land uses within a representative centerline developed for each route alternative, data from the National Land Cover Dataset, and several online research sites that are listed in Section 6.5. A 200-foot-wide representative ROW (100 feet on each side) centered on the representative centerline was developed. Section 3.10.6 presents a more detailed discussion of the specific footprint that would be affected during each phase of the Project. In the impacts discussion, the number and type of structures within the ROW are listed, although it is assumed that the displacement of structures would be avoided in the final engineering and design of the Project.

DOE has consulted with the state NRCS offices in Oklahoma, Arkansas, and Tennessee concerning impacts to farmland protected under the FPPA and has received a determination from the agencies that the transmission lines do not irreversibly convert farmland (Sagona 2014; Adams 2014). Further, this determination has been seconded by the NRCS National Leader for the FPPA. It should be noted, however, that this determination does not apply to the converter stations, the construction of which would potentially convert farmland and would require a Form AD-1006 be submitted for evaluation. The locations of access roads needed for the Project have not yet been determined; however, the Applicant would avoid placement of permanent access roads through farmland. Once the exact locations of Project components have been determined, a farmland conversion assessment would be completed by the NRCS for any remaining components for which the NRCS has not yet issued a determination. DOE is currently consulting with the NRCS to determine potential impacts to prime farmland associated with the converter stations.

Impacts to agriculture in eastern Arkansas were assessed using information from the Arkansas Delta Agricultural Economic Impact Study prepared for the Project. This agricultural economic impact study, which focuses on four counties in eastern Arkansas: Jackson (Regions 5 and 6), Cross (Region 6), Poinsett (Regions 6 and 7), and

Mississippi (Region 7), is included as Appendix J to this EIS. The study was prepared under the direction of the Applicant and independently reviewed by DOE.

The Applicant has developed a comprehensive list of EPMs to be integrated into the Project. Implementation of these EPMs is assumed throughout the impact analysis that follows for both the Applicant Proposed Project and the DOE Alternatives. Section 3.1 describes the EPMs in more detail. A complete list of EPMs for the Project is provided in Appendix F; those EPMs that are applicable to agricultural resources are listed below:

- GE-3: Clean Line will minimize clearing vegetation within the ROW, consistent with a Transmission Vegetation Management Plan filed with NERC, and applicable federal, state, and local regulations. The TVMP may require additional analysis under NEPA depending on whether and under what conditions DOE decides to participate in the Project.
- GE-7: Roads not otherwise needed for maintenance and operations will be restored to preconstruction conditions. Restoration practices may include decompacting, recontouring, and re-seeding. Roads needed for maintenance and operations will be retained.
- GE-8: Access controls (e.g., cattle guards, fences, gates) will be installed, maintained, repaired, replaced, or restored as required by regulation, road authority, or as agreed to by landowner.
- GE-9: Clean Line will avoid and/or minimize damage to drainage features and other improvements such as ditches, culverts, levees, tiles, and terraces; however, if these features or improvements are inadvertently damaged, they will be repaired and or restored.
- GE-10: Clean Line will work with landowners to repair damage caused by construction, operation, or maintenance activities of the Project. Repairs will take place in a timely manner, weather and landowner permitting.
- GE-11: Clean Line will conduct construction, operation, and maintenance activities to minimize the creation of dust. This may include measures such as limitations on equipment, speed, and/or travel routes utilized. Water, dust palliative, gravel, combinations of these, or similar control measures may be used. Clean Line will implement measures to minimize the transfer of mud onto public roads.
- GE-27: Clean Line will minimize compaction of soils and rutting through appropriate use of construction equipment (e.g., low ground pressure equipment and temporary equipment mats).
- LU-1: Clean Line will work with landowners and operators to ensure that access is maintained as needed to existing operations (e.g., to oil/gas wells, private lands, agricultural areas, pastures, hunting leases).
- LU-2: Clean Line will minimize the frequency and duration of road closures.
- LU-3: Clean Line will work with landowners to avoid and minimize impacts to residential landscaping.
- LU-4: Clean Line will coordinate with landowners to site access roads and temporary construction areas to avoid and/or minimize impacts to existing operations and structures.
- LU-5: Clean Line will make reasonable efforts, consistent with design criteria, to accommodate requests from individual landowners to adjust the siting of the ROW on their properties. These adjustments may include consideration of routes along or parallel to existing divisions of land (e.g., agricultural fields and parcel boundaries) and existing compatible linear infrastructure (e.g., roads, transmission lines, and pipelines), with the intent of reducing the impact of the ROW on private properties.
- AG-1: Clean Line will avoid or minimize adverse effects to surface and subsurface irrigation and drainage systems (e.g., tiles). Clean Line will work with landowners to minimize the placement of structures in locations that would interfere with the operation of irrigation systems.

- AG-2: Agricultural soils temporarily impacted by construction, operation, or maintenance activities will be restored to pre-activity conditions. For example, soil remediation efforts may include decompaction, recontouring, liming, tillage, fertilization, or use of other soil amendments.
- AG-3: Clean Line will consult with landowners and/or tenants to identify the location and boundaries of agriculture or conservation reserve lands and to understand the criteria for maintaining the integrity of these committed lands.
- AG-4: Clean Line will work with landowners and/or tenants to identify specialty agricultural crops or lands (e.g., certified organic crops or products that require special practices, techniques, or standards) that may require protection during construction, operation, or maintenance. Clean Line will avoid and/or minimize impacts that could jeopardize standards or certifications that support specialty croplands or farms.
- AG-5: Clean Line will work with landowners and/or tenants to consider potential impacts to current aerial spraying or application (i.e., aerial crop spraying) of herbicides, fungicides, pesticides, and fertilizers within or near the transmission ROW. Clean Line will avoid or minimize impacts to aerial spraying practices when routing and siting the transmission line and related infrastructure.
- AG-6: Clean Line will work with landowners to develop compensation for lost crop value caused by construction and/or maintenance.
- AG-7: Clean Line will work with landowners to develop a site plan for each cropland farm on which construction or maintenance is to be performed.
- GEO-1: Clean Line will stabilize slopes exposed by its activities to minimize erosion.

3.2.6.2 Impacts Associated with the Applicant Proposed Project

This section describes the potential impacts from the Project that would be common to the converter stations, AC interconnection, AC collection system routes, and Applicant Proposed Routes that are all part of the Applicant Proposed Project. Impacts from the construction, operations and maintenance, and decommissioning of the Applicant Proposed Project are discussed separately by Project component.

General Agriculture

Temporary impacts on agriculture productivity during construction could potentially occur as a result of vegetation, and soil disturbance or loss. Impacts to pasture and cultivated crops in the construction area would be temporary and would include the temporary loss of vegetation and soils. Additionally, vegetation would be lost when grading is required and along travel routes, or roads that construction equipment travel on to a construction destination, for construction vehicles and equipment. Additional impacts to soils are provided in Section 3.6.2. Figure 3.2-1a–f in Appendix A depicts agricultural lands that are located within the ROI and ROW.

Direct impacts to agricultural structures, such as barns, ponds, silos, and animal feeding operations, within the representative ROW would be minimal. The number of agricultural structures for each alternative is presented in Section 3.2.6.2.2.1. The Project could limit future expansion of existing structures in the long term since construction of new structures would be prohibited within the Project representative ROW. Potential impacts would occur in Regions 1 through 7.

Impacts to agriculture during operations and maintenance of the Project are expected to be minimal in most areas because the majority of the representative ROW could be used for grazing and cultivated crops, if it is already being used as agricultural land, once construction has been completed. Section 3.2.6.2 discusses the operation and maintenance impacts to agriculture. Maintenance of the Project facilities may occasionally disrupt agricultural activities and production on a localized basis. In addition, the transmission structures may interfere with farming equipment and the transmission lines and poles may interfere with aerial spraying of herbicides, pesticides, fungicides, and fertilizer.

DOE prepared an example construction sequence and timeline to illustrate typical construction activities that could take place on a single parcel of land being used for agricultural operations. This list of activities is provided as Table 3.2-10. Impacts to specific categories of agriculture are discussed below.

Table 3.2-10:
Typical Construction Activities on Agricultural Property

Activity	Access Typically Restricted?	Duration (Days)	Description[1]
ROW Mowing and/or Clearing	Yes	1 to 2	Mowing equipment enters from adjoining parcel and mows portions of the ROW. The area mowed would include an access path down the ROW (approximately 16 to 35 feet wide) and two areas (each 100 feet by 100 feet) for future structure construction pads. Access to the construction area is restricted during mowing operations for safety.
None	No	3 to 14	There is a period of inactivity between mowing and/or clearing (above) and the beginning of surveying and staking (below). This period may be shorter or longer depending on construction schedule.
Survey and Staking	No	15	A survey crew stakes each structure location with wooden lath.
Install Stormwater Protection Measures	No	16	According to state requirements, any stormwater protection measures (e.g., silt fences) are installed. Silt fences would be discontinuous, and would not limit livestock movement. Installation of a silt fence typically requires one or two pickup trucks with trailers, possibly a small excavator, and a small crew of workers.
Drill and Pour Foundations	Partially	17 to 19	Auger equipment drills holes for footings, rebar cages are set, concrete trucks deliver concrete to the pad, stub angles are set, and concrete is poured into holes and mold surrounding stub angles. Access is prohibited in a small area within a protective fence around foundation sites and is periodically restricted around the construction area so that trucks and other equipment can be moved safely.
None (Concrete Curing)	Partially	20 to 22	Access to ROW is not restricted, except for a small area within a protective fence around foundation sites.
Remove Concrete Forms	Partially	23	Access to ROW is not restricted, except for a small area within a protective fence around foundation sites.
None (Concrete Curing)	Partially	24 to 33	Access to ROW is not restricted, except for a small area within a protective fence around foundation sites.
Equipment Setup, Assembly, and Structure Erection	Partially	34 to 41	Structure material is delivered to each structure site with a heavy truck, structure sections are assembled, and sections are lifted by crane and set into place. Access to ROW may be periodically restricted around the construction area so that trucks, cranes, and other equipment can be moved safely.
Insulator Assemblies Fixed To Structure	Partially	42	Insulators and associated hardware are pre-assembled into strings, and the strings are then lifted by crane or lift truck and fixed to tower arms. Access to ROW is periodically restricted around the construction area so that the trucks, cranes, and other equipment can be moved safely.
None	Partially	42 to 86	There is a period of inactivity between the end of insulator installation (above) and the beginning of wire stringing (below). This period may be shorter or longer depending on location and site conditions. During this period, access to the ROW outside the structure pads is unrestricted.
Sock and Pilot Line Threading	Yes	87	A helicopter lifts a light weight sock/pilot line, which is threaded through rollers attached to the insulators. During stringing operations, access to the ROW is restricted for safety.

Table 3.2-10:
Typical Construction Activities on Agricultural Property

Activity	Access Typically Restricted?	Duration (Days)	Description[1]
Conductor Pulling and Tensioning	Yes	88 to 92	Conductor is attached to the end of the sock/pilot and pulled through. Pulling and tensioning equipment (located on other parcels in this example) ensure that the proper clearance and sag is achieved for each span of the conductor. During stringing operations, access to the ROW is restricted for safety.
Clipping In	Yes	93	Conductor is permanently attached ("clipped in") to hardware connection at the end of insulator strings using one to three bucket trucks. Access to ROW is periodically restricted around the construction area so that the trucks and other equipment can be moved safely.
None	No	94 to 122	There is a period of inactivity between the end of clipping in and the start of final restoration activities. This lag could be considerably shorter, depending on season and site conditions.

1 This list of activities is hypothetical and does not represent specific activities that would occur on any specific piece of agricultural land. Assumptions and notes include the following:
a. One-half mile (0.5 mile) of HVDC ROW on parcel.
b. Two tangent structures planned within parcel.
c. No grading required.
d. Access obtained via driving overland through the ROW from adjoining parcels with existing gates.
e. ROW has been previously surveyed and clearing boundaries have been staked.
f. Inspection and monitoring activities during construction may require intermittent access to the ROW between activities identified.
g. Breaks will occur in the construction process and the duration of these breaks may vary from the periods of time identified.

Livestock Grazing

Construction could affect livestock grazing by temporarily reducing forage areas in the representative ROW. Except while access to the ROW is temporarily restricted during construction, operations, and maintenance for safety reasons, livestock would not be displaced or prohibited from grazing in pastures overlapped by the ROW during construction, unless otherwise desired by the landowner. Construction activities during which restrictions to the ROW may occur are identified in the construction sequence and timeline provided in Table 3.2-10. Construction may affect livestock control and distribution if a gate is left open or a fence is damaged, as livestock may not be contained and may escape. Vehicular access during construction would increase the likelihood of livestock injury or death from collisions.

Once the Project has been constructed, livestock would be permitted to graze around Project features. Direct impacts to rangeland could include long-term loss of vegetation from structure foundations and permanent access roads. During Project operations, grazing land occupied by support structures, substations, or access roads would no longer be available for grazing. The acres of lands used for livestock and grazing that would be affected by the Project represent a small share of the total acres used for livestock area within the representative ROW and would result in relatively small temporary and long-term reductions in the area available for grazing within the representative ROW.

Crop Production

Construction would temporarily prevent or reduce crop production in the representative ROW. Potential impacts may extend outside the construction area due to access constraints, impacts to irrigation structures, and/or pesticide or fertilizer application practices. Access constraints could result in a diminished yield in and near the construction area if other methods of irrigation and fertilizer, insecticide, and herbicide application are not practical. Potential economic impacts related to cultivated crop impacts are discussed in Section 3.13.

During Project operations, the physical footprint of structures, substations, and access roads would displace cultivated crops. Tractors, combines, and other mechanized equipment would be required to maneuver around structures and would result in damage or destruction of crops that are growing within or around the structure footprint at the time of construction (see Appendix J). Structures and conductors could limit the aerial application of fertilizer, herbicide, and pesticide and could result in a diminished harvest. Crop production that involves mechanical irrigation, automated farming methods, or farming equipment with large spans (up to 100 feet) could also be adversely affected by the placement of overhead conductors and support structures. Production costs increase where farmers have to divert their equipment around structures, make additional passes, take additional time to maneuver, reconfigure surface drainage, skip acres, or re-treat acres.

In most cases, structures can be located strategically to allow existing pivots to continue to operate without adverse effects and interruption of agricultural activity.

Center-pivot Irrigation

Potential temporary impacts to center-pivot irrigation could occur primarily in Regions 1, 2, 6, and 7. The operation of center-pivot irrigation during construction could be limited in construction areas. Construction equipment at tensioning and pulling sites and structure work areas could prevent the movement of irrigation systems if construction occurs during the growing season, which would prevent portions of the field from being irrigated.

Project operation, schedule maintenance, and unscheduled repairs due to storm damage have the potential to damage crops and agricultural water management systems such as center-pivot irrigation. The Applicant would avoid or minimize adverse effects to surface and subsurface irrigation and drainage systems (e.g., tiles). The Applicant would work with landowners to minimize the placement of structures in locations that would interfere with the operation of irrigation systems (AG-1). Additionally, Project inspections could be performed outside areas of the fields. The Applicant would work with landowners to develop compensation for lost crop value caused by construction and/or maintenance (AG-6) and would work with landowners to develop a site plan for each cropland farm on which construction or maintenance would be performed (AG-7).

The representative 200-foot-wide ROW for the Applicant Proposed Route or HVDC alternative routes would cross agricultural fields that are irrigated by center pivots. Agricultural operations in these areas could be limited in the long term depending on the location of the transmission structures. Project components could prevent portions of fields from being irrigated by blocking the movement of the irrigation system. Direct impacts could potentially occur in Regions 1, 2, 6, and 7. The Applicant would avoid or minimize adverse effects to surface and subsurface irrigation and drainage systems (e.g., tiles). The Applicant would work with landowners to minimize the placement of structures in locations that would interfere with the operation of irrigation systems (AG-1). The resulting dryland area could be measured and the affected parties could be compensated for the decreased productivity that results (see Appendix H).

Flood Irrigation

During construction, access roads, temporary work areas, and other graded areas could temporarily disrupt the slope and flow patterns of water on flood-irrigated fields, such as rice fields in eastern Arkansas. This impact would vary depending on the location of the Project and whether it is located upslope or downslope. Soils within the representative ROW and construction area would be temporarily compacted. Construction activities could temporarily limit access to flood-irrigated fields or impair normal agricultural operations. In some cases, landowners or tenants would need to work around transmission structure construction sites when they are surveying and constructing new levees. In flooded irrigation systems, the landowners or tenants may have to move the levee to avoid the structure, which could result in the levees being out of position (see Appendix J). These direct impacts could result in a diminished yield and, dependent on the timing of construction, a loss of rice-growing opportunity inside and/or outside of the representative ROW.

During operations and maintenance, the Applicant would allow agricultural activities to resume within the ROW. Following completion of construction, the Applicant would return all slopes to preconstruction conditions as part of final reclamation so that flood irrigation can be resumed in areas that may have been previously impacted or disrupted. The presence of transmission line structures in fields would not prohibit the flow of flood water, because water can flow around structure foundations. In furrow-irrigated fields, however, structures may obstruct continuous furrows (when beds are formed, a continuous furrow is created from the top of the field to the bottom) and farmers may be required to do additional work in rows where furrows do not align with equipment. Maneuvering equipment around structures in these areas could interrupt field operations and require more time to till the field. This disruption could have a long-term impact by diminishing crop production in localized areas downhill from the water source.

Global Navigation Satellite Systems

Farming equipment often use Global Navigation Satellite Systems (GNSS) for automated steering, custom geographic seeding and fertilizing and harvest yield mapping. Regarding the issue of GNSS interference from overhead high voltage transmission lines, research performed on the impacts did not reveal a problem for the high-quality receivers used in precision agriculture or agriculture-related aviation. No effect due to transmission line on GNSS measurements was found to impact the quality of the GNSS (Bancroft et al. 2012).

Aerial Crop Spraying

Aerial crop spraying is common in the region where there is agricultural land. Aerial crop spraying is used to apply fertilizer, fungicides, or pesticides during the growing season. Aerial crop spraying is supported by a network of controlled airports and secondary airstrips. Aerial crop spraying can involve dry applications (usually fertilizer) and liquid applications of fungicides and pesticides. The typical aircraft used for aerial application is a fixed single-wing plane, which are typically equipped with digital global positioning systems or other guidance systems. Typically, liquid applications are applied from 8 feet to 12 feet above the target; while dry applications are applied from 45 feet to 70 feet above targeted land (see Appendix H).

The adjacent swath is the most common flight pattern used in crop fields, which involves the use of straight, parallel swaths to apply products in a back and forth pattern. Applicators are accustomed to turning their spray on and off to avoid overlapping or missing spots; they are also accustomed to maneuvering around obstacles in fields (see Appendix H).

Spraying operations occur 24 hours a day, depending on the time of season; nighttime operations occur when bees are pollinating crops during daylight hours. The quantity of farmed land receiving aerial crop spraying in and near the representative ROW is not known. As a result, the following analysis assumes that any dryland or irrigated farmland could receive aerial spraying.

Construction of the transmission line could reduce the area of crops that could be treated by aerial spraying. Transmission structures or construction cranes could interfere with the flight paths of aerial applications. The potential effects would vary, depending on the location of tall structures relative to crop planting patterns, and the presence of other tall structures. Aerial spraying is also sometimes used to control large-scale insect infestations on public and private land. The short-term inability to use aerial spraying could reduce productivity and cause economic effects to farming or rangeland operations. The presence of construction workers could also delay applications.

Once construction has been completed, aerial crop spraying planes could fly at a higher altitude to avoid transmission lines and structures. A common method to maneuver around obstacles in fields is to "trim" the edge of a field by flying perpendicular to the direction the field was flown. Another approach is to stop spraying as the obstacle is approached, turn at 360 degrees, fly over the obstacle, then drop back down and continue spraying. Applicators can fly beneath the lines or wires in cases where transmission lines and other wires are positioned high enough. It may be possible to spray over the top of the obstruction in situations where the transmission lines or wires are low (see Appendix H).

However, this could result in a less precise application of fertilizer, herbicide, and pesticide, and these treatments could spill into adjacent fields. Additionally, impacts associated with aerial application could extend beyond the representative ROW as a result of the need to fly over transmission lines. Although the Applicant has made efforts to site the transmission lines adjacent to existing infrastructure, impacts may still occur in these areas due to structure heights that are taller than existing structure heights and a wider area that aerial applications must avoid.

EPMs that would avoid the impacts to agriculture are discussed in Section 3.2.6.1.

3.2.6.2.1 Converter Stations and AC Interconnection Siting Areas

This section describes the impacts to agriculture from the converter stations on either end of the HVDC transmission line and their associated AC interconnection lines. Impacts from the construction, operations and maintenance, and decommissioning of the various Project components are discussed separately under each subsection. Section 3.13 provides additional information on the socioeconomic agricultural impacts.

3.2.6.2.1.1 Construction Impacts

Direct agricultural impacts during construction would consist of long-term conversion of land for the converter station and temporary conversion of land within the representative ROW for the AC interconnection line. Potential impacts to agriculture from the construction of the Oklahoma and Tennessee converter stations and their associated AC interconnection lines are discussed below. Construction of a single converter station is estimated to take 32 months.

3.2.6.2.1.1.1 Oklahoma Converter Station Siting Area and AC Interconnection Siting Area

The Oklahoma converter station would be located on undeveloped rangeland; approximately 95 percent of the land cover in the siting area is grassland/herbaceous. Construction of the converter station would convert 45 to 60 acres of rangeland to a utility land use. During construction, an additional 5 to 10 acres would be used as temporary laydown areas for equipment. An additional 4.2 acres of rangeland would be converted to access roads (2.4 acres long term, 1.8 acres temporary). Temporary construction areas that would be required outside the representative ROW include fiber optic regeneration sites, multi-use construction yards, and fly yards.

The Oklahoma AC interconnection would be approximately 3 miles long. The agricultural land cover in the representative ROW is currently composed of 58 acres of grasslands. Work in the representative ROW would include assembly of pole structures, wire splicing, and tensioning or pulling sites. A 25-acre multi-use construction yard required for the Oklahoma AC interconnection would be shared with that of the HVDC line.

During construction, assembly areas for the pole structures (either lattice or tubular structures) would be required, as would wire splicing sites and tensioning and pulling sites. Within the 65.5 acre ROW, an assembly area of 150 feet wide by 150 feet long for each structure would be required. Assuming five to seven structures per mile would be required, the assembly areas would take up to 10.7 acres within the ROW. Approximately two wire splicing sites, each 100 feet by 100 feet (0.2 acre) would be used within the ROW during construction.

Approximately four tensioning or pulling sites, 150 feet wide by 600 feet long, also would be required within the ROW, although it is estimated that 1 acre of the total would be located outside the ROW (2.0 acres each, minus 1 acre, for a total of 7 acres).

Tensioning or pulling sites would be located partially outside the ROW at locations where the line turns more than 8 degrees, estimated at 1 acre.

A total of approximately 74 acres would be required for the Oklahoma converter station (including access roads) and approximately 19 acres would be required for the Oklahoma AC interconnection during construction.

Construction may affect livestock control and distribution if a gate is left open or a fence is damaged. Vehicular access during construction would increase the likelihood of livestock injury or death from collisions. Access controls (e.g., cattle guards, fences, gates) would be installed, maintained, repaired, replaced, or restored as required by regulation, road authority, or as agreed to by landowner (GE-8).

3.2.6.2.1.1.2 Tennessee Converter Station Siting Area and AC Interconnection Tie

The land cover in the Tennessee Converter Station Siting Area is approximately 50.7 percent agricultural land cover (30.6 percent pasture/hay and 20.1 percent cultivated crops). No center-pivot irrigation or other irrigation infrastructure is known to occur. Although the exact location has not yet been determined, construction of this converter station would convert 45 to 60 acres of currently undeveloped land to a utility land use. During construction, an additional 5 to 10 acres used as temporary laydown areas for equipment. An additional 4.2 acres of rangeland would be converted to access roads (2.4 acres long term, 1.8 acres temporary).

The Tennessee AC interconnection would be entirely contained within the Tennessee converter station footprint and the Shelby Substation footprint. All tensioning and pulling for ties between the Shelby Substation and Tennessee converter station (if necessary) would be contained within the footprint of both stations. No temporary construction areas are needed, and the multi-use construction yard for the Tennessee AC interconnection would share construction yard space with the Tennessee converter station and would be contained within the footprint of the converter station.

Construction may affect livestock control and distribution if a gate is left open or a fence is damaged. Vehicular access during construction would increase the likelihood of livestock injury or death from collisions. Access controls (e.g., cattle guards, fences, gates) would be installed, maintained, repaired, replaced, or restored as required by regulation, road authority, or as agreed to by landowner (GE-8).

Approximately 74 acres would be required for the Tennessee converter station (including access road) during construction; it is anticipated that any temporary construction areas would be contained within the footprint of the Tennessee Converter Station and the Shelby Substation.

3.2.6.2.1.2 Operations and Maintenance Impacts

Maintenance of the AC interconnection lines would be similar to construction impacts, except maintenance would require shorter work duration and would be at a smaller scale. Maintenance would likely occur on an annual basis and as needed.

3.2.6.2.1.2.1 Oklahoma Converter Station Siting Area and AC Interconnection Siting Area

Once construction has been completed, only the 45- to 60-acre converter station, the AC interconnection pole structures, and a 20-foot-wide paved access road would remain; all other temporary construction areas would be returned to their previous use, primarily rangeland. Approximately 45 acres would be fenced.

Within the AC interconnection ROW (200 feet wide), only the pole structures would remain with a total footprint of up to less than 1 acre. All other land in the ROW could be returned to previous land uses, primarily grazing. Roads not otherwise needed for maintenance and operations would be restored to preconstruction conditions. Restoration practices may include decompacting, recontouring, and re-seeding. Roads needed for maintenance and operations would be retained (GE-7). During operations and maintenance, the extent to which these activities can continue to take place would be outlined in easement agreements and would be determined in cooperation with landowners based on site-specific conditions. For example, limitations on uses within the ROW could include the following:

- A prohibition on placing a building or structure within the ROW
- Restrictions on timber or the height of orchard trees within the ROW
- Restrictions on grading and land re-contouring within the ROW that would change the ground surface elevation within the ROW such that required electrical clearances are no longer maintained
- Restrictions and/or required coordination for the construction of future allowed facilities such as fences and/or irrigation lines within the ROW
- Restricted access for safety considerations where maintenance activities are being performed

Restrictions on land use within the ROW would be determined based on site-specific conditions and/or in coordination with landowners. These are not blanket limitations or restrictions that would apply to every parcel potentially impacted by the Project. The continued use of the ROW for routine agricultural practices such as grading and contouring and construction of ditches would be permitted and would be compatible with reliability criteria for HVDC and AC facilities and would not be restricted. Limitations on land uses would be described in the easement agreement; these limitations could be modified in the easement based on site-specific conditions and/or coordination with landowners.

3.2.6.2.1.2.2 Tennessee Converter Station Siting Area and AC Interconnection Tie

Once construction has been completed, only the 20- to 35-acre converter station, the AC interconnection pole structures, and 20-foot-wide paved access road would remain; all other temporary construction areas would be returned to their previous use, primarily cultivated crops and pasture/hay. Approximately 35 acres would be fenced.

Access would be restricted during the performance of maintenance activities.

3.2.6.2.1.3 Decommissioning Impacts

Potential impacts during decommissioning of the Project would be similar to those of the construction phase for all Project components. Upon completion of decommissioning, all land could be returned to preconstruction land uses described in Section 3.2.5.

3.2.6.2.2 AC Collection System

This section discusses the impacts from the AC collection system. The Applicant Proposed Project consists of 13 AC collection system routes. Of the 13 AC collection system routes, four to six 345kV AC collection transmission lines would be constructed. Each line would extend up to 40 miles from the Oklahoma converter station to points in the Oklahoma and Texas panhandles.

3.2.6.2.2.1 Construction Impacts

Construction of the AC collection system would directly affect livestock grazing by temporarily reducing forage in areas with grassland/herbaceous and pasture land cover. Construction may affect livestock control and distribution if a gate is left open or a fence is damaged. Vehicular access during construction would increase the likelihood of livestock injury or death from collisions. Access controls (e.g., cattle guards, fences, gates) would be installed, maintained, repaired, replaced, or restored as required by regulation, road authority, or as agreed to by landowner (GE-8). The Applicant would conduct construction, operation, and maintenance activities to minimize the creation of dust. This may include measures such as limitations on equipment, speed, and/or travel routes utilized. Water, dust palliative, gravel, combinations of these, or similar control measures may be used. Clean Line would implement measures to minimize the transfer of mud onto public roads (GE-11).

Cultivated crops would be directly affected by removal of vegetation and potential removal of agricultural structures such as irrigation systems, barns, and silos. Agricultural production may be temporarily diminished. The Applicant would avoid or minimize adverse effects to surface and subsurface irrigation and drainage systems (e.g., tiles). The Applicant would work with landowners to minimize the placement of structures in locations that would interfere with the operation of irrigation systems (AG-1).

The duration of construction for the complete AC collection system would be approximately 24 months from mobilization to restoration.

Livestock

Construction and operations and maintenance of the proposed transmission lines could affect the economic value of livestock production in the representative ROW by increasing ranchers' costs and decreasing available forage.

The Project could affect net earnings from livestock production in the following ways:

- Decreased forage from land taken out of production
- Increased management costs associated with controlling additional noxious and invasive vegetation species introduced by Project construction equipment
- Increased management costs associated with moving livestock around Project-related structures and easements if a landowner wishes to move livestock during the construction phase

The value of grazing land that would be affected is further discussed in Section 3.13.

Potential impacts to cultivated crops would vary based on the design and location of the proposed transmission line structures and access roads relative to existing agricultural operations. Section 3.13 further discusses the value of cultivated crops that would be affected.

For each route described below, it is assumed that the entire acreage within the ROW would be temporarily disturbed during construction, although construction would not occur on the entire length of a route at the same time.

3.2.6.2.2.1.1 Route E-1

The representative ROW is approximately 708.0 acres. Approximately 574.2 acres of grassland/herbaceous and 48.8 acres of cultivated crops would be disturbed; no pasture/hay is located within the representative ROW. One agricultural structure is located within the representative ROW.

3.2.6.2.2.1.2 Route E-2

The representative ROW is approximately 974.4 acres. Approximately 572.8 acres of grassland/herbaceous and 298.6 acres of cultivated crops would be disturbed; no pasture/hay is located within the representative ROW. No agricultural structures are present in the representative ROW that would be affected by the construction of AC Collection System Route E-2.

3.2.6.2.2.1.3 Route E-3

The representative ROW is approximately 977.5 acres. Approximately 650.3 acres of grassland/herbaceous and 105.2 acres of cultivated crops would be disturbed; no pasture/hay is located within the representative ROW. Two agricultural structures are present in the representative ROW.

3.2.6.2.2.1.4 Route NE-1

The representative ROW would disturb approximately 729.8 acres. Approximately 291.1 acres of grassland/herbaceous and 247.2 acres of cultivated crops would be disturbed; no pasture/hay is located within the representative ROW. No structures are present in the representative ROW that would be affected by the construction of AC Collection System Route NE-1.

3.2.6.2.2.1.5 Route NE-2

The representative ROW is approximately 637.4 acres. Approximately 450.2 acres of grassland/herbaceous and 50.2 acres of cultivated crops would be disturbed; no pasture/hay is located within the representative ROW. One agricultural structure is present in the representative ROW.

3.2.6.2.2.1.6 Route NW-1

The representative ROW is approximately 1,265.4 acres. Approximately 609.5 acres of grassland/herbaceous and 85.0 acres of cultivated crops would be disturbed; no pasture/hay is located within the representative ROW. One agricultural structure is present in the representative ROW.

3.2.6.2.2.1.7 Route NW-2

The representative ROW is approximately 1,365.0 acres. Approximately 629.3 acres of grassland/herbaceous and 410.9 acres of cultivated crops would be disturbed; no pasture/hay is located within the representative ROW. There are no existing agricultural structures in the representative ROW that would be affected by the construction of AC Collection System Route NW-2.

3.2.6.2.2.1.8 Route SE-1

The representative ROW is approximately 979.4 acres. Approximately 513.2 acres of grassland/herbaceous and 340.0 acres of cultivated crops would be disturbed; no pasture/hay is located within the representative ROW. No agricultural structures are present in the representative ROW that would be affected by the construction of AC Collection System Route SE-1.

3.2.6.2.2.1.9 Route SE-2

The representative ROW is approximately 325.4 acres. Approximately 169.9 acres of grassland/herbaceous and 130.6 acres of cultivated crops would be disturbed; no pasture/hay is located within the representative ROW. No agricultural structures are present in the representative ROW that would be affected by the construction of AC Collection System Route SE-2.

3.2.6.2.2.1.10 Route SE-3

The representative ROW is approximately 1,193.6 acres. Approximately 565.7 acres of grassland/herbaceous and 483.9 acres of cultivated crops would be disturbed; no pasture/hay is located within the representative ROW. No agricultural structures are present in the representative ROW that would be affected by the construction of AC Collection System Route SE-3.

3.2.6.2.2.1.11 Route SW-1

The representative ROW is approximately 325.6 acres. Approximately 312.8 acres of grassland/herbaceous would be disturbed; no cultivated crops or pasture/hay lands are located within the representative ROW. No agricultural structures are present in the representative ROW that would be affected by the construction of AC Collection System Route SW-1.

3.2.6.2.2.1.12 Route SW-2

The representative ROW is approximately 901.4 acres. Approximately 733.0 acres of grassland/herbaceous and 33.6 acres of cultivated crops would be disturbed; no pasture/hay located within the representative ROW. No agricultural structures are present in the representative ROW that would be affected by the construction of AC Collection System Route SW-2.

3.2.6.2.2.1.13 Route W-1

The representative ROW is approximately 507.8 acres. Approximately 377.0 acres of grassland/herbaceous and 47.2 acres of cultivated crops would be disturbed; no pasture/hay is located within the representative ROW. One agricultural structure is present in the representative ROW.

3.2.6.2.2.2 Operations and Maintenance Impacts

The long-term impacts by segment are discussed below for pole structures and are summarized in Table 3.10-22. No impacts are described for access roads, because the location of access roads has not yet been determined. Because the locations of access roads to the AC collection system are not known at this time, it is possible that the access roads could be located in such a way that small areas of agricultural land would be isolated and no longer practicable to be used for farmland or grazing.

Livestock

Construction and operations and maintenance of the proposed transmission lines could affect the economic value of livestock production in the ROW by increasing ranchers' costs and decreasing available forage. The Project could affect net earnings from livestock production in the following ways:

- Decrease forage from land taken out of production
- Increase management costs associated with controlling additional noxious and invasive vegetation species introduced by Project construction equipment
- Increase management costs associated with moving livestock around Project-related structures and easements if a landowner wishes to move livestock during the construction period

The value of grazing land that would be affected is further discussed in Section 3.13.

Most agricultural activities such as livestock grazing and cultivating crops could be returned to the ROW upon the completion of construction. During operations and maintenance, the extent to which these activities can continue to take place would be outlined in easement agreements and would be determined in cooperation with landowners based on site-specific conditions. For example, limitations on uses within the ROW could include the following:

- A prohibition on placing a building or structure within the ROW
- Restrictions on timber or the height of orchard trees within the ROW
- Restrictions on grading and land re-contouring within the ROW that would change the ground surface elevation within the ROW such that required electrical clearances are no longer maintained
- Restrictions and/or required coordination for the construction of future allowed facilities such as fences and/or irrigation lines within the ROW
- Restricted access for safety considerations during performance where maintenance activities are being performed

Restrictions on land use within the ROW would be determined based on site-specific conditions and/or in coordination with landowners. These are not blanket limitations or restrictions that would apply to every parcel potentially impacted by the Project. The continued use of the ROW for routine agricultural practices such as grading and contouring and construction of ditches would be permitted and would be compatible with reliability criteria for HVDC and AC facilities and would not be restricted. Limitations on land uses would be described in the easement agreement; these limitations could be modified in the easement based on site-specific conditions and/or coordination with landowners.

The long-term disturbance in the ROW is primarily grassland/herbaceous for all the routes except for AC Collection System Route NW-1. Approximately 75 percent of the ROW for AC Collection System Route NW-1 is grassland/herbaceous.

3.2.6.2.2.3 Decommissioning Impacts

Potential impacts during decommissioning of the Project would be similar to those of the construction phase for all Project components. Once decommissioning has been completed, all land could be returned to the preconstruction land uses described in Sections 3.2.4 and 3.2.5.

3.2.6.2.3 HVDC Applicant Proposed Route

This section discusses the potential impacts to agriculture of the approximate 720-mile-long transmission facility during the three phases of the Project: construction, operations and maintenance, and decommissioning. Specific EPMs developed to avoid land use impacts are described in Section 3.2.6.2.1 and are referenced in the discussion below in parentheses.

3.2.6.2.3.1 Construction Impacts

The majority of the impacts to agriculture would be temporary. Construction would prevent the uses of pasture/hay land and cultivated crops in the representative ROW as identified in Table 3.2-10, which outlines the typical construction sequence that would occur on agricultural property. Except while access to the ROW is temporarily restricted during construction for safety reasons, livestock would not be displaced or prohibited from grazing in pastures overlapped by the ROW during construction unless otherwise desired by the landowner. Construction activities, during which restrictions to the ROW may occur, are identified in the construction sequence and timeline provided in Table 3.2-10. Construction may affect livestock control and distribution if a gate is left open or a fence is damaged. Vehicular access during construction would increase the likelihood of livestock injury or death from collisions. Access controls (e.g., cattle guards, fences, gates) would be installed, maintained, repaired, replaced, or restored as required by regulation, road authority, or as agreed to by landowner (GE-8). The Applicant would make reasonable efforts, consistent with design criteria, to accommodate requests from individual landowners to adjust the siting of the ROW on their properties. These adjustments may include consideration of routes along or parallel to existing divisions of land (e.g., agricultural fields and parcel boundaries) and existing compatible linear infrastructure (e.g., roads, transmission lines, and oil and gas pipelines), with the intent of reducing the impact of the ROW on private properties (LU-5). Additionally, the Applicant would work with landowners to develop a site plan for each cropland farm on which construction or maintenance is to be performed (AG-7).

During construction, croplands would be directly affected by removal of vegetation and agricultural structures such as irrigation systems, barns, and silos. Agricultural production may be temporarily diminished. The Applicant would work with landowners to repair damage caused by construction, operation, or maintenance activities of the Project. Repairs would take place in a timely manner, weather and landowner permitting (GE-10). The Applicant would work with landowners to develop compensation for lost crop value caused by construction and/or maintenance (AG-6). In cases where agricultural structures are located within the representative ROW, the Applicant would work with landowners to microsite the location of transmission structures to avoid impacts to or relocation of these structures.

The duration of construction is expected to be approximately 36 to 42 months for the entire Project, although the duration of construction for a single HVDC segment is anticipated to be approximately 24 months from mobilization to restoration.

Impacts by region are discussed below. For each region described below, it is assumed that the entire acreage within the representative ROW would be temporarily disturbed during construction, although construction would not occur on the entire length of the representative ROW at the same time. EPMs AG-6, GE-10, and LU-4 would help to avoid or minimize impacts in each region described below.

3.2.6.2.3.1.1 Region 1

Approximately 1,742.3 acres of grassland/herbaceous and 748.8 acres of cultivated crops would be disturbed; no pasture/hay land is located within the representative ROW. One agricultural structure is present in the representative ROW of Applicant Proposed Route Link 4.

Outside the representative ROW, tensioning or pulling areas totaling approximately 100.8 acres would be required during construction. The land cover in these areas is primarily grassland/herbaceous land cover and cultivated crops.

No route variations were proposed in Region 1.

3.2.6.2.3.1.2 Region 2

Approximately 1,299.9 acres of grassland/herbaceous and 788.0 acres of cultivated crops would be disturbed; no pasture/hay land is located within the representative ROW. Two agricultural structures are present in the representative ROW of Applicant Proposed Route Link 3 that may need to be removed so that the transmission line could be built. The representative ROW would be temporarily unavailable during construction at this location.

Outside the representative ROW, tensioning or pulling areas totaling approximately 99.0 acres would be required during construction. The predominant land cover types are grassland/herbaceous and cultivated crops.

Two route variations to the Applicant Proposed Route were developed in Region 2 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.2. Link 1, Variation 1, was developed to reduce impacts to cultivated fields and structures. The variation would cross a greater acreage of agricultural land cover when compared to the original Applicant Proposed Route Link 1.

Link 2, Variation 2, would run closer to the quarter-section line that parallels parcel boundaries and would cross approximately the same acreage of agricultural land cover when compared to the original Applicant Proposed Route Link 1.

3.2.6.2.3.1.3 Region 3

Approximately 1,339.5 acres of grassland/herbaceous, 941.3 acres of pasture/hay lands, and 312.6 acres of cultivated crops would be disturbed.

Five agricultural structures (one in Link 1, one in Link 2, two in Link 4, and one in Link 6) are present in the representative ROW.

Outside the representative ROW, tensioning or pulling areas totaling approximately 379 acres would be required during construction. The predominant land cover in these areas is grassland/herbaceous.

Five route variations to the Applicant Proposed Route were developed in Region 3 in response to public comments on the Draft EIS. Link 1, Variation 2, would cross approximately the same acreage of agricultural land cover. This variation would reduce impacts to agricultural operations by avoiding the landowner's no-till cultivated cropland.

Links 1 and 2, Variation 1, would parallel parcel boundaries and would cross slightly more agricultural land cover when compared with the original Applicant Proposed Route Links 1 and 2. A route adjustment, HVDC Alternative Route 3-A, was created to maintain an end-to-end route with this variation.

Link 4, Variation 1, was identified to avoid impacts to a quarry operation and would cross slightly more agricultural land cover when compared to the original Applicant Proposed Route Link 4.

Route Link 4, Variation 2, was identified to reduce interference with a barn, cattle pens, and residence as identified by the requesting landowner. The route variation would cross less agricultural land cover when compared to the original Applicant Proposed Route Link 4.

Link 5, Variation 2, was identified to avoid a residence and would parallel a greater length of existing infrastructure. The representative ROW for this variation would cross approximately 10 fewer acres of agricultural land cover when compared to the original Applicant Proposed Route Link 5.

3.2.6.2.3.1.4 Region 4

Approximately 1,436.1 acres of pasture/hay lands, 77.5 acres of grassland/herbaceous, and 63.9 acres of cultivated crops would be disturbed. Four agricultural structures are present in the representative ROW of Applicant Proposed Route Links 6, 7, and 9 (one in Link 6, one in Link 7, and two in Link 9).

The Lee Creek Variation is 3.4 miles long. No portion of the route is parallel to existing infrastructure. The agricultural land cover in the 200-foot-wide representative ROW is 5.8 percent grassland/herbaceous.

Outside the representative ROW, tensioning or pulling areas totaling approximately 483 acres would be required during construction. The predominant land cover in these areas is pasture/hay. One agricultural structure is present in these areas. The tensioning and pulling areas would be temporarily impacted as identified in Table 3.2-10.

Seven route variations to the Applicant Proposed Route were developed in Region 4 in response to public comments on the Draft EIS.

Link 3, Variation 1, would parallel parcel boundaries and increase the distance from residences and a cemetery. The variation would cross approximately the same acreage of agricultural land cover when compared with the original Applicant Proposed Route Link 3.

Link 3, Variation 2, would avoid two airstrips, a residence, and an agri-tourism business operation while increasing the length parallel to existing infrastructure and follow existing parcel boundaries. The representative ROW of this variation would cross approximately 35 fewer acres of agricultural land cover when compared with the original Applicant Proposed Route Link 3.

Link 3, Variation 3, would cross fewer parcels, more closely follow parcel boundaries, and avoid potential impacts to known locations of protected bat species. The representative ROW of this variation would cross approximately 20 more acres of agricultural land cover when compared with the original Applicant Proposed Route Link 3.

Link 6, Variation 1, was identified to parallel parcel boundaries and to avoid existing residences in proximity to the variation. The representative ROW of this variation would cross approximately the same acreage of agricultural land cover when compared with the original Applicant Proposed Route Link 6.

Link 6, Variation 2, was identified to avoid a WRP easement and would cross approximately the same acreage of agricultural land cover when compared with the original Applicant Proposed Route Link 6.

Link 6, Variation 3, would increase the length parallel to existing infrastructure and minimize engineering constraints due to complex terrain. The representative ROW of this variation would cross approximately 2 fewer acres of agricultural land cover when compared with the original Applicant Proposed Route Link 6.

Link 9, Variation 1, would increase the distance from a residence and campground while maintaining the length parallel to existing infrastructure and minimize engineering constraints due to complex terrain. The representative ROW of this variation would cross approximately 4 additional acres of agricultural land cover when compared with the original Applicant Proposed Route Link 9.

3.2.6.2.3.1.5 Region 5

Approximately 773.4 acres of pasture/hay land, 149.3 acres of cultivated crops, and 78.5 acres of grassland/herbaceous would be disturbed. One agricultural structure is present in the representative ROW of Applicant Proposed Route Link 2.

Outside the representative ROW, tensioning or pulling areas totaling approximately 291acres would be required during construction. The land cover in these areas is primarily pasture/hay and deciduous forest.

Five route variations to the Applicant Proposed Route were developed in Region 5 in response to public comments on the Draft EIS.

Link 1, Variation 2, would decrease the number of parcels crossed and would avoid a recently constructed residence. The representative ROW for this variation would cross approximately the same acreage of agricultural land cover when compared with the original Applicant Proposed Route Link 1.

Link 2, Variation 2, was identified to reduce impacts to a commercial forestry operation. The representative ROW for this variation would cross approximately 2 additional acres of agricultural land cover when compared with the original Applicant Proposed Route Link 2.

Links 2 and 3, Variation 1, would increase the distance from a home not previously identified during route development and would reduce the number of landowners affected; it should be noted that a route adjustment was made for HVDC Alternative Route 5-B to maintain an end-to-end route with this variation. The representative ROW for this variation would cross approximately 4 additional acres of agricultural land cover when compared with the original Applicant Proposed Route Links 2 and 3.

Links 3 and 4, Variation 2, more closely parallels parcel boundaries while avoiding parcels with conservation easements and the location of a homestead structure. The representative ROW for this variation would cross approximately 4 additional acres of agricultural land cover when compared with the original Applicant Proposed Route Links 3 and 4. It should be noted that a route adjustment was made for HVDC Alternative Route 5-E to maintain an end-to-end route with this variation.

Link 7, Variation 1, would parallel parcel boundaries and would avoid a recently constructed residence. The representative ROW for this variation would cross approximately 3 additional acres of agricultural land cover when compared to the original Applicant Proposed Route Link 7.

3.2.6.2.3.1.6 Region 6

Approximately 1,060.0 acres or 79.9 percent of agricultural land (1,056.5 acres of cultivated crops, 3.1 acres of pasture/hay lands, and 0.5 acre of grassland/herbaceous) would be disturbed. The representative ROW of Link 7 includes a parcel of land enrolled in the WRP totaling approximately 0.3 acre. Five agricultural structures are present in the representative ROW of Applicant Proposed Route Links 4 and 6 (one in Link 4 and four in Link 6).

Outside the representative ROW, tensioning or pulling areas totaling approximately 115.6 acres would be required during construction. The land cover in these areas is primarily cultivated crops.

One route variation to the Applicant Proposed Route was developed in Region 6 in response to public comments on the Draft EIS. Applicant Proposed Route Link 2, Variation 1, was identified to reduce potential interference with aerial application and a water well used for crop irrigation and would parallel more parcel boundaries when compared with the original Applicant Proposed Route Link 2. The representative ROW for this variation would cross approximately 15 additional acres of agricultural land when compared with the original Applicant Proposed Route Link 2. It should be noted that a route adjustment was made for HVDC Alternative Route 6-A to maintain an end-to-end route with this variation.

3.2.6.2.3.1.7 Region 7

Approximately 729.5 acres or 69.8 percent of agricultural land (691.8 acres of cultivated crops and 36.1 acres of pasture/hay) would be disturbed; there are 1.5 acres of grassland/herbaceous in the representative ROW. The representative ROW of Link 1 includes a parcel of land enrolled in the WRP totaling approximately 2 acres. Two agricultural structures are present in the representative ROW of Applicant Proposed Route Link 5.

Outside the representative ROW, tensioning or pulling areas totaling approximately 162.4 acres would be required during construction. The land cover in these areas is primarily cultivated crops.

Three route variations to the Applicant Proposed Route were developed in Region 7 in response to public comments on the Draft EIS.

Link 1, Variation 1, was developed to reduce interference with crop irrigation and aerial application and would parallel more parcel boundaries when compared with the original Applicant Proposed Route Link 1. The representative ROW for this variation would cross approximately 5 additional acres of agricultural land cover when compared with the original Applicant Proposed Route Link 1.

Link 1, Variation 2, would cross fewer parcels and also follow parcel boundaries more closely to avoid impacts to agricultural operations, including center pivot irrigation, a precision-leveled field, and aerial application to these fields. The representative ROW for this variation would cross approximately the same acreage of agricultural land cover when compared with the original Applicant Proposed Route Link 1.

Link 5, Variation 1 was identified to avoid a proposed new home site and addresses landowner concerns about planned residential development. The variation does not result in a change of the Applicant Proposed Route 1,000-foot-wide corridor analyzed in the Draft EIS. This variation would cross approximately 1.3 acres fewer acres of pasture/hay and would cross approximately 1.2 more acres of cultivated crops when compared with the original Applicant Proposed Route Link 5.

3.2.6.2.3.2 Operations and Maintenance Impacts

Once construction has been completed, only the transmission structures, fiber optic regeneration sites, and access roads would remain. Most of the land in the ROW could be returned to previous land uses, primarily agriculture (grazing and crops). Because the locations of access roads for the HVDC transmission line are not known at this time, it is possible that the access roads could be located in such a way that small areas of agricultural land would be isolated and no longer practicable to be used for farmland or grazing.

During operations and maintenance, the extent to which these activities can continue to take place would be outlined in easement agreements and would be determined in cooperation with landowners based on site-specific conditions. For example, limitations on uses within the ROW could include the following:

- A prohibition on placing a building or structure within the ROW
- Restrictions on timber or the height of orchard trees within the ROW
- Restrictions on grading and land re-contouring within the ROW that would change the ground surface elevation within the ROW such that required electrical clearances are no longer maintained
- Restrictions and/or required coordination for the construction of future allowed facilities such as fences and/or irrigation lines within the ROW
- Restricted access for safety considerations during performance where maintenance activities are being performed

Restrictions on land use within the ROW would be determined based on site-specific conditions and/or in coordination with landowners. These are not blanket limitations or restrictions that would apply to every parcel potentially impacted by the Project. The continued use of the ROW for routine agricultural practices such as grading and contouring and construction of ditches would be permitted and would be compatible with reliability criteria for HVDC and AC facilities and would not be restricted. Limitations on land uses would be described in the easement agreement; these limitations could be modified in the easement based on site-specific conditions and/or coordination with landowners.

Livestock grazing and cultivating crops are compatible with the operations and maintenance of the Project, although there may be occasional disturbances during maintenance, which are expected to be minimal and localized in nature. Pole structures may interfere with farming equipment and aerial crop spraying, which may reduce crop yields.

The long-term impacts by region are summarized in Table 3.10-22 for pole structures. It is anticipated that all existing roads (including existing roads with repairs/improvements) would be retained for operations and maintenance of the Project. It is estimated that approximately 75 percent of the new overland roads with no improvements, 90 percent of the new overland roads with clearing, and new bladed roads would be retained for operations and maintenance access. These roads would be up to 20 feet wide and would total an estimated 1,851 acres. Access roads that are not needed for operations and maintenance of the Project would be restored (GE-7). Because the type of pole structure that would be used has not yet been determined, the impact calculations assumed lattice structures would be used for a conservative estimate of impacts. The operational footprint would be five to seven structures per mile, each measuring 28 feet by 28 feet (less than 0.02 acre). Assuming 720 miles of lattice structures were constructed, the operational footprint would be 86 acres.

Operation and maintenance impacts would not irreversibly convert prime farmland to non-agricultural uses in the representative ROW.

3.2.6.2.3.3 Decommissioning Impacts

Potential impacts during decommissioning of the Project would be similar to those of the construction phase for all Project components. Once decommissioning has been completed, all land could be returned to the preconstruction land uses described in Sections 3.2.4 and 3.2.5.

3.2.6.3 Impacts Associated with the DOE Action Alternatives

3.2.6.3.1 Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area

3.2.6.3.1.1 Construction Impacts

The land cover in the Arkansas Converter Station Alternative Siting Area is composed of approximately 96.0 acres (26.7 percent) pasture/hay and approximately 16.0 acres (4.5 percent) grassland/herbaceous land cover.

The Arkansas AC interconnection would be approximately 5 miles long, and during construction, approximately 146.5 acres of currently primarily pasture/hay land cover would be temporarily converted to an industrial use.

Construction of the converter station and AC interconnection would directly affect livestock grazing by temporarily reducing forage in up to approximately 661.6 acres of land. A 25- to 35-acre site for a new substation where the alternative AC transmission line would interconnect with an existing 500kV transmission line would be required, and an additional 5 acres would be temporarily required during the construction phase. This substation would be located near an existing transmission line in an area that is primarily grassland.

If any crop land is in the construction area, crops grown in these areas would be lost and crops in adjacent areas may have reduced yields if there are disturbances to irrigation structures or in aerial spraying. The Applicant would avoid or minimize adverse effects to surface and subsurface irrigation and drainage systems (e.g., tiles). The Applicant would work with landowners to minimize the placement of structures in locations that would interfere with the operation of irrigation systems (AG-1). The Applicant would work with landowners and/or tenants to consider potential impacts to current aerial spraying or application (i.e., aerial crop spraying) of herbicides, fungicides, pesticides, and fertilizers within or near the transmission ROW. The Applicant would avoid or minimize impacts to aerial spraying practices when routing and siting the transmission line and related infrastructure (AG-5). The

Applicant would conduct construction, operation, and maintenance activities to minimize the creation of dust. This may include measures such as limitations on equipment, speed, and/or travel routes utilized. Water, dust palliative, gravel, combinations of these, or similar control measures may be used. The Applicant would implement measures to minimize the transfer of mud onto public roads (GE-11). Construction may affect livestock control and distribution if a gate is left open or a fence is damaged. Vehicular access during construction would increase the likelihood of livestock injury or death from collisions. Access controls (e.g., cattle guards, fences, gates) would be installed, maintained, repaired, replaced, or restored as required by regulation, road authority, or as agreed to by landowner (GE-8). Additionally, the Applicant would work with landowners to develop a site plan for each cropland farm on which construction or maintenance is to be performed (AG-7).

3.2.6.3.1.2 Operations and Maintenance Impacts

Once construction has been completed, only the 20- to 35-acre converter station and 20-foot-wide paved access road would remain; all other temporary construction areas would be returned to their previous use, primarily rangeland. Approximately 35 acres would be fenced. The 25- to 35-acre substation where the alternative AC transmission line would interconnect with the existing 500kV transmission line would also remain as a utility use. Although most of this land is not currently used for agricultural purposes, up to 72.2 percent is used as pasture/hay and 0.3 percent is grassland/herbaceous. If any of these lands are used for long-term structures, they would be removed from agricultural use until decommissioning.

Within the Arkansas AC interconnection (150–200 feet wide by 5 miles long), only the pole structures and most access roads would remain. Roads not otherwise needed for maintenance and operations would be restored to preconstruction conditions. Restoration practices may include decompacting, recontouring, and re-seeding. Roads needed for maintenance and operations would be retained. (GE-7). All other land in the ROW could be returned to previous land uses, except that only low-growing vegetation would be permitted in the ROW. Short trees (up to 25 feet in height at maturity) would be permitted adjacent to the representative ROW.

During operations and maintenance, the extent to which these activities can continue to take place would be outlined in easement agreements and would be determined in cooperation with landowners based on site-specific conditions. For example, limitations on uses within the ROW could include the following:

- A prohibition on placing a building or structure within the ROW
- Restrictions on timber or the height of orchard trees within the ROW
- Restrictions on grading and land re-contouring within the ROW that would change the ground surface elevation within the ROW such that required electrical clearances are no longer maintained
- Restrictions and/or required coordination for the construction of future allowed facilities such as fences and/or irrigation lines within the ROW
- Restricted access for safety considerations during performance where maintenance activities are being performed

Restrictions on land use within the ROW would be determined based on site-specific conditions and/or in coordination with landowners. These are not blanket limitations or restrictions that would apply to every parcel potentially impacted by the Project. The continued use of the ROW for routine agricultural practices such as grading and contouring and construction of ditches would be permitted and would be compatible with reliability criteria for HVDC and AC facilities and would not be restricted. Limitations on land uses would be described in the easement agreement; these limitations could be modified in the easement based on site-specific conditions and/or coordination with landowners.

Because 72.2 percent of the Arkansas AC interconnection ROW is composed of pasture/hay land, it is anticipated that most of this land could be returned to pasture/hay during operations because it is a compatible use. Maintenance activities would have minimal impacts on the use of pasture/hay lands. Because the locations of access roads to the converter station are not known at this time, it is possible that the access roads could be located in such a way that small areas of agricultural land would be isolated and no longer practicable to be used for grazing.

3.2.6.3.1.3 Decommissioning Impacts

Potential impacts during decommissioning of the Project would be similar to those of the construction phase for all Project components. Once decommissioning has been completed, all land could be returned to the preconstruction land uses described in Sections 3.2.4 and 3.2.5.

3.2.6.3.2 HVDC Alternative Routes

This section discusses the potential impacts to agriculture within the 200-foot-wide representative ROWs of the HVDC alternative routes during the construction, operations and maintenance, and decommissioning phases of the Project.

3.2.6.3.2.1 Construction Impacts

The types of construction impacts would be similar to those discussed for the Applicant Proposed Route (Section 3.2.6.2.3). The majority of the impacts to agriculture would be temporary. Construction would prevent the use of rangeland and cultivated crops in the representative ROW. Construction of the transmission line would directly affect livestock grazing by temporarily reducing forage for livestock from grassland/herbaceous and pasture/hay. Temporary work areas that would be required outside the representative ROW include fiber optic regeneration sites, multi-use construction yards, and fly yards. Construction may affect livestock control and distribution if a gate is left open or a fence is damaged. Vehicular access during construction would increase the likelihood of livestock injury or death from collisions.

Cultivated crops would be directly affected by removal of vegetation and agricultural structures such as irrigation systems, barns, and silos. The Applicant would work with landowners to repair damage caused by construction, operation, or maintenance activities of the Project. Repairs would take place in a timely manner, weather and landowner permitting (GE-10). The Applicant would work with landowners to develop compensation for lost crop value caused by construction and/or maintenance (AG-6) and would work with landowners to develop a site plan for each cropland farm on which construction or maintenance is to be performed (AG-7). Agricultural production may be temporarily diminished.

Impacts by region are discussed below. For each alternative route described below, it is assumed that the entire acreage within the representative ROW would be temporarily disturbed during construction, although construction would not occur on the entire length of the representative ROW at the same time.

3.2.6.3.2.1.1 Region 1

3.2.6.3.2.1.1.1 Alternative Route 1-A

HVDC Alternative Route 1-A is approximately 123 miles long and corresponds to Applicant Proposed Route Links 2, 3, 4, and 5. If this route is selected, 3,003.1 acres would be removed from existing uses, of which 2,554.3 acres (85.0 percent) are agricultural lands (grassland/herbaceous and cultivated crops). HVDC Alternative Route 1-A has a comparable percentage of agricultural land when compared to Links 2 through 5 (2,450.9 acres and 88 percent. Thirteen agricultural structures are located within the representative ROW for HVDC Alternative Route 1-A. One agricultural structure is present in the representative ROW of the original Applicant Proposed Route.

Outside the representative ROW, tensioning or pulling areas totaling approximately 165.1 acres of primarily grassland/herbaceous would be required during construction.

3.2.6.3.2.1.1.2 Alternative Route 1-B

HVDC Alternative Route 1-B is approximately 52 miles long and corresponds to Applicant Proposed Route Links 2 and 3. If this route is selected, 1,268.4 acres would be removed from existing uses. Of the 1,268.4 acres, approximately 1009.1 acres (79.6 percent) are agricultural land that consists of grassland/herbaceous and cultivated crops. HVDC Alternative Route 1-B has less agricultural land than Links 2 and 3 (1,139.6 acres and 86.6 percent). One agricultural structure is present in the ROW; conversely, no structures are present in Applicant Proposed Route Links 2 and 3.

Outside the representative ROW, tensioning or pulling areas totaling approximately 46.2 acres would be required during construction. The predominant land cover in these areas is grassland/herbaceous. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 1-B.

3.2.6.3.2.1.1.3 Alternative Route 1-C

HVDC Alternative Route 1-C is approximately 52 miles long and corresponds to Applicant Proposed Route Links 2, and 3. If this route is selected, approximately 1,039.1 acres of agricultural land (grassland/herbaceous and cultivated crops) would be removed from existing uses in the representative ROW. HVDC Alternative Route 1-C has a smaller percentage of agricultural land (1,039.1 acres, or 83 percent) than the Applicant Proposed Route Links 2 and Link 3 (1,139.6 acres, or 86.6 percent). Seven agricultural structures are present in the ROW; conversely, no agricultural structures are present in Applicant Proposed Route Links 2 and 3.

Outside the representative ROW, tensioning or pulling areas totaling approximately 60 acres would be required during construction. Approximately 35.8 acres of grassland/herbaceous and 8.3 acres of cultivated crops would be required during construction. The predominant land cover is grassland/herbaceous. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 1-C.

3.2.6.3.2.1.1.4 Alternative Route 1-D

HVDC Alternative Route 1-D is approximately 33.5 miles long and corresponds to Applicant Proposed Route Links 3 and 4. If this route is selected, 819.2 acres would be removed from existing uses. Of the 819.2 acres, approximately 568.9 acres of grassland/herbaceous and 113.2 acres of cultivated crops would be removed from existing uses; no pasture/hay land is present in the representative ROW. Approximately 682.1 acres (83.2 percent) of agricultural land cover are present within the ROW. HVDC Alternative Route 1-D contains a smaller percentage of agricultural land compared to Links 3 and 4 (82.8 acres or 92.8 percent). Five agricultural structures are located in the representative ROW; conversely, one agricultural structure is located in the Applicant Proposed Route Link 4.

Outside the representative ROW, tensioning or pulling areas totaling approximately 28.5 acres, approximately 18.0 acres of which are grassland/herbaceous, would be required during construction. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 1-D.

3.2.6.3.2.1.2 Region 2

Table 3.10-24 presents the land cover in the ROW for each of the two HVDC alternative routes in Region 2. Each alternative route is discussed in more detail below.

3.2.6.3.2.1.2.1 Alternative Route 2-A

HVDC Alternative Route 2-A is approximately 57 miles long and corresponds to Applicant Proposed Route Link 2. If this route is selected, approximately 1,396.3 acres would be removed from existing uses. Of the 1,396.3 acres, HVDC Alternative Route 2-A would disturb approximately 1,147.7 acres (82.2 percent) of agricultural land (grassland/herbaceous, cultivated crops, and pasture/hay land). HVDC Alternative Route 2-A contains a greater percentage of agricultural land compared to Link 2 (77.0 percent). Three agricultural structures are located within ROW; conversely, no agricultural structures are present in Link 2.

Outside the representative ROW, tensioning or pulling areas totaling approximately 83.9 acres of primarily grassland/herbaceous and cultivated crops would be required during construction. The predominant land cover is grassland/herbaceous followed by cultivated crops. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 2-A.

3.2.6.3.2.1.2.2 Alternative Route 2-B

HVDC Alternative Route 2-B is approximately 30 miles long and corresponds to Applicant Proposed Route Link 3.If HVDC Alternative Route 2-B is selected, approximately 727.7 acres would be removed from existing uses. Of the 727.7 acres to be removed, approximately 680.3 acres (93.5 percent) are agricultural land (cultivated crops grassland/herbaceous)—more agricultural land than Applicant Proposed Route Link 3. No pasture/hay land is present in the representative ROW. No agricultural structures are present in the representative ROW. Two agricultural structures are present in the Applicant Proposed Route Link 3.

Outside the representative ROW, tensioning or pulling areas totaling approximately 31.2 acres of primarily cultivated crops would be required during construction. The predominant land cover is cultivated crops and no structures are present.

3.2.6.3.2.1.3 Region 3

Table 3.10-25 presents the land cover in the ROW for each of the five HVDC alternative routes in Region 3. Each alternative route is discussed in more detail below.

3.2.6.3.2.1.3.1 Alternative Route 3-A

HVDC Alternative Route 3-A is approximately 38 miles long and corresponds to Applicant Proposed Route Link 1. If this route is selected, 919.1 acres would be removed from existing uses. Of the 919.1 acres to be removed, approximately 497.3 acres of grassland/herbaceous and 150.4 acres of cultivated crops and 5.1 acres of pasture/hay would be disturbed.

The agricultural land cover within the ROW for HVDC Alternative Route 3-A is approximately 71.1 percent (652.8 acres), comparable to the agricultural land cover of HVDC Applicant Proposed Route Link 1. One agricultural structure is present in the representative ROW and one agricultural structure is present within Applicant Proposed Route Link 1.

Outside the representative ROW, tensioning or pulling areas totaling approximately 39.6 acres of primarily grassland/herbaceous would be required during construction. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 3-A.

As described in Appendix M and summarized in Section 2.4.2.3, a route adjustment was developed for HVDC Alternative Route 3-A to maintain an end-to-end route with Applicant Proposed Route Link 1, Variation 2, and Links 1 and 2, Variation 1. The route adjustment parallels more parcel boundaries and crosses 4 fewer acres of agricultural land cover when compared with the original HVDC Alternative Route 3-A.

3.2.6.3.2.1.3.2 Alternative Route 3-B

HVDC Alternative Route 3-B is approximately 48 miles long and corresponds to Applicant Proposed Route Links 1, 2, and 3. For HVDC Alternative Route 3-B, 1,166.6 acres would be removed from existing uses.

The agricultural land cover within the HVDC Alternative Route 3-B representative ROW is approximately 73.3 percent agricultural land (cultivated crops, grassland/herbaceous, and pasture/hay), and contains a larger percentage of agricultural land than Links 1 through 3 (69.0 percent). Two agricultural structures are present in the representative ROW. Two agricultural structures are located within the Applicant Proposed Route Links 1, 2, and 3.

Outside the representative ROW, tensioning or pulling areas totaling approximately 84.9 acres agricultural land (primarily grassland/herbaceous) would be required during construction. No agricultural structures are located within the tensioning or pulling areas for HVDC Alternative Route 3-B.

3.2.6.3.2.1.3.3 Alternative Route 3-C

HVDC Alternative Route 3-C is approximately 122 miles long and corresponds to Applicant Proposed Route Links 3, 4, 5, and 6. For HVDC Alternative Route 3-C, 2,967.5 acres would be removed from existing uses. The agricultural land cover within the representative ROW is approximately 1,980.1 acres (66.8 percent), comparable to Links 3 through 6 (64.3 percent). Seven agricultural structures are located within the representative ROW; conversely, three agricultural structures are located within the Applicant Proposed Route Links 3, 4, 5, and 6.

Outside the representative ROW, tensioning or pulling areas totaling approximately 220.8 acres (36.3 percent grassland/herbaceous and 23.7 percent pasture/hay) would be required during construction. No agricultural structures are located within the tensioning or pulling areas for HVDC Alternative Route 3-C.

3.2.6.3.2.1.3.4 Alternative Route 3-D

HVDC Alternative Route 3-D is approximately 39 miles long and corresponds to Applicant Proposed Route Links 5 and 6. If this route is selected, 958.8 acres would be removed from existing uses. The agricultural land cover within the representative ROW is approximately 734.2 acres, or 76.6 percent, of agricultural land cover (pasture/hay, grassland/ herbaceous, and cultivated crops). The percentage of agricultural land cover within the representative ROW is comparable to Links 5 and 6 (76.2 percent). Four agricultural structures are present in the representative ROW. Conversely, one agricultural structure is located in the Applicant Proposed Route Links 5 and 6.

Outside the representative ROW, tensioning or pulling areas totaling approximately 81.9 acres (46.2 percent pasture/hay) would be required during construction. The predominant land cover is pasture/hay and no structures are present.

3.2.6.3.2.1.3.5 Alternative Route 3-E

HVDC Alternative Route 3-E is approximately 8.5 miles long and corresponds to Applicant Proposed Route Link 6. If this route is selected, 207.8 acres would be removed from existing uses.

HVDC Alternative Route 3-E would disturb approximately 121.5 acres (58.5 percent) of agricultural land (pasture/hay and grassland/herbaceous) within the representative ROW. No agricultural structures are located within the representative ROW. The land cover within the representative ROW contains a higher percentage of agricultural land (58.5 percent) compared to Link 6 of the Applicant Proposed Route, which contains 51.5 percent agricultural land.

No agricultural structures are located within the representative ROW; conversely, one agricultural is located within the Applicant Proposed Route Link 6.

Outside the representative ROW, tensioning or pulling areas totaling approximately 25.2 acres of primarily pasture/hay would be required during construction. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 3-E.

3.2.6.3.2.1.4 Region 4

3.2.6.3.2.1.4.1 Alternative Route 4-A

HVDC Alternative Route 4-A is approximately 58 miles long and corresponds to Applicant Proposed Route Links 3, 4, 5, and 6. HVDC Alternative Route 4-A would disturb approximately 619.3 acres (43.4 percent) of agricultural land (pasture/hay, grassland/herbaceous, and cultivated crops). The agricultural land cover within the representative ROW (43.4 percent) contains a lower percentage of agricultural land compared to Links 3 through 6 (56.7 percent). Nine agricultural structures are located within the representative ROW; conversely, one agricultural structure is located within the Applicant Proposed Route Link 6.

Outside the representative ROW, tensioning or pulling areas totaling approximately 189 acres would be required during construction. The predominant land cover, or approximately 40.3 percent of the land cover, is pasture/hay. No structures are present within these areas.

3.2.6.3.2.1.4.2 Alternative Route 4-B

HVDC Alternative Route 4-B is approximately 79 miles long and corresponds to Applicant Proposed Route Links 2–8. For HVDC Alternative Route 4-B, 1,919.9 acres would be removed from existing uses. HVDC Alternative Route 4-B would disturb approximately 594 acres of agricultural land (30.9 percent). The agricultural land cover within the representative ROW contains a lower percentage of agricultural land compared to Applicant Proposed Route Links 2–8 (55.6 percent). The majority of HVDC Alternative Route 4-B is located within the boundaries of the Ozark

National Forest. Approximately 102 acres of the federally owned land in the Ozark National Forest is within the representative ROW; 157 acres of private land within the Ozark National Forest boundary (use unknown) is within the representative ROW. Ten agricultural structures are located within the representative ROW; conversely, four agricultural structures are located within the Applicant Proposed Route Links 2–8.

Outside the representative ROW, tensioning or pulling areas totaling approximately 198.7 acres (29.0 percent pasture/hay) would be required during construction. The predominant agricultural land cover, or approximately 29.0 percent, is pasture/hay. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 4-B.

3.2.6.3.2.1.4.3 Alternative Route 4-C

HVDC Alternative Route 4-C is approximately 3 miles long and corresponds to Applicant Proposed Route Link 5. For HVDC Alternative Route 4-C, 82.6 acres would be removed from existing uses. HVDC Alternative Route 4-C would disturb approximately 19.0 acres of pasture/hay and 4.8 acres of grassland/herbaceous; no cultivated crops are in the representative ROW. No agricultural structures would be removed to construct the transmission line.

The land cover within the representative ROW contains approximately 23.8 acres of agricultural land (29 percent), a percentage that is lower to Applicant Proposed Route Link 5 (28.8 percent). No agricultural structures are located within the representative ROW; similarly, no agricultural structures are present in the Applicant Proposed Route Link 5.

Outside the representative ROW, tensioning or pulling areas totaling approximately 25.9 percent pasture/hay would be required during construction. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 4-C.

3.2.6.3.2.1.4.4 Alternative Route 4-D

HVDC Alternative Route 4-D is approximately 25 miles long and corresponds to Applicant Proposed Route Links 4, 5, and 6. For HVDC Alternative Route 4-D, a total of 617.6 acres would be removed from existing uses. Approximately 319.4 acres (51.7 percent) of agricultural land would be removed from existing uses.

The percentage of agricultural land cover within the representative ROW (51.7 percent) is less than Links 4–6 (58.0 percent). Seven agricultural structures are located within the representative ROW. Conversely, one agricultural structure is present in the Applicant Proposed Route Link 6.

Outside the representative ROW, tensioning or pulling areas approximately 47.2 percent pasture/hay would be required during construction. The predominant land covers are pasture/hay and deciduous forest. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 4-D.

3.2.6.3.2.1.4.5 Alternative Route 4-E

HVDC Alternative Route 4-E is approximately 37 miles long and corresponds to Applicant Proposed Route Links 8 and 9. For HVDC Alternative Route 4-E, 897.2 acres would be removed from existing uses. HVDC Alternative Route 4-E would disturb approximately 410.7 acres (45.8 percent) of agricultural land cover.

The percentage of agricultural land cover (45.8 percent) within the representative ROW is lower than Links 8 and 9 (or approximately 48.6 percent). Two agricultural structures are present within the representative ROW; similarly, two agricultural structures are present in the Applicant Proposed Route Link 9.

Outside the representative ROW, tensioning or pulling areas totaling approximately 147.2 acres would be required during construction. The predominant land cover, or approximately 49.7 percent, is pasture/hay. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 4-E.

3.2.6.3.2.1.5 Region 5

3.2.6.3.2.1.5.1 Alternative Route 5-A

HVDC Alternative Route 5-A is approximately 13 miles long and corresponds to Applicant Proposed Route Link 1. For HVDC Alternative Route 5-A, 308.5 acres would be removed from existing uses. HVDC Alternative Route 5-A would disturb approximately 66.6 acres (21.6 percent) agricultural land (pasture/hay and grassland/herbaceous) are in the representative ROW.

The percentage of agricultural land cover within the representative ROW is comparable to Applicant Proposed Route Link 1 (approximately 21.6 percent agricultural land). No structures are located in the representative ROW, as is the case for Applicant Proposed Route Link 1.

Outside the representative ROW, tensioning or pulling areas totaling approximately 65.4 acres would be required during construction. Only 13.4 of these acres are agricultural (grassland/herbaceous or pasture/hay) in nature. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 5-A.

3.2.6.3.2.1.5.2 Alternative Route 5-B

HVDC Alternative Route 5-B is approximately 71 miles long and corresponds to Applicant Proposed Route Links 3, 4, 5, and 6. For HVDC Alternative Route 5-B, 1,732.3 acres would be removed from existing uses. HVDC Alternative Route 5-B would disturb approximately 861.5 acres, or 49.7 percent, agricultural land (740.3 acres of pasture/hay, 42.0 acres of cultivated crops, and 79.2 acres of grassland/herbaceous).

The land cover within the representative ROW contains approximately 861.5 acres (or 49.7 percent) agricultural land, which is greater than the percentage of agricultural land for Links 3 through 6 (approximately 39.4 percent). One agricultural structure is located within the representative ROW. Conversely, there are no agricultural structures located within the Applicant Proposed Route Links 3 through 6.

Outside the representative ROW, tensioning or pulling areas totaling approximately 220.9 acres would be required during construction. The predominant land cover is pasture/hay. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 5-B.

As described in Appendix M and summarized in Section 2.4.2.5, a route adjustment was developed for HVDC Alternative Route 5-B to maintain an end-to-end route with Applicant Proposed Route Links 2 and 3, Variation 1. The route adjustment crosses approximately 4 additional acres of agricultural land cover when compared with the original HVDC Alternative Route 5-B.

3.2.6.3.2.1.5.3 Alternative Route 5-C

HVDC Alternative Route 5-C is approximately 9 miles long and corresponds to Applicant Proposed Route Links 6 and 7. For HVDC Alternative Route 5-C, 224.6 acres would be removed from existing uses. HVDC Alternative Route 5-C would disturb approximately 81.8 acres of agricultural land (70.9 acres of pasture/hay, 10.7 acres of grassland/herbaceous, and 0.2 acre of cultivated crops).

The land cover within the representative ROW contains approximately 81.8 acres (36.4 percent) agricultural land. Agricultural land cover within the representative ROW is higher than the percentage in Applicant Proposed Route Links 6 and 7 (32.8 percent). One agricultural structure is present in the representative ROW; conversely, no agricultural structures are present in Applicant Proposed Route Link 6.

Outside the representative ROW, tensioning or pulling areas totaling approximately 54.0 acres would be required during construction. The predominant land cover, or approximately 47.6 percent, is pasture/hay. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 5-C.

3.2.6.3.2.1.5.4 Alternative Route 5-D

HVDC Alternative Route 5-D is approximately 22 miles long and corresponds to Applicant Proposed Route Link 9. For HVDC Alternative Route 5-D, 529.6 acres would be removed from existing uses. HVDC Alternative Route 5-D would disturb approximately 144.6 acres or 27.3 percent of agricultural land (cultivated crops, pasture/hay, and grassland/herbaceous.)

The percentage of agricultural land cover within the representative ROW, or 27.3 percent, is lower than the Applicant Proposed Route Link 9, which contains approximately 46.7 percent agricultural land. No agriculture structures are present in the representative ROW, as is the case in the Applicant Proposed Route Link 9.

Outside the representative ROW, tensioning or pulling areas totaling approximately 89.3 acres would be required during construction, of which approximately 21.0 percent is cultivated crops. No agricultural structures are present in the tensioning or pulling areas for HVDC Alternative Route 5-D.

3.2.6.3.2.1.5.5 Alternative Route 5-E

HVDC Alternative Route 5-E is approximately 36 miles long and corresponds to Applicant Proposed Route Links 4, 5, and 6. For HVDC Alternative Route 5-E, approximately 885.1 acres would be removed from existing uses. HVDC Alternative Route 5-E would disturb approximately 467.2 acres (or 52.7 percent) of agricultural land (pasture/hay, cultivated crops, and grassland/herbaceous). The percentage of agricultural land cover within the representative ROW is higher than Links 4–6, or 44.2 percent. One agricultural structure is present in the representative ROW. Conversely, no agricultural structures are located in the Applicant Proposed Route Links 4, 5, and 6.

Outside the representative ROW, tensioning or pulling areas totaling approximately 88.4 acres would be required during construction, of which is predominantly 45.8 percent is pasture/hay. The predominant land cover is pasture/hay. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 5-E.

As described in Appendix M and summarized in Section 2.4.2.5, a route adjustment was developed for HVDC Alternative Route 5-E in response to public comments on the Draft EIS to maintain an end-to-end route with

Applicant Proposed Route Links 3 and 4, Variation 2. The route adjustment crosses approximately 3 fewer acres of agricultural land cover when compared with the original HVDC Alternative Route 5-E.

3.2.6.3.2.1.5.6 Alternative Route 5-F

HVDC Alternative Route 5-F is approximately 22 miles long and corresponds to Applicant Proposed Route Links 5 and 6. For HVDC Alternative Route 5-F, 544.5 acres would be removed from existing uses. HVDC Alternative Route 5-F would disturb approximately 258.4 acres or 47.5 percent of agricultural land (pasture/hay, cultivated crops, and grassland/herbaceous).

The percentage of agricultural land cover (47.5 percent) within the representative ROW is greater than the percentage within the Applicant Proposed Route Links 5 and 6 (32.2 percent). No agricultural structures are present in the representative ROW. No agricultural structure is present in Link 5 and one other structure is present in Link 6.

Outside the representative ROW, tensioning or pulling areas totaling approximately 52.1 acres, of which 43.2 percent is pasture/hay, would be required during construction. No structures are present in the tensioning or pulling areas for Alternative Route 5-F.

3.2.6.3.2.1.6 Region 6

3.2.6.3.2.1.6.1 Alternative Route 6-A

HVDC Alternative Route 6-A is approximately 16 miles long and corresponds to Applicant Proposed Route Links 2, 3, and 4. For HVDC Alternative Route 6-A, 395.7 acres would be removed from existing uses. HVDC Alternative Route 6-A would disturb approximately 328.6 acres or 83.0 percent of agricultural land, all of which is cultivated crops in the representative ROW. The agricultural land cover within the representative ROW is composed entirely of cultivated crops (83.0 percent), a percentage that is lower than the corresponding links 2 through 4 of the Applicant Proposed Route (87.4). No agricultural structures are located in the representative ROW; conversely, one agricultural structure is present in Link 4.

Outside the representative ROW, tensioning or pulling areas totaling approximately 62.5 acres would be required during construction. The predominant land cover, or approximately 79.7 percent, is cultivated crops. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 6-A.

As described in Appendix M and summarized in Section 2.4.2.6, a route adjustment was developed for HVDC Alternative Route 6-A to maintain an end-to-end route with Applicant Proposed Route Link 2, Variation 1. The route adjustment crosses approximately 12 fewer acres of agricultural land when compared with the original HVDC Alternative Route 6-A.

3.2.6.3.2.1.6.2 Alternative Route 6-B

HVDC Alternative Route 6-B is approximately 14 miles long and corresponds to Applicant Proposed Route Link 3. HVDC Alternative Route 6-B would disturb approximately 272.1 acres (79.2 percent) of agricultural land, which is all cultivated crops, in the representative ROW. For HVDC Alternative Route 6-B, 343.7 acres would be removed from existing uses. The percentage of agricultural land cover within the representative ROW is approximately 79.2 percent, compared to 84.1 percent agricultural land in the Applicant Proposed Route Link 3. No agricultural structure is located within the representative ROW for HVDC Alternative Route 6-B and no agricultural structures are present in the Applicant Proposed Route Link 3.

Outside the representative ROW, tensioning or pulling areas totaling approximately 32.3 acres would be required during construction. The predominant land cover is cultivated crops (79.7 percent). No structures are present in the tensioning or pulling areas for Alternative Route 6-B.

3.2.6.3.2.1.6.3 Alternative Route 6-C

HVDC Alternative Route 6-C is approximately 23 miles long and corresponds to Applicant Proposed Route Links 6 and 7. For HVDC Alternative Route 6-C, approximately 565.6 acres would be removed from existing uses. HVDC Alternative Route 6-C would disturb approximately 430.6 acres (or 76.1 percent) of agricultural land (cultivated crops and pasture/hay) are present in the representative ROW. The land cover within the representative ROW contains approximately 430.6 acres or 76.1 percent of agricultural land, which is higher than the percentage in Links 6 and 7 (71.7 percent). One agricultural structure is present in the representative ROW; conversely, four agricultural structures are present in Applicant Proposed Route Link 6, and no agricultural structures are present in Link 7.

Outside the representative ROW, tensioning or pulling areas totaling approximately 50.7 acres would be required during construction. The predominant land cover, or 69.2 percent, is cultivated crops. No structures are present in the tensioning or pulling areas for Alternative Route 6-C.

3.2.6.3.2.1.6.4 Alternative Route 6-D

HVDC Alternative Route 6-D is approximately 9 miles long and corresponds to Applicant Proposed Route Link 7. For HVDC Alternative Route 6-D, 223.6 acres would be removed from existing uses. HVDC Alternative Route 6-D would disturb approximately 205.3 acres (91.8 percent) of agricultural lands, all of which is cultivated crops, in the representative ROW.

The land cover within the representative ROW contains approximately 205.3 acres or 91.8 percent agricultural land, similar to that of Applicant Proposed Route Link 7 (92.3 percent). No agricultural structures are present in the representative ROW, as is the case with the Applicant Proposed Route Link 7.

Outside the representative ROW, tensioning or pulling areas totaling approximately 17.8 acres of primarily cultivated crops or 87.8 percent, would be required during construction. The predominant land cover is cultivated crops. No structures are present in the tensioning or pulling areas for Alternative Route 6-D.

Outside the representative ROW, tensioning or pulling areas totaling approximately 17.8 acres of primarily cultivated crops, or 87.8 percent, would be required during construction.

3.2.6.3.2.1.7 Region 7

3.2.6.3.2.1.7.1 Alternative Route 7-A

HVDC Alternative Route 7-A is approximately 43 miles long and corresponds to Applicant Proposed Route Link 1. For HVDC Alternative Route 7-A, 1052.0 acres would be removed from existing uses. HVDC Alternative Route 7-A would disturb approximately 828.8 acres (78.8 percent) of agricultural lands, which the majority are cultivated crops, in the representative ROW. The land cover within the representative ROW contains approximately 78.8 percent agricultural lands, similar to that of Applicant Proposed Route Link 1 (78.1 percent). No structures are present in the representative ROW, as is the case with Applicant Proposed Route Link 1.

Outside the representative ROW, tensioning or pulling areas totaling approximately 165.9 acres of primarily cultivated crops, or 83.8 percent, would be required during construction. The predominant land cover is cultivated crops. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 7-A.

3.2.6.3.2.1.7.2 Alternative Route 7-B

HVDC Alternative Route 7-B is approximately 9 miles long and corresponds to Applicant Proposed Route Links 3 and 4. For HVDC Alternative Route 7-B, 209.9 acres would be removed from existing uses. HVDC Alternative Route 7-B would disturb approximately 120.4 acres or 57.4 percent of agricultural land (cultivated crops and pasture/hay) in the representative ROW.

The land cover within the representative ROW contains approximately 57.4 percent agricultural land, which is higher than the percent of agricultural land within the Applicant Proposed Route Links 3 and 4 (52.9 percent). One agricultural structure is present in the representative ROW; no agricultural structures are located within Links 3 and 4 and would not need to be removed in Links 3 and 4.

Outside the representative ROW, tensioning or pulling areas totaling approximately 53.9 acres would be required during construction. The predominant, or approximately 52.8 percent, land cover is cultivated crops. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 7-B.

3.2.6.3.2.1.7.3 Alternative Route 7-C

HVDC Alternative Route 7-C is approximately 24 miles long and corresponds to Applicant Proposed Route Links 3, 4, and 5. If this route is selected, 578.6 acres would be removed from existing uses. HVDC Alternative Route 7-C would disturb approximately 422.8 acres of agricultural land (cultivated crops and pasture/hay) in the representative ROW. The land cover within the representative ROW contains approximately 73.1 percent agricultural lands, a percentage that is higher than Applicant Proposed Route Links 3 - 5 (52.6 percent). One agricultural structure is present in the representative ROW; conversely, two agricultural structures are present in Applicant Proposed Route Link 5.

Outside the representative ROW, tensioning or pulling areas totaling approximately 112.1 acres would be required during construction. The predominant, or approximately 64.9 percent, land cover is cultivated crops. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 7-C.

3.2.6.3.2.1.7.4 Alternative Route 7-D

HVDC Alternative Route 7-D is approximately 7 miles long and corresponds to Applicant Proposed Route Links 4 and 5. For HVDC Alternative Route 7-D, 159.5 acres would be removed from existing uses. HVDC Alternative Route 7-D would disturb approximately 109.0 acres or 68.3 percent of agricultural land (cultivated crops and pasture/hay) in the representative ROW. The land cover within the representative ROW is approximately 68.3 percent agricultural lands, and is higher than the percentage of agricultural lands in Applicant Proposed Route Links 4 and 5 (63.5 percent). No structures are located in the representative ROW; conversely two agricultural structures may be removed in Link 5.

Outside the representative ROW, tensioning or pulling areas totaling approximately 30.1 acres would be required during construction. The predominant, or 59.5 percent, land cover is cultivated crops. No structures exist in the tensioning or pulling areas for HVDC Alternative Route 7-D.

3.2.6.3.2.2 Operations and Maintenance Impacts

Impacts from operations and maintenance of the HVDC alternative routes would be similar to those from the Applicant Proposed Route (see Section 3.2.6.2.3). The long-term impacts by region are summarized in Table 3.10-31 for pole structures. No permanent impacts are described for access roads because the locations of the access roads have not been determined at this time. It is possible that the access roads could be located in such a way that small areas of agricultural land would be isolated and no longer practicable to be used for farmland or grazing.

3.2.6.3.2.3 Decommissioning Impacts

Potential impacts during decommissioning of the Project would be similar to those of the construction phase for all Project components. Once decommissioning has been completed, all land could be returned to the preconstruction land uses described in Sections 3.2.4 and 3.2.5.

3.2.6.4 Best Management Practices

No BMPs are identified for this section. It should be noted that the Applicant has developed a comprehensive list of EPMs for the Project. A complete list of EPMs for the Project is provided in Appendix F. The EPMs would avoid or minimize potential impacts to agricultural resources.

3.2.6.5 Unavoidable Adverse Impacts

Unavoidable adverse impacts could occur if agricultural structures (e.g., barns, silos, and other out/accessory buildings) could not be avoided. Yields from lands used for crops, pasture/hay, and grazing livestock would be temporarily affected in the construction areas, and land used for transmission structures, long-term access roads, and converter stations would be removed from agricultural production until the Project was decommissioned.

3.2.6.6 Irreversible and Irretrievable Commitment of Resources

Upon decommissioning of the Project, all land could return to previous uses. There would be no irreversible or irretrievable commitment of agricultural resources.

3.2.6.7 Relationship between Local Short-term Uses and Long-term Productivity

The conversion of primarily agricultural land to an industrial use to construct and operate the Project would result in short-term use impacts. These direct effects would include the loss of crops pasture/hay and grazing land for livestock in the representative ROW as well as loss of agricultural structures. Other short-term and localized impacts include the disruption of access to local agricultural land uses during construction. The productivity of the soil in temporary construction areas may also be reduced due to compaction and soil erosion.

The short-term impacts would be minimized, however, because of multiple EPMs incorporated into the Project:

- Clean Line will coordinate with landowners to site access roads and temporary work areas to avoid and/or minimize impacts to existing operations and structures (LU-4).
- Clean Line will make reasonable efforts, consistent with design criteria, to accommodate requests from individual landowners to adjust the siting of the ROW on their properties. These adjustments may include consideration of routes along or parallel to existing divisions of land (e.g., agricultural fields and parcel boundaries) and existing

compatible linear infrastructure (e.g., roads, transmission lines, and pipelines), with the intent of reducing the impact of the ROW on private properties (LU-5).

- Clean Line will minimize clearing vegetation within the ROW, consistent with a Transmission Vegetation Management Plan filed with NERC, and applicable federal, state, and local regulations (GE-3). The TVMP may require additional analysis under NEPA depending on whether and under what conditions DOE decides to participate in the Project.
- Clean Line will work with landowners to avoid and minimize impacts to residential landscaping (LU-3).
- Clean Line will minimize the frequency and duration of road closures (LU-2).
- Clean Line will work with landowners and operators to ensure that access is maintained as needed to existing operations (e.g., to oil/gas wells, private lands, agricultural areas, pastures, hunting leases) (LU-1).

Additional Applicant EPMs that should ensure long-term productivity of land in the representative ROW include:

- Clean Line will avoid or minimize adverse effects to surface and subsurface irrigation and drainage systems (e.g., tiles). Clean Line will work with landowners to minimize the placement of structures in locations that would interfere with the operation of irrigation systems (AG-1).
- Agricultural soils temporarily impacted by construction, operation, or maintenance activities will be restored to pre-activity conditions. For example, soil remediation efforts may include decompaction, recontouring, liming, tillage, fertilization, or use of other soil amendments (AG-2).
- Clean Line will consult with landowners and/or tenants to identify the location and boundaries of agriculture or conservation reserve lands and to understand the criteria for maintaining the integrity of these committed lands. (AG-3).
- Clean Line will work with landowners and/or tenants to identify specialty agricultural crops or lands (e.g., certified organic crops or products that require special practices, techniques, or standards) that require protection during construction, operation, or maintenance. Clean Line will avoid and/or minimize impacts that could jeopardize standards or certifications that support specialty croplands or farms (AG-4).
- Clean Line will work with landowners and/or tenants to consider potential impacts to current aerial spraying or application (i.e., aerial crop spraying) of herbicides, fungicides, pesticides, and fertilizers within or near the transmission ROW. Clean Line will avoid or minimize impacts to aerial spraying practices when routing and siting the transmission line and related infrastructure (AG-5).
- Clean Line will work with landowners to develop compensation for lost crop value caused by construction and/or maintenance (AG-6).
- Clean Line will work with landowners to develop a site plan for each cropland farm on which construction or maintenance is to be performed (AG-7).
- Clean Line will stabilize slopes exposed by its activities to minimize erosion (GEO-1).

3.2.6.8 Connected Actions

3.2.6.8.1 Wind Energy Generation

The primary existing land use in the 12 WDZs is agriculture. Sections 3.2.6.8.1.1 through 3.2.6.8.1.12 provide more detailed information on the type of agricultural land impacted by the WDZs. It is estimated that during the construction phase, approximately 2 percent of land within a wind energy facility is affected (Denholm et al. 2009). Assuming between 20 and 30 percent of the WDZs would be built-out, between 4,328 and 6,492 acres of primarily agricultural land would be temporarily affected during construction.[1] Wind farm developers are typically able to microsite turbines and other facility components to avoid displacing or damaging agricultural structures such as irrigation equipment, barns, and silos.

During the operations and maintenance phase of wind energy facilities, approximately 1 percent or less of the land is affected or disturbed. Assuming 20 to 30 percent build-out for the 12 WDZs, a total of 2,164 to 3,246 acres of primarily agricultural land would be affected for the life of the Project (1 percent of the 20 percent for the low end, 1 percent of the 30 percent for the high end). Impacts to agricultural lands and soils would be similar to those discussed above for Project components, and a typical wind energy project could include similar EPMs.

Landowners could benefit financially from a wind farm through lease payments when turbines are sited on their lands. Given their relatively small footprints, wind turbines do not substantially decrease the land available for agricultural purposes, allowing landowners to benefit financially from lease payments and agriculture. Wind lease agreements typically include provisions to minimize the losses, including minimizing soil compaction and revegetating temporary work areas. In addition, the agreements typically stipulate compensation for landowners for any losses, such as damage or loss of crops, gates, fences, landscaping and trees, irrigation, and livestock.

Once construction has been completed, agricultural operations would be able to continue in most of the wind farm. Agricultural activities such as cultivating crops and livestock grazing are generally permitted up to the wind turbine pads, so only a very minimal area of existing agricultural land would be removed from production for the life of the Project, although long-term access roads and the configuration of wind turbines may change the configuration of fields for crops and grazing.

3.2.6.8.2 Optima Substation

The future Optima substation is anticipated to be constructed on 160 acres of currently undeveloped land near an operating wind energy facility. The land cover of the site is primarily grassland/herbaceous. Any agricultural practices, such as grazing, that currently occur on the site would be converted to a utility use.

3.2.6.8.3 TVA Upgrades

The TVA upgrades, like the Project, are linear projects (except for substation modifications) with relatively small amounts of long-term of ground disturbance considering the amount of area crossed (except in forested areas where ground disturbance resulting from ROW clearing can impact large areas). Upon completion of construction, much of the affected agricultural land could return to previous uses. Much of the following discussion is only relevant to the new 500kV transmission line, or for certain upgrades associated with the 161kV transmission lines. The TVA upgrades to existing facilities (including existing transmission lines and existing substations) should have minimal impacts to agricultural resources as ground disturbance is typically limited to the immediate vicinity of the structure.

[1] Approximately 20 to 30 percent of the 1,082,000 acres suitable for wind development would be built out (or between 216,400 and 324,600 acres). During the construction phase, approximately 2 percent of the total acreage would be disturbed. For the low end of the range, 2 percent of 216,400 is 4,328 acres. For the high end, 2 percent of 324,600 is 6,492 acres.

Upgrades required to interconnect into the TVA transmission grid could involve new disturbance of agricultural lands. Potential impacts to agricultural resources for the new transmission line, upgrades to existing lines, and modifications to substations would be similar to impacts described in detail in Section 3.2.6 for the Project. Impacts during construction could involve loss of vegetation and soil at construction sites and along travel routes; possible temporary loss of the use of structures such as barns, ponds, and silos; and possible curtailment of actions such as animal feeding operations. These types of impacts likely would be short term for the new 500 kV transmission line, although it is possible that loss of the use of structures could be long term. Potential agricultural impacts associated with the required upgrades to existing TVA facilities are not anticipated to result in significant impacts to agricultural land. The degree of potential impacts associated with the new electric transmission line would depend on the types of agriculture within the existing transmission line ROW. To the extent practicable, the new 500kV transmission line would be routed to avoid interference with crop irrigation systems. For the upgrades to existing structures, ground disturbance is typically limited to the immediate vicinity of the structure.

The majority of the ROW would be disturbed during construction of the new transmission line. Areas of fully dedicated uses (e.g., sites of structures and permanent access roads) would experience longer-term impacts than ROW areas, where existing land use may continue after construction.

During operations and maintenance of the new 500kV transmission line, agricultural activities could resume to a large extent on most disturbed areas, but some constraints and limitations would be likely, such as land use limitations within ROWs, physical interference with agricultural equipment operations, and periodic loss of access during maintenance activities. These impacts are long-term impacts. Also during operations, transmission structures could affect aerial spraying activities often used in agricultural areas. This effect could involve requiring the spraying to be performed at higher altitudes resulting in more chance for overspray or drift that could affect adjoining properties, or it could eliminate aerial spraying in some areas. Effects on the economic value of livestock production could occur through a combination of decreasing forage land available and by increasing management costs of controlling noxious and invasive vegetation species introduced during construction and costs of moving livestock around project-related structures and ROWs. Anticipated effects from upgrades to existing structures, conductor, or substations would be expected to include ground disturbance that is typically limited to the immediate vicinity of the structure; no changes would be expected with the existing uses of the ROWs.

3.2.6.9 Impacts Associated with the No Action Alternative

Under the No Action Alternative, DOE assumes for analytical purposes that the Project would not be constructed. There would be no impacts on agricultural land or resources. The existing agricultural activity throughout the regions would be expected to continue.

Contents

Tables

Figures Presented in Appendix A

3.3 Air Quality and Climate Change

This section addresses potential air quality and climate change impacts from the Project and alternatives during construction, operation, and decommissioning. Emissions of air pollutants from the Project would primarily be generated from the following activities:

- Construction of on- and off-ROW access roads
- Construction of the support structure pad sites and structure erection
- Post-construction activities involved with the ongoing use and maintenance of the transmission line, converter stations, and corridor

Air quality in a given location is determined by the concentration of various pollutants in the atmosphere. Air pollutants can be divided into three categories: criteria air pollutants for which EPA has established National Ambient Air Quality Standards (NAAQS) to protect health and welfare, toxic air pollutants (chemicals and chemical classes that have carcinogenic, mutagenic, or other hazardous effects), and greenhouse gases (GHGs) (gases that have been identified as the main cause of observed global climate change) (Buizer et al. 2013).

3.3.1 Regulatory Background

3.3.1.1 Federal

Federal air pollution regulations focus largely on criteria and toxic pollutants and include provisions applicable to stationary and mobile sources.

For criteria pollutants, NAAQS represent maximum levels of background pollution that are considered safe. Primary standards protect public health, including the health of sensitive populations, such as asthmatics, children, and the elderly. Secondary standards protect public welfare, including protecting against decreased visibility and damage to animals, crops, vegetation, and buildings. Pursuant to the CAA, EPA has established NAAQS for ambient concentrations of ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter (PM_{10} [i.e., particulate matter 10 microns or smaller in diameter] and $PM_{2.5}$), and airborne lead. NAAQS represent maximum acceptable concentrations that generally may not be exceeded more than once per year, except the annual standards, which may never be exceeded. The federal CAA amendments of the 1990s require states to control air pollution emission sources so that NAAQS are met and maintained. An area that does not meet the NAAQS is designated as a nonattainment area on a pollutant-by-pollutant basis.

Toxic air pollutants cause or may cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental and ecological effects. The Clean Air Act currently requires EPA to regulate 187 toxic air pollutants. In contrast to the geographically based approach used for criteria pollutants, for toxic air pollutants, EPA has identified major industrial sources that emit these pollutants and developed national technology-based performance standards to significantly reduce their emissions.

A substantial amount of construction activity would occur with the Project, and fuel-fired construction equipment is a mobile source of air pollution. Mobile sources of air pollution are primarily regulated at the point of manufacture (manufacturers have been required to meet increasingly stringent emissions requirements in 40 CFR Parts 86, 89, 90, 1039, and 1048) and fuels are regulated at the fuel supplier end (40 CFR Part 80 requirements apply to criteria air pollutants and toxics, and include Renewable Fuels Standard requirements to address GHG emissions). Mobile sources can also trigger the need for a General Conformity determination (40 CFR Part 93, Subpart B) if they are emitting sufficiently large quantities of an air pollutant in an area designated “nonattainment” with respect to a current NAAQS, or which was previously designated “nonattainment” with respect to a current NAAQS (and is therefore a “maintenance” area). In such areas, a federal agency must make a determination that permitting or approving an activity will conform to the state implementation plan when the total of direct and indirect emissions (of the nonattainment/maintenance pollutant, or its precursors) in that area would equal or exceed *de minimis* levels identified in 40 CFR Part 93 Subpart B, which vary depending on the pollutant and attainment status but are no higher than 100 TPY.

3.3.1.2 State

The Project would cross through portions of Oklahoma, Arkansas, Tennessee, and Texas, with each state providing regulations for air pollutant emissions. Generally each state’s ambient air quality standards are the same as the NAAQS. In addition, each state and/or locality may have specific air regulations that the potential construction activities may need to comply with or that may require the Applicant to obtain necessary permits. Specifically, in the event that any controlled burning activities would be conducted, they would be performed in accordance with all local, state, and federal requirements. These activities also would be performed in accordance with any applicable smoke management guidelines for each state and/or locality.

3.3.2 Data Sources

Data sources used to evaluate the affected environment for air quality and climate change, as well as assess air quality and climate change impacts, include the following:

- Historical meteorological data from the National Oceanic and Atmospheric Administration’s National Climatic Data Center (NCDC 2014)
- EPA AirData archived historical ambient air quality measurements (GIS Data Source: EPA 2014)
- CAA attainment designations (42 USC § 7401 et seq.)
- U.S. Global Change Research Program (USGCRP) climate assessments (USGCRP 2014)
- Clean Line-required construction equipment (Appendix F)
- Clean Line-required operational equipment (Appendix F)
- Intergovernmental Panel on Climate Change Fifth Assessment Report (IPCC 2013)
- EPA emission factors for stationary point and area sources (EPA 2008)
- EPA NONROAD2008a emissions model (EPA 2009)
- EPA Motor Vehicle Emissions Simulator (MOVES) 2010b emissions model (EPA 2012)
- EPA Air Quality Monitoring Stations (GIS Data Source: EPA 2014)

3.3.3 Region of Influence

For air quality, the ROI for the Applicant Proposed Route, DOE Alternatives, and connected actions are generally the same as Section 3.1.1. However, for criteria air pollutants, to be conservative the ROI has been extended to approximately 300–500 feet from the roadway (CARB 2005). The reason for the expansion of the ROI is to provide an added level of conservatism in the analysis of air quality impacts to sensitive areas. The ROI includes sensitive areas including residential areas and schools. Locations of residences and schools are shown in Figure 1.0-2 located in Appendix A of the EIS. The only two schools within the ROI are within AC Collection System Route E-1, located within the town of Hardesty. Appendix E lists specific air quality concerns expressed during public scoping which are evaluated for each region of the Project.

GHGs are a global issue, involving pollutants that have relatively long lifetimes in the atmosphere and that accumulate over time. Science has not yet progressed to the point where localized impacts from GHGs as a whole can be quantitatively predicted (Kerr 2013), and GHG emissions that result from construction activities by themselves are likely to have a negligible impact on current GHG concentrations because the current concentrations reflect accumulations of pollutants over time and are therefore many orders of magnitude higher than the contribution of GHGs from the Project. GHGs are primarily of interest because of the cumulative impacts (i.e., from all sources) on global climate, as will be discussed in more detail in Section 3.3.4.

3.3.4 Affected Environment

As mentioned previously, air pollutants can be divided into three classes: criteria pollutants, toxic pollutants, and GHGs. The seven air pollutants listed below are criteria pollutants for which EPA has developed NAAQS:

- SO_2
- CO
- NO_2
- O_3
- PM_{10}
- $PM_{2.5}$
- Lead and its compounds (measured as lead)

Precursors to criteria pollutants include those that cause the formation of the pollutant after they are emitted; for example, O_3 in the ambient air is predominantly formed by photochemical reactions between oxides of nitrogen (NO_x) and volatile organic compounds (VOCs).

Concentrations of pollutants in the ambient air vary over time and therefore many of the NAAQS (Table 3.3-1) are focused on statistical functions (98th percentile concentrations, 99th percentile concentrations, etc.). They also vary spatially, so a network of air quality monitoring stations is used to assess regional air quality (see Figure 3.3-1 in Appendix A) to determine whether counties should be designated as “attainment” or “nonattainment” with respect to the NAAQS. For any particular NAAQS, if an area previously designated as “nonattainment” is redesignated as “attainment,” it is classified as a “maintenance” area (i.e., the subset of attainment areas that were previously designated as nonattainment for that standard). As identified in 40 CFR 81, the entire ROI has been designated as attainment for all of the NAAQS, with the exception of Shelby County, Tennessee (containing the city of Memphis), which is designated “marginal” nonattainment for ozone and is a maintenance area for CO.

Each of the criteria pollutants listed in Table 3.3-1 except ozone are emitted directly; ozone can also be emitted directly by a few sources but is predominantly a result of reactions between NO_x—predominantly NO_2 and nitrogen oxide (NO)—and VOCs in the air, particularly in the warmer months. For this reason, criteria pollutant emissions inventories include NO_x and VOCs, even though they are not criteria pollutants themselves.

Table 3.3-1:
Criteria Pollutants, National Ambient Air Quality Standards

Air Pollutant	Averaging Period	Primary NAAQS	Secondary NAAQS
SO_2 (ppb)	1-Hour [1]	75	NA
	3-Hour	NA	500
CO (ppm)	1-Hour [2]	35	NA
	8-Hour [2]	9	NA
NO_2 (ppb)	1-Hour [3]	100	NA
	Annual	53	53
Ozone (ppm)	8-Hour [4]	0.075	0.075
PM_{10} (µg/m^3)	24-Hour [5]	150	150
$PM_{2.5}$ (µg/m^3)	24-Hour [6]	35	35
	Annual [7]	12.0	15.0
Lead (µg/m^3)	3-Month [8]	0.15	0.15

µg/m^3 = micrograms per cubic meter
ppb = parts per billion
ppm = parts per million
1 NAAQS applies to the 3-year average of the annual (99th percentile) of the daily maximum1-hour average concentration.
2 NAAQS is not to be exceeded more than once per calendar year.
3 NAAQS applies to the 3-year average of the annual (98th percentile) of the daily maximum 1-hour average concentration.
4 NAAQS applies to the 3-year average of the annual 4th highest daily maximum 8-hour average concentration.
5 Not to be exceeded more than once per year on average over 3 years.
6 NAAQS applies to the 3-year average of the annual 98th percentile 24-hour concentration.
7 NAAQS applies to the 3-year average of annual concentrations.
8 NAAQS applies to the maximum arithmetic 3-month mean.

While the scientific understanding of climate change continues to evolve, the Intergovernmental Panel on Climate Change Fifth Assessment Report has stated that warming in the of the Earth's climate is unequivocal, that continued emissions of GHGs will cause further warming and changes in all of the components of the climate system, and that limiting climate change will require substantial and sustained reductions of GHG emissions (IPCC 2013). The report also states that it is "virtually certain" that there will be more frequent hot and fewer cold temperature extremes over most land areas on daily and seasonal timescales as global mean temperatures increase, that it is "very likely" that heat waves will occur with a higher frequency and duration, that the global ocean will continue to warm during the 21st century, that global mean sea level will continue to rise during the 21st century, and that most aspects of climate change will persist for many centuries even if emissions of CO_2 are stopped (IPCC 2013). GHGs include CO_2, methane (CH_4), and nitrous oxide (N_2O). No specific "ambient standards" exist for these pollutants, but for context, total U.S. anthropogenic (human-caused) GHG emissions were 6,576 million metric tonnes carbon dioxide equivalent (CO_2e) in 2009, and 40 percent of these were from the electric power sector (EIA 2011). Unlike criteria pollutants and air toxics, GHG concentrations have been increasing over time, and are continuing to increase. Although there are not localized monitoring networks, 2011 average concentrations of CO_2, CH_4, and N_2O were 391 ppm, 1,803 parts per billion, and 324 parts per billion, respectively, meaning that they exceeded pre-industrial levels (year 1750) by about 40 percent, 150 percent, and 20 percent, respectively (IPCC 2013). The Intergovernmental Panel on Climate Change (2013) has concluded that it is "likely" (66–100 percent probability) that GHGs contributed a global mean surface warming in the range of 0.5 C to 1.3 C over the period 1951 to 2010 and "extremely likely" (95–100 percent probability) that more than half of the observed increase in global average surface temperature from 1951 to 2010 was caused by the anthropogenic increase in GHG concentrations and other anthropogenic forcings together.

In response to public comments on the Draft EIS, several route variations to the Applicant Proposed Route were developed in Regions 2–7. These route variations are described by region in Sections 2.4.2.1 through 2.4.2.7. Because none of the route variations resulted in a change to equipment, operating schedules, vehicle trips, ground disturbance areas, etc. associated with construction activities, none of the route variations would result in changes to impacts to air quality or climate change.

3.3.4.1 Meteorological Conditions

Locally, the climate of the ROI varies by state depending largely on proximity to large waterbodies and mountain ranges (NCDC 2014). The portion of the ROI in Oklahoma and the Texas Panhandle experience extreme temperature changes, especially in the winter months, from cold fronts moving west to east after crossing the Rocky Mountains. The Oklahoma and Texas panhandles represent the driest portions of the ROI. Arkansas' climate is generally warmer and more humid in the lowlands than in the mountainous regions. Arkansas rarely incurs drought conditions given the relatively consistent annual precipitation. The Shelby County, Tennessee, portion of the ROI has similar meteorological conditions to those of the Arkansas lowlands.

3.3.5 Regional Description

Tables 3.3-2 through 3.3-8 provide existing air quality monitoring data for criteria air pollutants for stations located within or in relatively close proximity to each of the regions (GIS Data Source: EPA 2014). Generally, the monitoring stations are located in populated areas and therefore the reported concentrations may be higher than those in the more rural areas where project construction is occurring. The following subsections provide a brief description of each region's topography and meteorology. Topography and meteorology affect how air moves. For example, mountainous regions can act as barriers between air pollution concentrations and other areas.

3.3.5.1 Region 1

Region 1 is referred to as the Oklahoma Panhandle Region and includes the Applicant Proposed Route and HVDC Alternative Routes I-A through I-D. The area is generally flat with temperature extremes resulting from weather patterns moving west to east after crossing the Rocky Mountains (NCDC 2014). Existing air quality monitoring for Region 1 is summarized in Table 3.3-2. Generally, the monitoring stations are sited in populated areas and, as a result, criteria pollutant levels in more rural areas of Region 1 are likely lower than those obtained by the nearest monitoring stations. Region 1 is rural in nature with limited development.

Table 3.3-2:
Criteria Pollutants, National Ambient Air Quality Standards and Existing Air Quality in Region 1

Air Pollutant	Averaging Period	Primary NAAQS	Secondary NAAQS	Nearest Ambient Monitoring Site(s)	Distance to Nearest Monitoring Station (miles)[9]	Most Recent Quality-Assured Data [10]
SO_2 (ppb)	1-Hour [1]	75	NA	Oklahoma County, OK	127	5.3
	3-Hour	NA	500			—[11]
CO (ppm)	1-Hour [2]	35	NA	Oklahoma County, OK	127	1.37
	8-Hour [2]	9	NA			0.8
NO_2 (ppb)	1-Hour [3]	100	NA	Oklahoma County, OK	127	54
	Annual	53	53			—[11]

Table 3.3-2:
Criteria Pollutants, National Ambient Air Quality Standards and Existing Air Quality in Region 1

Air Pollutant	Averaging Period	Primary NAAQS	Secondary NAAQS	Nearest Ambient Monitoring Site(s)	Distance to Nearest Monitoring Station (miles)[9]	Most Recent Quality-Assured Data [10]
Ozone (ppm)	8-Hour [4]	0.075	0.075	Dewey County, OK	40	0.074
PM_{10} ($\mu g/m^3$)	24-Hour [5]	150	150	Ford County, KS	70	58
$PM_{2.5}$ ($\mu g/m^3$)	24-Hour [6]	35	35	Oklahoma County, OK	127	20
	Annual [7]	12.0	15.0	Oklahoma County, OK	127	10
Lead ($\mu g/m^3$)	3-Month [8]	0.15	0.15	Amarillo, TX	115	EPA AirData does not publish data

$\mu g/m^3$ = micrograms per cubic meter
ppb = parts per billion
ppm = parts per million
1 NAAQS applies to the 3-year average of the annual (99th percentile) of the daily maximum1-hour average concentration.
2 NAAQS is not to be exceeded more than once per calendar year.
3 NAAQS applies to the 3-year average of the annual (98th percentile) of the daily maximum 1-hour average concentration.
4 NAAQS applies to the 3-year average of the annual 4th highest daily maximum 8-hour average concentration.
5 Not to be exceeded more than once per year on average over 3 years.
6 NAAQS applies to the 3-year average of the annual 98th percentile 24-hour concentration.
7 NAAQS applies to the 3-year average of annual concentrations.
8 NAAQS applies to the maximum arithmetic 3-month mean.
9 Distance to the nearest monitoring station was estimated from Applicant Proposed Route and HVDC alternative routes.
10 Data for 2013 have not yet been quality-assured/finalized; therefore, the data shown are for 2010–2012 (and exclude exception events per 40 CFR 50.14). The values in this column for the Seiling, Oklahoma, station data were obtained from the state's 2012 Annual Monitoring Report http://www.deq.state.ok.us/aqdnew/airreport2012/2012o3.html and for remaining sites not included in Oklahoma's annual report data were obtained from EPA AirData (GIS Data Source: EPA 2014).
11 These averages not tabulated, since highest one-hour concentrations are well below the average standard.

3.3.5.2 Region 2

Region 2 is referred to as the Oklahoma Central Great Plains Region and includes the Applicant Proposed Route and HVDC Alternative Routes 2-A through 2-B. Like Region, 1 it is generally flat with temperature extremes resulting from weather patterns moving west to east after crossing the Rocky Mountains (NCDC 2014). Existing air quality monitoring for Region 2 is provided in Table 3.3-3. Generally, the monitoring stations are sited in populated areas and, as a result, criteria pollutant levels in Region 2 may be lower than those obtained by the nearest monitoring stations. The area is rural and development is limited.

Table 3.3-3:
Criteria Pollutants, National Ambient Air Quality Standards and Existing Air Quality in Region 2

Air Pollutant	Averaging Period	Primary NAAQS	Secondary NAAQS	Nearest Ambient Monitoring Site(s)	Distance to Nearest Monitoring Station (miles)[9]	Most Recent Quality-Assured Data[10]
SO_2 (ppb)	1-Hour [1]	75	NA	Oklahoma County, OK	40	5.3
	3-Hour	NA	500			—[11]
CO (ppm)	1-Hour [2]	35	NA	Oklahoma County, OK	40	1.37
	8-Hour [2]	9	NA			0.8

Table 3.3-3:
Criteria Pollutants, National Ambient Air Quality Standards and Existing Air Quality in Region 2

Air Pollutant	Averaging Period	Primary NAAQS	Secondary NAAQS	Nearest Ambient Monitoring Site(s)	Distance to Nearest Monitoring Station (miles)[9]	Most Recent Quality-Assured Data[10]
NO_2 (ppb)	1-Hour [3]	100	NA	Oklahoma County, OK	40	54
	Annual	53	53			—[11]
Ozone (ppm)	8-Hour [4]	0.075	0.075	Dewey County, OK	9	0.074
PM_{10} (µg/m^3)	24-Hour [5]	150	150	Oklahoma County, OK	40	59
$PM_{2.5}$ (µg/m^3)	24-Hour [6]	35	35	Oklahoma County, OK	40	20
	Annual [7]	12.0	15.0	Oklahoma County, OK	40	10
Lead (µg/m^3)	3-Month [8]	0.15	0.15	Tulsa, OK	97	0.008

For table notes, see Table 3.3-2.

3.3.5.3 Region 3

Region 3 is referred to as the Oklahoma Cross Timbers Region and includes the Applicant Proposed Route and HVDC Alternative Routes 3-A through 3-E. The area, much like Regions 1 and 2, is generally flat, although at the Oklahoma-Arkansas border there are some mountainous areas coinciding with the Ouachita Mountains. Temperature extremes result from weather patterns moving west to east after crossing the Rocky Mountains (NCDC 2014). Existing air quality monitoring for Region 3 is provided in Table 3.3-4. Although all three monitoring stations show ozone concentrations in excess of the NAAQS, the area has not been redesignated as “nonattainment” for ozone.

Table 3.3-4:
Criteria Pollutants, National Ambient Air Quality Standards and Existing Air Quality in Region 3

Air Pollutant	Averaging Period	Primary NAAQS	Secondary NAAQS	Nearest Ambient Monitoring Site(s)	Distance to Nearest Monitoring Station (miles) [9]	Most Recent Quality-Assured Data[10]
SO_2 (ppb)	1-Hour [1]	75	NA	Oklahoma County, OK	29	5.3
	3-Hour	NA	500			—[11]
CO (ppm)	1-Hour [2]	35	NA	Oklahoma County, OK	29	1.37
	8-Hour [2]	9	NA			0.8
NO_2 (ppb)	1-Hour [3]	100	NA	Oklahoma County, OK	29	54
	Annual	53	53			—[11]
Ozone (ppm)	8-Hour [4]	0.075	0.075	Glenpool, OK	14	0.077
				Mannford, OK	13	0.078
				Oklahoma County, OK	29	0.079
PM_{10} (µg/m^3)	24-Hour [5]	150	150	Oklahoma County, OK	29	59
$PM_{2.5}$ (µg/m^3)	24-Hour [6]	35	35	Oklahoma County, OK	29	20
	Annual [7]	12.0	15.0	Oklahoma County, OK	29	10
Lead (µg/m^3)	3-Month [8]	0.15	0.15	Tulsa, OK	30	0.008

For table notes see Table 3.3-2.

3.3.5.4 Region 4

Region 4 is referred to as the Arkansas River Valley Region and includes the Applicant Proposed Route and HVDC Alternative Routes 4-A through 4-E as well as the Lee Creek Variation. The Region includes elevation changes associated with the Ouachita Mountains in the western part of the state as the Arkansas River meanders through the region, although the region is generally flat. The temperature is generally warmer in Arkansas than in Project regions to the west (NCDC 2014). Existing air quality monitoring for Region 4 is provided in Table 3.3-5. Though the Stilwell monitoring station shows ozone concentrations in excess of the NAAQS, the area is still formally classified as "attainment" for ozone and has yet to be redesignated as nonattainment for ozone.

Table 3.3-5:
Criteria Pollutants, National Ambient Air Quality Standards and Existing Air Quality in Region 4

Air Pollutant	Averaging Period	Primary NAAQS	Secondary NAAQS	Nearest Ambient Monitoring Site(s)	Distance to Nearest Monitoring Station (miles)[9]	Most Recent Quality-Assured Data[10]
SO_2 (ppb)	1-Hour [1]	75	NA	Adair County, OK	12	7.3
	3-Hour	NA	500			—[11]
CO (ppm)	1-Hour [2]	35	NA	Adair County, OK	12	0.63
	8-Hour [2]	9	NA			0.33
NO_2 (ppb)	1-Hour [3]	100	NA	Adair County, OK	12	16
	Annual	53	53			—[11]
Ozone (ppm)	8-Hour [4]	0.075	0.075	Adair County, OK	12	0.077
				Sequoyah County, OK	6	0.073
PM_{10} (µg/m^3)	24-Hour [5]	150	150	Adair County, OK	12	87
$PM_{2.5}$ (µg/m^3)	24-Hour [6]	35	35	Adair County, OK	12	26
	Annual [7]	12.0	15.0	Adair County, OK	12	12
				Sequoyah County, OK	6	10.8
Lead (µg/m^3)	3-Month [8]	0.15	0.15	Pulaski County, AR	70	EPA AirData does not publish data

For table notes, see Table 3.3-2.

3.3.5.5 Region 5

Region 5 is referred to as the Central Arkansas Region and includes the Applicant Proposed Route and HVDC Alternative Routes 5-A through 5-F. The region is generally flat and, like Region 4, the temperature is generally warmer in Arkansas than in Project regions further west (NCDC 2014). Existing air quality monitoring for Region 5 is provided in Table 3.3-6. The Little Rock monitoring station shows ozone concentrations in excess of the NAAQS, but the area has not been redesignated as "nonattainment" for ozone. In addition, Little Rock is a highly populated area, so criteria pollutant levels in the more remote Region 5 area (rural, with limited development) are likely to be lower than those measured in Little Rock and would be included in the nonattainment area for Little Rock.

Table 3.3-6:
Criteria Pollutants, National Ambient Air Quality Standards and Existing Air Quality in Region 5

Air Pollutant	Averaging Period	Primary NAAQS	Secondary NAAQS	Nearest Ambient Monitoring Site(s)	Distance to Nearest Monitoring Station (miles)[9]	Most Recent Quality-Assured Data[10]
SO_2 (ppb)	1-Hour [1]	75	NA	Pulaski County, AR	40	10.3
	3-Hour	NA	500			—[11]
CO (ppm)	1-Hour [2]	35	NA	Pulaski County, AR	40	1.8
	8-Hour [2]	9	NA			1.47
NO_2 (ppb)	1-Hour [3]	100	NA	Pulaski County, AR	40	51
	Annual	53	53			—[11]
Ozone (ppm)	8-Hour [4]	0.075	0.075	Pulaski County, AR	40	0.078
				Newton County, AR	25	0.069
PM_{10} ($\mu g/m^3$)	24-Hour [5]	150	150	Pulaski County, AR	40	87
$PM_{2.5}$ ($\mu g/m^3$)	24-Hour [6]	35	35	Pulaski County, AR	40	26
	Annual [7]	12.0	15.0	Pulaski County, AR	40	12
Lead ($\mu g/m^3$)	3-Month [8]	0.15	0.15	Pulaski County, AR	40	EPA AirData does not publish data

For table notes, see Table 3.3-2.

3.3.5.6 Region 6

Region 6 is referred to as the Cache River and Crowley's Ridge Region and the Applicant Proposed Route and includes HVDC Alternative Routes 6-A through 6-D. The region is generally flat and, like Regions 4 and 5, the temperature is generally warmer in Arkansas than in Project regions further west (NCDC 2014). Existing air quality monitoring for Region 6 is provided in Table 3.3-7. Generally the monitoring stations are sited in populated areas and, as a result, criteria pollutant levels in Region 6 are assumed to be lower than those obtained by the monitoring stations. For example, the levels monitored at the Crittenden County, Arkansas, and Shelby County, Tennessee, stations are within the Memphis metropolitan area, which is nonattainment for criteria pollutant ozone. Region 6 is rural, located over 30 miles from the monitoring stations near Memphis; therefore, ozone emissions are thought to be lower than those provided in Table 3.3-7. The area is rural in nature with limited development.

Table 3.3-7:
Criteria Pollutants, National Ambient Air Quality Standards and Existing Air Quality in Region 6

Air Pollutant	Averaging Period	Primary NAAQS	Secondary NAAQS	Nearest Ambient Monitoring Site(s)	Distance to Nearest Monitoring Station (miles)[9]	Most Recent Quality-Assured Data[10]
SO_2 (ppb)	1-Hour [1]	75	NA	Shelby County, TN	41	12
	3-Hour	NA	500			—[11]
CO (ppm)	1-Hour [2]	35	NA	Shelby County, TN	41	2.3
	8-Hour [2]	9	NA			1.8
NO_2 (ppb)	1-Hour [3]	100	NA	Crittenden County, AR	25	46
	Annual	53	53			—[11]
Ozone (ppm)	8-Hour [4]	0.075	0.075	Crittenden County, AR	25	0.080
				Shelby County, TN	41	0.079
PM_{10} ($\mu g/m^3$)	24-Hour [5]	150	150	Shelby County, TN	41	41

Table 3.3-7:
Criteria Pollutants, National Ambient Air Quality Standards and Existing Air Quality in Region 6

Air Pollutant	Averaging Period	Primary NAAQS	Secondary NAAQS	Nearest Ambient Monitoring Site(s)	Distance to Nearest Monitoring Station (miles)[9]	Most Recent Quality-Assured Data[10]
$PM_{2.5}$ (µg/m^3)	24-Hour [6]	35	35	Jackson County, AR	5	22
	Annual [7]	12.0	15.0	Jackson County, AR	5	10
Lead (µg/m^3)	3-Month [8]	0.15	0.15	Pulaski County, AR	74	EPA AirData does not publish data

For table notes, see Table 3.3-2.

3.3.5.7 Region 7

Region 7 is referred to as the Arkansas Mississippi River Delta and Tennessee Region and includes the Applicant Proposed Route and HVDC Alternative Routes 7-A through 7-D.The region is generally flat and shares meteorological conditions similar to the lowland areas of Arkansas (NCDC 2014). Much of the area is rural in nature with limited development, although the portions closest to the Memphis area are slightly more developed. Existing air quality monitoring for Region 7 is provided in Table 3.3-8. As stated in Section 3.3.4, Shelby County, Tennessee is designated “marginal nonattainment” with respect to the current ozone NAAQS, and is also a maintenance area with respect to the carbon monoxide NAAQS.

Table 3.3-8:
Criteria Pollutants, National Ambient Air Quality Standards and Existing Air Quality in Region 7

Air Pollutant	Averaging Period	Primary NAAQS	Secondary NAAQS	Nearest Ambient Monitoring Site(s)	Distance to Nearest Monitoring Station (miles)[9]	Most Recent Quality-Assured Data[10]
SO_2 (ppb)	1-Hour [1]	75	NA	Shelby County, TN	11	12
	3-Hour	NA	500			—[11]
CO (ppm)	1-Hour [2]	35	NA	Shelby County, TN	11	2.3
	8-Hour [2]	9	NA			1.8
NO_2 (ppb)	1-Hour [3]	100	NA	Crittenden County, AR	18	46
	Annual	53	53			—[11]
Ozone (ppm)	8-Hour [4]	0.075	0.075	Crittenden County, AR	18	0.080
				Shelby County, TN	11	0.079
PM_{10} (µg/m^3)	24-Hour [5]	150	150	Shelby County, TN	11	41
$PM_{2.5}$ (µg/m^3)	24-Hour [6]	35	35	Crittenden County, AR	18	23
				Shelby County, TN	11	23
	Annual [7]	12.0	15.0	Crittenden County, AR	18	11
				Shelby County, TN	11	10
Lead (µg/m^3)	3-Month [8]	0.15	0.15	Shelby County, TN	11	EPA AirData does not publish data

For table notes, see Table 3.3-2.

3.3.5.8 Connected Actions

3.3.5.8.1 Wind Energy Generation

The WDZs are all located within the Oklahoma Panhandle and the adjacent portions of Texas; therefore, the existing air quality is the same as that discussed in Section 3.3.5.1 for Region 1.

3.3.5.8.2 Optima Substation

The future Optima Substation would be located partially located within the Oklahoma AC Interconnection Siting Area. The existing air quality is the same as discussed in Section 3.3.5.1 for Region 1.

3.3.5.8.3 TVA Upgrades

The ROI for the direct assignment facilities (which are included in the Applicant Proposed Project) would occur within the Tennessee Converter Station Siting Area and more specifically within the Shelby Substation. The ROI for the network upgrades, and in particular TVA's future 500kV transmission line, cannot be fully determined at this time. The new 500kV transmission line would be constructed in western Tennessee. The upgrades to existing facilities would mostly be in western and central Tennessee. Upgrades to existing infrastructure would include upgrading terminal equipment at three existing 500kV substations and six existing 161kV substations, making appropriate upgrades to increase heights on 16 existing 161kV transmission lines to increase line ratings, and replacing the conductors on eight existing 161kV transmission lines. With the exception of Shelby County (see Section 3.3.5.7), none of western and central Tennessee is designated as nonattainment with current NAAQS. Where possible, general impacts associated with the required TVA upgrades are discussed in the impact sections that follow.

3.3.6 Impacts to Air Quality and Climate Change

Construction and operations and maintenance of the Project would involve sources of emissions of air pollutants and GHG emissions. This section is organized as follows:

- Section 3.3.6.1 summarizes the methodology used to quantify emissions.
- Section 3.3.6.2 describes the impacts associated with the Applicant Proposed Project.
- Section 3.3.6.3 describes the impacts associated with the DOE Alternatives.
- Section 3.3.6.4 describes the BMPs for emissions minimization.
- Sections 3.3.6.5 and 3.3.6.6 discuss unavoidable adverse impacts and irreversible and irretrievable commitments of resources, respectively.
- Sections 3.3.6.7 describe the relationship between local short-term uses and long-term productivity.
- Section 3.3.6.8 discusses impacts from connected actions, i.e., the wind farms proposed to be located on the western end of the line.
- Section 3.3.6.9 discusses impacts to air quality and climate change from the No Action Alternative.

3.3.6.1 Methodology

Emissions were estimated by calculating emissions factors (e.g., pounds per horsepower-hour of construction equipment activity, pounds per vehicle mile traveled, etc.) and multiplying by activity data provided by the Applicant (Clean Line 2013). The emission calculation methods, which represent currently accepted techniques, include the following:

- Use of equations in Sections 13.2.1, 13.2.2, and 13.2.3 of EPA's AP-42 publication to estimate fugitive dust emissions from construction (e.g., access roads, transmission line construction, and converter station construction) (EPA 2006b, 2011)
- Use of EPA's NONROAD2008a model (EPA 2009) to estimate emissions from construction equipment exhaust
- Use of factors/equations in Section 11.12 of EPA's AP-42 publication (EPA 2006a) to estimate emissions from portable concrete batch plant emissions during construction
- Construction soil disturbance and wind erosion resulting in fugitive dust emissions were calculated using methods described in WRAP Fugitive Dust Handbook (Countess Environmental 2006)
- Use of EPA's MOVES2010a model (EPA 2012) to estimate vehicle exhaust emissions for worker travel and movement of supplies during construction
- All mileages for worker trip and construction equipment trip calculations were provided by the Applicant

The Applicant provided information with respect to typical pieces of construction equipment (sizes, types, and hours of operation) and on-road vehicle traffic for (a) the construction of converter stations, (b) the construction of every 40 miles of AC collection system line (which were then scaled based on actual mileage), and (c) the construction of every 140 miles of HVDC transmission line (which were then scaled based on actual mileage). Emissions expected from the operations and maintenance phase of the Project would be negligible and would consist of emissions associated with periodic maintenance activities (e.g., worker vehicle trips). Displacement of fossil fuel power production via wind energy generation is an anticipated result from the connected wind energy developments that are anticipated to result from the Project. A qualitative assessment was undertaken to assess the benefits of these developments.

The Applicant has developed a comprehensive list of EPMs that would avoid or minimize impacts to air quality. Implementation of these EPMs is assumed throughout the impact analysis that follows for both the Applicant Proposed Project and the DOE Alternatives. A complete list of EPMs for the Project is provided in Appendix F; those EPMs that would specifically minimize the potential for release or mismanagement of hazardous constituents that could result in an impact on air quality are listed below:

- GE-3: Clean Line will minimize clearing vegetation within the ROW, consistent with a Transmission Vegetation Management Plan filed with NERC, and applicable federal, state, and local regulations. The TVMP may require additional analysis under NEPA depending on whether and under what conditions DOE decides to participate in the Project.
- GE-11: Clean Line will conduct construction, operation, and maintenance activities to minimize the creation of dust. This may include measures such as limitations on equipment, speed, and/or travel routes utilized. Water, dust palliative, gravel, combinations of these, or similar control measures may be used. Clean Line will implement measures to minimize the transfer of mud onto public roads.
- GE-21: Clean Line will maintain construction equipment in good working order. Equipment and vehicles that show excessive emissions of exhaust gasses and particulates due to poor engine adjustments or other inefficient operating conditions will be repaired or adjusted.
- GE-22: Clean Line will impose speed limits during construction for access roads (e.g., to reduce dust emissions, for safety reasons, and for protection of wildlife).
- GE-25: Clean Line will turn off idling equipment when not in use.

3.3.6.2 Impacts Associated with the Applicant Proposed Project

This section describes the potential impacts from the Applicant Proposed Project that would be common to the converter stations, AC interconnection, AC collection system, and HVDC Applicant Proposed Routes.

3.3.6.2.1 Converter Stations and AC Interconnection Siting Areas

Potential impacts from construction and operations and maintenance activities of the Project, including the converter stations and AC interconnections, are described below.

3.3.6.2.1.1 Construction Impacts

Air quality construction emissions would be temporary, lasting up to 42 months for the entire Project, but only 12 months for each converter station. Construction along AC interconnection lines would be shorter duration, with construction lasting for a matter of days to weeks. Although temporary, these emissions could impact sensitive areas nearby. The construction activities that would generate emissions include land clearing, ground excavation, and cut-and-fill operations (see Appendix F for more detail regarding equipment types). The intermittent and short-term emissions generated by these activities would include dust from soil disruption and combustion emissions from the construction equipment. Emissions associated with construction equipment include PM_{10}, $PM_{2.5}$, NO_x, CO, VOCs, SO_x, GHGs, and small amounts of air toxics. Because the emissions for mobile equipment, especially equipment used over wide distances to construct transmission lines, would occur in any one location for a matter of days or weeks, they would result in minor temporary impacts on air quality in the vicinity of ongoing construction activities. Additional information about emissions from construction equipment is included in the sections that follow. Detailed emissions calculations are provided in Appendix H.

3.3.6.2.1.1.1 Converter Stations

Emissions for constructing each of the converter stations are estimated to be approximately the same because the converter station sizes and construction processes are similar. Construction of the converter stations would be completed in three stages: site preparation, foundation installation, and erection of the station. Table 3.3-9 lists the total emissions (from all three stages) for each converter stations from non-road construction equipment exhaust; it does not include emissions from the use of portable concrete batch plants, which are addressed in Section 3.3.6.2.3.

Table 3.3-9:
Converter Station Non-Road Construction Equipment Emissions (Tons per Station)

CO	NO_x	SO_2	VOC	$PM_{10}/PM_{2.5}$	CO_2e
71.2	66.9	0.1	6.9	5.3	13,806.6

Note: Emissions factors obtained from the EPA's NONROAD2008a model (EPA 2009) and $PM_{2.5}$ emissions are conservatively estimated at being equal to PM_{10} emissions. CO_2e refers to emissions of the GHGs CO_2), CH_4, and N_2O, expressed as a weighted total where the weighting is based on the global warming potential of each gas. The global warming potential for CO_2 is 1 (by definition); for CH_4, it is 25, and for N_2O, it is 298.

On-road emissions would result from movement of construction equipment and worker vehicle trips/commutes to/from the construction areas. Because the exact routing and movement of equipment and workers is unknown for each of the converter stations, emissions estimates are based on the same assumptions for each converter station under consideration and were provided by the Applicant. Table 3.3-10 provides the total estimated on-road emissions associated with construction of each converter station.

Table 3.3-10:
Converter Station On-Road Emissions (Tons per Station)

Vehicle/Equipment[1]	CO	NO_x	SO_2	VOC	$PM_{10}/PM_{2.5}$	CO_2e
Construction Equipment Transportation	7.3	5.2	0.0	0.6	0.2/0.2	2,410
Worker Trips/Commutes	7.2	0.9	0.0	0.1	0.0/0.0	738

1 Emissions factors obtained from the EPA's MOVES2010b model (EPA 2012). $PM_{10}/PM_{2.5}$ emissions include brake and tire wear.

Fugitive dust emissions would be generated by construction of each converter station. These emissions would result from both construction and commuter vehicles traveling on area paved and unpaved roadways. Additional fugitive dust emissions would result from construction ground disturbance and wind erosion during construction of each 45- to 70-acre converter station site. Table 3.3-11 provides the estimated fugitive dust calculations for each converter station (based on an assumption of 70 acres per site). Tire and brake wear are accounted for in on-road PM_{10} and $PM_{2.5}$ emissions.

Table 3.3-11:
Converter Station Fugitive Dust Emissions (Tons per Station)

Roadway Type[1]	PM_{10}	$PM_{2.5}$
Paved Roads	9.2	2.3
Unpaved Roads	15.0	1.5
Ground Disturbance and Wind Erosion	46.2	4.6

1 Emissions factors obtained via Project-anticipated vehicle miles traveled for converter stations and by implementing the guidelines in AP 42 Chapter 13 Section 13.2.1 (EPA 2006b) and AP 42 Chapter 13 Section 13.2.2 (EPA 2011). Fugitive dust calculations do not include tire and brake wear. Ground disturbance and wind erosion calculations made using WRAP Fugitive Dust Handbook guidance.

The Tennessee converter station and AC interconnection tie would be located in Shelby County, Tennessee. Shelby County is part of a three-county marginal nonattainment area for ozone (i.e., Crittenden County, Arkansas, Shelby County, Tennessee, and a portion of DeSoto County, Mississippi) and is also a CO maintenance area. If it is determined that in any calendar year emissions of either VOC or NO_x (i.e., ozone precursors) from all Project construction activities within the ozone nonattainment area exceed the General Conformity Rule *de minimis* levels of 100 tons per year (TPY) for NO_x or VOCs, or emissions of CO from Project construction activities within Shelby County exceed the General Conformity Rule threshold of 100 TPY, federal agencies are required to make determinations of general conformity with the State Implementation Plans (SIPs) in accordance with the requirements in 40 CFR Part 93, Subpart B. Construction of the converter stations could overlap with construction of the Applicant Proposed Route in Shelby County, Tennessee. Therefore, of these three nonattainment pollutants, as shown in Tables 3.3-9 and 3.3-10, CO is the pollutant emitted in the highest quantity by construction equipment at the converter station and NO_x is the pollutant emitted in the highest quantity by construction equipment for the HVDC transmission line (as described in Section 3.3.6.2.4). However, only 5 miles of Applicant Proposed Route would be constructed in Shelby County, TN. Therefore total emissions from construction of the Applicant Proposed converter station and HVDC transmission line within Shelby County, Tennessee, would be 83 tons of NO_x. These emissions estimates would be even lower as the Applicant intends to distribute these activities over an estimated 2-year construction period, such that emissions in each year would be even further below *de minimis* level of 100 TPY; therefore, a general conformity determination is not required.

3.3.6.2.1.2 Operations and Maintenance Impacts

During the operations and maintenance phase of the Project, the converter stations and AC interconnection would emit negligible air pollutants. Standard operation of the converter stations and AC interconnection would not emit air pollutants, but maintenance activities would emit small amounts of pollutants associated with combustion of fossil fuels for worker vehicles and equipment. Converter station gas insulated switchgear may contain sulfur hexafluoride, a potent GHG. However, with BMPs implemented sulfur hexafluoride emissions would be negligible to nonexistent. As a result, levels below the *de minimis* thresholds are anticipated from operation or maintenance of the converter stations and AC interconnection.

3.3.6.2.1.3 Decommissioning Impacts

Decommissioning of the Project may occur at the end of its functional usefulness. Although details of decommissioning cannot be predicted, it is generally estimated that decommissioning emissions would be similar to (or less than) those associated with construction. The Applicant would create a Decommissioning Plan before decommissioning the Project.

3.3.6.2.2 AC Collection System

Construction of the proposed AC collection system, located in Region 1, would result in air quality and GHG emissions. Construction of AC collection system would be completed in discrete stages: ROW clearing, access roads and pad construction, foundation installation, structure lacing, structure setting, wire stringing, and restoration in addition to other support of these operations such as compliance monitoring and refueling. Because the exact routing and movement of equipment and workers is unknown for each of the AC collection system route alternatives, the analyses in this section are based on the same assumptions for each alternative under consideration. Total emissions associated with construction of the AC collection system route alternatives were calculated on a combined basis for all construction phases. Table 3.3-12 lists the estimated non-road emissions of criteria pollutants and CO_2e that would be generated by each 40-mile segment of AC transmission line construction—excluding emissions from concrete batch plants (which are addressed in Section 3.3.6.2.3. Emissions would not be localized, taking place across 40-mile segments, and therefore are not anticipated to cause or significantly contribute to a violation of an applicable ambient air quality standard or contribute substantially to an existing or projected air quality violation.

Table 3.3-12:
Non-Road Construction Equipment Emissions (Tons) per 40-Mile Segment of AC Collection System

	CO	NO_x	SO_2	VOC	$PM_{10}/PM_{2.5}$	CO_2e
Non-Road Emissions	17.7	39.1	0.1	3.7	2.5	7,598.1

Note: Emissions factors obtained from the EPA's NONROAD2008a model (EPA 2009) and $PM_{2.5}$ emissions are conservatively estimated at being equal to PM_{10} emissions.

Total emissions for each AC collection system route were calculated by taking the distance of each AC transmission line, dividing by 40 miles, and multiplying by the values in Table 3.3-12. Table 3.3-13 provides the results of this analysis (excluding those associated with portable concrete batch plants) and shows that the highest emissions would be associated with AC Collection System Route NW-2 (the longest) and the lowest emissions would be associated with AC Collection System Route SW-1 (the shortest).

Table 3.3-13:
AC Collection System Routes Non-Road Construction Equipment Emissions (Tons) by Route

AC Collection	Length (miles)	Pollutant Emissions (tons)					
		CO	NOx	SO2	VOC	$PM_{10}/PM_{2.5}$	CO2e
E-1	28.9	12.4	27.4	0.0	2.6	1.8	5318.7
E-2	39.8	17.7	39.1	0.1	3.7	2.5	7598.1
E-3	40.0	17.7	39.1	0.1	3.7	2.5	7598.1
NE-1	30.1	14.2	31.3	0.0	3.0	2.0	6078.5
NE-2	26.3	12.4	27.4	0.0	2.6	1.8	5318.7
NW-1	51.9	23.0	50.9	0.1	4.8	3.3	9877.6
NW-2	56.0	24.8	54.8	0.1	5.2	3.5	10637.4
SE-1	40.3	17.7	39.1	0.1	3.7	2.5	7598.1
SE-2	13.4	5.3	11.7	0.0	1.1	0.8	2279.4
SE-3	49.1	21.2	47.0	0.1	4.4	3.0	9117.8
SW-1	13.4	5.3	11.7	0.0	1.1	0.8	2279.4
SW-2	37.0	15.9	35.2	0.1	3.3	2.3	6838.3
W-1	20.7	8.9	19.6	0.0	1.9	1.3	3799.1

On-road emissions would result from movement of construction equipment and worker vehicle trips/commutes to/from the construction areas (including those associated with transporting portable concrete batch plants). Table 3.3-14 provides the estimated on-road emissions associated with construction of each 40-mile segment of AC transmission line (including those associated with transporting portable concrete batch plants); these are substantially lower than the non-road emissions identified in Table 3.3-12.

Table 3.3-14:
AC Collection System Routes On-Road Emissions (Tons) per 40-Mile Segment

Vehicle/Equipment	CO	NO_x	SO_2	VOC	$PM_{10}/PM_{2.5}$	CO_2e
Construction Equipment Transport	2.4	5.4	0.0	0.4	0.2/0. 2	2,159
Worker Trips/Commutes	5.0	0.6	0.0	0.1	0.0/0.0	542

Notes: Emissions factors obtained from the EPA's MOVES2010b model (EPA 2012). $PM_{10}/PM_{2.5}$ emissions include brake and tire wear.

Fugitive dust emissions would result from construction of the AC transmission lines. These emissions would result from both construction and commuter vehicles traveling on area paved and unpaved roadways. Table 3.3-15 provides the fugitive dust calculations for a representative 1-mile and 40-mile segment of AC line construction (excluding those associated with use of concrete batch plants), respectively. Construction of the AC transmission line would be localized, so these representative segment lengths of transmission line ROW construction provide a range for comparative purposes. In reality, construction of any given segment of AC transmission line would generally result in ground disturbance along the ROW between 5 and 10 miles in length. Although the values are relatively high, it should be recognized that it is widely known that there are several technical issues associated with the quantification of fugitive dust and they may overstate air quality impacts. For example, although regional emissions inventories typically show fugitive dust as the predominant source of PM emissions, chemical analyses of ambient PM concentrations shows that fugitive dust is a minor contributor to ambient PM concentrations, perhaps because a large fraction of fugitive dust from roadways is not suspendable and/or transportable over long distances (Watson and

Chow 2000; Countess Environmental 2001). As a result, EPA transportation conformity regulations allow re-entrained road dust and construction-related fugitive dust to be excluded from emissions evaluations unless they have been identified as significant contributors to ambient PM concentrations.[1]

Table 3.3-15:
AC Collection System Route Fugitive Dust Emissions (Tons) per 1-mile and 40-Mile Segments

Representative Segment	Fugitive Dust Emission Source	PM_{10}	$PM_{2.5}$
1-Mile of AC Collection System Route	Paved Roads	0.1	0.0
	Unpaved Roads	1.4	0.1
	Ground Disturbance and Wind Erosion	1.3	0.1
40-Mile of AC Collection System Route	Paved Roads	5.1	1.3
	Unpaved Roads	54.0	5.4
	Ground Disturbance and Wind Erosion	640.0	64.0

Note: Emissions factors obtained via Project anticipated vehicle miles traveled for converter stations and by implementing the guidelines in AP 42 Chapter 13 Section 13.2.1 (EPA 2011) and AP 42 Chapter 13 Section 13.2.2 (EPA 2006b). Fugitive dust calculations do not include tire and brake wear. Ground disturbance and wind erosion calculations made using WRAP Fugitive Dust Handbook guidance. Forty-mile segment emissions were estimated for 12-month period and 1-mile segment emissions were estimated for 1-month duration.

Fugitive dust emissions, including wind erosion and ground disturbance, associated with construction of each of the AC collection system routes were calculated by scaling the 40-mile emissions values in Table 3.3-15 to the distance of each AC line. Table 3.3-16 provides the results of this analysis and shows that the highest fugitive dust emissions would be associated with AC Collection System Route SE-3 and the lowest would be associated with AC Collection System Route SW-1. Brake and tire wear are accounted for in on-road emissions.

Table 3.3-16:
AC Collection System Routes Fugitive Dust Emissions (Tons)

Route	Length (Miles)	PM_{10}	$PM_{2.5}$
E-1	28.9	516.3	52.3
E-2	39.8	702.1	71.0
E-3	40.0	704.2	71.2
NE-1	30.1	531.7	53.8
NE-2	26.3	467.3	47.3
NW-1	51.9	905.3	91.4
NW-2	56.0	974.8	98.4
SE-1	40.3	705.9	71.3
SE-2	13.4	249.6	25.4
SE-3	49.1	855.3	86.4
SW-1	13.4	249.7	25.4
SW-2	37.0	651.4	65.9
W-1	20.7	376.7	38.2

[1] 40 CFR Part 93 Subpart A, §93.119(f)(8), §93.122(e), §93.122(f).

3.3.6.2.2.1 Operations and Maintenance Impacts

Operations and maintenance of the AC collection system routes would result in negligible amounts of air pollutants. Standard operation of the AC transmission lines would not emit air pollutants, but maintenance activities would emit small amounts of pollutants associated with combustion of fossil fuels for worker vehicles and equipment. As a result, inconsequential impacts are anticipated from operations or maintenance of the AC collection system routes.

3.3.6.2.2.2 Decommissioning Impacts

Decommissioning of the Project—i.e., the partial and/or total removal of built structures—may occur at the end of its functional usefulness. Although details of decommissioning cannot be predicted, it is generally estimated that emissions associated with decommissioning would be similar to (or less than) those associated with construction (in part because tearing things down involves less effort than erecting them, and in part because it is assumed that decommissioning would occur many years in the future, when the engines used are likely to be lower-emitting). The Applicant would create a Decommissioning Plan before decommissioning the Project.

3.3.6.2.3 Portable Concrete Batch Plants

Access to concrete would be required at approximate 60-mile intervals along the transmission line corridor. The Applicant would use local concrete plants where possible. Construction of the Project may require the use of portable concrete batch plants. The Applicant has indicated where the haul distance exceeds 25 to 30 miles the use of portable concrete batch plants is anticipated. The construction of concrete batch plants would result in air quality and GHG emissions. Table 3.3-17 lists the estimated non-road emissions of criteria pollutants and CO_2e for each portable concrete batch plant. At this time it is unknown where each portable concrete batch plant would be required and located; however, the emission levels associated with construction of each batch plant would be negligible relative to the emissions identified in Sections 3.3.6.2.1 and 3.3.6.2.2.

Table 3.3-17:
Portable Concrete Batch Plant Non-Road Construction Equipment Emissions (Tons)

CO	NO_x	SO_2	VOC	PM_{10}/PM2.5	CO_2e
0.3	0.8	0.0	0.1	0.1	205

Note: Emissions factors obtained from the EPA's NONROAD2008a model (EPA 2009) and $PM_{2.5}$ emissions are conservatively estimated at being equal to PM_{10} emissions.

Fugitive dust emissions would result from construction of the portable concrete batch plants. These emissions would result from both construction and commuter vehicles traveling on paved and unpaved roadways and are predicted to be 0.67 ton of PM_{10} and 0.07 tons of $PM_{2.5}$. These emissions impacts would be temporary and low level, so they would be considered minor. Fugitive dust calculations do not include tire and brake wear.

Operation of each portable concrete batch plant during construction would result in emissions of particulate matter (PM_{10} and $PM_{2.5}$). The Applicant has identified that fugitive dust from (a) unloading cement and cement supplement to silos, (b) mixer loading, and (c) truck loading would all be controlled (e.g., by fabric filter for silo loading, and by water sprays, enclosures, hoods, curtains, shrouds, movable and telescoping chutes, central duct collection systems, etc.), and that the total throughput for all of the portable concrete batch plants would be approximately 3,030 tons of cement and 450 tons of cement supplement (Clean Line 2013). Like other emissions associated with construction, because they would be temporary and would result in low emissions (0.2 ton of PM_{10} and 0.02 ton of $PM_{2.5}$), impacts are expected to be minor.

On-road emissions estimates for the portable concrete batch plants (excluding fugitive dust) are included in the respective transmission line analysis (e.g., AC or HVDC).

3.3.6.2.4 HVDC Applicant Proposed Route

Air quality emissions from construction and operation would potentially result from construction of the HVDC Applicant Proposed Route.

3.3.6.2.4.1 Construction Impacts

Construction of the Applicant Proposed Route would result in criteria air pollutant and GHG emissions. Construction of the proposed HVDC transmission line would be completed in discrete stages: ROW clearing; access roads and pad construction; foundation installation; structure lacing; structure setting; wire stringing; restoration; in addition to other support of these operations such as compliance monitoring and refueling. Because the exact routing and movement of equipment and workers is unknown by region, emissions would be based on the same assumptions for each of the regions. Total emissions for each region were considered regardless of construction stage or phase. Table 3.3-18 lists the estimated non-road emissions that would be generated by each 140-mile segment of HVDC transmission line (see Section 2.1.4) construction (excluding concrete batch plant emissions). Construction of the transmission line would occur in one continuous operation, so emissions would be localized in and have been assumed to take place within 140-mile segments along the HVDC transmission line. Because the emissions would be temporary and are for mobile equipment spread out over wide distances, they would result in minor temporary impacts on air quality in the vicinity of construction activities.

Table 3.3-18:
Non-Road Construction Equipment Emissions (Tons) per 140-Mile Segment of HVDC Line
(compared to 140-mile segment of Interstate 40 for perspective)

	CO	NO_x	SO_2	VOC	PM_{10}/PM2.5	CO_2e
Construction Equipment Emissions	61.2	134.4	0.2	12.8	8.7	26,031

Note: Emissions factors obtained from the EPA's NONROAD2008a model (EPA 2009) and $PM_{2.5}$ emissions are conservatively estimated at being equal to PM_{10} emissions; Interstate 40 is assumed to have traffic volume of 20,000 vehicles per day

Total estimated emissions for the Applicant Proposed Route in each region were derived by scaling the emissions for a 140-mile segment to the length of the actual route (in miles). Table 3.3-19 provides the results of this analysis.

Table 3.3-19:
HVDC Line Alternatives Non-Road Construction Equipment Emissions (Tons) by Alternative

		Pollutant Emissions (Tons)					
Route	Length (miles)	CO	NO_x	SO_2	VOC	PM_{10}/$PM_{2.5}$	CO_2e
APR Region 1	115.46	50.5	110.8	0.2	10.5	7.2	21,468
APR Region 2	105.97	46.4	101.7	0.2	9.7	6.6	19,704
APR Region 3	161.69	70.7	155.2	0.2	14.8	10.1	30,064
APR Region 4	126.28	55.2	121.2	0.2	11.5	7.9	23,480
APR Region 5	112.8	49.3	108.2	0.2	10.3	7.0	20,974
APR Region 6	54.36	23.8	52.2	0.1	5.0	3.4	10,108
APR Region 7	42.83	18.7	41.1	0.1	3.9	2.7	7,964

Estimated on-road emissions would result from movement of construction equipment and worker vehicle trips/commutes to/from the construction areas. Table 3.3-20 provides the on-road emissions associated with construction of each 140-mile segment of the Applicant Proposed Route.

Table 3.3-20:
On-Road Construction Equipment Emissions (Tons) per 140-Mile Segment of HVDC Line

Vehicle/Equipment	CO	NO_x	SO_2	VOC	$PM_{10}/PM_{2.5}$	CO_2e
Construction Equipment	8.4	18.9	0.1	1.6	0.7/0.7	7,557
Worker Trips/Commutes	18.4	2.2	0.0	0.4	0.1/0.0	1,896

Note: Emissions factors obtained from the EPA's MOVES2010b model (EPA 2012). $PM_{10}/PM_{2.5}$ emissions include brake and tire wear. See

Fugitive dust emissions would result from construction of the Applicant Proposed Route. These emissions would result from both construction and commuter vehicles traveling on local paved and unpaved roadways. Table 3.3-21 provides the estimated fugitive dust calculations for a representative 1-mile and 140-mile segment of HVDC transmission line construction, respectively. Construction of the HVDC transmission line would be localized, so these representative segment lengths of transmission line ROW construction provide a range for comparative purposes. In reality, construction of any given segment of HVDC transmission line would generally result in ground disturbance along the ROW between five and 10 miles in length.

Table 3.3-21:
Fugitive Dust Emissions (Tons) per 140-Mile Segment of HVDC Line

Representative Segment	Fugitive Dust Emission Source	PM_{10}	$PM_{2.5}$
1-Mile of AC Collection System Route	Paved Roads	0.1	0.0
	Unpaved Roads	1.4	0.1
	Ground Disturbance and Wind Erosion	1.3	0.1
40-Mile of AC Collection System Route	Paved Roads	18.1	4.4
	Unpaved Roads	189.1	18.9
	Ground Disturbance and Wind Erosion	2,240.0	224.0

Note: Emissions factors obtained via Project anticipated vehicle miles traveled for converter stations and by implementing the guidelines in AP 42 Chapter 13 Section 13.2.1 (EPA 2011) and AP-42 Chapter 13 Section 13.2.2 (EPA 2006b). Fugitive dust calculations do not include tire and brake wear. Ground disturbance and wind erosion calculations made using WRAP Fugitive Dust Handbook guidance. 140-mile segment emissions estimated for 12 month period, 1-mile segment emissions estimated for 1-month duration.

Fugitive dust emissions for each region of the Applicant Proposed Route were calculated by taking the distance of each HVDC transmission line, dividing by 140 miles, and multiplying by the emissions shown in Table 3.3-21. Table 3.3-22 provides the results of this analysis. Tire and brake wear are accounted for in on-road emissions.

Table 3.3-22:
HVDC Line Alternatives Fugitive Dust Emissions (Tons)

Route	Length (miles)	PM_{10}	$PM_{2.5}$
APR Region 1	115.5	2,049.3	207.3
APR Region 2	106.0	2,026.4	204.9
APR Region 3	161.7	2,833.4	286.2
APR Region 4	126.3	2,232.3	225.7
APR Region 5	112.8	2,003.4	202.7

Table 3.3-22:
HVDC Line Alternatives Fugitive Dust Emissions (Tons)

Route	Length (miles)	PM_{10}	$PM_{2.5}$
APR Region 6	54.4	1,007.6	196.6
APR Region 7	42.8	809.7	82.5

3.3.6.2.4.2 Operations and Maintenance Impacts

Operations and maintenance of the Applicant Proposed Route would emit negligible amounts of air pollutants. Standard operation of the transmission lines would not emit air pollutants, but maintenance activities would result in very low level temporary emissions of pollutants associated with combustion of fossil fuels for worker vehicles and equipment. As a result, negligible impacts would be anticipated from construction or operations and maintenance of the Applicant Proposed Route.

3.3.6.2.4.3 Decommissioning Impacts

Decommissioning of the Project may occur at the end of its functional usefulness. Although details of decommissioning cannot be predicted, it is generally estimated that decommissioning emissions would be similar to (or less than) those associated with construction. The Applicant would create a Decommissioning Plan before decommissioning the Project.

3.3.6.3 Impacts Associated with the DOE Alternatives

Air quality emissions were calculated for the DOE Alternatives.

3.3.6.3.1 Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area

Predicted air quality emissions from the construction, operations and maintenance, and decommissioning of the Arkansas converter station would be approximately the same as those described in Section 3.3.6.2.1 for each of the Applicant Proposed Project converter stations because this converter station would be of similar size and all would be constructed following the same process. Additionally, the emission estimates for the Arkansas converter station account for the new substation that would be required at the point where the 500kV AC interconnection line taps the existing Arkansas Nuclear One-Pleasant Hill 500kV line.

3.3.6.3.2 HVDC Alternative Routes

Construction and operational impacts from the HVDC alternative routes would be similar to those of the Applicant Proposed Route, the only variation being the amount of air quality emissions based on the respective length of each HVDC alternative route. Operationally, air quality emissions for each HVDC alternative route would be the same as those described in Section 3.3.6.2.4 for the Applicant Proposed Route.

3.3.6.3.2.1 Construction Impacts

The HVDC alternative routes would use the same construction approaches described in Section 3.3.6.2.4. Air quality emissions would vary with the length of each HVDC alternative route. Table 3.3-23 provides the air quality emissions for each HVDC alternative route and Table 3.3-24 provides fugitive dust emissions for each alternative. Brake and tire wear are included in on-road emissions.

Table 3.3-23:
Non-Road Construction Equipment Emissions (Tons)—HVDC Alternative Routes

Route	Length (miles)	Pollutant Emissions (tons)					
		CO	NO_x	SO_2	VOC	PM_{10}/PM2.5	CO_2e
Region 1							
AR 1-A	123.0	53.8	118.0	0.2	11.2	7.7	22,864.7
AR 1-B	51.9	22.7	49.8	0.1	4.7	3.2	9,642.7
AR 1-C	52.0	22.8	49.9	0.1	4.8	3.2	9,674.3
AR 1-D	33.5	14.6	32.1	0.1	3.1	2.1	6,219.6
Region 2							
AR 2-A	57.2	25.0	54.9	0.1	5.2	3.6	10,628.2
AR 2-B	29.8	13.0	28.5	0.0	2.7	1.9	5,531.6
Region 3							
AR 3-A	37.6	16.5	36.1	0.1	3.4	2.3	6,993.1
AR 3-B	47.7	20.9	45.8	0.1	4.4	3.0	8,874.8
AR 3-C	121.6	53.2	116.7	0.2	11.1	7.6	22,615.6
AR 3-D	39.3	17.2	37.7	0.1	3.6	2.5	7,312.9
AR 3-E	8.5	3.7	8.1	0.0	0.8	0.5	1,578.6
Region 4							
AR 4-A	58.4	25.5	56.0	0.1	5.3	3.6	10,858.8
AR 4-B	78.6	34.4	75.4	0.1	7.2	4.9	14,614.7
AR 4-C	3.4	1.5	3.2	0.0	0.3	0.2	626.6
AR 4-D	25.3	11.1	24.3	0.0	2.3	1.6	4,707.9
AR 4-E	36.7	16.1	35.2	0.1	3.4	2.3	6,827.6
Region 5							
AR 5-A	12.6	5.5	12.1	0.0	1.2	0.8	2,346.5
AR 5-B	71.0	31.0	68.1	0.1	6.5	4.4	13,194.1
AR 5-C	9.2	4.0	8.8	0.0	0.8	0.6	1,708.8
AR 5-D	21.7	9.5	20.8	0.0	2.0	1.4	4,036.7
AR 5-E	36.3	15.9	34.8	0.1	3.3	2.3	6,742.1
AR 5-F	22.3	9.8	21.4	0.0	2.0	1.4	4,152.0
Region 6							
AR 6-A	16.2	7.1	15.5	0.0	1.5	1.0	3,008.5
AR 6-B	14.1	6.2	13.5	0.0	1.3	0.9	2,623.6
AR 6-C	23.1	10.1	22.2	0.0	2.1	1.4	4,298.9
AR 6-D	9.2	4.0	8.8	0.0	0.8	0.6	1,701.3
Region 7							
AR 7-A	43.2	18.9	41.5	0.1	3.9	2.7	8,039.9
AR 7-B	8.6	3.8	8.3	0.0	0.8	0.5	1,600.9
AR 7-C	23.8	10.4	22.9	0.0	2.2	1.5	4,430.9
AR 7-D	6.5	2.9	6.3	0.0	0.6	0.4	1,216.0

Table 3.3-24:
HVDC Alternatives Fugitive Dust Emissions (Tons)

Route	Length (miles)	PM_{10}	$PM_{2.5}$
Region 1			
AR 1-A	123.0	2,173.5	208.0
AR 1-B	51.9	963.4	14.2
AR 1-C	52.0	966.3	14.3
AR 1-D	33.5	650.1	12.3
Region 2			
AR 2-A	57.2	1,052.7	199.8
AR 2-B	29.8	626.3	12.0
Region 3			
AR 3-A	37.6	719.8	73.4
AR 3-B	47.7	892.4	90.8
AR 3-C	121.6	2,148.8	217.3
AR 3-D	39.3	747.6	76.2
AR 3-E	8.5	223.7	23.5
Region 4			
AR 4-A	58.4	1,073.5	218.7
AR 4-B	78.6	1,417.9	17.0
AR 4-C	3.4	136.3	9.2
AR 4-D	25.3	509.6	11.5
AR 4-E	36.7	704.6	12.7
Region 5			
AR 5-A	12.6	293.9	30.5
AR 5-B	71.0	1,287.1	130.5
AR 5-C	9.2	235.4	24.7
AR 5-D	21.7	448.2	46.1
AR 5-E	36.3	696.1	71.0
AR 5-F	22.3	458.5	47.1
Region 6			
AR 6-A	16.2	354.7	36.7
AR 6-B	14.1	318.5	33.0
AR 6-C	23.1	473.2	48.6
AR 6-D	9.2	234.7	24.6
Region 7			
AR 7-A	43.2	812.7	82.8
AR 7-B	8.6	225.1	23.6
AR 7-C	23.8	482.4	49.5
AR 7-D	6.5	190.0	20.1

3.3.6.3.2.2 Operations and Maintenance Impacts

Operations and maintenance of any of the HVDC alternative routes would emit negligible air pollutants similar to those described in Section 3.3.6.2.4 for the Applicant Proposed Route.

3.3.6.3.2.3 Decommissioning Impacts

Decommissioning of the Project would be the same as those described in Section 3.3.6.2.4 for the Applicant Proposed Route.

3.3.6.4 Best Management Practices

In addition to the EPMs developed by the Applicant the following BMPs have been identified to control fugitive dust, emissions associated with mobile and stationary sources, and potential emissions of sulfur hexafluoride.

To reduce the impacts associated with blowing fugitive dust and/or under windy conditions, the following BMPs have been identified:

- Stabilize spoil piles and sources of fugitive dust by implementing control measures, such as covering and/or applying water or chemical/organic dust palliative where appropriate at active and inactive sites during workdays, weekends, holidays, and windy conditions. EPA (1995) lists common sources of fugitive dust as unpaved roads, agricultural tilling operations, aggregate storage piles, and heavy construction operations; all but agricultural tilling operations would apply to the Project and require appropriate control measures.
- Install wind fencing and phase grading operations where appropriate, and operate water trucks for stabilization of surfaces under windy conditions.
- Prevent spillage when hauling spoil material.
- In active construction areas including access roads, Limit speeds of non-earth-moving equipment to 15 miles per hour. Limit speed of earth-moving equipment to 10 mph.

To mitigate emissions resulting from mobile and stationary sources, the following BMPs have been identified:

- Plan construction scheduling to minimize vehicle trips.
- Limit idling of heavy equipment to less than 5 minutes unless needed for the safe operation of the equipment and verify through unscheduled inspections.
- Maintain and tune engines per manufacturer's specifications to perform at EPA certification levels, prevent tampering of source engines (i.e., knowingly disabling an emission control system component or element of design of a certified engine so that it no longer meets the manufacturer’s specifications), and conduct unscheduled inspections to ensure these measures are followed.

The quantity of sulfur hexafluoride emissions from maintenance activities (and potential leaks in equipment) would be minimized through the use of hermetically sealed equipment, leak detection programs, and sulfur hexafluoride recycling programs.

3.3.6.5 Unavoidable Adverse Impacts

No unavoidable adverse impacts to air quality are anticipated to result from the Project.

3.3.6.6 Irreversible and Irretrievable Commitment of Resources

No irreversible and irretrievable commitments of air quality resources are anticipated to result from the Project.

3.3.6.7 Relationship between Local Short-term Uses and Long-term Productivity

Emissions from construction of the Project are not predicted to impact sensitive receptors and also would not impact long-term productivity. While over the short-term emissions from construction would be higher in localized areas—because the Project provides for development of non-fossil fuel energy sources over the long term—air quality would be improved in comparison to not building the Project.

3.3.6.8 Impacts from Connected Actions

3.3.6.8.1 Wind Energy Generation

The impacts from the wind energy generation facilities that would interconnect to the Project as a result of the Project being built were qualitatively assessed because precise wind energy developments have not been identified that may result after the Project is constructed. The anticipated wind energy developments are all located within the Region 1 Oklahoma Panhandle and the adjacent portions of Texas. Although site-specific layouts of wind energy generation facilities in the wind energy development zones identified in Region 1 have yet to be designed, information regarding air emissions impacts from these potential wind energy generation facilities has been provided by the Applicant (Clean Line 2014). Emissions from construction activities were calculated based on techniques similar to those that were used to analyze impacts from the Applicant Proposed Project and DOE Alternatives. The potential impacts would be more than compensated for by reductions in emissions associated with the fact that wind energy projects generate nominal emissions, such as those from maintenance activities, and the power generated by wind energy would displace power that could otherwise be generated from fuel combustion. The benefit to air quality of these wind energy developments via displacing fossil fuel energy sources would outweigh the temporary construction air quality impacts. Section 3.3.6.8.1.2 provides qualitative analysis of the air quality emissions that may be expected from wind energy developments.

3.3.6.8.1.1 Construction Impacts

Construction of wind farms would result in criteria air pollutant and GHG emissions via engines burning fossil fuels. Fugitive dust would also result from construction of wind farms. Construction equipment emissions would be intermittent and generated in relatively small areas confined to the areas of wind farm construction. Construction planners estimate that the erection of wind farms requires roughly 150,000 gallons of fuel (approximately 85 percent diesel, 15 percent gasoline) per 100MW of capacity constructed (Repholz 2014). The GHG emissions associated with construction of 4,000–4,550MW of generating capacity is therefore approximately 66,000 to 75,000 tons CO_2e;[2] the corresponding emissions of NO_x, the most prevalent criteria pollutant in the exhaust of construction equipment, would depend on the exact mix of equipment but would be in the neighborhood of 300 to 600 tons.[3] These

[2] This calculation is based on fuel heating values and GHG emission factors in 40 CFR Part 98, Subpart C.

[3] The lower end of this range is based on an average NO_x emissions rate of approximately 0.74 pound per one million British thermal units (mmBtu) of heat input for 4,000MW of generation; the higher end is based on an average NOx emissions rate of approximately 1.3 lb/mmBtu for 4,550MW of generation.

construction emissions would be temporary, and are not expected to contribute to substantially increased air pollutant concentrations.

Dust suppressants would be implemented to reduce fugitive dust emissions during construction of the wind farms. Typically, impacts related to fugitive dusts during construction of wind farms are reduced through the use of dust palliatives and through micrositing the turbines and related components in such a way to minimize or eliminate potential temporary impacts.

3.3.6.8.1.2 Operations and Maintenance Impacts

Operational impacts to air quality associated with the wind farms are expected to be beneficial, because operations and maintenance of wind farms would result in negligible emissions (Clean Line 2014), whereas much of the electricity generated today is produced with fossil fuels such as coal or natural gas. The Applicant used a commercially available simulation model (PROMOD version 10.1) to determine a best estimate of which power sources would be displaced and what the corresponding emissions reduction would be. The Applicant used the Ventyx East NERC version 9.4 root database and updated the database to reflect expected 2018 market conditions as of May/June 2013, when the simulation work began. The model updates included but were not limited to transmission upgrades to reflect ISO transmission plans, market membership changes (e.g., Entergy joining MISO), then-current natural gas forecast, and recently announced coal plant retirements. The model provided a best estimate of displaced emissions as follows: approximately 0.00058 pounds NO_x/megawatt hours (MWh), 0.0017 pounds SO_x/MWh, 0.707 pounds CO_2/MWh, and 0.0000114 pounds mercury/MWh. Using these displaced emissions rates with the range of megawatts of anticipated power production from wind energy as identified in Section 2.5.1 (4,000MW from the wind farm build-out and 4,550MW with the addition of the Arkansas converter station alternative), calculations of displaced emissions were calculated as follows:

- NO_x, 9,800 to 11,100 TPY
- SO_x 29,000 to 33,000 TPY
- CO_2e 12 to 14 million TPY
- Mercury 0.1 TPY (approximate)

These reductions in emissions occur each year, and even 1 year of emissions reduction far exceeds the combined emissions increases associated with the construction of the Project and the wind farms. Although the emissions reduction from this single project is small relative to the 7,249 million tons CO_2e (6,576 million metric tonnes) emitted by anthropogenic sources in the United States in 2009, the electric power generation sector contributes approximately 40 percent of those emissions (EIA 2011) and the implementation of lower-GHG electricity generation is therefore an important component of achieving significant GHG emissions reductions both nationally and globally. Currently, there is no methodology that would allow DOE to estimate the specific impacts (if any) this increment of climate change would produce in the vicinity of the facility or elsewhere.

3.3.6.8.2 Optima Substation

Operationally the Substation would not result in air quality impacts. Construction emissions would be similar to those for the Project or DOE alternative converter stations and therefore would not result in exceedance of the NAAQS. Therefore, no impacts to air quality are anticipated from construction of the future Optima Substation.

3.3.6.8.3 TVA Upgrades

Upgrades required to interconnect into the TVA transmission grid could involve potential impacts to air quality for the new transmission line, upgrades to existing lines, and modifications to substations. These impacts would be similar to those described in detail in Section 3.3.6 for the Project. For upgrades to or new transmission lines and modifications to substations air quality and climate change impacts of concern would be associated primarily with construction and include fugitive dust emissions and exhaust from construction equipment and vehicles. Air emissions during construction would be intermittent and short term, with anticipated minor temporary impacts on air quality near the construction activities. The TVA upgrades would be anticipated to result in negligible air quality impacts because they would be temporary and not contribute to air quality impacts on a continued basis.

If the new or upgraded transmission lines or substation modifications occur in areas classified as nonattainment with respect to any of the air quality standards, they would be subject to provisions of regulatory requirements.

The TVA upgrades would be expected to result in negligible contributions of GHGs during short-term construction activities, similar to the Project.

3.3.6.9 Impacts from the No Action Alternative

Under the No Action Alternative, DOE assumes for analytical purposes that the Project would not be constructed or operated, so no emissions would be associated with any activities related to the Project and no emissions reduction associated with the displacement of fossil-fueled power generation by the wind generation associated with the Project.

This page intentionally left blank.

Contents

Tables

Figures Presented in Text*

*Other EIS figures presented in Appendix A.

3.4 Electrical Environment

The Project includes the following electrical facilities associated with the electrical environment:

- Applicant Proposed Project:
  - A ±600kV HVDC overhead electric transmission line with the capability to deliver approximately 3,500MW (utilizing two proposed line design configurations) along a preferred route
  - Two AC/DC converter stations (one in Oklahoma and another in Tennessee)
  - One double circuit AC transmission line of up to 345kV to connect the Oklahoma converter station
  - Two 500kV AC transmission lines to connect the Tennessee converter station
  - Four to six AC transmission lines of up to 345kV for the AC Collection System in Oklahoma and Texas
- DOE Alternatives:
  - A ±600kV HVDC overhead electric transmission line utilizing alternative routes
  - One AC/DC converter station (in Arkansas)
  - One 500kV AC transmission line to connect the Arkansas converter station (if constructed)

Detailed information regarding the transmission line configurations and convertor stations can be referenced in Chapter 2. The electrical environment evaluation involves analysis of the following electrical effects:

- DC electric fields
- AC electric fields
- DC magnetic fields
- AC magnetic fields
- Audible noise
- Radio and television noise interference
- Ozone and air ions

The following sections describe each of these electrical effects and how they relate to electrical facilities such as transmission lines.

3.4.1 Electric Fields

Voltage (electrical pressure) on an object causes an electric field. Any object with an electric charge on it has a voltage at its surface, caused by the accumulation of more electrons on that surface as compared with another object or surface. The voltage effect is not limited to the surface of the object but exists in the space surrounding the object in diminishing intensity. Electric fields can exert a force on other electric charges at a distance. The change in voltage over distance is known as the electric field. The units describing an electric field are volts per meter (V/m) or thousands of volts per meter (kilovolts per meter or kV/m). These units are measures of the difference in electrical voltage that exists between two points 1 meter apart (about 3 feet apart). The electric field becomes stronger near a charged object and decreases with distance away from the object. The electric field is a vector having both magnitude and direction as shown in Figure 3.4-1.

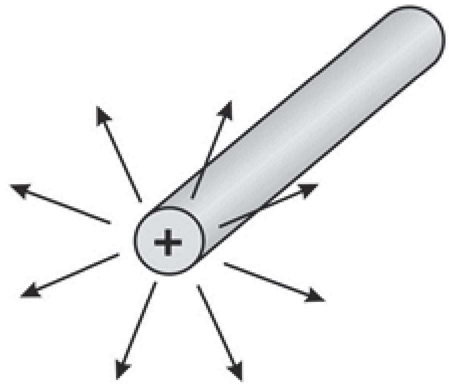


Figure 3.4-1: Electric Field around a Conductor

3.4.1.1 DC Electric Fields

Static or DC electric fields are very common phenomena. The earth creates a natural static electric field in fair weather that is a result of the 300,000 to 400,000 volt potential difference between the ionosphere and the surface of the earth (Veimeister 1972). The normal fair weather static electric field of the earth varies from month to month, reaching a maximum of about 20 percent above normal in January (when the earth is closest to the sun) and falling to about 20 percent below normal by July (when the earth is farthest from the sun). At ground level, the average value of the earth's DC electric field is approximately 120 V/m. This means that a 6-foot-tall person would have a difference in static voltage of about 220 volts between the top and bottom of their body.

Static electric fields can exist within storm clouds, where the electric potential of clouds (with respect to earth) can reach 10 to 100 million volts (Veimeister 1972). Natural static electric fields under clouds and in dust storms can reach 3 to 10kV/m (CRC 1981).

Static electric fields can also result from friction generated when someone takes off a sweater, slides across a car seat, or walks across a carpet. For example, body voltages as high as 10–16,000 volts have been measured after walking across a carpet (Chakravarti and Pontrelli 1976). It is a common occurrence that someone receives a small shock (a discharge of built-up body voltage) when touching a doorknob after walking across a carpet.

3.4.1.2 AC Electric Fields

AC electric fields are different from static DC electric fields, since AC electric fields are caused by the changing direction of electric voltage while static fields have a constant voltage direction. In the United States, AC electric power transmission lines operate at a frequency of 60 Hertz (Hz) (i.e., the voltage reverses direction at a rate of 60 cycles per second). AC transmission lines therefore create 60Hz AC electric fields, which result from the voltage on the transmission line conductors with respect to the ground.

Electric fields from a transmission line decrease with distance away from the outermost conductor, typically at a rate of approximately one divided by the distance squared ($1/d^2$). Transmission line electric fields remain relatively constant over time because the voltage of the transmission line is kept within about ±5 percent of its rated nominal voltage.

Transmission line electric fields are affected by the presence of grounded and conductive objects, as demonstrated by Figure 3.4-2. Trees and buildings, for example, can greatly reduce ground level electric fields by shielding the area near the object (Deno and Silva 1987).

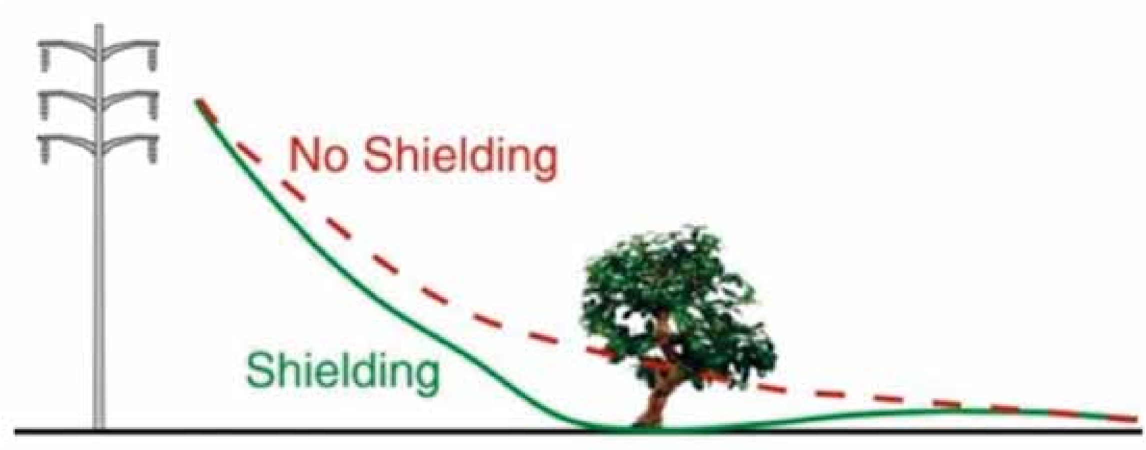


Figure 3.4-2: Electric Field Shielding Due to a Tree

Household appliances and other devices that operate on electricity also create AC electric fields. The electric field caused by small compact household appliances generally attenuates more rapidly with distance than transmission line electric fields. Appliances need not be in operation to create an electric field. Simply plugging an appliance into an electrical outlet creates an electric field around the outlet. Typical values of electric field measured 1 foot away from some common appliances are shown in Table 3.4-1.

Table 3.4-1:
Typical AC Electric Field Values for Appliances (at 12 Inches)

Appliance	Electric Field (kV/m)
Electric Blanket	0.25 [1]
Broiler	0.13
Refrigerator	0.06
Iron	0.06
Hand Mixer	0.05
Coffee Pot	0.03

1 One to 10kV/m next to blanket wires.
Source: Carstensen (1987), Enertech Consultants (1985)

3.4.2 Magnetic Fields

An electric current (the flow of electrical charges or moving electrons) in a conductor or wire creates a magnetic field. The commonly used magnetic field intensity unit of measure is the gauss (G). For most applications, the gauss is too large, so a smaller unit, the milliGauss (mG), is used for reporting magnetic field magnitudes. The milliGauss is one thousandth of a gauss.

The magnetic field is a vector quantity having magnitude and direction. The magnetic field encircles the current in the wire and the direction of the magnetic field is dependent upon the direction of current flow as shown in Figure 3.4-3.

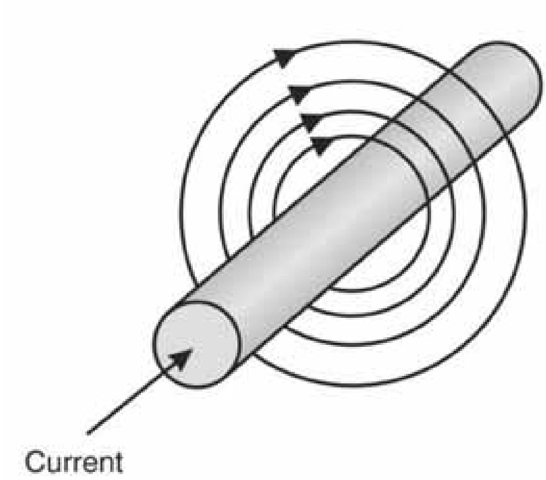


Figure 3.4-3: Magnetic Field around a Conductor

3.4.2.1 DC Magnetic Fields

Static or DC magnetic fields are very common phenomena. As a general reference, the earth has a natural static magnetic field of about 0.51 G, or 510 mG, in the Oklahoma/Arkansas/Tennessee area (Merrill and McElhinny 1983). Static magnetic fields are also found very close to everyday objects such as common refrigerator magnets (bar magnets) and radio/stereo speaker magnets (thousands of gauss field strength). Many appliances utilize DC charging current (chargeable electric razors, electric toothbrushes, electronic tablets, calculators, and other small appliances). Medical devices such as magnetic resonance imaging (MRI) machines utilize large DC magnetic fields to create scanned images (generally stronger than 10,000 G) (Olsen and Sheppard 2012).

3.4.2.2 AC Magnetic Fields

AC magnetic fields from electric power facilities and appliances differ from static (or DC) fields because they are caused by the flow of 60Hz alternating currents. Power frequency magnetic fields reverse direction at a rate of 60 cycles per second corresponding to the 60Hz operating frequency of electric power systems in the United States. Electric transmission lines therefore create 60Hz AC magnetic fields. These magnetic fields are generated by the current flowing on the transmission line conductors.

Similar to a transmission line AC electric field, the AC magnetic field typically decreases with the inverse square of the distance away from the transmission line ($1/d^2$). However, unlike AC electric fields that remain relatively constant over time, AC magnetic fields can vary considerably over time because the current on any transmission line changes in response to increasing and decreasing electrical load demands. Transmission line magnetic fields are also not easily shielded by objects, as are electric fields (EPRI 1999).

Since the magnetic field is caused by the flow of an electric current, a device must be operated to create a magnetic field. Magnetic field strengths of a large number of common household appliances were measured by the Illinois Institute of Technology Research (1984) for the U.S. Navy (Gauger 1985), and by Enertech Consultants for the Electric Power Research Institute (EPRI) (Silva et al. 1989). Typical magnetic field values for some appliances have been measured as low as 0.3mG to as high as 20,000mG (Table 3.4-2). It should be noted that anything that supplies or uses AC electrical power creates an AC magnetic field. There are other electric utility sources (e.g., distribution lines, power transformers, electrical panels, etc.), office sources (e.g., copiers, printers, computers, electric pencil sharpeners, etc.), school sources (overhead/slide projectors, aquariums, TV monitors, etc.), retail sources (e.g., refrigeration units, escalators, cash registers, etc.).

Table 3.4-2:
AC Magnetic Fields from Household Appliances

Appliance	Magnetic Field at 12 inches Away (mG)	Maximum Magnetic Field (mG)
Electric Range	3 to 30	100 to 1,200
Electric Oven	2 to 25	10 to 50
Garbage Disposal	10 to 20	850 to 1,250
Refrigerator	0.3 to 3	4 to 15
Clothes Washer	2 to 30	10 to 400
Clothes Dryer	1 to 3	3 to 80
Coffee Maker	0.8 to 1	15 to 250
Toaster	0.6 to 8	70 to 150
Crock Pot	0.8 to 1	15 to 80
Iron	1 to 3	90 to 300
Can Opener	35 to 250	10,000 to 20,000
Blender, Popper, Processor	6 to 20	250 to 1,050
Vacuum Cleaner	20 to 200	2,000 to 8,000
Portable Heater	1 to 40	100 to 1,100
Fans/Blowers	0.4 to 40	20 to 300
Hair Dryer	1 to 70	60 to 20,000
Electric Shaver	1 to 100	150 to 15,000
Fluorescent Light Fixture	2 to 40	140 to 2,000
Fluorescent Desk Lamp	6 to 20	400 to 3,500
Circular Saws	10 to 250	2,000 to 10,000
Electric Drill	25 to 35	4,000 to 8,000

Source: Gauger (1984), Silva et al. (1989)

3.4.2.3 Distinction between DC and AC Transmission Line Field Effects

Often DC transmission line and AC transmission line electrical effects are mistakenly considered as though the field effects from both types of lines are similar. The same is also true when it comes to evaluating health effect studies or potential medical device interference. For example, there are a multitude of AC magnetic field studies that have been performed related to the evaluation of health effects (such as childhood leukemia), but these results are not directly applicable to DC magnetic fields. Similarly, field effects from radio frequency sources, such as cellular telephones and smart meters, are also different from both AC and DC transmission line field effects. Therefore, it is very important to recognize these differences between DC and AC transmission line field effects as well as other higher frequency sources.

Figure 3.4-4 presents the electromagnetic spectrum arranged by increasing frequency. As shown in this figure, the static frequency of 0Hz is at the lowest end of the spectrum. The electric and magnetic fields from a DC transmission line are constant in frequency and do not alternate as other frequencies do. AC transmission lines operate at 60Hz in the United States and the fields alternate at a rate of 60 cycles per second. These fields are classified as extremely low frequency (ELF). As frequencies increase to millions or billions of Hertz, the frequency bands of AM radio, FM radio, cellular telephones, WiFi modems, microwave and satellite broadcasts, and, ultimately x-rays are reached. It is important to understand that the human body interacts differently with each of these various frequency ranges. In addition, higher frequency range fields contain higher energy levels, to the point where non-ionizing radiation crosses over into ionizing radiation (ionizing radiation is electromagnetic radiation that carries enough energy to liberate electrons from atoms or molecules).

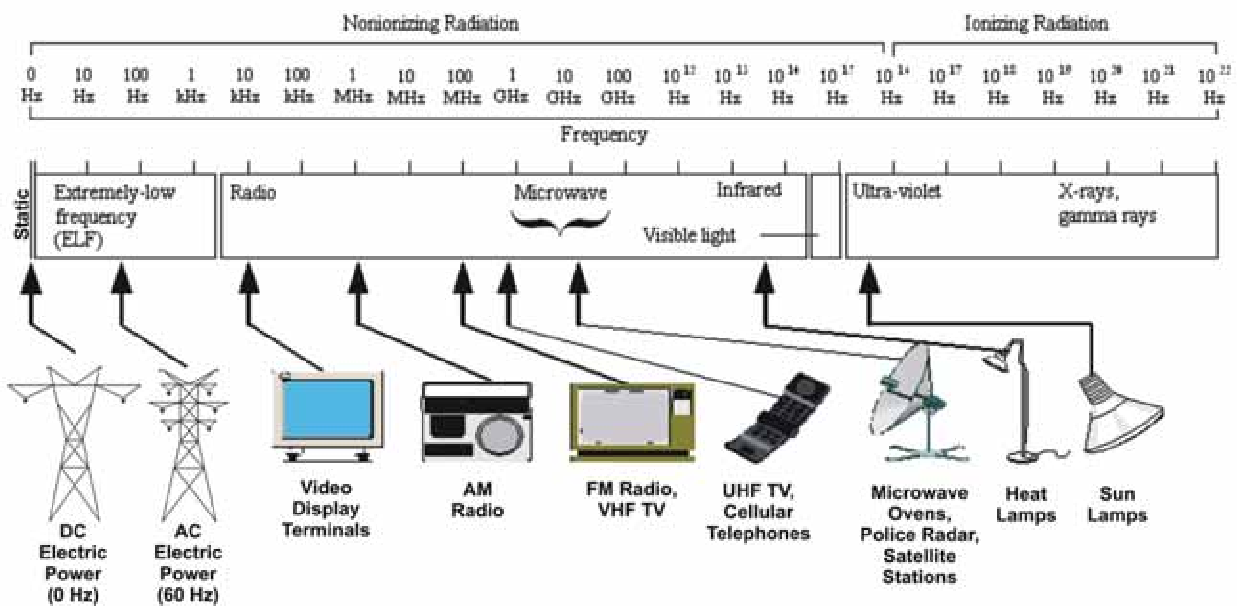


Figure 3.4-4: The Electromagnetic Spectrum

The majority of the Project consists of the ±600kV HVDC overhead electric transmission line (approximately 720 miles in length). Therefore, only DC electric and magnetic field effects would be associated with this portion of the Project (i.e., not AC field effects). In other words, only DC health effects studies would be applicable to this area of the Project.

Short segments of AC transmission line are proposed as part of the Project, and these segments would connect into convertor stations (either connecting wind farms to convertor stations or convertor stations to other substations). Only in these limited areas would AC electric and magnetic field effects be associated with this smaller portion of the Project (i.e., not DC field effects).

Within this section on the Electrical Environment, AC electric and magnetic field research is presented separately from DC electric and magnetic field research to distinguish the two topics and avoid mistakenly combining the results from these two separate and distinct subjects. Table 3.4-3 presents a summary of the sections where AC versus DC topics are found. These sections were purposefully separated from each other to minimize the misapplication of results from one section to another. For example, many of the health studies discussed in Section 3.4.11.2.1.2.2.7 for AC electric and magnetic fields are not applicable to DC transmission line effects.

Table 3.4-3:
Section Discussions for AC Versus DC Electric and Magnetic Field Electrical Effects

Topic	Section
AC Electrical Effects Research on Human Health	3.4.11.2.1.2.2.7
AC Electrical Effects Research on Pacemakers and Implanted Medical Devices	3.4.11.2.1.2.2.8
AC Electrical Effects Research on Plant and Animal Health	3.4.11.2.1.2.2.9
DC Electrical Effects Research on Human Health	3.4.11.2.3.2.6
DC Electrical Effects Research on Pacemakers and Implanted Medical Devices	3.4.11.2.3.2.7
DC Electrical Effects Research on Plant and Animal Health	3.4.11.2.3.2.8

Other health studies, such as those associated with higher radio or microwave frequencies, would not be applicable to either the DC transmission line or the AC transmission lines associated with the Project. For example, a 2013 Turkish study presented results concerning the impact of electromagnetic waves (microwaves) on epileptic seizures (Cinar et al. 2013). The study found a possible trigger effect of electromagnetic waves on seizure activity in mice, and this study was referenced in comments received on the Draft EIS out of concern over possible seizures in humans living close to the Project transmission lines. However, the study utilized electromagnetic frequencies approaching the microwave band (ranging from 100MHz to 900MHz). This frequency in no way compares to static frequency (0Hz), which is 100–900 million times higher in frequency (and almost 10 million times higher for power frequency). In fact, the paper itself cites another study (Canseven et al. 2007) that states that they “did not find any effect of 50Hz electromagnetic waves” (50Hz being the European power frequency, which is very close in frequency to the power frequency in the United States of 60Hz). There are significant differences in electric and magnetic fields associated with static frequencies (0Hz), power-frequencies (50/60Hz), and much higher frequencies (such as radio, microwave, and higher ranges).Therefore, caution must be exercised to ensure that findings associated with a particular frequency are not applied to other frequencies (even between DC and AC power frequencies).

3.4.3 Transmission Line Audible Noise

The natural phenomenon of corona can also occur on a transmission line and can create audible noise. Corona is an electrical discharge of energy that occurs on an energized surface such as a transmission line conductor (as shown in Figure 3.4-5). The electrical voltage at a specific location on an energized surface increases wherever surface irregularities occur (such as nicks on the transmission line conductor, water droplets, insects, or debris) to the point that the air surrounding that location becomes ionized and creates a tiny electrical discharge (EPRI 2010). Corona on high voltage transmission lines generates a small amount of sound or noise. The audible noise level can increase during foul weather conditions when the transmission line conductors are wet (during rain, snow, or fog) and at higher elevations. For example, water drops that collect on the surface of the conductors increase corona activity so that a crackling or humming sound may be heard near a transmission line. Audible noise decreases with distance from a transmission line.

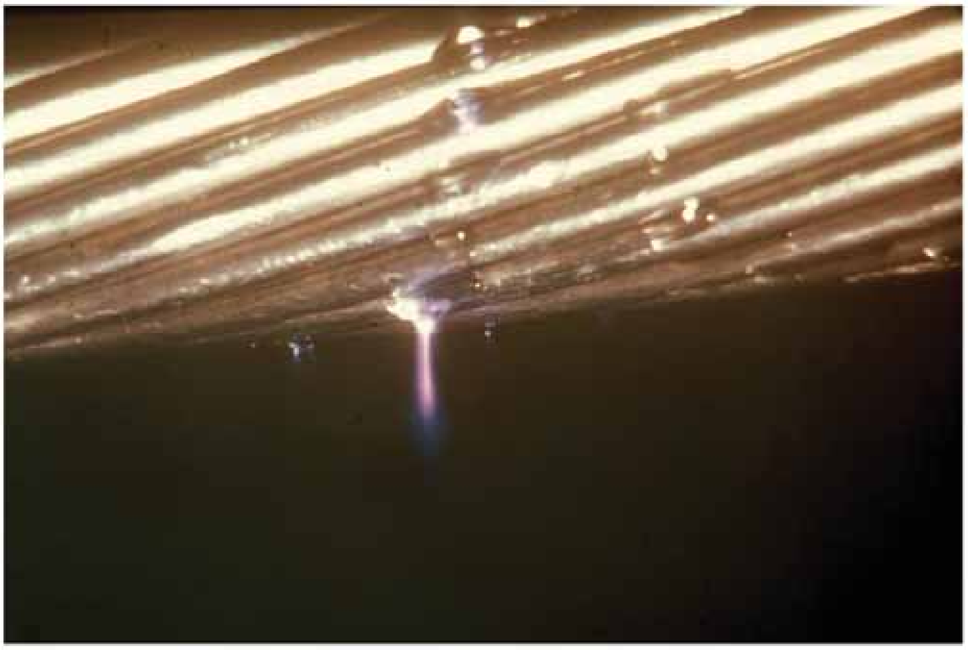


Figure 3.4-5: Close-up View of a Tiny Corona Discharge at the Surface of a Conductor

Audible noise is measured in decibels (dB), a logarithmic (i.e., dimensionless) unit that is the ratio of a sound pressure referenced to the threshold of human hearing. The apparent loudness that is attributed to sound varies not only with the sound pressure but also with the frequency (or pitch) of the sound. Since the human ear is not equally sensitive to sound at all frequencies, a specific frequency-dependent rating scale was devised (A-weighted dB scale, or dBA) to approximate the sensitivity of the human ear. This dBA scale has been chosen by most authorities for purposes of environmental noise regulation.

Typical sounds in a community may range from about 40 dBA (very quiet) to 100 dBA (very loud) or higher. Some typical noise levels range from the relative quiet of the library to the loud trains (Table 3.4-4).

Table 3.4-4:
Typical Sound Levels for Common Sources (in A-Weighted Decibels)

Source/Location	Sound Level (dBA)
Threshold of Hearing	0
Motion Picture Studio–Ambient	20
Library	35
Chicago Suburbs—nighttime minimum	40
Wind in Deciduous Trees (2–14 mph)	3–61
Falling Rain (Variable Rainfall Rates)	41–63
Tomato Field on California Farm	44
Small Town/Quiet Suburb	47–53
Private Business Office	50
Light Traffic at 100 feet Away	50

Table 3.4-4:
Typical Sound Levels for Common Sources (in A-Weighted Decibels)

Source/Location	Sound Level (dBA)
Average Residence	50
Large Retail Store	60
Accounting Office	60
Boston Inside House on Major Avenue	68
Average Traffic on Street Corner	75
Inside Sports Car (50 mph)	80
Diesel Freight Train at High Speed at 25 meters	80
Los Angeles–0.75 mile from Jet Landing	86
Loud Automobile Horn (at 1 meter)	115

Source: EPA (1974), IEEE (1974), Miller (1978)

It is important to remember that transmission line audible noise is variable and therefore is characterized using statistics that estimate the probability of a certain level of noise occurring. Statistical noise descriptors include what engineers call exceedance levels, for example, L10, L50, and L90. These descriptors indicate what percentage of time a certain noise level will be exceeded. For example, a L50 of 65 dBA indicates that 50 percent of the time, noise levels will be greater than 65 dBA at a certain location and, conversely, it could be less than 65 dBA for 50 percent of the time. Additional methods to characterize audible noise have been developed to evaluate the long-term characteristics of sound. The equivalent sound level, L_{eq}, is the average level of a varying sound over a specified period of time (EPA 1974; Keast 1980). This value is a single-number equal to the level of an equivalent constant unchanging sound.

Some government agencies have adopted a level similar to L_{eq} called the day-night averaged noise level (an equivalent day-night sound level, or L_{dn}). The L_{dn} represents a time-weighted 24-hour average noise level based on the A-weighted decibel for a variety of weather conditions. Time-weighted refers to the fact that noise occurring during certain sensitive time periods (nighttime, when other background sounds are relatively subdued) is adjusted for occurring at those times. L_{dn} includes an additional 10 dBA increase that is added to noise events occurring during the nighttime hours of 10 p.m. to 7 a.m. (because people are more sensitive to noise at night).

In most, but not all, aspects, HVDC transmission line audible noise is similar to that of HVAC transmission lines. Audible noise on HVDC lines is typically highest in fair weather or during the transition from fair to foul weather, whereas noise on HVAC lines is typically highest in foul or rainy weather (EPRI 2010). For HVAC transmission lines, the audible noise has two components: (1) a high frequency broadband noise (that distinguishes it from most common environmental noises) caused by impulsive corona, and (2) a low-frequency pure tone “hum,” at 120Hz and multiples of 120Hz, propagating laterally from the conductor (EPRI 2006c). The broadband noise spectrum extends well beyond the sonic (audible) range; i.e., beyond about 15kHz to several tens of kilohertz. The hum is a pure tone that is superimposed over the broadband noise. In different weather conditions, the relative magnitude of broadband noise and hum may be different. For example, during rain the broadband component generally dominates, whereas under icy conditions, the hum dominates. As opposed to HVAC, HVDC corona noise does not contain pure tones emerging from the broadband noise. The low frequency components of the noise (up to the 125Hz octave band) can rarely be distinguished from ambient noise, while high frequency corona noise ranges from 500Hz to 16kHz. The positive pole of a bipolar HVDC line produces more audible noise than the negative pole; in fact, audible noise generation from the negative pole is negligible. Therefore, HVDC audible noise is mostly limited to the positive conductors, unlike HVAC audible noise, where all of the conductors generate noise.

Research (EPRI 2010, 1982) has demonstrated that annoyance to HVAC transmission line audible noise is stronger than audible noise from HVDC transmission lines below 50 dBA (i.e., levels beyond the transmission line ROW). At audible noise levels lower than 50 dBA, DC audible noise was found to produce less perceived annoyance than the corresponding AC noise level. However, above 50 dBA, DC audible noise was shown to produce more annoyance than AC audible noise. As previously stated, HVDC audible noise is higher in fair weather (when people may be outside more often and no rainfall is present to mask the noise).

The laws of acoustics govern the propagation of corona-generated noise from conductors, for both the broadband and pure tone (hum) components of noise. The atmosphere, trees, and structures diminish the broadband component of the noise significantly more than the hum. If the sound has a large broad band component, different sound frequencies may attenuate at different rates, and hence the overall characteristics of the sound may change. Reflected noise by the earth has a negligible effect on the broadband noise and can be disregarded, while the ground is a good reflector of hum. Reflections from objects close to the point of interest may also have a significant effect. The pure tone hum is only slightly attenuated by air, trees, and walls. Therefore, at larger distances from the line or inside houses, the hum may become more noticeable in relation to the high-frequency random noise. Fortunately, no pure tones are present in HVDC line audible noise (which would be associated with the Project HVDC transmission line) (EPRI 2010). Altitude above sea level also affects audible noise levels. For HVAC, audible noise typically increases by about 1 dB for every 1000 feet of altitude above sea level; the same type of variation is also expected for HVDC audible noise (EPRI 2010). Audible noise calculation software typically assumes a flat, open terrain with no sound-modifying objects present (such as uneven terrain, trees, buildings, and other objects).

Electrical sparks or arcing can also create audible noise. However, during normal operation, the transmission line should not arc or spark unless there is a broken or damaged insulator or other piece of hardware. Such damage could cause very tiny arcs between the broken or damaged pieces of hardware on the transmission line itself and can be located and repaired on any modern transmission line. Trees and other growth are cleared away within the transmission line ROW to facilitate line operation and maintenance.

3.4.4 Radio and Television Noise Interference

In addition to audible noise, corona from a transmission line can also create radio and television noise. Sporadic pulses of current, such as those produced by corona and gap discharges (tiny electrical gaps between mechanically connected parts) generate electromagnetic energy over a broad range of frequencies, including the radio and television bands. Overhead transmission lines do not, as a general rule, interfere with radio or TV reception. Corona-generated radio frequency noise decreases with distance from a transmission line and also decreases with higher frequencies. (When it is a problem, it is usually for amplitude modulation [AM] radio and usually not the higher frequencies associated with TV or satellite signals.) The severity of interference depends on the strength and quality of the transmitted radio or TV signal, the quality of the radio or TV set and antenna system, and the distance between the signal receiver (radio or TV) and the transmission line. The units used for radio or TV noise are decibels referenced to 1 μV/m (or one-millionth of a volt per meter) and written as dBμV/m.

It is difficult to determine whether the radio frequency noise level produced by a transmission line will cause unacceptable interference, because the strength of the received signal, the sensitivity of the receiver, the orientation of the receiving antenna, and the ambient radio frequency noise are all important parameters in determining the degree to which noise from the transmission line may cause signal degradation. A common measure to evaluate possible interference levels is the signal-to-noise ratio (SNR): the ratio of average signal power to average noise power (for a given frequency bandwidth). Based upon listening tests, if the limit of tolerability is assessed as the point at which reception quality becomes less than satisfactory, then the radio interference level of a transmission line should be 22 dB or more below the average strength of the desired radio signal (EPRI 2006a). For television interference, an SNR of at least 30–40 dB is required if corona noise is not to cause objectionable interference (EPRI 2006a). Radio and TV noise levels caused by the proposed transmission line can be computed, but without knowing broadcast signal strengths at various locations of interest along the possible line routes, it is difficult to determine that a tolerable SNR criterion would be met.

Corona-generated noise may also potentially impact amateur radio station operators. Amateur radio operators often try to receive broadcast signals down at the lowest level of noise, so additional noise from a transmission line may impact the signal reception. In addition, there are many parameters that may influence signal reception, including the broadcast signal frequency, direction of the signal, alignment of the receiver antenna, quality of the radio station equipment, terrain variations and altitude, and especially weather conditions. Because of these various parameters, it is not feasible to precisely determine whether a particular level of transmission line radio frequency noise will cause unacceptable interference to a nearby amateur radio station operator. Transmission line owners are required to resolve interference complaints from licensed operators in accordance with the Federal Communications Commission (FCC) Rules and Regulations at 47 CFR Part 15.

An important new issue is the radio and TV conversion to digital broadcast system technology. Low levels of interference may not noticeably affect a digital receiver's performance but higher levels may break up or stop reception. In principle, the new digital signal should be less susceptible to interference than an old analog signal (Smith 2004). The quality of digital reception should be better in a given noise level and would stay good at SNRs beyond which the old analog reception is no longer viable. These results have been documented in previous studies, such as the FCC study (FCC 1999), which indicated that digital signals will provide superior coverage and immunity to impulse noise (such as noise interference from household appliances as well as power lines) than analog signals. The International Electrotechnical Commission has endorsed the Digital Radio Mondiale on-air system, which is expected to be built to be immune to atmospheric electro-magnetic interference (EMI), and therefore are highly likely to be immune to power line EMI as well (EPRI 2006a). As new digital receivers emerge for high definition television and other applications, more testing will need to be performed to determine their susceptibility to power line interference (EPRI 2006a). No interference resulting from corona-generated noise would be expected for digital signals broadcast at frequencies above 1 gigahertz (GHz) from satellites. A possible problem could be a transmission tower in the direct line-of-sight between a dish antenna and a satellite, but this could be resolved by moving the dish antenna to a different location.

Questions sometimes arise about use of GPS devices in close proximity to high voltage transmission lines. The concern is that GPS units are unable to receive a signal from the satellites and that this will negatively affect agricultural operations that require GPS. In general, interference noise must be in the same frequency band as the band in which GPS receivers operate. Transmission lines produce little to no noise in the microwave bands used by GPS systems. Research performed on this subject did not reveal a problem for the high-quality receivers used in precision agriculture or agriculture-related aviation (Silva and Olsen 2002).

There are also important differences between DC and AC radio noise. Results from laboratories, tests, and operating DC lines have shown that the highest levels of radio noise occur during fair, dry weather rather than wet weather as for AC lines. While water drops are very effective corona sources, the ionization of air near the surface of DC line conductors in wet weather is very intense and has the effect of maintaining the electric field at a relatively low level near the surface of the conductors (EPRI 2010). The positive pole of a bipolar HVDC line also produces the greatest amount of radio noise (to the extent that noise generation from the negative pole can be ignored), whereas all conductors generate noise for AC transmission lines (EPRI 2010).

3.4.5 Ozone and Air Ions

Corona from a transmission line can also create oxidants such as ozone and air ions. Ozone consists of three oxygen molecules and is measured in parts per billion (ppb). The energy emission during corona on a transmission line ionizes (electrically charges) the surrounding air, creating ozone. Air ions are also produced when high voltage corona ionizes air molecules and these are measured in ions per centimeter cubed (ions/cm^3). Negative ions are particles with one or more extra electrons (resulting in a net negative charge) while positive ions are missing one or more electrons (resulting in a net positive charge). Air ions are present throughout the earth's atmosphere and occur during weather events (thunderstorms, lightning, rain), thermal combustion (a candle flame, internal combustion engines), water droplet formation (near waterfalls or in rain), and radioactivity as shown in Table.3.4-5 (EPRI 2012; Olsen and Sheppard 2012). Several factors influence the rate of generation of these elements, the most important being the transmission line conductor characteristics, mode of corona discharge, and the ambient weather conditions—i.e., temperature, humidity, precipitation, direction and intensity of wind speed, and terrain topography. Precipitation on a conductor surface decreases the conductor surface irregularity and increases corona losses, so rainy conditions, therefore, produce one of the highest levels of ozone generation on transmission lines. The presence of water and humidity, although it increases the efficiency of ozone generation, it makes ozone decay faster than in dry weather.

Table 3.4-5:
Air Ion Concentrations for Selected Environments

Environment	Air Ion Concentration (ions/cm^3)		
	Total	Positive	Negative
Ambient (typical)	$1x10^3$ to $2x10^3$	$5x10^2$ to $1x10^3$	$5x10^2$ to $1x10^3$
Thunderstorm	$2.1x10^4$	$7x10^3$	$1.4x10^4$
Rain (increments above ambient)		$6x10^2$	$9x10^2$
Waterfall (increments above ambient)	$1.5x10^4$ to $2.7x10^4$	$2.2x10^2$ to $5.6x10^2$	$1.5x10^2$ to $5.4x10^3$
Burning Match (30 centimeters above match)	$2x10^5$ to $3x10^5$		
Cave (radioactive rock)	$15.4x10^5$	$6.7x10^5$	$6.7x10^5$
Maximum Measured Under HVDC Transmission Line (±400 and 500kV)	$3x10^5$		

Source: EPRI (2012)

Air ions are also created near HVDC transmission line conductors. Ions are formed by the ionization of air molecules (stripping away electrons from neutral air molecules to form ions) and become either positively or negatively charged. Most air ions are attracted toward the HVDC transmission line conductor of opposite polarity, but others are also directed toward the ground. If there is no wind, ions travel along the lines of electric field. In the presence of wind, air ions travel downwind until they are eventually neutralized by transferring their charge to aerosols or by coming into contact with the ground. Because aerosols have masses larger than those of air molecules, they are not as easily moved by electric field forces, and their direction is controlled primarily by the wind (the movement of space charges results in current flow).

Results of careful studies in the laboratory and measurements near transmission lines indicate that it would be unlikely that air ions and ozone from transmission lines would cause adverse health effects (EPRI 2012; NRPB 2004). Some effects have been reported, but the findings are inconsistent, and many studies have reported no effect (EPRI 2010).

3.4.6 Regulatory Background

Neither the state governments of Oklahoma, Arkansas, Tennessee, or Texas in which the Project will be constructed and operated, nor the federal government, have any statues or regulations relating to DC or AC electric and magnetic fields or radio and television interference specific to transmission lines. In the absence of any statutes or regulations, recommendations and guidelines of other state, international, and non-regulatory agencies have been consulted as an aid to the evaluation of potentially adverse impacts. The basis for some of these guidelines and recommendations and how they were developed is not always clearly defined, and not all of them represent science-based exposure limits to protect health and safety. It is also important to note that recommendations proposed to protect health and safety typically incorporate additional “safety” or “uncertainty” factors. However, the EPA has established guidelines for audible noise and ozone/air ions, which are also electrical effects associated with transmission lines.

The DOE has participated in two publications that summarize EMF: Questions and Answers About EMF, Electric and Magnetic Fields Associated with the Use of Power (NIEHS and DOE 1995) and EMF Electric and Magnetic Fields Associated with the Use of Electric Power, Questions and Answers (NIEHS and NIH 2002). These booklets contain information describing the principles of EMF, an overview of the results of major studies, and summarize the conclusions of expert review panels (additional discussion on this topic is presented in Section 3.4.11.2.1.2.2.7).

3.4.6.1 DC Electric Field Exposure Guidelines

No federal regulatory agencies or state agencies in which the Project will be operated (Oklahoma, Arkansas, Tennessee or Texas) have DC electric field exposure limits. Non-regulatory organizations have established or recommended the following DC electric field exposure limits:

- The International Committee on Electromagnetic Safety (ICES), which is a technical committee within the Institute of Electrical and Electronics Engineers (IEEE), has established a guideline of 20kV/m (thousands of volts per meter) for occupational exposure and 5kV/m for public exposure at 0Hz (ICES 2002).
- The American Conference of Governmental Industrial Hygienists (ACGIH) has established an occupational guideline of 25kV/m (ACGIH 2010), which is an industrial/occupational standard that is designed to protect workers in high field environments and not a public exposure standard. Public (non-occupational) exposure would be incidental/short-term exposure within and near the transmission line ROW. It is not clear how applicable this standard would be to construction and operation of the Project.
- The International Committee on Non-Ionizing Radiation Protection (ICNIRP) has established a guideline of 20kV/m for occupational exposure and 5kV/m for public exposure at 1Hz (ICNIRP 2010). This guideline is an international standard and is provided as an aid for DC electric field evaluation.

The consensus of these non-regulatory groups indicates that public exposure to DC electric field should be limited to 5kV/m (with occupational exposure limited to the range of 20 to 25kV/m).

3.4.6.2 AC Electric Field Exposure Guidelines

No federal regulatory agencies or state agencies in which the Project will be operated (Oklahoma, Arkansas, Tennessee or Texas) have AC electric field exposure limits. Non-regulatory organizations have established or recommended the following AC electric field exposure limits:

- The ICES, which is a technical committee within the IEEE, has established a guideline of 20kV/m for occupational exposure, 10kV/m within a transmission line ROW, and 5kV/m for public exposure (ICES 2002).
- The ACGIH has established an occupational threshold of 25kV/m, and for workers with implanted medical devices (such as cardiac pacemakers) the recommended limit is 1kV/m (ACGIH 2010). Manufacturers of implanted medical devices often provide specifications about AC electric field thresholds to patients, and these may be different from the ACGIH recommendation (additional discussion on this topic is presented in Section 3.4.11.2.1.2.2.8). The ACGIH standard is an industrial/occupational standard (which is designed to protect workers in high field environments) and not a public exposure standard. Public (non-occupational) exposure may typically be incidental/short-term exposure within and near the transmission line ROW and it is not clear how applicable this standard would be in these situations.
- Although the states of Oklahoma, Arkansas, Tennessee, and Texas do not have electric field standards for transmission lines, at least six other states have established regulations regarding electric fields (either within the ROW or at the ROW edges, as shown in Table 3.4-6) (NIEHS and NIH 2002). Within the ROW, thresholds range from 7kV/m to 11.8kV/m, depending upon the state. At the ROW edges, thresholds range from 1 to 3kV/m, depending upon the state. These regulations are engineering standards (rather than health-based standards) so that new transmission lines will have similar field levels to existing, operational transmission lines or are safety-based engineering standards to establish electric field levels to limit electric discharges that could cause a nuisance shock.
- The NESC requires that the electric field be reduced such that the largest anticipated object underneath an overhead transmission line has a current to ground of no greater than 5 milliamps (mA). High voltage transmission lines can induce a voltage, and therefore induce electric currents, in metallic objects such as a truck parked under the transmission line. The NESC therefore requires that additional ground clearance or other means shall be used to limit anticipated electric field effects to 5mA or less (IEEE 2012).
- The ICNIRP has established a guideline of 8.3kV/m for occupational exposure and 4.2kV/m for public exposure at 60Hz (ICNIRP 2010). This guideline is an international standard and is provided as an aid for AC electric field evaluation.

The consensus of these non-regulatory groups indicates that public exposure to 60Hz AC electric field should be limited to 5kV/m or less (with occupational exposure limited to the range of about 8 to 25kV/m). For occupational workers with implanted medical devices, a limit of 1kV/m has been recommended (ACGIH 2010). Specifically for a transmission line, a limit of 10kV/m has been recommended within the ROW (ICES 2002).

Table 3.4-6:
Summary of State Transmission Line Standards and Guidelines for AC Fields[1]

State	AC Electric Field		AC Magnetic Field	
	On ROW	ROW Edge	On ROW	ROW Edge
Florida*	8kV/m[a] 10kV/6 [b]	2kV/m	—	150 mG[a] (max load) 200 mG[b] (max load) 250 mG[c] (max load)
Minnesota	8kV/m	—	—	—
Montana	7kV/m[d]	1kV/m[e]	—	—
New Jersey	—	3kV/m	—	—
New York	11.8kV/m 11.0kV/m[f] 7.0kV/m[d]	1.6kV/m	—	200mG (max load)
Oregon	9kV/m	—	—	—

* ROW includes certain additional areas adjoining the ROW for Florida only
a For lines of 69–230kV
b For 500kV lines
c For 500kV lines on certain existing ROW
d Maximum for highway crossings
e Applies in residential and subdivided areas and may be waived by the landowner
f Maximum for private road crossings
Source: NIEHS and NIH (2002)

3.4.6.3 DC Magnetic Field Exposure Guidelines

No federal regulatory agencies or state agencies in which the Project will be operated (Oklahoma, Arkansas, Tennessee or Texas) have DC magnetic field exposure limits. Non-regulatory organizations have established or recommended the following DC magnetic field exposure limits:

- The ICES, which is a technical committee within the IEEE, has established a guideline of 3,530G for occupational exposure and 1,180G for public exposure at 0Hz (ICES 2002).
- The U.S. Food and Drug Administration (FDA) has established a limit of 40,000G for medical patients receiving MRI treatments and 5G for patients with pacemakers (FDA 1998).
- The ACGIH has established an occupational guideline of 20,000G for whole body exposure and 5G for persons with implanted medical devices (ACGIH 2010). Manufacturers of implanted medical devices often provide specifications about DC magnetic field thresholds to patients, which may be different from the ACGIH recommendation (additional discussion on this topic is presented in Section 3.4.11.2.3.2.7). The ACGIH standard is an industrial/occupational standard (which is designed to protect workers in high field environments) and not a public exposure standard. Public (non-occupational) exposure may typically be incidental/short-term exposure within and near the transmission line ROW and it is unclear how applicable this standard would be in these situations.

1 None of these states are locations where the Project will be constructed and operated. Field values are provided as an aid for AC electric and magnetic field evaluation.

- The ICNIRP has established a guideline of 20,000G for occupational exposure, 4,000G for public exposure, and 5G for persons with implanted medical devices (ICNIRP 2009). This is an international standard and is provided as an aid for AC electric field evaluation.

The consensus of these non-regulatory groups indicate that public exposure to DC magnetic field should be limited to the range of 1,180 to 4,000G (with occupational exposure limited to the range of 3,530 to 20,000G). For people with implanted medical devices, a limit of 5G has been recommended.

3.4.6.4 AC Magnetic Field Exposure Guidelines

No federal regulatory agencies or state agencies in which the Project will be operated (Oklahoma, Arkansas, Tennessee or Texas) have AC magnetic field exposure limits. Non-regulatory organizations have established or recommended the following AC magnetic field exposure limits:

- The ICES, which is a technical committee within the IEEE, has established a guideline of 27.1G for occupational exposure and 9.0G for public exposure to 60Hz magnetic fields (ICES 2002).
- The ACGIH has established an occupational threshold of 10 G, and for workers with implanted medical devices (such as cardiac pacemakers) the recommended limit is 1G (ACGIH 2010). Manufacturers of implanted medical devices often provide specifications about AC magnetic field thresholds to patients, which may be different from the ACGIH recommendation (additional discussion on this topic is presented in Section 3.4.11.2.1.2.2.8). The ACGIH standard is an industrial/occupational standard (which is designed to protect workers in high field environments) and not a public exposure standard. Public (non-occupational) exposure may typically be incidental/short-term exposure within and near the transmission line ROW and it is not clear how applicable this standard would be in these situations.
- Although the states of Oklahoma, Arkansas, Tennessee, and Texas do not have magnetic field standards for transmission lines, at least two other states have established regulations regarding magnetic field at the ROW edges (levels range from 150 to 250 mG, depending upon the state) as summarized in Table 3.4-6 (NIEHS and NIH 2002). These regulations are engineering standards (rather than health-based standards) so that new transmission lines will have similar field levels to existing operational transmission lines.
- The ICNIRP has established a guideline of 10G for occupational exposure and 2G for public exposure (ICNIRP 2010). This is an international standard and is provided as an aid for AC electric field evaluation.

The consensus of these non-regulatory groups indicate that public exposure to AC magnetic field should be limited to the range of 2 to 9G (2,000 to 9,000 mG) (with occupational exposure limited to the range of 10 to 27.1 G). For occupational workers with implanted medical devices, a limit of 1G has been recommended (ACGIH 2010).

3.4.6.5 Audible Noise Exposure Guidelines

Regulatory organizations have established or recommended the following audible noise exposure limit:

- The EPA has established an outdoor activity L_{dn} noise guideline of 55 dBA (EPA 1974). This value represents the sound energy averaged over a 24-hour period; it has a 10 dBA nighttime weighting (between 10:00 p.m. and 7:00 a.m.) (EPRI 2006a). The noise level is applicable to outdoor residential areas and farms and other outdoor areas where people spend time.

No other local noise ordinances establishing numerical limits were identified (Clean Line 2014a).

3.4.6.6 Radio and Television Noise Exposure Guidelines

Regulatory and non-regulatory organizations have established the following exposure limits for radio and television noise interference:

- The FCC has established that if unacceptable interference from transmission lines is present at nearby amateur radio stations (i.e. notification to an FCC representative that harmful interference is present), the owners of the transmission line are required to resolve interference complaints from licensed operators in accordance with the FCC Rules and Regulations requirements at 47 CFR Part 15.
- The IEEE established the Radio Noise Design Guide of 56 dBμV/m at a frequency of 1 million hertz (MHz) measured at 15 meters (50 feet) from the outside conductor in fair weather (IEEE 1971), which was modified by IEEE to a standard frequency of 0.5MHz by IEEE Standard 430-1986 (IEEE 1986) and corresponds to 61 dBμV/m at 0.5MHz (Olsen 2014). However, this is a design guide rating for acceptable noise performance; actual performance is dependent upon many parameters that may influence signal reception (IEEE 1971), including the broadcast signal frequency, direction of the signal, alignment of the receiver antenna, quality of the radio station equipment, terrain variations and altitude, and, especially, weather conditions.

3.4.6.7 Ozone/Air Ion Concentration Exposure Guidelines

Regulatory organizations have established the following exposure limits for ozone concentration:

- The EPA ozone standard is in terms of 8-hour average exposures to a level of 75 ppb (EPA 2008).
- The states of Oklahoma (ODEQ 2013), Arkansas (ADEQ 2014), and Tennessee (TDEC 2014) have endorsed and adopted the EPA ozone standard (EPA 2008).

3.4.7 Data Sources

Transmission line geometry and loading information was provided in the Applicant's Technical Report on the Electrical Environment Assessment of the Plains and Eastern Transmission Line Project (Clean Line 2014b).

Land use information was provided in the Applicant's Land Use and Recreation Technical Report for the Plains and Eastern Transmission Line Project (Clean Line 2013) and is also discussed in Section 3.10.

Weather information was provided by the U.S. National Oceanic and Atmospheric Administration website (http://www.noaa.gov), the Weather Underground website (http://www.wunderground.com), and the Weather Channel website (http://www.weather.com).

Locations where existing AC transmission lines are present along the proposed HVDC overhead electric transmission line route were evaluated using GIS files provided by the Applicant.

3.4.8 Region of Influence

3.4.8.1 Region of Influence for Project and DOE Alternative

The ROI associated with the Project is the transmission line ROW for the HVDC transmission line and for all AC transmission lines as described in Section 3.1.1. The precise ROW width has not yet been determined for each route section, and could vary from 150 to 200 feet in width. Certain electrical effects may extend beyond the ROW edges, so this evaluation was extended to include a distance of 200 feet beyond the maximum assumed ROW edges (which corresponds to a total of 300 feet on either side of centerline for the HVDC transmission line) and AC collection system routes.

For the AC/DC converter stations, the ROI is the potential siting areas for each converter station within which the converter station would be located (as described in Section 3.1.1). Converter stations (DC to AC) are similar to substations (AC) with respect to electrical effects such as electric and magnetic fields. The equipment associated with converter stations would not be a source of elevated fields or corona effects outside the boundaries of the proposed sites; substation and converter station equipment is typically located centrally within the site, and fields from these sources attenuate very quickly with distance away from the equipment. This equipment characteristic is recognized by IEEE in their standards (IEEE 1998), which states that: *"In a substation, the strongest fields around the perimeter fence come from the transmission and distribution lines entering and leaving the substation. The strength of fields from equipment inside the fence decreases rapidly with distance, reaching very low levels at relatively short distances beyond substation fences."* Therefore, no additional electrical field effects analysis was performed for the converter stations.

Some types of substation and switching station equipment can potentially be a source of electrical effects (for example, power transformers can produce audible noise, and converter equipment can produce radio noise, etc.). These effects can be reduced or eliminated by the use of filtering equipment, sound walls, and other methods. Computer modeling and calculations of electrical effects for the proposed converter stations were therefore not performed, except for audible noise as described in Section 3.11.6. The Applicant would use filtering equipment at each converter station if necessary to reduce noise. Therefore, no additional electrical noise effects analysis was evaluated for the converter stations.

3.4.8.2 Region of Influence for Connected Actions

The ROI for wind energy generation, the future Optima substation, and TVA upgrades is described in Section 3.1.1.

3.4.9 Affected Environment

The affected environment would include the proposed transmission line ROWs through Oklahoma, Arkansas, Tennessee, and Texas (i.e. the transmission line ROI) and the proposed converter stations. The primary electrical component of the Project is the approximately 720-mile-long ±600kV HVDC overhead electric transmission line that would be routed within each state. At each end of the DC transmission line, AC/DC converter stations are required to convert DC electricity to AC electricity for interconnection into the AC electrical grid. One double circuit AC transmission line of up to 345kV would be required to connect the Oklahoma converter station, while two 500kV AC transmission lines would be required to connect the Tennessee converter station. An additional converter station could be sited in Pope County, Arkansas, as part of the DOE alternatives. This alternative converter station would be similar to the Oklahoma and Tennessee converter stations. One 500kV AC transmission line would be required to connect the Arkansas converter station alternative to an interconnection point along an existing 500kV transmission line in Arkansas. Four to six AC transmission lines are also proposed to transport AC electrical power (the AC collection system) from wind farm generation in Oklahoma to the converter station in Oklahoma.

Detailed information regarding the transmission line configurations, convertor stations, and transmission line routes are described in Chapter 2 and in Appendix F. Several route variations to the Applicant Proposed Route in Regions 2–7 were developed in response to public comments on the Draft EIS and are described in Appendix M and summarized in Sections 2.4.2.1–2.4.2.7. The variations are presented graphically in Exhibit 1 of Appendix M. Electrical effects are associated with the type of transmission line configuration, rather than a region or particular line route. Therefore, transmission line electrical effects along a proposed route or for a route variation within a region would remain the same (assuming the transmission line configuration remains the same for the variations).

3.4.10 Regional Description

The Project (which includes the HVDC transmission line, AC collector lines, and convertor stations) would be located in Oklahoma, Arkansas, Tennessee, and Texas. Locations within these four states have been divided into seven different regions, primarily based upon the routing of the HVDC transmission line (including the Applicant proposed and alternative routes). Detailed information regarding each of the proposed transmission line routes can be referenced in Chapter 2.

Existing sources of electrical effects are present along each of the transmission line routes. These effects include static and power-frequency fields as well as radio frequency signals. Sources of these effects include existing power lines, communications equipment, and other related sources. Since the use of electricity is an integral part of our modern lifestyle, these effects are commonly found in our everyday environment and, therefore, within each of the Project regions being evaluated.

As previously discussed, static (DC) electric and magnetic fields are a common, natural phenomenon. Static electric fields are present in our environment due to the difference in voltage potential between the ionosphere and the surface of the earth. The earth's magnetic field is a natural static field, whose intensity is about 0.51 G, or 510 mG, in the Oklahoma/Arkansas/Tennessee area where the HVDC transmission line would be constructed. Many household appliances also utilize DC charging current (e.g., chargeable electric razors and electric toothbrushes). AC electric and magnetic fields exist wherever electricity is generated, transmitted, or distributed in power lines or cables or used in electrical appliances. Existing high voltage AC electric transmission lines are therefore present in power line corridors within each Project state. Overhead AC distribution lines are also commonly present along roadways and in towns, providing lower voltage electrical service directly to residents, farms, businesses, and industries in each local area. These existing power lines all produce AC electric and magnetic fields that currently contribute to the existing overall field environment. In our homes, electrical appliances are also sources of AC electric and magnetic field.

Currently, there are other high voltage DC transmission lines in operation within the United States. For example, the Pacific Intertie is an approximate 845-mile HVDC transmission line routed from the Washington/Oregon border to northern Los Angeles, California, that has been in operation since 1970. Originally operating at an electrical voltage of 400kV, the Pacific Intertie was upgraded to 500kV in 1984 and has operated at that voltage ever since.

At numerous locations within each region, the proposed HVDC transmission line is located parallel to other existing AC transmission lines. In these situations, electrical effects from existing AC transmission lines may influence effects associated with the proposed HVDC transmission line by itself (effects could be additive or subtractive). Because the HVDC transmission line route has not yet been selected, and given the numerous existing AC transmission lines present along various routes and regions, calculations of the combined electrical effects was not performed for these situations.

Electrical effects from multiple power line sources are not simply additive. For example, contributions from multiple magnetic field sources are not simply cumulative in determining the resulting magnetic field level, since magnetic fields are vectors and phasors, and thus must be added while considering both their space and time components (since AC field values from each source may not occur at precisely the same instant in time). When the vectors are in opposite directions, the fields cancel, and when the vectors are in the same direction, they add. The magnetic field at any point in space is the vector sum of the field contributions from all sources (at each instant in time). Magnetic fields from multiple sources are influenced by the distance relative to each source, the amount and direction of current flow on each source, and the configuration of the source (i.e., the arrangement of the current-carrying conductors associated with the source). Since the spatial and time components of magnetic fields from various sources are not always known, a reasonable estimation of their additive effect assumes that they will add in quadrature (the square root of the sum of the squared field components) as a "root-mean-square" (rms) value. For example, combining in quadrature a magnetic field of 10mG with a field of 5mG would equal 11.2mG (the square root of $10^2 + 5^2$) rather than 15mG if the fields were simply additive.

Audible noise is present in our environment. We experience sounds from nature (e.g. birds singing, dogs barking, thunder, etc.) as well as manmade noises (e.g. automobiles, music, human speech). Existing high voltage transmission lines may also contribute to the audible environment by creating a humming sound (resulting from the discharge of energy which that occurs on the energized surface of the transmission line conductors) within their immediate proximity. Transmission line audible noise can increase during foul weather conditions when the conductors become wet (during rain, snow, or fog) and at higher elevations. Existing high voltage AC electric transmission lines are present within each Project state, and the contribution of some transmission line audible noise is therefore also present within each region.

Existing radio frequency sources would also be present within each region of the Project. Sources such as cellular telephone antennas and microwave antennas are often located on communication towers near interstates, on tall buildings, and on power line structures. Radio and television broadcast station signals are also present within the existing environment. GPS transmitters and receivers, which utilize radio frequency and/or satellite signals, are common in automobiles, trucks, and farm equipment. In addition, equipment such as wireless routers utilize radio frequency signals to provide a communication link between computers, cellular telephones, printers, and other electronic devices. The presence of existing radio frequency signals is a very common occurrence as demonstrated by the abundance of sources that can be found in our modern society.

Within each of the following regional descriptions, the number of existing AC transmission lines present that would parallel the Project line was estimated using GIS (geographic information system) files provided by the Applicant (GIS Data Source: Clean Line 2013a, 2013b) and Tetra Tech (GIS Data Source: Tetra Tech 2014a). Radio frequency sources such as microwave and communication towers were also enumerated along the proposed HVDC routes using information provided by the FCC (GIS Data Source: FCC 2012). In evaluating the electrical effects for each region, one of the primary factors of importance would include the number of residences present along the HVDC electric transmission line route. The number of residences and other building structures were therefore also enumerated from information provided by the Applicant (GIS Data Source: Clean Line 2013a). Overall, the environment is predominantly rural agricultural land or forested land interspersed with residential areas. Detailed land use information is presented in detail in Section 3.10.

3.4.10.1 Region 1

Region 1 is referred to as the Oklahoma Panhandle Region and includes the Applicant Proposed Route, Alternative Routes 1-A through 1-D, AC collection system of up to 345kV, the Oklahoma converter station, and potentially the future Optima substation. The westernmost portion of the HVDC transmission line would be connected into the Oklahoma converter station located in Texas County, Oklahoma. The HVDC transmission line could parallel at least three other overhead AC transmission lines within this region (ranging from 69kV to 345kV in voltage). Table 3.4-7 provides the number of residences located within the ROI for the Applicant Proposed Route and HVDC alternative routes within Region 1. Table 3.4-8 provides the number of residences located within the ROI for the AC collection system. There are no residences within the ROI for the Oklahoma Converter Station Siting Area or AC Interconnection Siting Area.

Table 3.4-7:
Residences Located Within the ROI for the Applicant Proposed Route and HVDC Alternative Routes in Region 1

HVDC Transmission Line Routes	Number of Residences
APR	8
AR 1-A	7
AR 1-B	3
AR 1-C	6
AR 1-D	9

GIS Data Sources: Clean Line (2013a, 2013b), Tetra Tech (2014a)

Table 3.4-8:
Residences Located Within the ROI for the AC Collection System

AC Collection System	Number of Residences
E-1	193
E-2	19
E-3	39
NE-1	48
NE-2	24
NW-1	25
NW-2	44
SE-1	7
SE-2	10
SE-3	19
SW-1	8
SW-2	10
W-1	5

GIS Data Sources: Clean Line (2013a, 2013b), Tetra Tech (2014a)

3.4.10.2 Region 2

Region 2 is referred to as the Oklahoma Central Great Plains Region and includes the Applicant Proposed Route and HVDC Alternative Routes 2-A through 2-B. The HVDC transmission line could parallel at least three other overhead AC transmission lines within this region (all 115kV voltage). Table 3.4-9 provides the number of residences located within the ROI for the Applicant Proposed Route and HVDC alternative routes within Region 2.

Table 3.4-9:
Residences Located Within the ROI for the Applicant Proposed Route and HVDC Alternative Routes in Region 2

HVDC Transmission Line Routes	Number of Residences
APR	26
AR 2-A	5
AR 2-B	2

GIS Data Sources: Clean Line (2013a, 2013b), Tetra Tech (2014a)

3.4.10.3 Region 3

Region 3 is referred to as the Oklahoma Cross Timbers Region and includes the Applicant Proposed Route and HVDC Alternative Routes 3-A through 3-E. The HVDC transmission line could parallel at least eleven other overhead AC transmission lines within this region (ranging from 69kV to 345kV in voltage). Table 3.4-10 provides the number of residences located within the ROI for the Applicant Proposed Route and HVDC alternative routes within Region 3.

Table 3.4-10:
Residences Located Within the ROI for the Applicant Proposed Route and HVDC Alternative Routes in Region 3

HVDC Transmission Line Routes	Number of Residences
APR	114
AR 3-A	13
AR 3-B	26
AR 3-C	102
AR 3-D	40
AR 3-E	20

GIS Data Sources: Clean Line (2013a, 2013b), Tetra Tech (2014a)

3.4.10.4 Region 4

Region 4 is referred to as the Arkansas River Valley Region and includes the Applicant Proposed Route and HVDC Alternative Routes 4-A through 4-E as well as the Lee Creek Variation[2]. The HVDC transmission line could parallel at least 13 other overhead AC transmission lines within this region (ranging from 69kV to 345kV in voltage). Table 3.4-11 provides the number of residences located within the ROI for the Applicant Proposed Route and HVDC alternative routes within Region 4.

Table 3.4-11:
Residences Located Within the ROI for the Applicant Proposed Route and HVDC Alternative Routes in Region 4

HVDC Transmission Line Routes	Number of Residences
APR	151
AR 4-A	103

[2] The Lee Creek Variation is a variation of the Applicant Proposed Route that was created in response to scoping comments from the City of Fort Smith, Arkansas expressing concern about the proximity of the proposed route to the Lee Creek Dam and Reservoir.

Table 3.4-11:
Residences Located Within the ROI for the Applicant Proposed Route and HVDC Alternative Routes in Region 4

HVDC Transmission Line Routes	Number of Residences
AR 4-B	107
AR 4-C	6
AR 4-D	67
AR 4-E	61
Lee Creek Variation	0

GIS Data Sources: Clean Line (2013a, 2013b), Tetra Tech (2014a)

3.4.10.5 Region 5

Region 5 is referred to as the Central Arkansas Region and includes the Applicant Proposed Route, HVDC Alternative Routes 5-A through 5-F, and Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area. The HVDC transmission line could parallel at least two other overhead AC transmission lines within this region (138kV and 500kV in voltage). Table 3.4-12 provides the number of residences located within the ROI for the Applicant Proposed Route and HVDC alternative routes within Region 5. There are 152 residences within the Arkansas Converter Station Alternative Siting Area. There are 38 residences within the Arkansas AC Interconnection Siting Area.

Table 3.4-12:
Residences Located Within the ROI for the Applicant Proposed Route and HVDC Alternative Routes in Region 5

HVDC Transmission Line Routes	Number of Residences
APR	81
AR 5-A	54
AR 5-B	11
AR 5-C	6
AR 5-D	50
AR 5-E	24
AR 5-F	20

GIS Data Sources: Clean Line (2013a, 2013b), Tetra Tech (2014a)

3.4.10.6 Region 6

Region 6 is referred to as the Cache River and Crowley's Ridge Region and includes the Applicant Proposed Route and HVDC Alternative Routes 6-A through 6-D. It should be noted that the Cache/Lower White River systems are designated as a "wetlands of International Importance" under the Ramsar Convention on International Wetlands, and the Cache River is a forested wetland crossed by the ROI area. The HVDC transmission line could parallel at least one other overhead AC transmission line within this region (161kV voltage). Table 3.4-13 provides the number of residences located within the ROI for the Applicant Proposed Route and HVDC Alternative Routes within Region 6.

Table 3.4-13:
Residences Located Within the ROI for the Applicant Proposed Route and HVDC Alternative Routes in Region 6

HVDC Transmission Line Routes	Number of Residences
APR	26
AR 6-A	6
AR 6-B	2
AR 6-C	16

GIS Data Sources: Clean Line (2013a, 2013b), Tetra Tech (2014a)

3.4.10.7 Region 7

Region 7 is referred to as the Arkansas Mississippi River Delta and Tennessee Region and includes the Applicant Proposed Route, Alternative Routes 7-A through 7-D, 500kV transmission collector lines, and the Tennessee converter station. The HVDC transmission line could parallel at least four other overhead AC transmission lines within this region (ranging from 161kV to 500kV in voltage). Table 3.4-14 provides the number of residences located within the ROI for the Applicant Proposed Route and HVDC alternative routes within Region 7. There are no residences within the Tennessee Converter Station Siting Area and AC Interconnection Tie.

Table 3.4-14:
Residences Located Within the ROI for the Applicant Proposed Route and HVDC Alternative Routes in Region 7

HVDC Transmission Line Routes	Number of Residences
APR	30
AR 7-A	12
AR 7-B	10
AR 7-C	44
AR 7-D	30

GIS Data Sources: Clean Line (2013a, 2013b), Tetra Tech (2014a)

3.4.10.8 Connected Actions

3.4.10.8.1 Wind Energy Generation

Wind energy generation facilities may be interconnected to the Project's ±600kV HVDC overhead electric transmission line to transport electricity. Electrical equipment associated with wind farms can include wind turbine generators, underground collection cables, substation with electric transformers, and AC transmission lines to connect the wind power generation to the electrical grid. Most of this equipment is located within the generation facility itself.

Wind energy generation facilities require AC transmission lines to interconnect into the electrical grid. Any generation transmission interconnection lines would be similar in size and voltage to the transmission lines associated with the AC collection system. Therefore, the regions where existing environmental conditions and the potential effects associated with these wind generation interconnection lines would be similar to the AC collection system transmission lines (Clean Line 2014b, 2014c).

3.4.10.8.2 Optima Substation

The future Optima substation would be constructed on approximately 160 acres partially within the area identified on Figure 2.1-3 as the AC interconnection siting area.

3.4.10.8.3 TVA Upgrades

The ROI for the direct assignment facilities (which are included in the Applicant Proposed Project) would occur within the Tennessee Converter Station Siting Area and more specifically within the Shelby Substation. The ROI for the network upgrades, and in particular TVA's future 500kV transmission line, cannot be determined at this time. The new 500kV transmission line would be constructed in western Tennessee. The upgrades to existing facilities would mostly be in western and central Tennessee. Upgrades to existing infrastructure would include upgrading terminal equipment at three existing 500kV substations and six existing 161kV substations, making appropriate upgrades to increase heights on 16 existing 161kV transmission lines to increase line ratings, and replacing the conductors on eight existing 161kV transmission lines. Where possible, general impacts associated with the required TVA upgrades are discussed in the impact sections that follow.

3.4.11 Electrical Environment Impacts

This section describes the electrical environment and environmental impacts associated with the AC/DC converter stations (located in Oklahoma, Arkansas, and Tennessee), the ±600kV HVDC overhead electric transmission line, the AC transmission line interconnections, and the AC transmission line collection system alternatives. The electrical effects evaluated include electric and magnetic fields, air ions and ozone, audible noise, and radio and television interference.

3.4.11.1 Methodology

Computer modeling was performed to calculate values for electrical effects associated with each of the proposed transmission line configurations. For the AC/DC converter stations, the dominant sources of electrical effects are the overhead transmission lines entering and exiting the stations. Some types of substation and switching station equipment can potentially be a source of electrical effects (for example, power transformers can produce audible noise; converter equipment can produce radio noise, etc.). These effects can be reduced or eliminated by the use of filtering equipment, sound walls, and other methods (CRC 2007), and Project converter stations are planned to be located in either rural areas or areas where other electrical substations already exist; therefore computer modeling and calculations of electrical effects for the proposed converter stations was not performed, except for audible noise as described in Section 3.11.6. Detailed calculation results are presented in Appendix I.

Two different configurations were evaluated for the proposed ±600kV HVDC overhead electric transmission line (bi-polar monopole and bi-polar lattice configurations), while nine different configurations were evaluated for the proposed AC collection system routes and converter station interconnections (five 345kV and four 500kV configurations). All of the computer modeling data related to line design configuration, conductor specifications and spacing, loading, and other parameters were provided by the Applicant (GIS Data Source: Clean Line 2013a).

Calculations were performed using the minimum midspan conductor clearance for all electrical effects except audible noise. For audible noise, calculations are performed using the minimum midspan conductor clearance plus one-third of the sag (which represents an average conductor height along the entire span between support structures) (EPRI 2006a). For transmission line corona effects, conservative assumptions for overvoltage conditions and ground elevation were used to calculate effects. Voltage levels for a high voltage transmission line are typically held relatively constant (within ±5-10 percent) while the load on the line is allowed to fluctuate with demand. A conservative overvoltage condition was assumed for all transmission lines (+5 percent for 345kV AC, +10 percent for 500kV AC, and approximately +5 percent for ±600kV DC) as cited by the Applicant (Clean Line 2014b). In addition, higher elevations accentuate corona effects, so the highest reported altitude along the Project routes (an elevation of 3,000 feet above sea level) was used. These conservative assumptions are used to calculate a maximum electrical effect value; at lower elevations, for lower voltage conditions, or for higher conductor ground clearances, the calculated electrical effects values will be lower. For AC and DC magnetic fields, two different loading conditions were modeled: average and maximum loading.

For electric and magnetic fields, calculations were performed at a height of 3.28 feet (1 meter) in accordance with IEEE Standards (IEEE 1994). For audible noise, calculations were performed at a height of 4.9 feet, which approximates the height of a human ear. For radio noise, calculations were performed at an antenna height of 6.6 feet in accordance with IEEE Standards (IEEE 1986). For television noise, calculations were performed at an antenna height of 9.8 feet. The reference frequency for the calculations is 0.5MHz for radio noise and 75MHz for TV noise. For ozone and air ions, calculations were performed at ground level (EPA 2014). Radio noise calculation results are presented for both fair and rainy weather, while television noise and ozone are presented for rainy weather only.

Environmental conditions were assumed to be at an elevation of 3,000 feet above sea level (corona effects are accentuated at higher elevations and this elevation represents the highest reported altitude along the Project routes), with a wind speed of 8.5 miles per hour (mph) and rain rate of 0.1 inch/hour. The assumed wind speed and rain rate are calculated averages based upon 2013 monthly weather data for the cities of Oklahoma City, Little Rock, and Memphis. Audible noise calculation software typically assumes a flat, open terrain with no sound-modifying objects present (such as uneven terrain, trees, buildings, and other objects). For electrical effects associated with the ±600kV HVDC overhead electric transmission line, the EPRI Transmission Line Workstation software program Version 3.0 (specifically the ACDC Line module) was used to perform the computer modeling (EPRI 1996, 2006b). For electrical effects associated with the AC transmission line collection system alternatives and interconnections, three different software programs were used for calculations. For electric and magnetic fields, the EPRI EMFWorkstation 2013 software program was used (EPRI 2013b). For audible noise, the EMFWorkstation software Version 2.51 (specifically the ENVIRO Version 3.52 module) was used to calculate L_{dn} noise levels (EPRI 1997). For all other electrical effects, the Bonneville Power Administration Corona and Field Effects software program was used (BPA 1977).

The Applicant has developed a comprehensive list of EPMs that is provided in Appendix F. Since these EPMs would be adopted, calculations assume the use of these EPMs throughout the impact analysis that follows for both the Applicant Proposed Project and the DOE alternatives.

For electrical effects, EPMs will involve the use of line design configurations and conductor types to reduce effects at and beyond the ROW edges. The Applicant has proposed using “optimal phasing” for the proposed AC transmission collection lines to reduce EMF at the ROW edges for double circuit configurations (Clean Line 2014a).

Optimal phasing takes into account the direction of current flow in all circuits to determine the appropriate phasing sequence for maximizing magnetic field reduction. For double circuit (or multiple circuit) lines located together on the same support structure (or in close proximity to one another), the overall magnetic field generated from the lines will be dependent upon the arrangement of each circuit's phase sequence (among other parameters). Circuits can be arranged so that the phase sequence for one circuit is placed adjacent to the same phase sequence of the other circuit. This situation is often called "like phasing." Circuits can also be arranged so that the phase sequence for one circuit is placed adjacent to the opposite phase sequence of the other circuit. This situation is often called "unlike phasing" (or "cross-phasing," "reverse phasing," or "low reactance phasing"). This phasing arrangement can be applied to double (or multi-circuit) transmission and/or distribution lines, or transmission lines with a lower voltage underbuild. For magnetic field reduction, the "unlike" method works best when current flow in the adjacent circuits is equal in magnitude and direction. If the current flow in adjacent circuits is in the opposite direction, then the "like" phasing method works best for magnetic field reduction.

Of the EPMs presented in Appendix F, three would specifically apply to electrical effects: GE-17, GE-18, and GE-19. GE-17 and GE-18 relate to audible noise, radio noise, and television interference by maintaining tension on insulator assemblies, protection of the conductor surface from damage during construction, inspection and repair/replace damaged equipment, and consideration of conductor size, quantity, and bundle configurations in designing the transmission line. GE-19 relates to grounding of conductive objects within the ROW to reduce the potential for induced voltage and currents on these objects.

3.4.11.2 Impacts Associated with the Applicant Project

3.4.11.2.1 Converter Stations and AC Interconnection Siting Areas

This section describes the electrical effects associated with the two applicant proposed converter stations and the AC transmission line interconnections associated with those stations. Electrical effects would only be present during operation and maintenance of these facilities. Electrical facilities need to be energized to create electrical effects such as electric and magnetic fields, audible noise, and radio and television interference. Electrical effects would not be present during the construction and decommissioning phases of the Project.

Existing facilities are present within these siting areas, some of which already create electrical effects within the environment. Table 3.4-15 presents the number of existing AC transmission lines that parallel proposed interconnection routes to the two converter stations as well as nearby communication facilities (which are existing radio-frequency sources) within a 1,000-foot-wide corridor for each proposed route alternative. Table 3.4-15 also presents a summary of the number of existing building structures (residences, agricultural buildings, churches, and schools) within the same 1,000-foot-wide corridor for each siting area.

Table 3.4-15:
Occurrence of Existing Facilities within the Applicant Proposed Converter Station and AC Interconnection Siting Areas

DC Transmission Interconnection Route	Parallels Existing AC Transmission Lines (Quantity and Voltage Range)	Existing Building Structures within 1,000-Foot-Wide Corridor (Residential/Agricultural/Church/School)[1]	Existing Communication Facilities Within 1,000-Foot-Wide Corridor (Quantity and Type)[2]
Oklahoma	1 (345kV)	0/0/0/0	0
Tennessee	0	11/13/0/0	2 (microwave towers)

1 GIS Data Source: Clean Line (2013a), Tetra Tech (2014a)
2 GIS Data Source: FCC (2012)

3.4.11.2.1.1 Construction Impacts

There are no electrical effects associated with construction of the converter stations or AC transmission lines, because these facilities would not be energized during construction. Electrical facilities need to be energized to create electrical effects such as electric and magnetic fields, audible noise, and radio and television interference.

3.4.11.2.1.2 Operations and Maintenance Impacts

For the Oklahoma AC/DC converter station, the dominant sources of electrical effects are the overhead transmission lines entering and exiting the station. Some types of substation and switching station equipment can potentially be a source of electrical effects (e.g., power transformers can produce audible noise; converter equipment can produce radio noise, etc.). These effects can be reduced or eliminated by the use of filtering equipment, sound walls, and other methods, so the dominant sources of electrical effects are associated with the overhead transmission lines; evaluation of electrical effects for the proposed converter stations was not performed except for audible noise as described in Section 3.11.6.

For the Tennessee AC/DC converter station, no electrical effects were evaluated because the overhead transmission lines are the dominant sources of electrical effects near the converter station, and the converter station interconnection would occur entirely within the converter station and the adjacent Shelby Substation site (i.e., no public access).

3.4.11.2.1.2.1 Oklahoma Converter Station Siting Area and AC Interconnection Siting Area

No electrical effects were evaluated for the Oklahoma converter station because overhead transmission lines are the dominant sources of electrical effects near the station.

There are three different 345kV AC transmission line configurations associated with the interconnection into the Oklahoma converter station. All three line designs are double circuit configurations (i.e., two circuits supported on a single structure). One line design is a double circuit monopole, supported on a tubular pole. The other two line designs (double circuit lattice tower and double circuit danube configuration) are each supported on lattice structures. Each transmission line configuration is located within its 150-foot-wide ROW, and would primarily provide voltage support (so very little or no loading would be present on the lines). Figures 3.4-6 through 3.4-8 present dimensioned drawings of the three representative 345kV AC transmission line configurations.

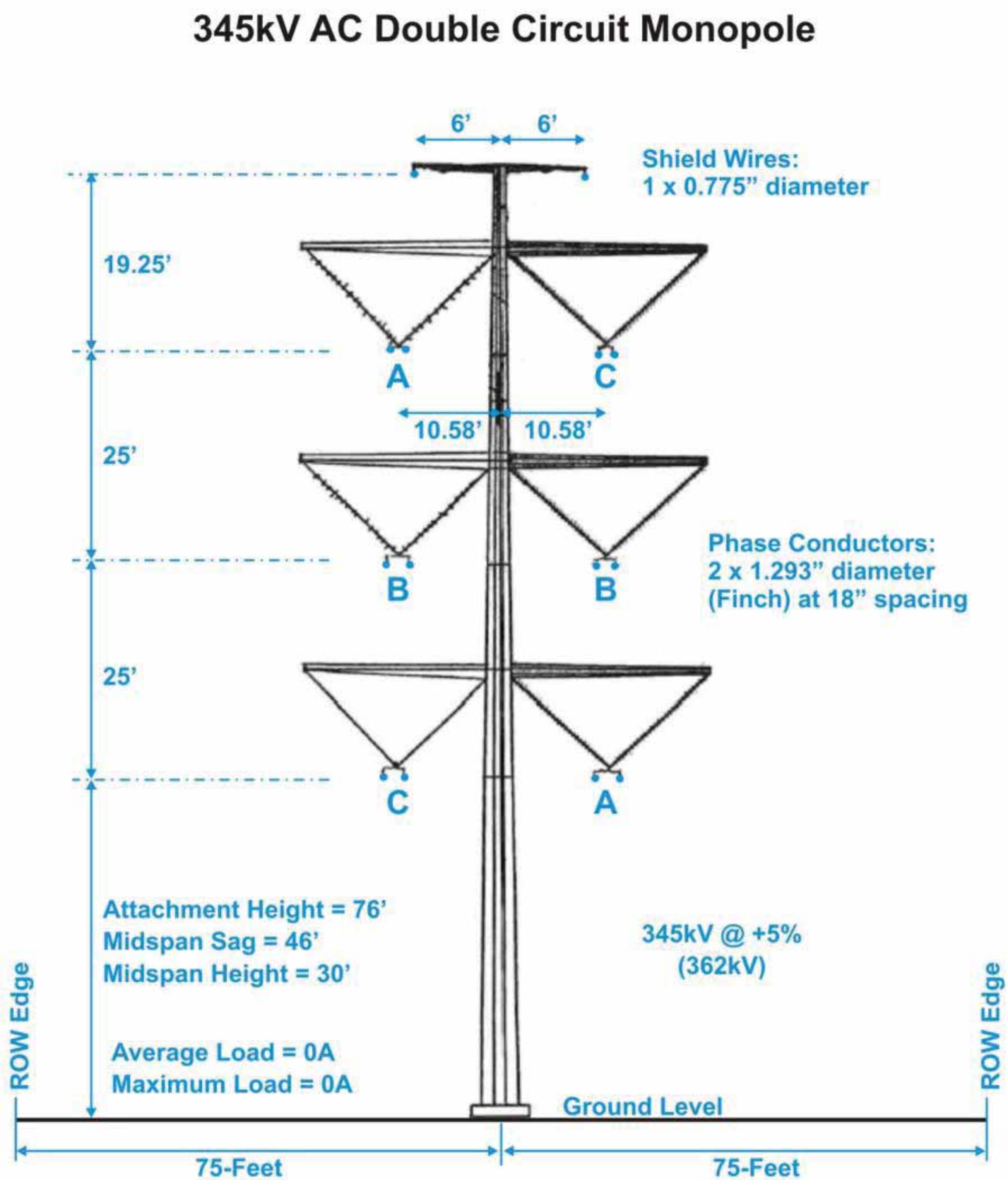


Figure 3.4-6: 345kV AC Transmission Line Double Circuit Monopole Configuration for Interconnection to Oklahoma Converter Station

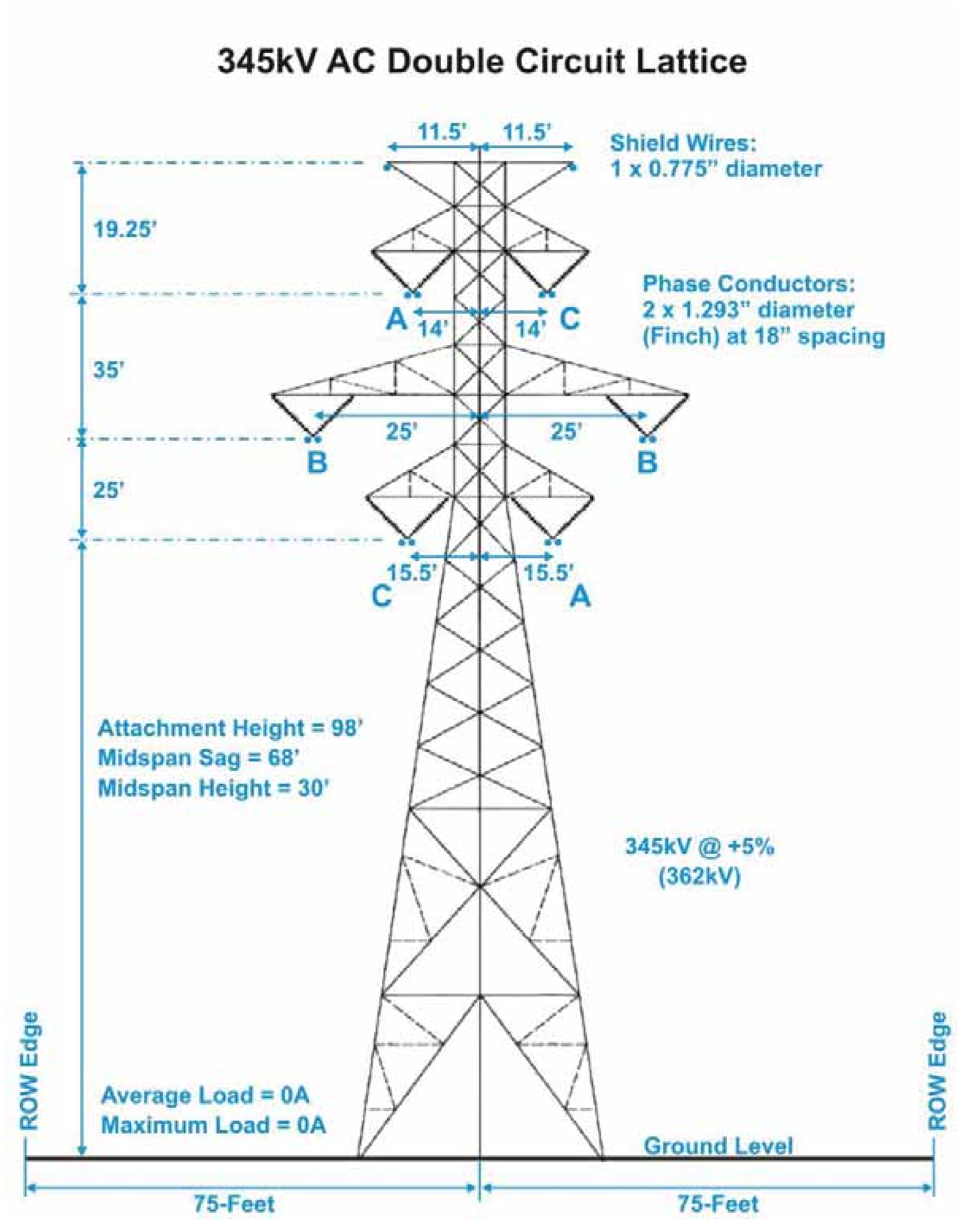


Figure 3.4-7: 345kV AC Transmission Line Double Circuit Lattice Tower Configuration for Interconnection to Oklahoma Converter Station

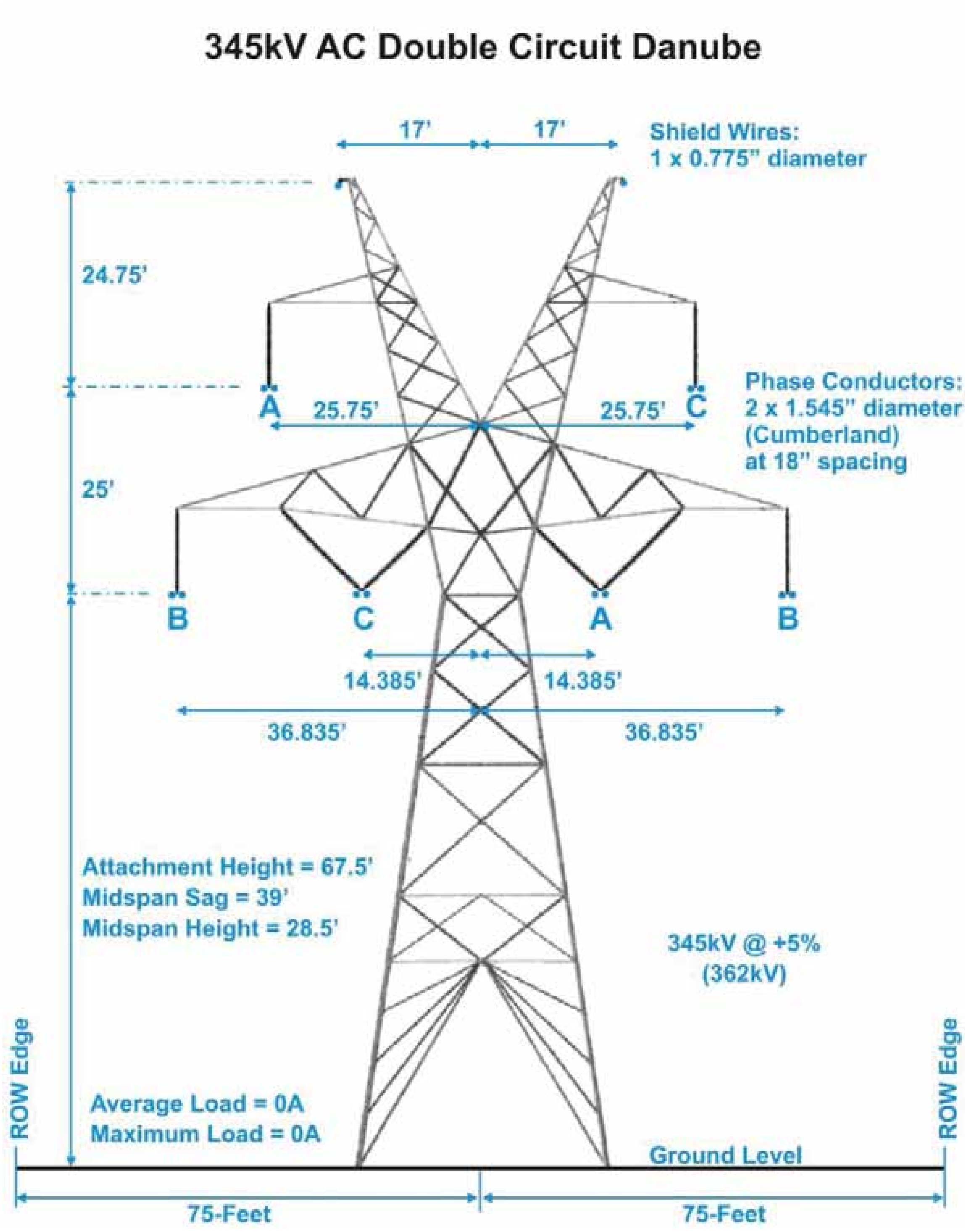


Figure 3.4-8: 345kV AC Transmission Line Double Circuit Danube Tower Configuration for Interconnection to Oklahoma Converter Station

3.4.11.2.1.2.1.1 AC Electric Field Calculation Results

AC electric field calculations were performed for the three transmission line configurations. Table 3.4-16 presents a summary of the calculated electric field at the ROW edges and for the maximum field within the ROW. Calculated field levels vary depending upon the line configuration. Figure 3.4-9 presents a graph of the calculated AC electric field for each line configuration.

Table 3.4-16:
Calculated AC Electric Field for 345kV AC Transmission Line Interconnections to Oklahoma Converter Station

345kV AC Transmission Line Configuration	Calculated AC Electric Field (kV/m)		
	ROW Edge (-75 Feet from CL)	Maximum on ROW	ROW Edge (+75 Feet from CL)
Double Circuit Monopole	0.2	4.6	0.2
Double Circuit Lattice	0.8	5.3	0.8
Double Circuit Danube	1.7	5.7	1.7

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300 feet on either side of a representative centerline.

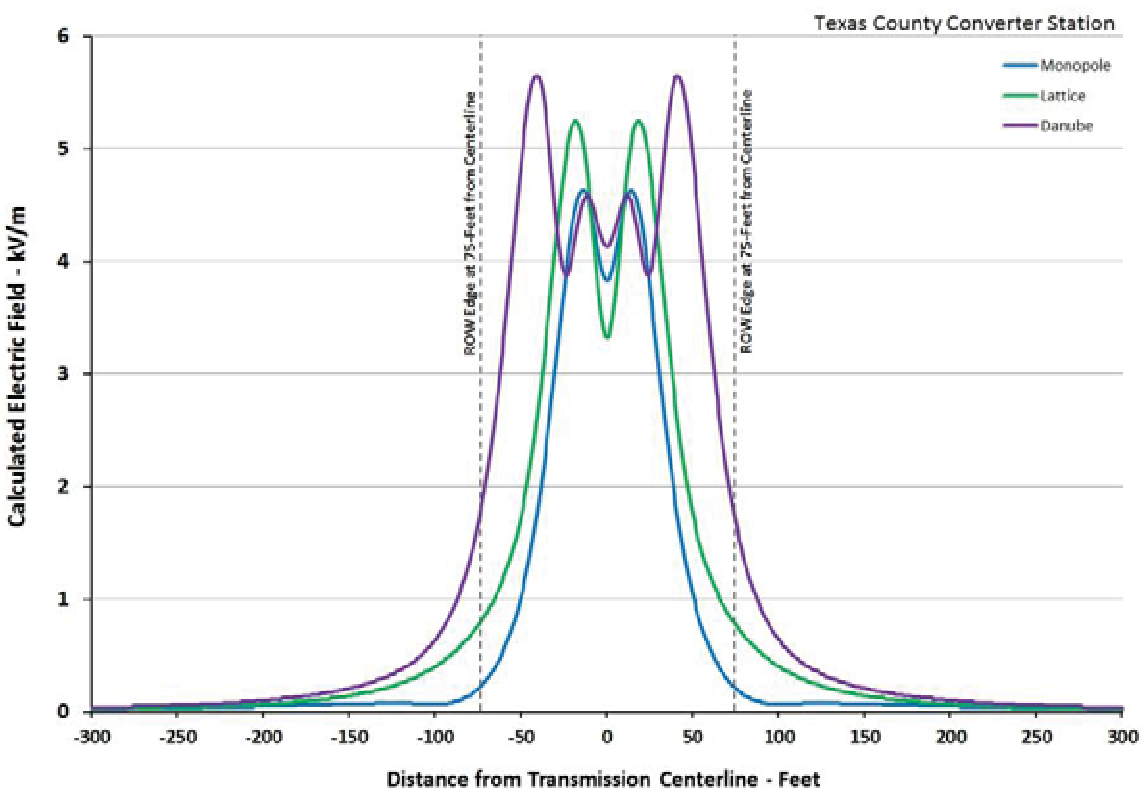


Figure 3.4-9: Calculated AC Electric Fields for 345kV AC Transmission Line Interconnections to Oklahoma Converter Station

Calculated electric field levels at the ROW edges (75 feet from centerline of the transmission line) for all of the AC transmission line interconnections are below the ICES and ICNIRP guidelines for public exposure (5kV/m and 4.2kV/m, respectively; see Section 3.4.6). Within the ROW, calculated electric field levels are below the ICES guideline of 10kV/m. For the double circuit Danube configuration, calculated electric field at the ROW edge (1.7kV/m) exceeds the ACGIH guideline of 1kV/m for workers with implanted medical devices.

3.4.11.2.1.2.1.2 AC Magnetic Field Calculation Results

The Applicant reported that there would not be any load on these transmission line interconnections (only voltage) (Clean Line 2014a). AC magnetic field calculations were therefore not performed for the three transmission line configurations because there was assumed to be no load on the transmission line. If no loading is present, no magnetic fields would be generated as a result of the transmission line.

3.4.11.2.1.2.1.3 AC Audible Noise Calculation Results

Audible noise calculations were performed for the three AC transmission line configurations. Table 3.4-17 presents a summary of the calculated day-night (L_{dn}) audible noise at the ROW edges and for the maximum noise level within the ROW. Calculated levels vary, depending upon the line configuration. Figure 3.4-10 presents a graph of the calculated audible noise for each AC transmission line configuration.

Table 3.4-17:
Calculated Audible Noise for 345kV AC Transmission Line Interconnections to Oklahoma Converter Station

345kV AC Transmission Line Configuration	Calculated Audible Noise (dBA)—L_{dn}		
	-75 Feet from CL	Maximum on ROW	+75 Feet from CL
Double Circuit Monopole	55.2	57.8	55.2
Double Circuit Lattice	52.2	54.2	52.2
Double Circuit Danube	51.0	53.6	51.0

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300 feet on either side of a representative centerline.

Calculated audible noise levels at the ROW edges (75 feet from centerline of the transmission line) for two of the AC transmission line interconnections are at or below the EPA guideline for L_{dn} (day-night) noise of 55 dBA. The calculated audible noise level for the third (double circuit monopole) configuration is slightly higher than the EPA guideline (at 55.2 dBA), but calculated audible noise levels assume a 5 percent overvoltage condition at the highest line elevation (3,000 feet).

The sound level for a typical wilderness area is about 30 dBA, while a small town or quiet suburb is reported to be about 47–53 dBA (EPA 1974), which is similar to calculated L_{dn} noise levels from the transmission line at the ROW edge (51–55.2 dBA). The audible noise from a transmission line decreases with distance away from the line and would approach background levels within a few thousand feet of the line. During rain it may be possible to hear most high voltage AC transmission lines at close distances, but often this noise is masked by the noise of falling rain and wind.

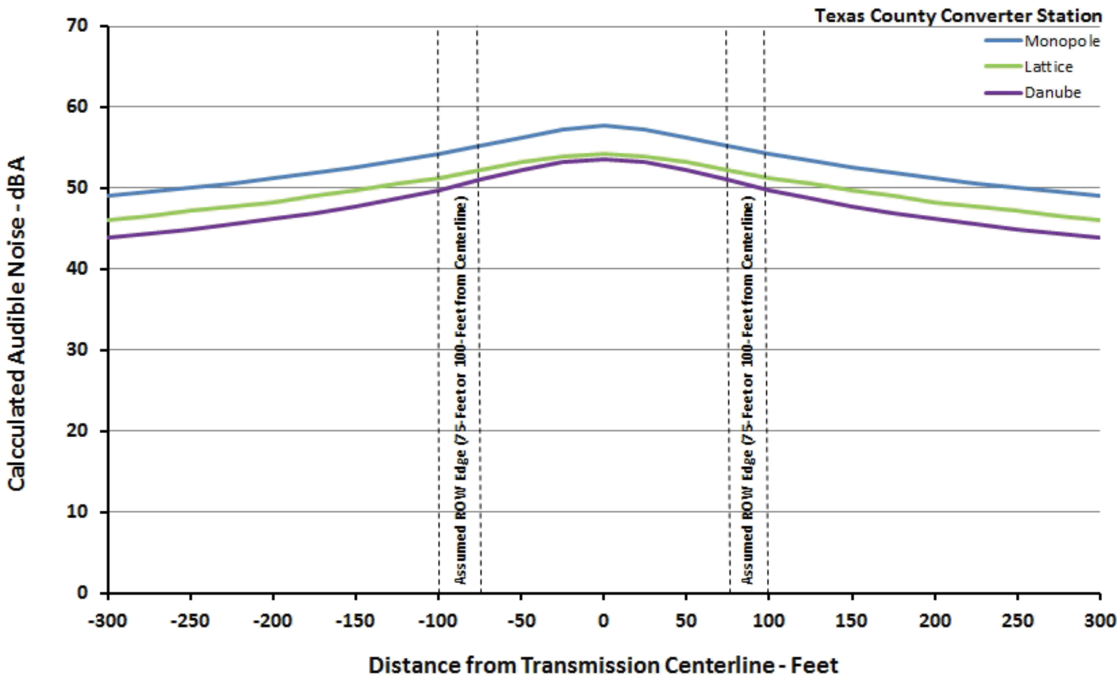


Figure 3.4-10: Calculated Audible Noise Levels (L_{dn}) for 345kV AC Transmission Line Interconnections to Oklahoma Converter Station

3.4.11.2.1.2.1.4 AC Radio Noise Calculation Results

Radio noise calculations were performed for the three AC transmission line interconnections for rainy and fair weather conditions. Table 3.4-18 presents a summary of the calculated radio noise at the ROW edges and for the maximum noise within the ROW at 500 kilohertz (kHz) for both weather conditions. Table 3.4-18 also presents calculated 500kHz radio noise at 50 feet from the outside conductor for comparison with the IEEE Standard. Calculated radio noise levels vary, depending upon the line configuration and weather conditions. As shown in Table 3.4-18, calculated radio noise levels at 50 feet from the outside conductor comply with the IEEE 61 dB:V/m threshold during fair weather conditions. Figure 3.4-11 presents a graph of the calculated radio noise levels for each AC line configuration in rainy weather, adjusted to the 500kHz reference level. Figure 3.4-12 presents a corresponding graph of the calculated radio noise levels for fair weather (adjusted to the 500kHz reference level).

Table 3.4-18:
Calculated Radio Noise for 345kV AC Transmission Line Interconnections to Oklahoma Converter Station at 500kHz

345kV AC Transmission Line Configuration	Calculated Radio Noise (dB:V/m) at 500kHz (Rainy/Fair Weather)				
	-50 Feet from Outside Conductor	ROW Edge (-75 Feet from CL)	Maximum on ROW	ROW Edge (+75 Feet from CL)	+50 Feet from Outside Conductor
Double Circuit Monopole	67.9/50.9	66.0/49.0	82.4/65.4	66.0/49.0	67.9/50.9
Double Circuit Lattice	63.3/46.3	63.3/46.3	80.0/63.0	63.3/46.3	63.3/46.3
Double Circuit Danube	61.8/44.8	65.3/48.3	77.9/60.9	65.3/48.3	61.8/44.8

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300 feet on either side of a representative centerline.

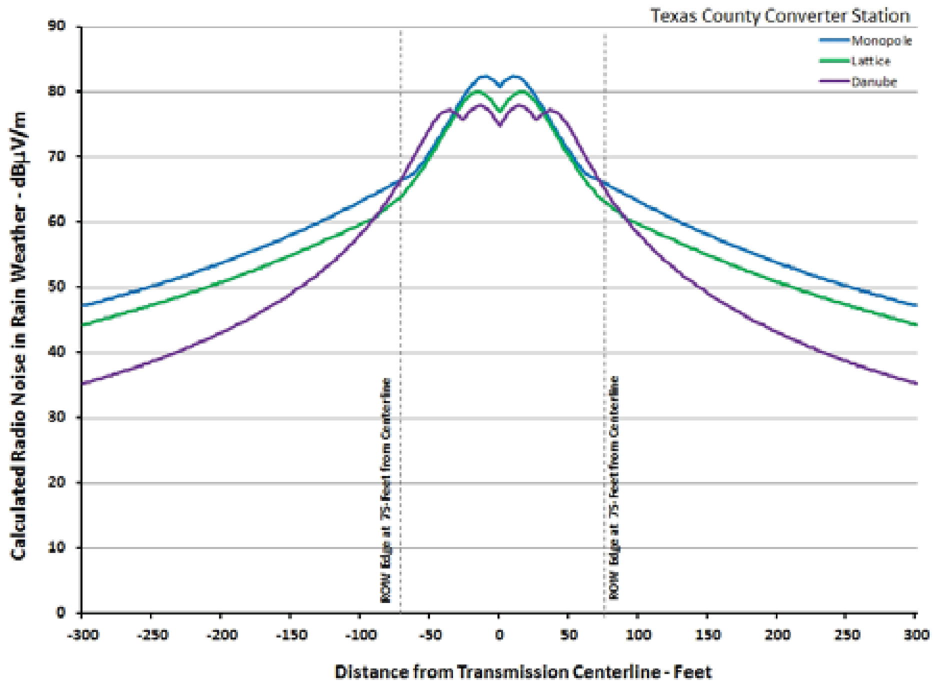


Figure 3.4-11: Calculated Radio Noise for 345kV AC Transmission Line Interconnections to Oklahoma Converter Station (Rainy Weather)

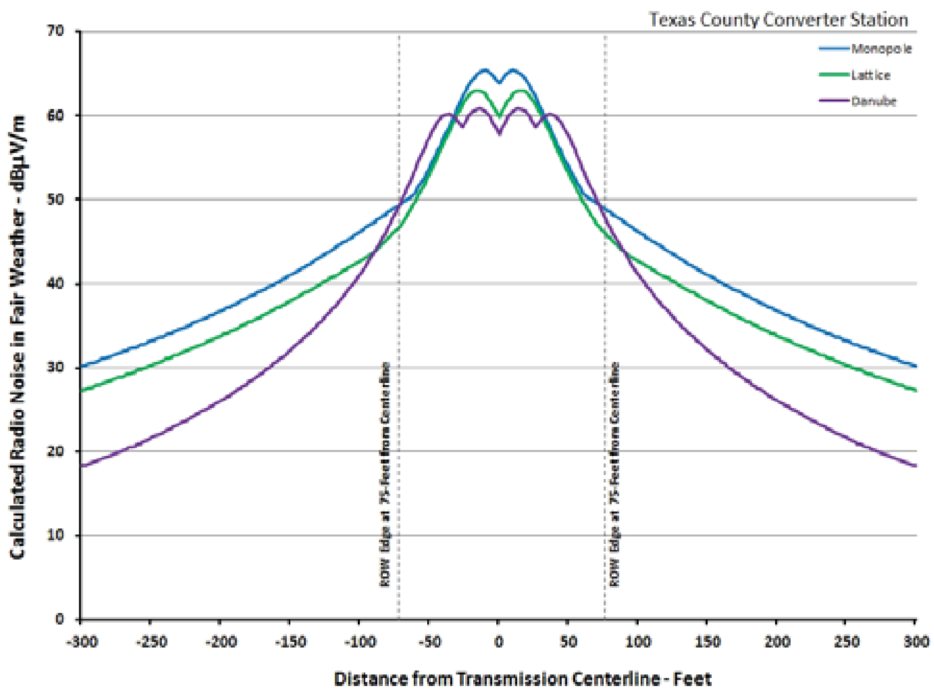


Figure 3.4-12: Calculated Radio Noise for 345kV AC Transmission Line Interconnections to Oklahoma Converter Station (Fair Weather)

It is difficult to determine whether the radio noise produced by a transmission line or any other source would cause unacceptable interference without knowing broadcast signal strengths at various locations of interest along the possible line routes. Parameters such as the strength of the received signal, the sensitivity of the receiver, the orientation and design of the receiving antenna, and ambient radio frequency noise are also important in determining the degree to which noise from any source may cause degradation of radio reception quality. Modern sources of man-made noise have grown over time and this increase has led to increasing interference in the AM broadcast band. Utilities have considerable experience in addressing complaints of interference to radio or TV reception and there are a variety of ways of mitigating interference.

For AM radio broadcasts (within 520 to 1,720kHz), coverage can be described as follows (Radio Locator 2014):

- Areas able to receive a radio station on almost any radio with moderately good to very good reception (local coverage)
- Areas where the signal of the radio station may be weak unless using a good radio or good antenna (distant coverage)
- Areas where the station signal is very weak even with a good radio and antenna, and interference may prevent reception (fringe coverage)

Radio reception from AM radio stations in fringe coverage areas may not be possible even in fair weather, regardless of the presence of radio noise sources. Reception of AM radio stations in distant coverage areas may be possible, but the potential for interference may increase near the ROW edges or within the transmission line ROW, especially during rain. Reception of AM radio stations in local coverage areas should be possible near the transmission line ROW edges, with a decreasing potential for interference with distance away from the transmission line. Rainy weather can increase interference levels.

IEEE used published listening tests of transmission line noise to create a quality-of-reception curve based upon the difference in AM radio reception quality versus the SNR—a difference between signal strength and radio noise level (previously discussed in Section 3.4.4):

- A difference of about 14 dB represents a quality of reception where background noise is very evident, but speech is easily understood
- A difference of about 20–22 dB represents a quality of reception that is fairly satisfactory but background noise is plainly evident
- A difference of about 24 dB represents a quality of reception that is very good and background noise is unobtrusive
- A difference of about 28 dB (or greater) represents an entirely satisfactory quality of reception (IEEE 1965; EPRI 2006a)

Another method for evaluating the potential for radio noise interference is based upon the IEEE Radio Noise Design Guide (IEEE 1971). This guide is intended to provide a summary of good engineering design practices that will result in a tolerable radio noise level for a proposed transmission line when placed in service. This method relates the calculated maximum surface gradient of the transmission line conductor and conductor diameter to levels of radio interference. The range of calculated maximum surface gradients for the proposed AC transmission line conductors comply with (or are less than) the established range for limiting fair weather radio noise levels in the frequency range of 150kHz to 5MHz, which includes radio broadcast frequencies.

The new digital broadcast system technology should provide improved reception and better immunity to impulse-type noise from sources such as transmission lines or vehicle ignition systems. Rather than a slowly degrading AM radio sound quality for analog systems, interference will have a threshold for performance that is essentially a go/no go proposition for digital receivers. A digital receiver can accept interference without the user noticing anything until the interference becomes so great that the reception stops. The new digital signal will be less susceptible to interference noise than an old analog signal (Smith 2004). The quality of digital reception should be better in a given noise level and would stay good beyond which the old analog reception is no longer viable. These results have been documented in previous studies, such as the FCC study (FCC 1999) that indicated that digital signals will provide improved reception and immunity to impulse noise (such as noise interference from transmission lines) than analog signals.

In 2002, the FCC selected in-band, on-channel technology as the technology AM and frequency modulation (FM) broadcasters use for digital radio broadcasting. Transition to digital radio requires broadcasters to install new equipment, and during the transition, broadcasters operate in a “hybrid” mode (broadcasting the same programming using both analog and digital signals within a single AM or FM channel). Although many stations now broadcast in digital, radio broadcasters are not required to convert to “all-digital” broadcasting at this time (FCC 2014).

FM radio stations transmit in a band of frequencies between 88MHz and 108MHz, and use a different signal modulation than AM radio which makes FM transmission immune to impulse-type noise. Transmission line corona noise, therefore, would not affect FM radio reception. FM radio is essentially a line of sight broadcast, and terrain affects FM signals.

3.4.11.2.1.2.1.5 AC Television Noise Calculation Results

Television noise calculations were performed for the three AC transmission line interconnections for rainy weather conditions. Table 3.4-19 presents a summary of the calculated television noise at the ROW edges and for the maximum noise within the ROW for the 75MHz reference level. Calculated television noise levels vary, depending upon the line configuration. Figure 3.4-13 presents a graph of the calculated television noise levels for each AC line configuration in rainy weather.

Table 3.4-19:
Calculated Television Noise for 345kV AC Transmission Line Interconnections to Oklahoma Converter Station

345kV AC Transmission Line Configuration	Calculated Television Noise (dB:V/m) at 75MHz for Rainy Weather		
	ROW Edge (-75 Feet from CL)	Maximum on ROW	ROW Edge (+75 Feet from CL)
Double Circuit Monopole	24.3	34.8	24.3
Double Circuit Lattice	22.5	32.4	22.5
Double Circuit Danube	22.4	30.2	22.4

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300 feet on either side of a representative centerline.

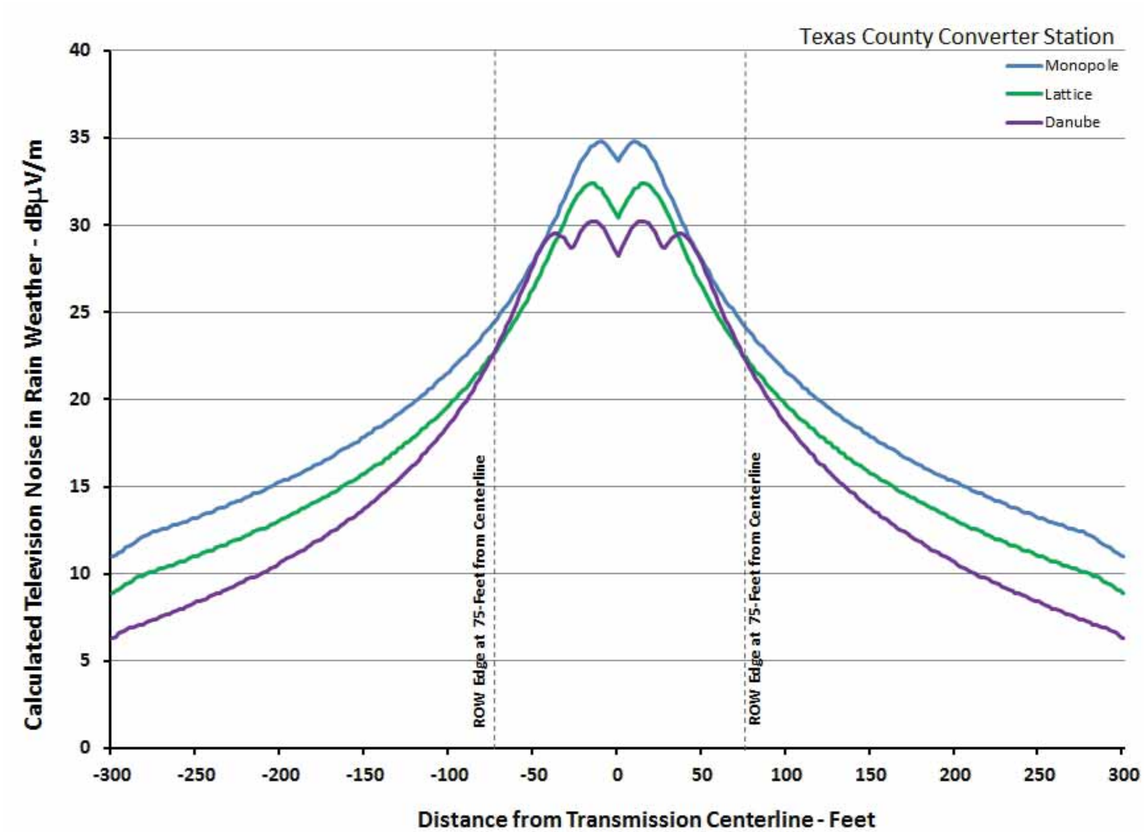


Figure 3.4-13: Calculated Television Noise for 345kV AC Transmission Line Interconnections to Oklahoma Converter Station (Rainy Weather)

As with radio noise interference, it is difficult to determine whether the television noise level produced by a transmission line would cause unacceptable interference. The new digital broadcast system technology for radio and television, however, should provide better coverage and immunity to transmission line noise than analog television signals. No interference resulting from corona-generated noise would be expected for digital signals broadcast at frequencies above 1GHz from satellites (EPRI 2006a).

3.4.11.2.1.2.1.6 Ozone Calculation Results

Ozone levels for the three AC transmission line interconnections were calculated for rainy weather conditions. Table 3.4-20 presents a summary of the calculated maximum ozone concentrations at ground level within 300 feet of the transmission centerline. Maximum ozone levels are far below the EPA standard of 75 ppb for all three line design configurations.

Table 3.4-20:
Calculated Ozone Levels for 345kV AC Transmission Line Interconnections to Oklahoma Converter Station

345kV AC Transmission Line Configuration	Calculated Ozone (ppb) Maximum within +/-300 Feet of CL
Double Circuit Monopole	0.1
Double Circuit Lattice	0.1
Double Circuit Danube	0.1

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300 feet on either side of a representative centerline.

3.4.11.2.1.2.2 Tennessee Converter Station Siting Area and AC Interconnection Tie

No electrical effects were evaluated for the Tennessee converter station because the overhead transmission lines are the dominant sources of electrical effects near the converter station, and the converter station interconnection would occur entirely within the converter station and the adjacent Shelby Substation site (i.e., no public access).

There are two different 500kV AC transmission line configurations associated with the interconnection into the Tennessee converter station. Both line designs are double circuit configurations (i.e., two circuits supported on a single structure). One line design is a double circuit monopole and is supported on a tubular pole, while the other is a double circuit line supported on a lattice structure. Each transmission line configuration is located within a 150-foot-wide to 200-foot-wide ROW (actual ROW width has not yet been determined). Proposed loading for these lines is 1,050MW (1,212 amperes) for average loading and 1,750MW (2,021 amperes) for maximum loading. Figures 3.4-14 and 3.4.15 present dimensioned drawings of the two representative 500kV AC transmission line configurations.

3.4.11.2.1.2.2.1 AC Electric Field Calculation Results

AC electric field calculations were performed for the two transmission line configurations. Table 3.4-21 presents a summary of the calculated electric field at the ROW edges and for the maximum field within the ROW. Because the ROW width has not yet been determined, ROW edge values are provided for both possible edge locations (either 75 feet or 100 feet from the transmission centerline). Calculated field levels vary, depending upon the line configuration. Figure 3.4-16 presents a graph of the calculated AC electric field for each line configuration.

Table 3.4-21:
Calculated AC Electric Field Values for 500kV AC Transmission Line Interconnections to Tennessee Converter Station

500kV AC Transmission Line Configuration	Calculated AC Electric Field (kV/m)[1]				
	-100 Feet from CL	-75 Feet from CL	Maximum on ROW	+75 Feet from CL	+100 Feet from CL
Double Circuit Monopole	0.2	0.7	8.4	0.7	0.2
Double Circuit Lattice	1.0	1.8	9.4	1.8	1.0

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300 feet on either side of a representative centerline.
1 Edges of the ROW have not been established and are assumed to be either 75 feet or 100 feet from centerline.

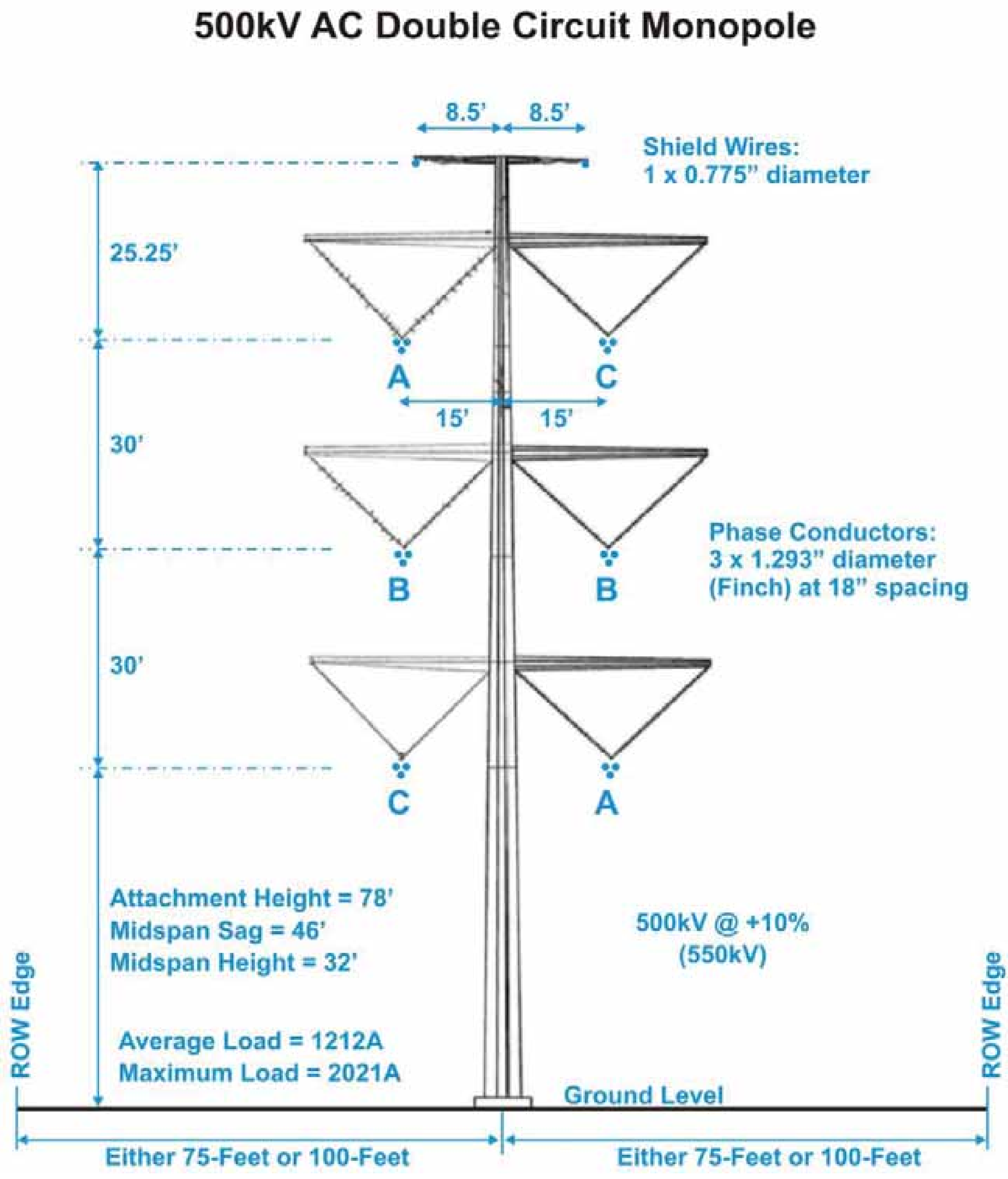


Figure 3.4-14: 500kV AC Transmission Line Double Circuit Monopole Configuration for Interconnection to Tennessee Converter Station

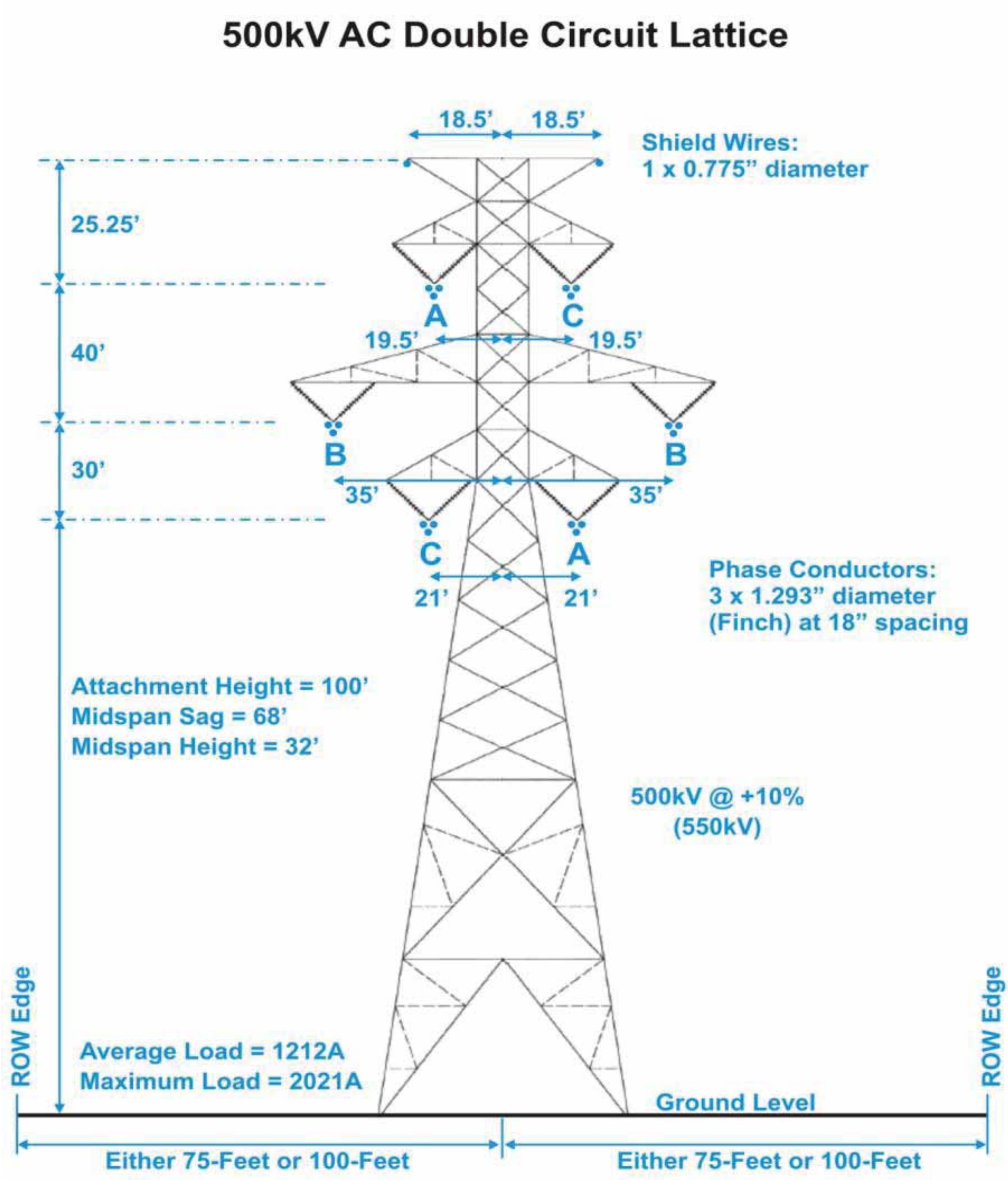


Figure 3.4-15: 500kV AC Transmission Line Double Circuit Lattice Tower Configuration for Interconnection to Tennessee Converter Station

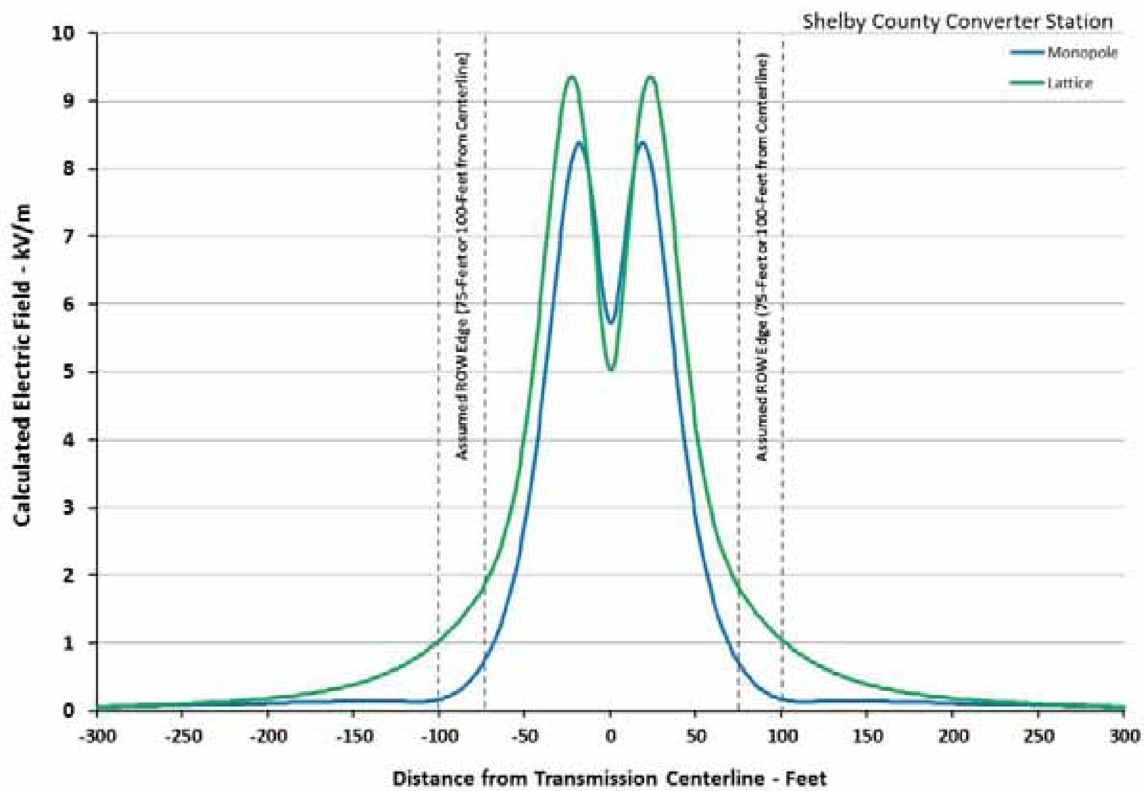


Figure 3.4-16: Calculated AC Electric Fields for 500kV AC Transmission Line Interconnections to Tennessee Converter Station

Calculated electric field levels at the ROW edges (either 75 feet or 100 feet from centerline of the transmission line) for all of the AC transmission line interconnections are below the ICES and ICNIRP guidelines for public exposure (5kV/m and 4.2kV/m respectively). Within the ROW, calculated electric field levels are below the ICES guideline of 10kV/m. For the double circuit lattice configuration, calculated electric field at the 75-foot ROW edge (1.8kV/m) exceeds the ACGIH guideline of 1kV/m for workers with implanted medical devices, but complies at the 100-foot ROW edge. Electric field effects for these transmission lines would occur primarily within the Tennessee converter station and Shelby Substation since the converter station interconnection would occur entirely within the substation site (i.e., no public access).

3.4.11.2.1.2.2.2 AC Magnetic Field Calculation Results

AC magnetic field calculations were performed for the two transmission line configurations under two different loading conditions (average and maximum loading of 1212A and 2021A respectively). Table 3.4-22 presents a summary of the calculated magnetic field at the ROW edges and for the maximum field within the ROW. Calculated field levels vary, depending upon the line configuration and loading conditions. Figure 3.4-17 presents a graph of the calculated AC magnetic field for each line configuration under average and maximum loading conditions.

Table 3.4-22:
Calculated AC Magnetic Field Values for 500kV AC Transmission Line Interconnections to Tennessee Converter Station

500kV AC Transmission Line Configuration	Calculated AC Magnetic Field (mG) for Average/Maximum Load[1]				
	-100 Feet from CL	-75 Feet from CL	Maximum on ROW	+75 Feet from CL	+100 Feet from CL
Double Circuit Monopole	17.7/29.6	32.4/54.0	178.6/297.6	32.8/54.7	18.0/30.0
Double Circuit Lattice	29.6/49.3	52.6/87.6	210.2/350.3	53.3/88.9	30.1/50.2

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300 feet on either side of a representative centerline.
1 Edges of the ROW have not been established and are assumed to be either 75 feet or 100 feet from centerline.

Calculated magnetic field levels at the ROW edges (for either ROW width) for both AC transmission line interconnection designs are below the ICES and ICNIRP guidelines for public exposure (9,040mG and 2,000mG respectively). Calculated magnetic field levels within the ROW are also below the ACGIH guideline of 1,000mG for workers with implanted medical devices for both configurations. Magnetic field effects for these transmission lines would occur primarily within the Tennessee converter station and the Shelby Substation since the converter station interconnection would occur entirely within the substation site (i.e., no public access).

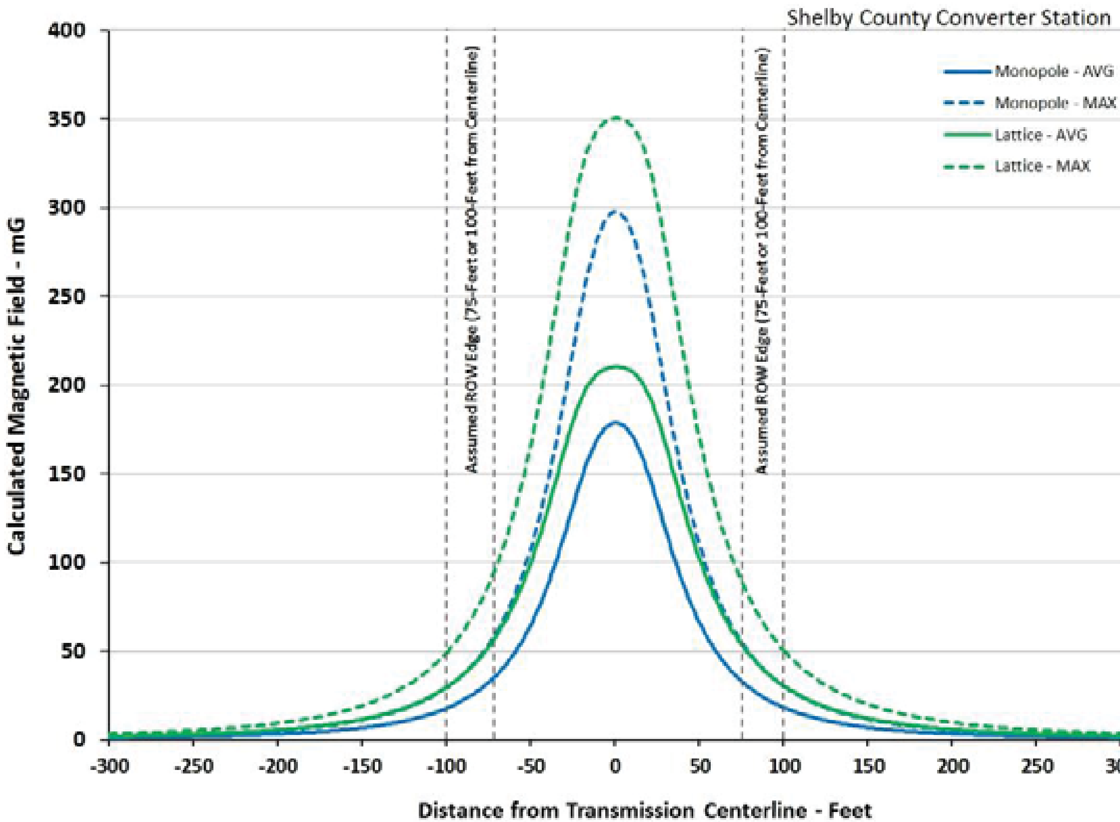


Figure 3.4-17: Calculated AC Magnetic Fields for 500kV AC Transmission Line Interconnections to Tennessee Converter Station (Average and Maximum Loading)

3.4.11.2.1.2.2.3 AC Audible Noise Calculation Results

Audible noise calculations were performed for the three AC transmission line configurations. Table 3.4-23 presents a summary of the calculated day-night (L_{dn}) audible noise at the ROW edges and for the maximum noise level within the ROW. Calculated levels vary, depending upon the line configuration. Figure 3.4-18 presents a graph of the calculated audible noise for each AC transmission line configuration.

Table 3.4-23:
Calculated Audible Noise for 500kV AC Transmission Line Interconnections to Tennessee Converter Station

500kV AC Transmission Line Configuration	Calculated Audible Noise (dBA)—L_{dn}[1]				
	-100 Feet from CL	-75 Feet from CL	Maximum on ROW	+75 Feet from CL	+100 Feet from CL
Double Circuit Monopole	60.8	61.7	64.0	61.7	60.8
Double Circuit Lattice	58.1	59.0	60.7	59.0	58.1

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300 feet on either side of a representative centerline.
1 Edges of the ROW have not been established and are assumed to be either 75 feet or 100 feet from centerline.

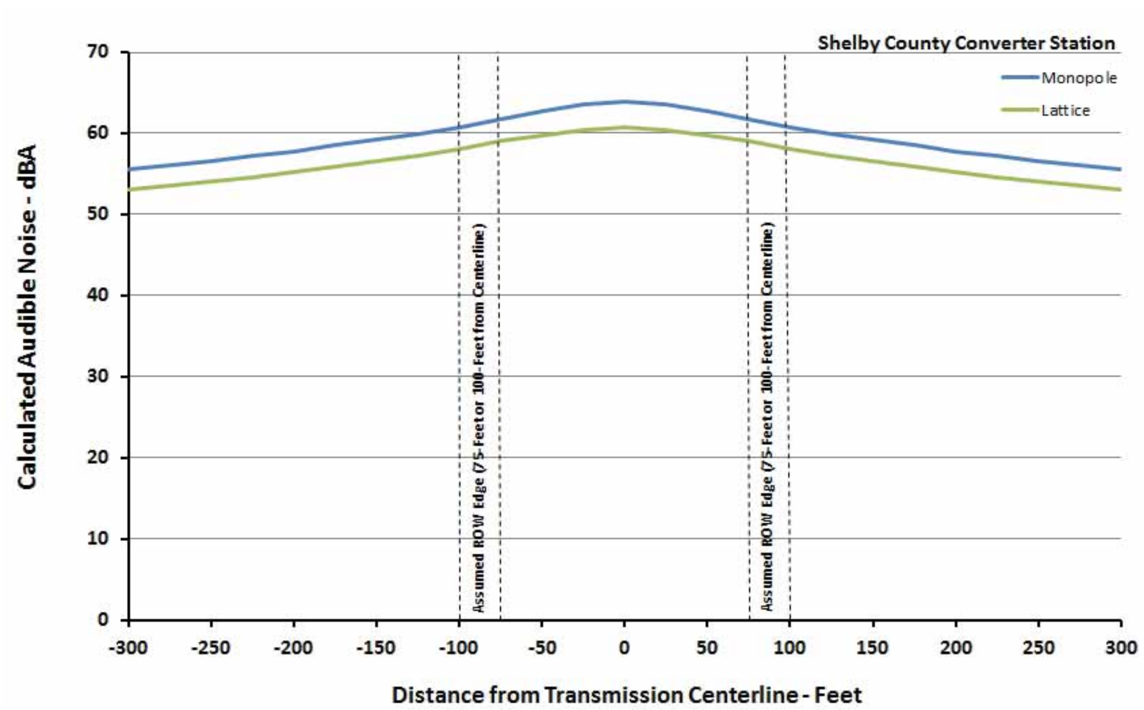


Figure 3.4-18: Calculated Audible Noise Levels (L_{dn}) for 500kV AC Transmission Line Interconnections to Tennessee Converter Station

Calculated audible noise levels at the ROW edges (either 75 feet or 100 feet from centerline of the transmission line) for all of the AC transmission line interconnections are above the EPA guideline for L_{dn} (day-night) noise of 55 dBA. Calculated audible noise levels assume a 10 percent overvoltage condition at the highest line elevation (3,000 feet). Audible noise effects for these transmission lines would occur primarily within the Tennessee converter station and the Shelby Substation since the converter station interconnection would occur entirely within the substation site (i.e., no public access).

3.4.11.2.1.2.2.4 AC Radio Noise Calculation Results

Radio noise calculations were performed for both AC transmission line interconnection designs for rainy and fair weather conditions. Table 3.4-24 presents a summary of the calculated radio noise at the ROW edges and for the maximum noise within the ROW at 500kHz for both weather conditions. Table 3.4-24 also presents calculated 500kHz radio noise at 50 feet from the outside conductor for comparison with the IEEE Standard. Calculated radio noise levels vary, depending upon the line configuration and weather conditions. As shown in Table 3.4-24, calculated radio noise levels at 50 feet from the outside conductor comply with the IEEE 61 dB:V/m threshold during fair weather conditions. Figure 3.4-19 presents a graph of the calculated radio noise levels for each AC line configuration in rainy weather, adjusted to the 500kHz reference level. Figure 3.4-20 presents a corresponding graph of the calculated radio noise levels for fair weather (adjusted to the 500kHz reference level). Radio noise interference from these transmission lines would occur primarily within the Tennessee converter station and the Shelby Substation since the converter station interconnection would occur entirely within the substation site (i.e., no public access).

Table 3.4-24:
Calculated Radio Noise for 500kV AC Transmission Line Interconnections to Tennessee Converter Station

500kV AC Transmission Line Configuration	Calculated Radio Noise (dB:V/m) at 500kHz (Rain/Fair Weather)[1]						
	-100 Feet from CL	-50 Feet from Outside Conductor	-75 Feet from CL	Maximum on ROW	+75 Feet from CL	+50 Feet from Outside Conductor	+100 Feet from CL
Double Circuit Monopole	70.5/53.5	75.4/58.4	72.9/55.9	88.8/71.8	72.9/55.9	75.4/58.4	70.5/53.5
Double Circuit Lattice	68.8/51.8	71.1/54.1	72.5/55.5	86.4/69.4	72.5/55.5	71.1/54.1	68.8/51.8

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300 feet on either side of a representative centerline.

1 Edges of the ROW have not been established and are assumed to be either 75 feet or 100 feet from centerline.

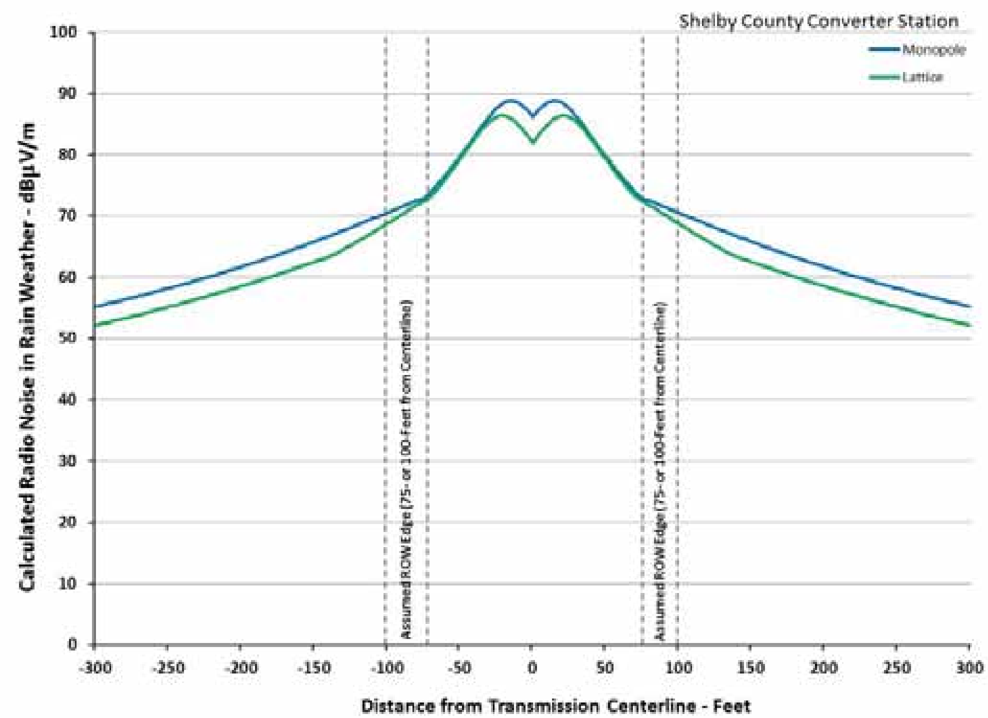


Figure 3.4-19: Calculated Radio Noise for 500kV AC Transmission Line Interconnections to Tennessee Converter Station (Rainy Weather)

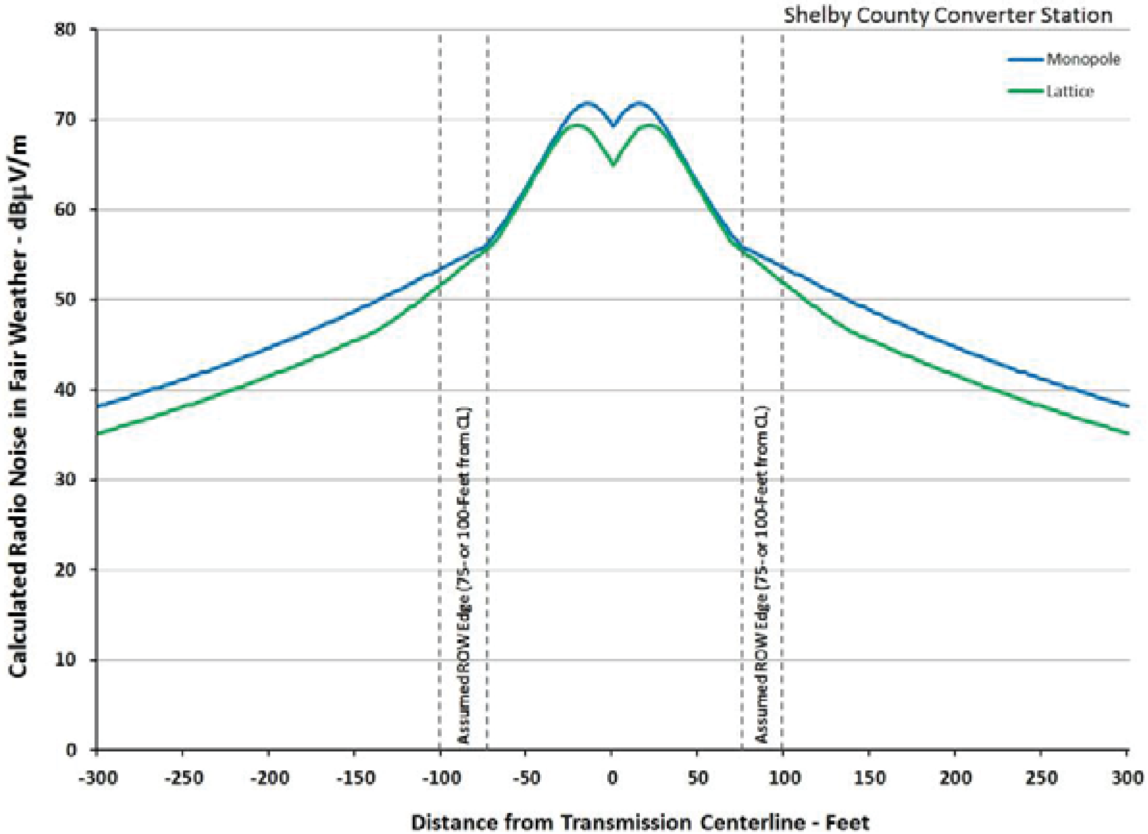


Figure 3.4-20: Calculated Radio Noise for 500kV AC Transmission Line Interconnections to Tennessee Converter Station (Fair Weather)

It is difficult to determine whether the radio noise produced by a transmission line or any other source would cause unacceptable interference without knowing broadcast signal strengths at various locations of interest along the possible line routes. Parameters such as the strength of the received signal, the sensitivity of the receiver, the orientation and design of the receiving antenna, and ambient radio frequency noise are also important in determining the degree to which noise from any source may cause degradation of radio reception quality. Section 3.4.4 presents a discussion on radio noise interference and Section 3.4.6.6 on radio noise standards.

3.4.11.2.1.2.2.5 AC Television Noise Calculation Results

Television noise calculations were performed for both AC transmission line interconnections for rainy weather conditions. Table 3.4-25 presents a summary of the calculated television noise at the ROW edges and for the maximum noise within the ROW for the 75MHz reference level. Calculated television noise levels vary, depending upon the line configuration. Figure 3.4-21 presents a graph of the calculated television noise levels for each AC line configuration in rainy weather.

Table 3.4-25:
Calculated Television Noise for 500kV AC Transmission Line Interconnections to Tennessee Converter Station

500kV AC Transmission Line Configuration	Calculated Television Noise (dB:V/m) at 75MHz for Rainy Weather[1]				
	-100 Feet from CL	-75 Feet from CL	Maximum on ROW	+75 Feet from CL	+100 Feet from CL
Double Circuit Monopole	29.3	32.0	41.2	32.0	29.3
Double Circuit Lattice	27.5	30.4	38.8	30.4	27.5

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300 feet on either side of a representative centerline.
1 Edges of the ROW have not been established and are assumed to be either 75 feet or 100 feet from centerline

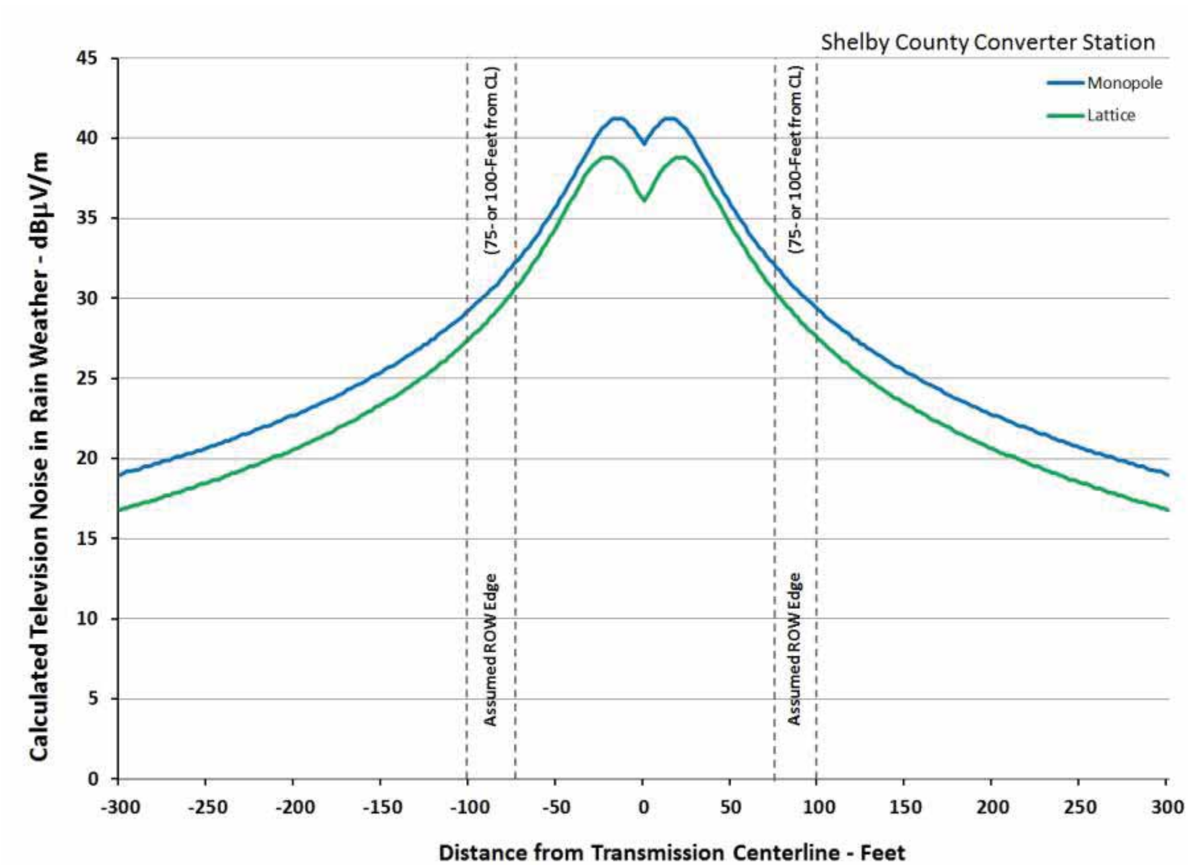


Figure 3.4-21: Calculated Television Noise for 500kV AC Transmission Line Interconnections to Tennessee Converter Station (Rainy Weather)

As with radio noise interference, it is difficult to determine whether the television noise level produced by a transmission line would cause unacceptable interference. However, the new digital broadcast system technology for radio and television should provide better coverage and immunity to transmission line noise than analog television signals. No interference resulting from corona-generated noise would be expected for digital signals broadcast at frequencies above 1GHz from satellites (EPRI 2006a). Television noise interference from these transmission lines would occur primarily within the Tennessee converter station and the Shelby Substation since the converter station interconnection would occur entirely within the substation site (i.e., no public access).

3.4.11.2.1.2.2.6 Ozone Calculation Results

Ozone levels for both AC transmission line interconnections were calculated for rainy weather conditions. Table 3.4-26 presents a summary of the calculated maximum ozone concentrations at ground level within 300 feet of the transmission centerline. Maximum ozone levels are far below the EPA standard of 75 ppb for all three line design configurations. Ozone effects from these transmission lines would occur primarily within the Tennessee converter station and the Shelby Substation since the converter station interconnection would occur entirely within the substation site (i.e., no public access).

Table 3.4-26:
Calculated Ozone Levels for 500kV AC Transmission Line Interconnections to Tennessee Converter Station

500kV AC Transmission Line Configuration	Calculated Ozone (ppb)
	Maximum within +/-300 Feet of CL
Double Circuit Monopole	0.3
Double Circuit Lattice	0.2

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300 feet on either side of a representative centerline.

3.4.11.2.1.2.2.7 Overview of AC Electrical Effects Research on Human Health

Research has been conducted in the United States and around the world to determine whether exposure to power-frequency AC electric and magnetic fields has human health effects. This research includes epidemiological studies, laboratory studies of animals and cell tissues, and multi-disciplinary reviews (or pooled analysis). Some studies have reported a statistical association between magnetic fields and health outcomes while other studies have not. The general consensus among researchers and the medical and scientific communities is that there is insufficient evidence at this time to conclude whether magnetic fields are a cause of adverse health issues or not. The National Institute of Environmental Health Sciences (NIEHS) report to the United States Congress, at the conclusion of its multi-year EMF Rapid Program, summarized its research (NIEHS and NIH 2002). The following is an excerpt from the 1999 NIEHS report:

> *The NIEHS believes that the probability that ELF-EMF (extremely low frequency electric and magnetic field) exposure is truly a health hazard is currently small. The weak epidemiological associations and lack of any laboratory support for these associations provide only marginal, scientific support that exposure to this agent is causing any degree of harm.*

The NIEHS stated that, for most health outcomes, there is no evidence that exposure to electric and magnetic fields has adverse effects. There is some evidence from epidemiology studies that exposure to power-frequency magnetic field is associated with an increased risk for childhood leukemia. This association is difficult to interpret in the absence of reproducible laboratory evidence or a scientific explanation that links magnetic fields with childhood leukemia (NIEHS and NIH 2002).

The following discussions report on various organizations and study results concerning AC electrical effects and their conclusions:

- The International Agency for Research on Cancer (IARC) has reviewed numerous epidemiological and laboratory animal studies relevant to AC and DC fields to assess the potential for cancer causation. The epidemiology studies included residential and occupational studies of adults and children that examine the relationship between AC magnetic or electric fields and various cancers, including leukemia and brain and breast cancers. Based on its review, the IARC found limited epidemiological evidence in humans, particularly for childhood leukemia, and found that the evidence for other outcomes in adults and children, and in laboratory animals, was inadequate. A consistent relationship between adult cancer and exposure to electric or magnetic fields has not been found. Based on this evaluation of the available data, the working group classified power-frequency magnetic fields as possibly carcinogenic to humans (Group 2B) (IARC 2002). This classification is applicable only to the AC transmission line magnetic fields connecting the wind farms and other substations to converter stations. For comparison, IARC also lists coffee and pickled vegetables as Group 2B carcinogens. Power-frequency electric fields and static DC electric and magnetic fields are defined by IARC as not classifiable as to their carcinogenicity (Group 3). The proposed HVDC transmission line DC fields would be included in this Group 3 category.
- The World Health Organization (WHO) published the Environmental Health Criteria 238 (EHC 238) (WHO 2007) to address the possible health effects of exposure to AC electric and magnetic fields. The document is a thorough review of the scientific literature on the biological effects of exposure to power-frequency electric and magnetic fields to evaluate potential health risks. The Task Group was composed of international experts from a variety of scientific disciplines and organizations involved in this area and examined epidemiological, in vitro, and in vivo studies. In its assessment of the health risk posed by AC electric and magnetic fields, the Task Group concluded that (WHO 2007):

  > *Scientific evidence suggesting that every day, chronic low-intensity (above 3–4 mG) power-frequency magnetic field exposure poses a health risk is based on epidemiological studies demonstrating a consistent pattern of increased risk for childhood leukemia. Uncertainties in the hazard assessment include the role that control selection bias and exposure misclassification might have on the observed relationship between magnetic fields and childhood leukemia. In addition, virtually all of the laboratory evidence and the mechanistic evidence fail to support a relationship between low-level ELF magnetic fields and changes in biological function or disease status. Thus, on balance, the evidence is not strong enough to be considered causal, but sufficiently strong to remain a concern.*

  The information provided by the WHO is its most current statement regarding EMF information and has not changed since 2007. Comments received on the Draft EIS related concern about the WHO being under investigation for being heavily influenced by the electricity transmission industry; however, no active investigation is publicly underway. In addition, their conclusions about EMF are shared by other leading health organizations.
- Currently, the National Cancer Institute website (NCI 2015) states that “Several early epidemiological studies raised the possibility of an association between certain cancers, especially childhood cancers, and ELF-EMFs. Most subsequent studies have not shown such an association, but scientists have continued to investigate the possibility that one exists.” Additionally, NCI’s website states that no mechanism by which electric and magnetic fields could cause cancer has been identified, and animal studies have not provided any indications that EMF exposure is associated with cancer. Currently, researchers conclude that there is little evidence that exposure to EMF from power lines causes leukemia, brain tumors, or any other cancers in children. The website also states that “More recent studies, including some that considered the participant’s job title as well as measurements of their exposures, have not shown consistent findings of an increasing risk of leukemia, brain tumors, or female breast cancer with increasing exposure to magnetic fields at work.”

- The National Radiological Protection Board (NRPB; now a part of Public Health England as of April 2013) was a United Kingdom public body set up to disseminate information about the protection of mankind from radiation hazards. The NRPB later became the Advisory Group on Non-ionizing Radiation (AGNIR). The AGNIR performed an assessment of the scientific literature on potential effects of AC electric and magnetic field assessment on the information available from experimental studies on tissues, living cells and animals, and human volunteer and epidemiological studies. The AGNIR concluded that laboratory experiments have provided no good evidence that power-frequency electric and magnetic fields are capable of producing cancer, nor do human epidemiological studies suggest that they cause cancer in general. There is however some epidemiological evidence that prolonged exposure to higher levels of power-frequency magnetic field is associated with a small risk of leukemia in children. In practice, such levels of exposure are seldom encountered by the general public in the United Kingdom. In the absence of clear evidence of a carcinogenic effect in adults, or of a plausible explanation from experiments on animals or isolated cells, the epidemiological evidence is currently not strong enough to justify the firm conclusion that such fields cause leukemia in children. Unless further research indicates that the finding is due to chance or some currently unrecognized artifact, the possibility remains that intense and prolonged exposures to magnetic fields can increase the risk of leukemia in children (NRPB 2004a, 2004b).
  The BioInitiative report (2007) was prepared by a self-selected group of EMF activists and researchers and makes many claims that greatly differ from established and recognized health organizations in several countries. The purpose of this report was to *"assess scientific evidence on health impacts from EM radiation below current public exposure limits and evaluate what changes in these limits are warranted now to reduce possible public health risks in the future."* The authors of this report contend that the current procedure for developing exposure guidelines is not sufficient and should be replaced by a system that sets exposure guidelines at levels at which biological effects have been reported in some studies, but not substantiated in a rigorous review of the science or supported by other research. Based on this premise, the report proposes that significantly lower exposure levels be adopted than those that are presently considered. The conclusions in the BioInitiative report deviate substantially from those of reputable scientific organizations because they are not based on standard, scientific methods. Valid scientific conclusions are based upon weight-of-evidence reviews, which entail a systematic evaluation of the entire body of scientific evidence. This report has been criticized as not providing a valid weight-of-evidence review, since the report is a compilation of individual sections, each authored by only one to three members of the "ad hoc" group of scientists, and as a whole does not appear to be collaborative or reviewed in its entirety by the collective group. For instance, the Health Council of The Netherlands states that the report was compiled with "the selective use of scientific data" and "is not an objective and balanced reflection of the current state of scientific knowledge" (HCN 2008). Other organizations have also made similar statements. As a practical matter, the BioInitiative report implies that EMF exposure is a universal toxin and carcinogen causing many different types of diseases. This conclusion is strikingly different from what established and recognized health organizations have found.
- The California EMF Program published the results of an evaluation on scientific EMF research in 2002 (Neutra et al. 2002). Sponsored at the request of the California Public Utilities Commission and conducted by three scientists from the California Department of Health Services, these scientists reviewed numerous EMF health studies and determined a level of confidence in their opinion that a health relationship may exist from high EMF exposures (Neutra et al. 2002). The scientists evaluated these studies using a similar approach as the IARC review, in which the "quality of evidence" was evaluated. However, their evaluation focused on the epidemiology studies in particular and not as much on experimental or animal data. Based upon the guidelines developed by

the California EMF Program, each scientist expressed a level of confidence to which EMF can cause some degree of increased risk to certain specified heath conditions. These scientists concluded that the epidemiological research provided little support for an association of EMF with many of the diseases considered. For the remaining diseases (such as childhood leukemia; adult brain cancer; ALS, or amyotrophic lateral sclerosis; and miscarriages), the scientists indicated that some degree of increased risk may be present, but their confidence ratings for these conditions were not sufficient to indicate any strong certainty. In fact, these scientists report that *"there is a chance that EMFs have no effect at all"* (Neutra and Del Pizzo 2001). They also agree that EMF is not a universal carcinogen (Neutra et al. 2002). Furthermore, the scientists did not recommend that the state of California establish an EMF exposure limit.

- The 2015 EPA website (EPA 2015) states that "Scientific experiments have not clearly shown whether or not exposure to EMF increases cancer risk. There is no clear scientific evidence that electromagnetic fields affect health."
- The 2015 American Cancer Society webpage has the following statements:

  > *One study did show an increase risk of tumors and cancer that start in the C-cells of the thyroid in male rats at certain exposures. This increase risk was not seen in mice or female rats, and was not seen at the highest field strength. These inconsistencies, and the fact that these findings were not seen in the other studies, make it hard to conclude that the increased risk of tumors was really from the ELF radiation. Other studies in mice and rats looked specifically for a link between leukemia and lymphoma and exposure to ELF radiation, but no link was found.* (ACS 2015a)

  Under the American Cancer Society website section entitled "Factors with uncertain, controversial, or unproven effects on brain tumor risk:"

  > *Exposure to aspartame (a sugar substitute), exposure to electromagnetic fields from power lines and transformers, and infection with certain viruses have been suggested as possible risk factors, but most researchers agree that there is no convincing evidence to link these factors to brain tumors.* (ACS 2015b)

- In a more recent 2015 review of scientific studies, the Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR) - an agency of the European Commission - published its latest review of the scientific literature on the issue of EMF and health (SCENIHR 2015). The SCENIHR report reviewed a full multiplicity of both negative and positive scientifically plausible studies. This 2015 report, which is entitled "Potential Health Effects of Exposure to Electromagnetic Fields (EMF)," reaches a similar conclusion to its previous 2009 report (SCENIHR 2009) entitled "Health Effects of Exposure to EMF:"

  > *Overall, existing studies do not provide convincing evidence for a causal relationship between ELF MF exposure and self-reported symptoms.*
  >
  > *The new epidemiological studies are consistent with earlier findings of an increased risk of childhood leukaemia with estimated daily average exposures above 0.3 to 0.4 μT. As stated in the previous Opinions, no mechanisms have been identified and no support is existing from experimental studies that could explain these findings, which, together with shortcomings of the epidemiological studies prevent a causal interpretation.*
  >
  > *Studies investigating possible effects of ELF exposure on the power spectra of the waking EEG are too heterogeneous with regard to applied fields, duration of exposure, and number of considered leads, and statistical methods to draw a sound conclusion. The same is true for behavioural outcomes and cortical excitability.*
  >
  > *Epidemiological studies do not provide convincing evidence of an increased risk of neurodegenerative diseases, including dementia, related to power frequency MF exposure.*

> *Furthermore, they show no evidence for adverse pregnancy outcomes in relation to ELF MF. The studies concerning childhood health outcomes in relation to maternal residential ELF MF exposure during pregnancy involve some methodological issues that need to be addressed. They suggest implausible effects and need to be replicated independently before they can be used for risk assessment.* (SCENIHR 2015)

While individual scientific studies may provide support for a given hypothesis of potential health impacts, a thorough literature review is helpful in determining the scientific consensus—where one exists. Individual studies do not provide a comprehensive view of what is known in any field of science. When taken and scientifically evaluated collectively, a balanced perspective is provided. Multidisciplinary expert panels, acting on behalf of a number of national and international health and scientific agencies, and numerous health organizations have reviewed the available scientific literature regarding potential health effects of electric and magnetic fields and concluded that there are no known adverse health impacts from the electrical and magnetic fields associated with AC transmission lines. Using a systematic identification and review of the relevant literature for a specific exposure and potentially related health outcome, none of these agencies found reliable evidence of biologically harmful effects. These panels and organizations have also looked at power-frequency electric and magnetic fields, and have concluded that the association between AC magnetic fields and adverse health effects is weak.

The Precautionary Principle of risk management states that if an action or policy has a suspected risk of causing harm to the public or to the environment, in the absence of scientific consensus that the action or policy is not harmful, the burden of proof that it is not harmful falls on those taking an action. However, the scientific consensus from multidisciplinary expert panels and numerous health organizations is that there are no known adverse health impacts from the electrical and magnetic fields associated with AC transmission lines.

In addition, these health studies primarily address AC magnetic fields. While AC transmission lines are proposed as part of this Project, the main focus of the Project is the high voltage DC transmission line (approximately 720 miles in length).

If the AC electric field intensity is sufficiently large, then spark discharges due to currents induced on objects can occur. The NESC (IEEE 2012) within the United States requires that the electric field or its effects be reduced such that the largest anticipated object under a transmission line has a current to ground of no greater than 5mA. High voltage transmission lines can induce a voltage on ungrounded metallic objects such as a truck parked under the transmission line. If a path to ground is provided, such as a grounded person touching an ungrounded object, a small electric current can flow. Average adult humans can detect electric currents of about 1–2mA. Electric currents above 5mA can cause pain and startle response reactions and could be harmful under certain conditions. The NESC, therefore, requires that additional ground clearance or other means shall be used to limit electric field effects to 5mA or less.

The electric field levels from the Project are similar to other transmission lines already operating in the United States and around the world. The electric field decreases rapidly with distance away from a transmission line and electric fields from power lines are easily shielded by objects such as trees or building walls. No scientific data is available by which to conclude that transmission line electric fields have any effect on seizures. There has been some research on laboratory animals involving artificially embedded electrodes in an attempt to control seizures. However, the internal electric fields in these experiments are not like power line fields, have unusual characteristics, are at levels in tissue much higher than transmission line fields would cause, and involve use of embedded metal wires or electrodes in the test subject.

Other health studies have investigated seizures associated with higher radio and microwave frequencies, which would not be applicable to either the DC transmission line or the AC transmission lines associated with this Project. For example, a 2013 Turkish study presented results concerning the impact of electromagnetic waves (microwaves) on epileptic seizures (Cinar et al. 2013). The study found a possible trigger effect of electromagnetic waves on seizure activity in mice, and this study was raised in concern over possible seizures in humans living close to the Project transmission lines. However, the study utilized electromagnetic frequencies approaching the microwave band (ranging from 100MHz to 900MHz). This frequency in no way compares to static frequency (0Hz), which is 100–900 million times higher in frequency (and almost 10 million times higher for power frequency). In fact, the Cinar et al. cite another paper (Canseven et al. 2007) in which the authors state that they "did not find any effect of 50Hz electromagnetic waves". Therefore, caution must be exercised to ensure that findings associated with a particular frequency are not applied to other frequencies (i.e., field effects are different for different frequencies). High frequency fields, such as those associated with this seizure study, would not be applicable to either the HVDC transmission line (0Hz) or the AC transmission lines (60Hz) associated with the Project.

Studies have also been performed on electromagnetic hypersensitivity (EHS), which can include a variety of symptoms including headache, fatigue, stress, tiredness, concentration difficulties, dizziness, and sleep disturbances. The majority of studies indicate that EHS individuals cannot detect EMF exposure any more accurately than non-EHS individuals, and well-controlled double-blind studies have shown that symptoms were not correlated with EMF exposure (WHO 2005). There are also some indications that these symptoms may be due to pre-existing psychiatric conditions as well as stress reactions as a result of worrying about EMF health effects, rather than EMF exposure itself (WHO 2005).Similar results have been published in other scientific literature (Rubin et.al. 2005; Foster and Rubin 2014; Beale et. al. 1997; BioEM 2015; Mild and Sandstrom 2015).

Studies to date have not associated proximity to AC transmission lines or their electric or magnetic fields with an increased risk in autism. Hypersensitivity to noise can be one of the concerns for some children with autism. Engineers take steps in the design of transmission lines to keep noise levels low by using larger or multiple conductors for each phase and hardware with smooth and curved surfaces. In fair weather, the audible noise from a transmission line at a few thousand feet and beyond would not be possible to measure in comparison to background levels. At that distance under rainy conditions, it would be very low as well, much less than the noise of falling rain or wind.

Within the ROW, the maximum calculated AC electric field from the Project transmission lines is about 4.6 to 10.2kV/m. In this level of electric field, induced currents may create shocks from touching ungrounded metallic objects (although metal buildings and fences on or adjacent to high voltage transmission line easements are typically grounded during transmission line construction). Utilities often may supply information on living and working safely around high voltage power lines (BPA 2010, 2007).

This section is not a comprehensive review of the entire body of evidence, and excludes consideration of many other relevant published scientific studies. Scientific research utilizes epidemiology studies, animal models, and laboratory studies of basic mechanisms to scientifically evaluate a disease risk. Based upon a comprehensive review of the scientific literature, the association between AC magnetic fields and adverse health effects is weak and research is continuing. Currently, there are no U.S. state government or federal government health-based limits established for electric and magnetic fields, and where the Project is to be located, no states have any state-mandated electric and magnetic field limits.

3.4.11.2.1.2.2.8 Overview of AC Electrical Effects Research on Pacemakers and Implanted Medical Devices

Public concern has been expressed related to the electric and magnetic fields of transmission lines with the possibility of interference with cardiac pacemakers. When pacemakers detect a spurious signal of sufficient magnitude, such as an induced 60Hz current, they can change from a synchronous mode of operation to an asynchronous or fixed pacing mode of operation and then return to a synchronous mode of operation within a specified time after the signal is no longer detected. The issue is whether transmission line fields could adversely affect the pacemaker's operational mode and the resulting effect it could have on users.

For AC electric and magnetic fields, studies have determined thresholds for interference of the most sensitive units to be about 2,000 to 12,000mG for magnetic fields and about 1.5 to 2.0kV/m for electric fields. One study specifically looked at pacemaker interference under a 400kV AC transmission line (Korpinen et al. 2012). A disturbance was noted for only one device (a unipolar pacemaker) out of the 31 different types of pacemakers tested (in an electric field of 6.7–7.5kV/m and magnetic field of 24–29 mG). The pacemaker disturbance set the pace to 60 times per minute, and when the same pacemaker was configured with a bipolar lead, no disturbance was observed. The study concluded that the risk of disturbance was not deemed to be high.

The American Heart Association website lists devices with risk for pacemakers (AHA 2012), including anti-theft systems, security metal detectors, cell phones, MP3 players, and welding equipment. However, AC transmission lines are not included in the list. For implantable cardioverter defibrillators, the American Heart Association website lists low voltage power lines (typical in residential areas) as devices with little or no risk to implantable cardioverter defibrillators (ICDs) (AHA 2013).

The biological consequences of brief reversible pacemaker malfunction are mostly benign (typically the implanted device will resume a normal mode of operation if the patient moves away from the source of the interference) (Medtronic 2013a; Korpinen et al. 2012). An exception would be an individual who has a sensitive pacer and is completely dependent on it for maintaining all cardiac rhythms. For such an individual, a malfunction that compromised pacemaker output or prevented the unit from reverting to the fixed pacing mode, even brief periods of interference, could be life-threatening. The precise coincidence of events (i.e., pacer model, field characteristics, and biological need for full function pacing) would generally appear to be a rare event.

The European Committee for Electrotechnical Standardization (CENELEC) recently developed specific procedures to assess potential risks to workers with active implantable medical devices (CENELEC 2010). CENELEC has determined that these devices are expected to function without interference below a reference level of 1,000mG at 50Hz for magnetic fields (833mG at 60Hz, the frequency of the electric power system in the United States).

Medical equipment certified by the U.S. Food and Drug Administration must pass rigorous electromagnetic compatibility testing to gain approval. This assessment allows manufacturers to evaluate the compatibility performance of a medical device and demonstrate that the product achieves an appropriate level of electromagnetic immunity in environments that patients may encounter. Three of the major manufacturers of implantable medical devices recommend limits for AC electric and magnetic fields (Medtronic 2013b; Boston Scientific 2015; St. Jude Medical 2014). These three manufacturers recommend a power-frequency AC magnetic field limit in the range of 800mG to 1,600mG (depending upon the manufacturer and type of implanted device) and AC electric fields of 6 to 11.7kV/m. By comparison, the calculated EMF levels from the proposed transmission lines would be well below these levels outside of the ROW. Within the ROW, AC magnetic fields would also be below these levels. Calculated AC electric fields within the ROW range from 4.6kV/m to 10.2kV/m, depending on line voltage and configuration. These AC electric field levels are at the recommended limits from these three manufacturers.

In addition, electric fields are very easily shielded. Electric fields would generally be shielded levels (i.e., lower levels) except directly underneath the line in open areas. Riding in a vehicle, for example, the metallic body of the vehicle would provide electric field shielding for occupants inside the vehicle. Over the past decade or so, major manufacturers of pacemakers and other implantable medical devices have designed these devices to provide shielding and improved filtering from the different types of EMF that arise from many sources in our daily environments. Modern pacemakers are digital devices that are designed to filter out peripheral electrical signals and these electrical filters increase the pacemaker's ability to distinguish extraneous signals from legitimate cardiac signals. In addition, most of the pacemaker circuitry is enclosed within a metallic case that shields the device from external EMF. Based on all of these factors, no interference with medical devices would be expected due to EMF from the proposed transmission line. While a variety of electronic devices are known to affect the operation of pacemakers and other implanted medical devices, transmission lines have not been reported as a significant source to produce functional disturbances to these devices. There is a possibility that induced potentials on the leads of these devices by AC electric fields on the ROW could affect the operation of these devices, but the clinical significance of such changes appears small. Patients with implanted medical devices should observe certain precautions and need to discuss their treatment with their doctor or physician. In addition, there are a variety of different medical devices which are constantly evolving and changing. It is also impossible to quantify all of the various types of magnetic field sources encountered in people's day-to-day lives. The potential for interference to implanted devices may depend upon a variety of different parameters, including the device manufacturer, model and setting, and implantation method, among other factors. Typically implanted medical devices are set specifically for an individual by their doctor or physician within the doctor's office or medical facility. As with any implanted medical device, the user should always consult with their doctor and the device manufacturer to determine safe operational parameters for use of their specific medical device and associated medical condition.

Currently, there has been little research done on the subject of spinal cord stimulators (neurostimulation systems) and the results are mixed. EPRI reports that "there remains a paucity of information on EMI (electromagnetic interference) and neurostimulators in the literature" (EPRI 2013a). Common EMI are security systems, metal detectors, and wireless equipment. The Southern Surgical Hospital Louisiana (SSHLA 2015) states: "be mindful of high voltage power lines and other DC sources". Barrow, a neurostimulator manufacturer, says that: "yes, it is safe to be near power lines and substations" (Barrow 2015). The organization Power Over Our Pain references a device manufacturer (St. Jude Medical 2015) that states: "high voltage power lines may generate sufficient EMI to interfere if approached too closely; use caution and turn off the IPE if you feel any unusual sensations".

Manufacturers also report that "Implanted neurostimulation systems may adversely affect the operation of implanted cardiac demand pacemakers and cardioverter defibrillators" and that "an implanted cardiac device (e.g., pacemaker, defibrillator) may damage a neurostimulator" (Medtronic 2013c; St. Jude Medical 2015). One manufacturer provides information on how to approach strong EMI environments (such as a security screening device) for patients with a neurostimulator (Medtronic 2008) and states that many newer models of neurostimulators are not affected by such devices.

Some types of implanted medical devices (such as metallic stents, joint/metal replacements, etc.) do not incorporate electronic or electrical circuits and do not require power to operate. To date, no adverse interactions related to EMF exposure and metallic implants have been reliably reported or documented.

Hearing aids are another type of medical device used by people. Older hearing aids are analog and amplify all sounds in the same way. Digital hearing aids convert sound waves into digital signals using computer chips with complex amplification processing and are the most popular form of hearing aid today (FDA 2015a). Different styles of digital hearing aids include behind-the-ear, on-the-ear, in-the-ear, in-the-canal, and completely-in-the-canal designs. Other features include a telephone coil ("T-coil") setting to switch from the normal microphone setting to a setting that utilizes a coil to eliminate environmental sounds and allow better hearing during telephone conversations. Digital hearing aids operate within a frequency range of 250Hz–8kHz, which is higher than power frequency (60Hz). Interference has been observed with digital hearing aids and higher frequency sources such as cellular phones (FDA 2015b) and radar (WHO 2015). For the Project HVDC transmission line, DC magnetic field levels would be comparable to the earth's natural static magnetic field and should not create an interference issue. For AC magnetic fields, one case study (McKinnon 1994) identified power-frequency ground current on water and steam pipes which created interference only while using the T-coil setting on digital hearing aids (i.e. no interference was reported while using the normal setting). While similar issues could be present near AC transmission lines, switching from the T-coil setting to the normal setting could eliminate the interference issue. Medical devices such as digital hearing aids are constantly being redesigned and improved to be less susceptible to interference issues.

3.4.11.2.1.2.2.9 Overview of AC Electrical Effects Research on Plant and Animal Health

Research has been conducted to determine whether exposure to power-frequency AC electric and magnetic fields has environmental effects on plant or animal life. Numerous studies have examined the effect of power-frequency electric and magnetic field exposure on plant species, both forest and agricultural. For trees located near very high voltage transmission lines (above 1,200kV), needle burn occurred on trees within 100 feet of the transmission lines (these 1,200kV lines are much higher in voltage than the 345kV and 500kV lines associated with the Project). Other studies of seed germination, seedling growth, seed production, and biomass found no adverse effects due to AC electric and magnetic field exposure. Results from studies on some groups of animals did not report any effect due to electric or magnetic fields, while other studies found mixed results, with some studies indicating an effect due to electric or magnetic fields while others did not. These results were therefore inconsistent and inconclusive.

The following discussions report on various study results concerning electrical effects and their conclusions:

- Numerous studies have examined the effect of AC electric and magnetic field exposure on plant species, both forest and agricultural. Needle burn occurred on trees within 100 feet of very high voltage (above 1,200kV) transmission lines (Rogers et al. 1984). Other studies of seed germination, seedling growth, seed production, and biomass found no adverse effects due to AC electric and magnetic field exposure (Lee et al. 1996).
- The National Grid website presents the results on farm crop studies and AC transmission lines reviewed during a 1991 study (National Grid 2014b). Seven studies had findings of either no effects (five studies) or low yields and reduced germination rates in a minority of the tests (two studies). Similar effects were also reported for electric and magnetic fields and farm animals. Of eight studies, six studies reported no effects, one study reported no

major effects (but various minor effects), and one study reported some effects (National Grid 2014a). Overall, the majority of these studies found that generally there were no effects on crops or animals.

- Because of the shielding effects of trees, shrubs, grass, and the soil, ground-dwelling and underground species are largely shielded from AC electric fields under transmission lines (Deno and Silva 1987). Larger species of animals such as deer, elk, and domestic animals may have greater potential exposure to electric fields. Magnetic field exposure is unaffected by these shielding factors and all plant and animal species would experience greater exposure in the vicinity of transmission lines.
- Domestic animals grazing near transmission lines are subject to potentially higher levels of AC electric and magnetic field exposure than large game species. Two studies (Algers and Hennichs 1985; Algers and Hultgren 1987) compared the reproductive functions of pregnant cows exposed to 50Hz AC fields with unexposed animals and found no effect. Two studies (Goodwin 1975; Picton et al. 1985) monitored the behavior of big game species near a 500kV transmission line. Neither study found any effect due to AC electric or magnetic fields. In fact the Goodwin study states: "…the presence of the towers and the levels of audible noise and electric and magnetic fields recorded on the right-of-way did not influence animal behavior".
- AC electric and magnetic field effects on cellular functions in sheep, in particular immune response, have also been examined (Hefeneider et al. 2001). In a previously unpublished report, these researchers noted differences in the production of leukocyte proteins between exposed and control groups. In a replicated effort, sheep were subjected to much longer periods of electric and magnetic field exposure but found no evidence of differences in immune response.
- The studies of cows performed at McGill University in Quebec (Burchard et al. 1996, 1998, 2004) were controlled experiments designed to mimic the exposures of cows standing continuously under a 735kV AC transmission line to determine whether EMF exposure caused a biological response in dairy cows that affected milk fat percentage, dry matter intake, blood progesterone, reduction of melatonin, or changes to milk production. Two groups of eight cows were continuously exposed to 10kV/m AC electric fields and 300mG AC magnetic fields for about thirty days. The researchers concluded that EMF did cause some biological response in productivity variables for the dairy cattle, but these responses did not represent a health hazard for exposed cattle and recommended further research (Burchard et al.1996, 1998, 2004). Figure 3.4-22 presents a photograph of cows grazing under a high voltage transmission line.
- Avian species are exposed to AC electric and magnetic field during flybys of transmission lines and nesting or roosting in their vicinity. A study by Fernie et al. (2000) reported that continuous AC electric and magnetic field exposure reduced hatching and fledging success, reduced embryonic development, and increased egg size. These researchers also found effects of continuous, extended electric and magnetic field exposure on the body mass and food intake of reproducing falcons and altered melatonin levels in male falcons. However, another study of embryonic development (Beaver et al. 1994) showed no adverse impacts of magnetic field exposure. After a review of AC electric and magnetic field from transmission lines and avian species, another study (Fernie and Reynolds 2005) concluded that electric and magnetic field can affect birds but the results are not consistent or even in a consistent direction.
- Research on AC electric and magnetic field and melatonin levels in seasonal breeding species has produced inconsistent results (Wilson et al. 1981; Holmberg 1995; Kroeker et al. 1996; Vollrath et al. 1997; and Huuskonen et al. 2001). An examination of sheep and cattle exposed to electric and magnetic field from transmissions lines above 500kV showed no effect on hormone melatonin levels (Stormshak et al. 1992; Lee et al. 1993, 1995; Thompson et al. 1995; Burchard et al. 1998, 2004).

- Beehives exposed to AC electric fields of 7kV/m compared to unexposed hives were found to have adverse effects on the colonies including decreased hive weight, increased mortality, loss of the queen, and a decrease in the hive's survival (Greenberg et al. 1981). These effects were caused by induced currents and micro-shocks from the electric field, and eliminated by shielding the hive, using hives without metallic parts, or placing the hive farther away from the transmission line.
- A study of native bees was performed near high voltage AC transmission lines in Maryland, Wisconsin, and Oregon. The study evaluated larval development, floral visitation, pollination, species' diversity and abundance. No indication of negative impacts of EMF was found in any of the study areas and there continues to be no credible evidence that native bee species are harmed by EMF in terms of foraging, nesting, or behavior (Russell et al. 2013).
- A study on cattle and deer herds reported that the animals preferentially aligned themselves along the geomagnetic axis (Begall et al. 2008). Satellite images were used to obtain alignment data for herds over various regions of the earth. A second study from the same research team (Burda et al. 2009) reported this alignment was not observed for herds near AC transmission lines. However, an independent research group (Hert et al. 2011) was unable to confirm the results using the same satellite-based images. Two different statistical evaluation methods (one evaluation method tried to replicate the original study and the second tried an improved method) did not replicate the same findings.

Figure 3.4-22: Cattle Grazing Underneath a High Voltage Transmission Line

Several laboratory and field studies have investigated the potential effect of electric and magnetic fields from transmission lines on plants, such as agricultural crops, trees, and forest and woodland vegetation. No adverse biological effects were consistently observed, and none have been confirmed at exposure at levels similar to those of the Project. Other research on the health, behavior, or productivity of animals, including livestock (e.g., dairy cows, sheep, and pigs) and a variety of other species (e.g., small mammals, deer, elk, birds, and bees) has not identified any reliable effects at the field levels associated with the Project. This section was intended to provide a review of many of the relevant scientific studies which have been published and is not meant to be a comprehensive review of the entire body of evidence (many other scientific studies have been performed). Based upon a comprehensive review of the scientific literature, the association between AC magnetic fields and adverse effects to plant life and animal health is weak.

3.4.11.2.1.2.2.10 Grounding and Stray Voltage for AC Fields

Electric currents can be induced by EMFs in conductive objects near AC transmission lines. For magnetic fields, the concern is for very long objects parallel and close to the line. The majority of concern is about the potential for small electric currents to be induced by electric fields in ungrounded metallic objects very close to transmission lines. Metallic roofs, vehicles, vineyard trellises, and fences are examples of objects that can develop a small electric charge in proximity to high-voltage transmission lines. Object characteristics, degree of grounding, and electric field strength affect the amount of induced charge. An electric current can flow when an object has an induced charge and a path to ground is presented. The amount of current flow is determined by the impedance of the object to ground and the voltage induced between the object and ground. It is important to evaluate the amount of induced current that can flow because of the potential for nuisance shocks to people and animals.

Agricultural operations can occur on or near a transmission line ROW. Long fences parallel to a transmission line can present an induced current situation, especially if the fence posts are non-metallic and insulate wires from ground. This problem is solved by adequately grounding the fence with a ground rod connected to the fencing wire (usually done during power line construction or by using metal fence posts). Electric company engineers typically provide grounding guidelines for objects, including fences, close to high-voltage transmission lines.

Irrigation systems often incorporate long runs of metallic pipes that can be subject to field induction when located parallel and close to transmission lines (BPA 2007). Electric field induction is generally negligible because the irrigation pipes contact moist soil, but annoying currents could still be experienced from electric field coupling to the pipe. However, caution should be used in storing, handling, and installing irrigation pipe near power lines. While moving irrigation pipe under or near power lines, equipment should be kept in a horizontal position to keep away from the overhead wires (never oriented vertically toward the wires). Pipe runs laid at right angles to the transmission line will minimize induced currents, although such a layout may not always be feasible. If there are induction problems, they can be mitigated by grounding and/or insulating the pipe runs. For example, the possibility of nuisance shocks can be eliminated by having metallic pipes touching ground or by the use of grounding straps for activities such as unloading sections of pipe from a vehicle.

Operation of irrigation systems beneath transmission lines presents another safety concern. If the system uses a high-pressure nozzle to project a stream of water, the water may make contact with the energized transmission line conductors. Generally, the water stream consists of solid and broken portions. If the solid stream contacts an energized conductor, an electric current could flow down the water stream to someone contacting the high-pressure nozzle. Transmission line contact by the broken-up part of the water stream is unlikely to present any hazard. Guidance on safe operation of irrigation systems near transmission lines can be provided by electric utility engineers.

Contact current impacts can also be a source of concern regarding potential effects on animal health and productivity. These impacts can result from two different and separate situations: stray voltage and induced currents. The term “stray voltage” is often loosely used but generally describes a voltage between two objects where no voltage difference should exist. Small voltages can sometimes be measured between two grounded objects in different locations due to current in a grounding system. Larger voltages can be on enclosures of electrical equipment due to induced voltage or failure of insulation systems. Effects of stray voltage can occur, for example, when an animal makes contact between two different electrical system grounds (such as an on-farm neutral and an off-farm neutral). Commonly accepted sources of stray voltage on a farm include a variety of internal electrical wiring problems, as well as non-farm related problems (such as high resistance wires and connections within the lower voltage local electric distribution system). Small stray voltages may never be noticed and may be difficult to detect. Larger voltages can have impacts from barely perceptible to nuisance electric shocks. Metal electrical equipment cases are bonded to ground to prevent a shock hazard if energized conductors accidentally contact the case. In situations where this bonding is not provided or has failed, a potentially dangerous hazard of electric shock exists when energized conductors contact the case. In any place where equipment is in direct contact with a person or animal (such as electric milking machines and other conditions), stray voltages must be removed. Typically, high voltage overhead transmission lines themselves do not create stray voltage problems.

Stray voltage due to electrical systems and wiring should not be confused with induced currents, where small electric currents are induced by the electric field of a high-voltage transmission line. In this latter case, a voltage difference could be created, for example, by the electric field and different grounding between two objects. This situation can be resolved by relocating objects or animals away from under a high-voltage line, grounding conductive objects, and/or possibly shielding an area (such as a chicken wire canopy) to reduce the electric field strength locally within that area. In some rare cases, a distribution line built directly under and parallel to a high-voltage transmission line could become a source of elevated primary neutral currents. This induced current could result in high enough neutral to earth voltages that in turn might contribute to an excess of acceptable current in a cow contacting an area on an adjoining farm.

Livestock have a threshold for the perception of electrical effects. For example, in Wisconsin the “level of concern” for a cow is defined as 2 mA AC rms steady-state or 1 volt AC rms steady state (PSCW 1996). The level of concern is not a damage level but a very conservative pre-injury level, below the point where moderate avoidance behavior is likely to occur and well below where a cow’s behavior or milk production would be harmed. This finding coincides with a USDA report that states 1.0mA is the lowest threshold at which the most sensitive cows perceive shock, that levels of 1.0 to 3.0mA have no effect on milk production, a moderate behavioral response will occur at 3.0 to 6.0mA, and severe response occurs above 6.0mA (USDA 1991). Other studies have examined whether transmission line-induced currents disturb animals (IEEE 1985). One study indicated that the power-frequency current induced in a cow present in a 10kV/m field is about 0.25mA. This level of current passing through the animal’s tongue during drinking would not exceed the animal’s apparent reaction threshold. Pigs and sheep have been found similarly insensitive to the currents induced by such a field. Another study of farm animals near 745kV transmission lines was performed to determine the effects, if any, of EMFs (Amstutz and Miller 1980). This 2-year study on 11 livestock farms (beef cattle, dairy cattle, swine, and sheep) concluded that none of the farm operators indicated that they observed any health problems caused by the 765kV line.

However, another study of cattle in 1982 found that there are slight but detectable changes in cattle location patterns near energized power lines (Rogers et al. 1982). This study showed a pattern of decreased cattle use near the power line; however, it was not clear whether these changes were in response to the energized power line itself or some related factor (such as audible noise associated with the power line, perception of electric fields through hair stimulation, electric shocks to the animals from grounded objects, or simply a response to possible uneven forage production patterns over time). Overall, numerous studies have been performed related to possible EMF effects on various animals, and no consistent detectable effect has been found on, for example, health, milk production, fertility, behavior, and carcass quality. While the results of the health assessments are unclear, the interaction with induced currents would be considered an adverse impact of the proposed Project.

Besides agricultural operations and farms, electric transmission lines often share utility corridors with pipelines. In these situations, transmission line electrical effects are generally analyzed so that measures can be taken to control the induced voltage on a pipeline to meet the National Association of Corrosion Engineers guideline (NACE 2007). If an electric transmission line route parallels a pipeline, engineers for the Applicant would conduct field investigations to determine any potential safety issues or other design requirements that may result from the presence of the pipeline. The Project would then address those requirements as a part of the detailed transmission line design, including consultation with the pipeline company to determine design requirements specifically related to the presence and location of the pipeline. Crossings of pipelines by electric transmission lines are also commonplace, but are even less of a concern because of the weak magnetic-field coupling of the two systems.

Engineering constraints and obstructions, including oil and gas infrastructure, are also commonly encountered and routinely dealt with during the routing and engineering design processes for electric transmission lines. Oil and gas wells have been identified within the 1,000-foot-wide ROI. The transmission line would be designed using adequate minimum clearances so as to not restrict the movement of oilfield equipment, such as drilling rigs, workover rigs, vacuum tracks, tank trucks, and other equipment necessary to operate the oil field facilities. EPM GE-29 states that "Clean Line will work with landowners and operators of oil and gas wells, utilities, and other infrastructure to identify and verify the location of facilities and to minimize adverse impacts. Identification may include use of the One Call system and surveying of existing facilities."

The maximum calculated AC electric field from the Project transmission lines is about 4.6 to 10.2kV/m and 19.4 to 24.3kV/m for DC electric fields, which is above some public and occupational thresholds within the ROW. In this level of electric field, induced currents may create shocks from touching ungrounded metallic objects. Metal buildings and fences on or adjacent to high voltage transmission line easements are routinely grounded during construction.

3.4.11.2.1.2.2.11 Interference to Radio Frequency Equipment

Concerns are sometimes raised that transmission lines may interfere with other communication devices, such as precision agricultural equipment (which utilizes GPS signals), cellular telephones, wireless internet (Wi-Fi/modems/local area networks), computer systems, radio, satellite television systems, and other types of telecommunications equipment. However, these devices all utilize radio frequency signals that are not affected by power lines.

Research has been performed to evaluate the potential for high voltage AC power lines to affect GPS signals (Silva and Olsen 2002). The work involved theoretical analysis of GPS signals in relation to transmission lines and practical measurements at different locations in the United States directly under power lines up to 500kV and including 345kV lines. The results of the theoretical analysis indicated that it is unlikely that high voltage transmission lines can interfere with the GPS satellite signals. Evaluation was made of the potential for interference due to partial blocking of the satellite signals by overhead wires or the overhead conductors, a process called "signal scattering." The analysis showed that interference was not possible because of the small electrical size of the power line conductors relative to a GPS microwave signal wavelength and the relatively large height above ground of electrical wires. Because power line conductors are much smaller than the GPS signal wavelength, little blocking of the signals would occur when they pass around the conductors. Moreover, the conductors are high enough above the ground that any blocking is insignificant. Practical measurements were performed using a precision agriculture GPS receiver underneath the transmission lines. These measurements were performed to determine any changes in positioning accuracy or the strength of the received satellite signals while driving under power lines (both in fair and rainy weather). The practical measurements showed no effect on the received GPS signal strength due to multiple transmission lines, which was expected based on the authors original theoretical calculations.

GPS equipment is constantly improving and manufacturers design their systems for an array of sophisticated applications. In general, high-quality GPS manufacturers supply GPS units that are designed to function in the environment for which they are intended to be used. Since there are over 300,000 miles of high voltage transmission lines in the United States, GPS manufacturers can reasonably anticipate an electric power line as one part of a diverse operating environment for GPS equipment. In addition, there are continuing improvements to the GPS system itself, such as the addition of new and stronger signals for the next generation of satellites, that will enhance reception and performance.

The cell phone industry makes extensive use of GPS. GPS is used for the precise timing standards in the operation of cell phone networks and some cell phone companies use a signal modulation scheme that is similar to GPS. One practical example of successful use of GPS and microwave signals near power lines is the common practice of mounting cell phone base antennas and high accuracy GPS antennas directly onto high voltage transmission line towers throughout North America (Figures 3.4-23 and 3.4-24). This is significant, because the microwave cell phone signals from distant users are received by the base station antennas which are located on towers much closer to high voltage conductors than a tractor on the ground, for example. In addition to cell phone antennas, GPS antennas are also mounted on high voltage transmission line towers as well. The fact that the cell phone industry currently mounts its GPS and cell phone antennas on transmission line towers clearly indicates that power line interference is not a concern for the industry.

Figure 3.4-23: GPS Antennas Used by Cellular Base Stations Mounted Directly on High Voltage Transmission Line Towers

Figure 3.4-24: Examples of Cellular Antennas Installed Directly on High Voltage Transmission Lines

Other research has also been performed on the potential for interference to GPS from high voltage transmission lines, including two studies near two HVDC lines (±450kV and ±500kV) adjacent to a 230kV HVAC transmission line (Pollock and Wright 2011; Bancroft et.al. 2012). Both of these studies support the findings of the previous studies, reporting that AC and DC transmission lines did not create interference with GPS systems.

The Project will not interfere with wireless internet or cellular telephone use. WiFi and local area networks operate using radio frequency signals (2.4 to 5.9GHz range) as does cellular telephones (700MHz to 2.7GHz), and the transmission lines in the Project will operate at a frequency a billion times lower than that of these devices. Line-of-sight can be an issue if a tower structure physically blocks a transmitter and receiver. In these circumstances, either the placement of the transmitter or receiver can be moved locally to a new location where line-of-sight can be reestablished.

As of 2009, broadcast TV transmission (full power) is in digital format and the digital signal is less susceptible to interference than the old analog signal. A Federal Communications Commission study shows that digital signals provide superior immunity to impulse type noise. If TV service is provided by satellite (such as high definition TV or HDTV), the signal comes from space in microwave frequencies (4–18 billion Hz) and no interference would occur from DC or 60Hz transmission line EMF.

3.4.11.2.1.3 Decommissioning Impacts

No electrical effects would be associated with the decommissioning of the converter stations or the AC overhead transmission interconnection lines. Once decommissioned, no electrical energy would be generated that would create electrical effects such as electric and magnetic fields, audible noise, or radio and television interference.

3.4.11.2.2 AC Collection System

This section describes the electrical effects associated with AC transmission line collection system in Oklahoma and Texas. Electrical effects would only be present during operations and maintenance of these facilities. Electrical facilities need to be energized to create electrical effects such as electric and magnetic fields, audible noise, and radio and television interference. Electrical effects would not be present during the construction and decommissioning phases of the Project.

Existing facilities are present along many of the AC collection system routes, some of which already create electrical effects within the environment. Table 3.4-27 presents the number of existing AC transmission lines that parallel the AC collection system routes as well as nearby communication facilities (which are existing radio-frequency sources) within a 1,000-foot-wide corridor for each proposed route alternative. Table 3.4-27 also presents a summary of the number of existing building structures (residences, agricultural buildings, churches, and schools) within the same 1,000-foot-wide corridor for each route.

Table 3.4-27:
Occurrence of Existing Facilities along Proposed AC Collection System Routes

AC Collection System Route	Parallels Existing AC Transmission Lines (Quantity and Voltage Range)	Existing Building Structures within 1,000-Foot Corridor (Residential/ Agricultural/Church/School)[1]	Existing Communication Facilities Within 1,000-Foot-WideCorridor (Quantity and Type)[2]
E-1	1 (115kV)	193/207/1/2	3 (CT, AS)
E-2	2 (345kV)	19/73/0/0	0
E-3	0	39/162/0/0	5 (MT, PM, AS)
NE-1	0	48/376/0/0	5 (PM, AS)
NE-2	1 (345kV)	24/180/0/0	13 (MT, PM, CM, FM, AS)
NW-1	4 (69-115kV)	25/84/0/0	18 (MT, PM, CT)
NW-2	0	44/259/0/0	5 (PM, AS)
SE-1	2 (345kV)	7/26/0/0	0
SE-2	3 (115-345kV)	10/24/0/0	0
SE-3	2 (345kV)	19/71/0/0	2 (PM)
SW-1	2 (345kV)	8/14/0/0	0
SW-2	2 (115kV)	10/31/0/0	0
W-1	1 (115kV)	5/21/0/0	0

PM—Private Land Mobile, MT—Microwave Tower, AS—Antenna Structure, CM—Commercial Land Mobile, CT—Cellular Tower, FM—FM Radio

1 GIS Data Source: Clean Line (2013a, 2013b), Tetra Tech (2014a)

2 GIS Data Source: FCC (2012)

3.4.11.2.2.1 Construction Impacts

No electrical effects are associated with construction of the AC collection system routes, because these AC transmission lines would not be energized during construction. Electrical facilities must be energized to create electrical effects such as electric and magnetic fields, audible noise, and radio and television interference.

3.4.11.2.2.2 Operations and Maintenance Impacts

There are two different 345kV AC transmission line design configurations associated with the AC collection system in Oklahoma. Both line designs are single circuit configurations (i.e., one single circuit supported on a structure). The monopole line design is supported on a tubular pole, while the other design is a single circuit supported on a lattice structure. Each transmission line configuration is located within a representative 150-foot-wide to 200-foot-wide ROW (the actual ROW width has not yet been determined). Proposed loading for these lines is 570MW (945 amperes) for average loading and 950MW (1,590 amperes) for maximum loading. Figures 3.4-25 and 3.4-26 present dimensioned drawings of the two representative 345kV AC transmission line configurations.

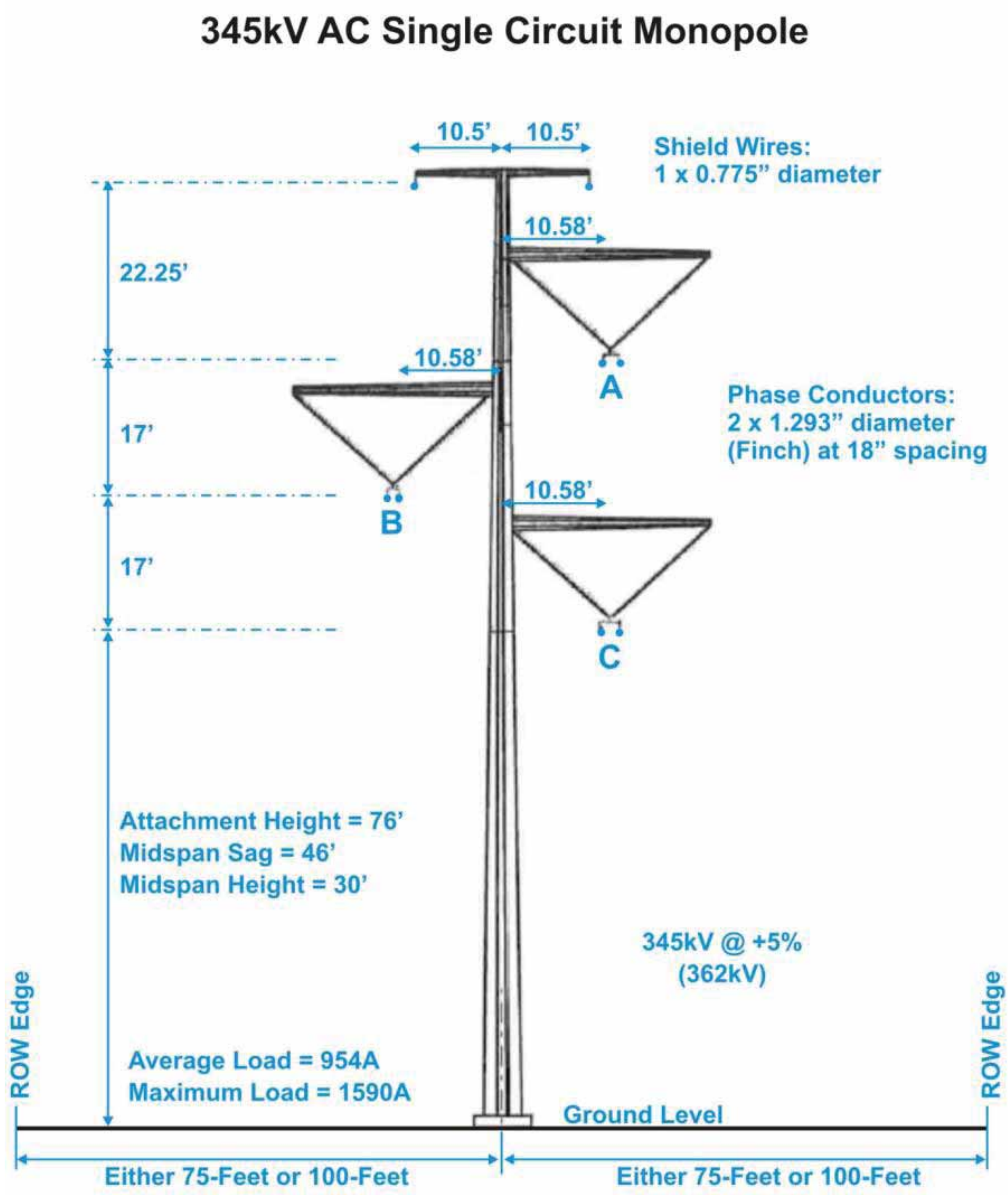


Figure 3.4-25: 345kV AC Transmission Line Single Circuit Monopole Configuration

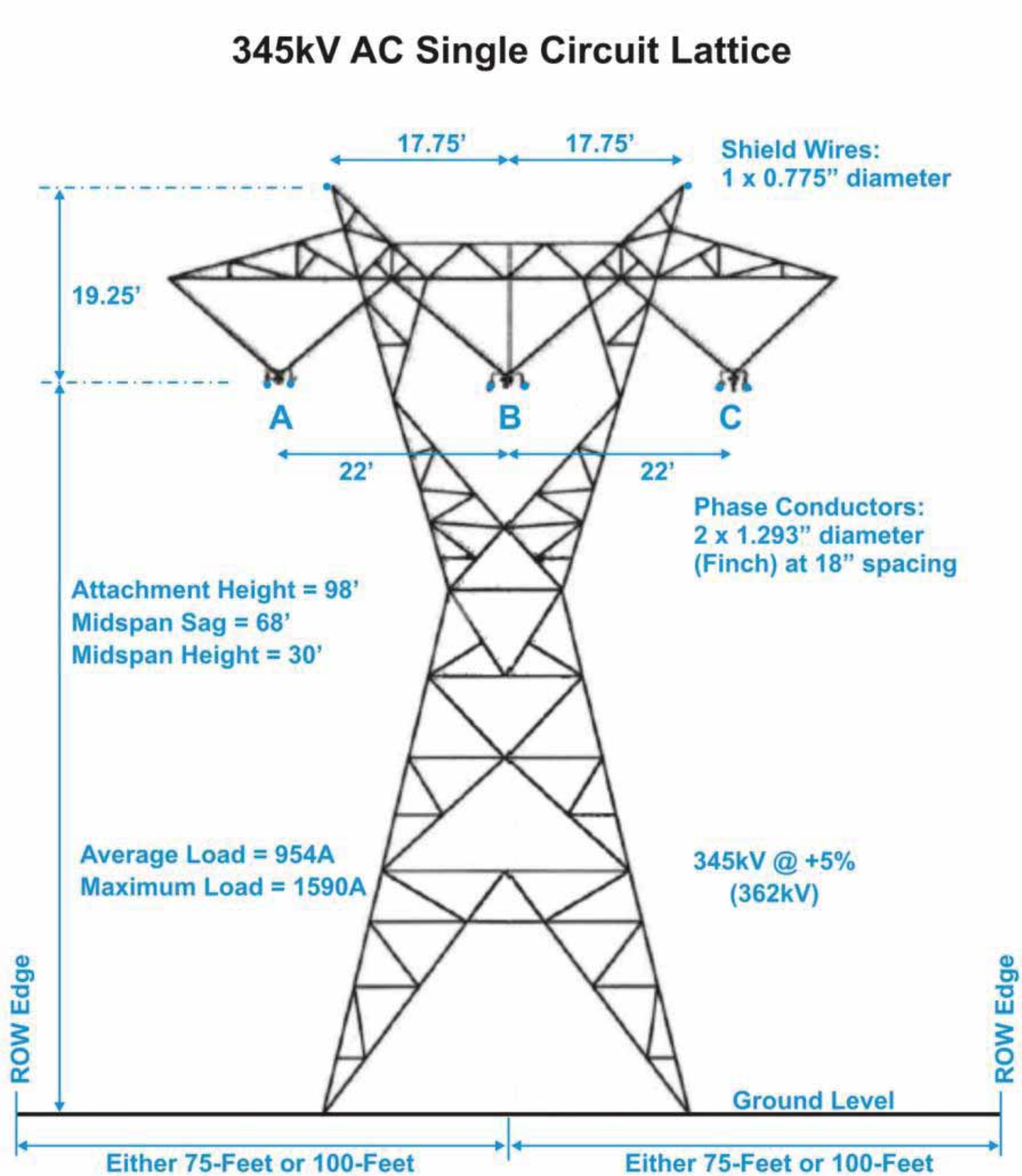


Figure 3.4-26: 345kV AC Transmission Line Single Circuit Lattice Tower Configuration

3.4.11.2.2.2.1 AC Electric Field Calculation Results

AC electric field calculations were performed for the two transmission line configurations. Table 3.4-28 presents a summary of the calculated electric field at the ROW edges and for the maximum field within the ROW. Because the ROW width has not yet been determined, ROW edge values are provided for both possible edge locations (either 75 feet or 100 feet from the transmission centerline). Calculated field levels vary, depending upon the line configuration. Figure 3.4-27 presents a graph of the calculated AC electric field for each line configuration.

Table 3.4-28:
Calculated AC Electric Field Values for 345kV AC Transmission Lines Associated with the AC Collection System Alternatives

345kV AC Transmission Line Configuration	Calculated AC Electric Field (kV/m)[1]				
	-100 Feet from CL	-75 Feet from CL	Maximum on ROW	+75 Feet from CL	+100 Feet from CL
Single Circuit Monopole	0.5	0.8	6.0	0.6	0.4
Single Circuit Lattice	0.6	1.3	6.0	1.3	0.6

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300 feet on either side of a representative centerline.
1 Edges of the ROW have not been established and are assumed to be either 75 feet or 100 feet from centerline.

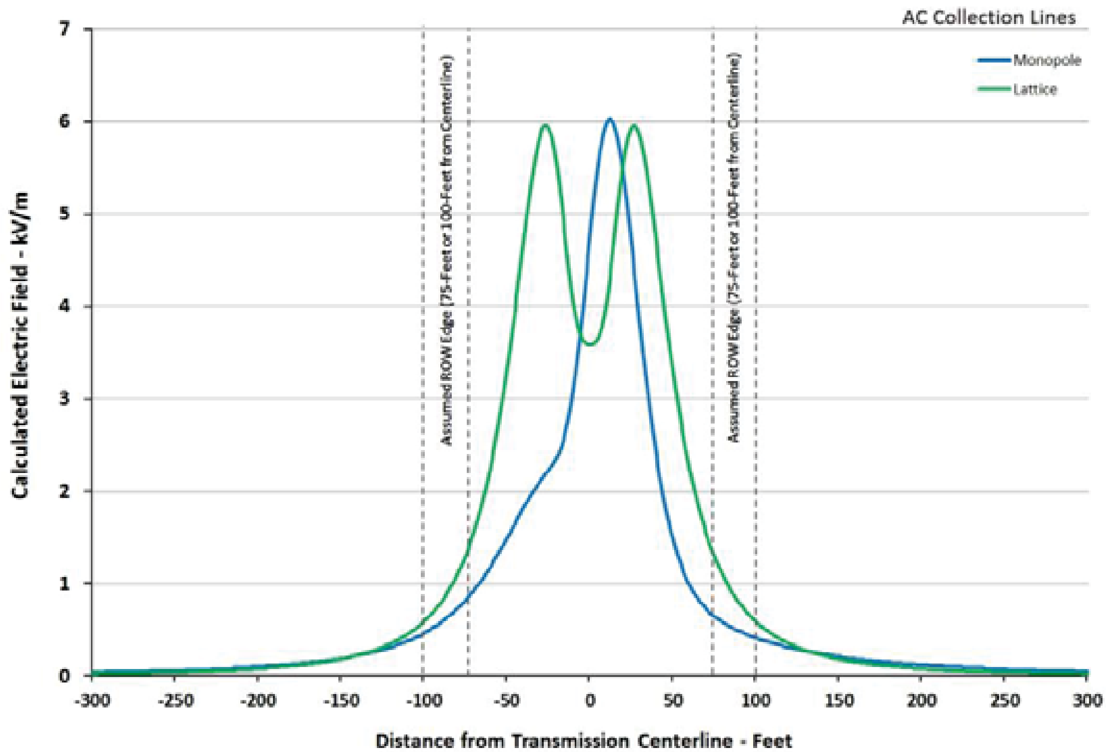


Figure 3.4-27: Calculated AC Electric Fields for 345kV AC Transmission Lines Associated with the AC Collection System

Calculated electric field levels at the ROW edges (either 75 feet or 100 feet from centerline of the transmission line) for both AC transmission line configurations are below the ICES and ICNIRP guidelines for public exposure (5kV/m and 4.2kV/m, respectively). However, the maximum electric field within the ROW exceeds both of these public standards. Within the ROW, however, calculated electric field levels are below the ICES guideline of 10kV/m for a transmission line ROW. Calculated electric fields at the ROW edge exceed the ACGIH guideline of 1kV/m for workers with implanted medical devices for the single circuit lattice configuration if the ROW width is only 150 feet (as opposed to 200 feet).

3.4.11.2.2.2.2 AC Magnetic Field Calculation Results

AC magnetic field calculations were performed for both transmission line configurations under two different loading conditions (average and maximum loading of 945 amperes and 1,590 amperes respectively). Table 3.4-29 presents a summary of the calculated magnetic field at the ROW edges and for the maximum field within the ROW. Calculated field levels vary, depending upon the line configuration and the number of circuits present. Figure 3.4-28 presents a graph of the calculated AC magnetic field for each line configuration under average and maximum loading conditions.

Calculated magnetic field levels at the ROW edges for both AC transmission line interconnection designs are below the ICES and ICNIRP guidelines for public exposure (9,040mG and 2,000mG, respectively). Calculated magnetic field levels within the ROW are also below the ACGIH guideline of 1,000mG for workers with implanted medical devices for both configurations.

Table 3.4-29:
Calculated AC Magnetic Field Values for 345kV AC Transmission Line Configurations Associated with the AC Collection System

345kV AC Transmission Line Configuration	Calculated AC Magnetic Field (mG) for Average/Maximum Load[1]				
	-100 Feet from CL	-75 Feet from CL	Maximum on ROW	+75 Feet from CL	+100 Feet from CL
Single Circuit Monopole	18.3/30.5	28.4/47.3	138.3/230.4	33.0/55.1	20.3/33.9
Single Circuit Lattice	23.1/38.5	40.2/66.9	220.3/367.1	40.7/67.8	23.5/39.2

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300 feet on either side of a representative centerline.

1 Edges of the ROW have not been established and are assumed to be either 75 feet or 100 feet from centerline.

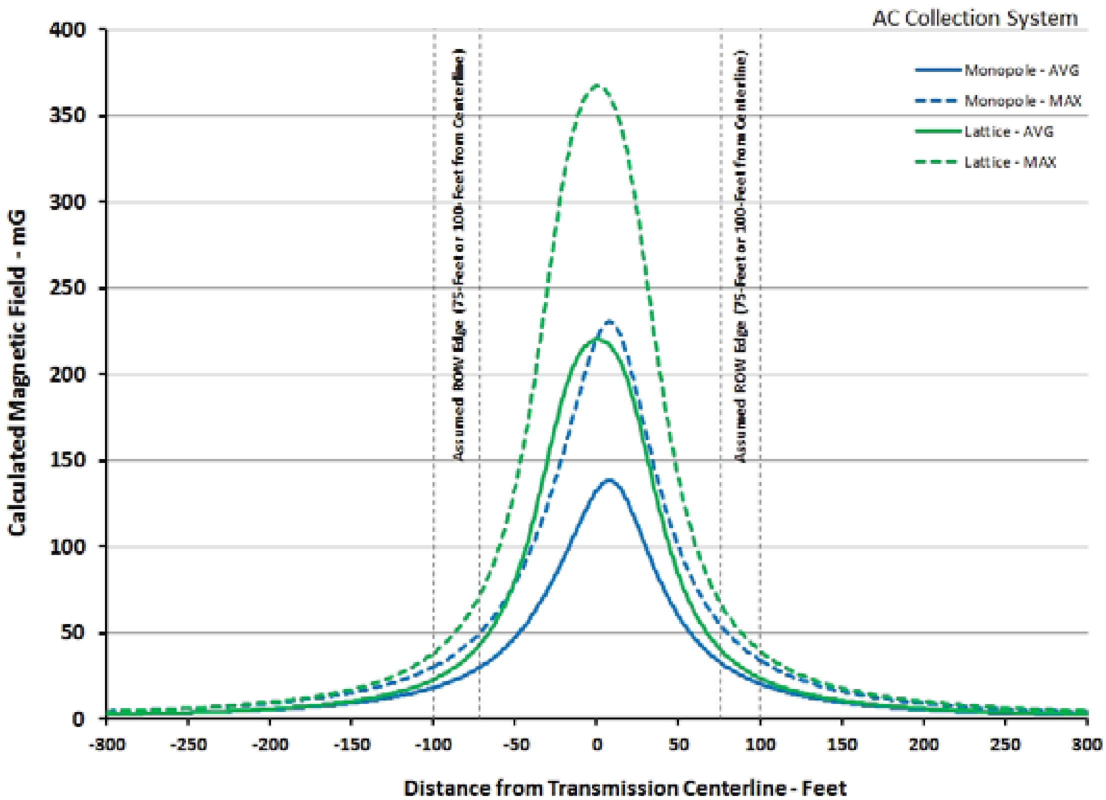


Figure 3.4-28: Calculated AC Magnetic Fields for 345kV AC Transmission Lines Associated with the AC Collection System

3.4.11.2.2.2.3 AC Audible Noise Calculation Results

Audible noise calculations were performed for both AC transmission line configurations. Table 3.4-30 presents a summary of the calculated day-night (L_{dn}) audible noise at the ROW edges and for the maximum noise level within the ROW. Calculated levels vary, depending upon the line configuration. Figure 3.4-29 presents a graph of the calculated audible noise for each AC transmission line configuration.

Table 3.4-30:
Calculated Audible Noise for 345kV AC Transmission Line Configurations Associated with the AC Collection System

345kV AC Transmission Line Configuration	Calculated Audible Noise (dBA)—L_{dn}[1]				
	-100 Feet from CL	-75 Feet from CL	Maximum on ROW	+75 Feet from CL	+100 Feet from CL
Single Circuit Monopole	47.9	48.9	51.6	49.1	48.1
Single Circuit Lattice	50.1	51.2	53.9	51.2	50.1

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300 feet on either side of a representative centerline.

1 Edges of the ROW have not been established and are assumed to be either 75 feet or 100 feet from centerline.

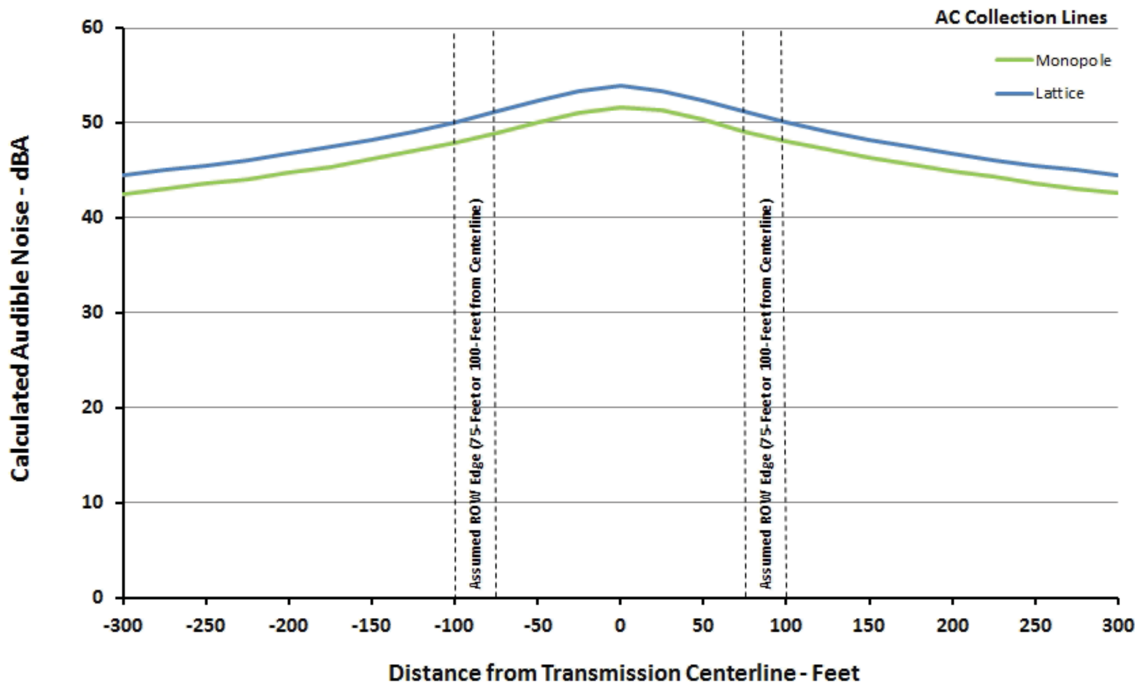


Figure 3.4-29: Calculated Audible Noise Levels (L_{dn}) for 345kV AC Transmission Lines Associated with the AC Collection System

Calculated audible noise levels at the ROW edges (either 75 feet or 100 feet from centerline of the transmission line) for all of the AC transmission line interconnections are below the EPA guideline for L_{dn} (day-night) noise of 55 dBA. Calculated audible noise levels assume a 5 percent overvoltage condition at the highest line elevation (3,000 feet).

3.4.11.2.2.2.4 AC Radio Noise Calculation Results

Radio noise calculations were performed for both AC transmission line designs for rainy and fair weather conditions. Table 3.4-31 presents a summary of the calculated radio noise at the ROW edges and for the maximum noise within the ROW at 500kHz for both weather conditions. Table 3.4-31 also presents calculated 500kHz radio noise at 50 feet from the outside conductor for comparison with the IEEE Standard. Calculated radio noise levels vary, depending upon the line configuration and weather conditions. As shown in Table 3.4-31, calculated radio noise levels at 50 feet from the outside conductor comply with the IEEE 61 dB:V/m threshold in fair weather conditions. Figure 3.4-30 presents a graph of the calculated radio noise levels for each AC line configuration in rainy weather, adjusted to the 500kHz reference level. Figure 3.4-31 presents a corresponding graph of the calculated radio noise levels for fair weather (adjusted to the 500kHz reference level).

Table 3.4-31:
Calculated Radio Noise for 345kV AC Transmission Line Configurations Associated with the AC Collection System Alternatives

345kV AC Transmission Line Configuration	Calculated Radio Noise (dB:V/m) at 500kHz (Rainy/Fair Weather)[1]						
	-100 Feet from CL	-50 Feet from Outside Conductor	-75 Feet from CL	Maximum on ROW	+75 Feet from CL	+50 Feet from Outside Conductor	+100 Feet from CL
Single Circuit Monopole	57.7/40.7	64.9/47.9	61.9/44.9	78.7/61.7	61.1/44.1	64.3/47.3	57.6/40.6
Single Circuit Lattice	56.8/39.8	63.3/46.3	62.5/45.5	81.7/64.7	62.5/45.5	63.3/46.3	56.8/39.8

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300 feet on either side of a representative centerline.

1 Edges of the ROW have not been established and are assumed to be either 75 feet or 100 feet from centerline.

It is difficult to determine whether the radio noise produced by a transmission line or any other source would cause unacceptable interference without knowing broadcast signal strengths at various locations of interest along the possible line routes. Section 3.4.4 presents a discussion on radio noise interference and Section 3.4.6.6 on radio noise standards.

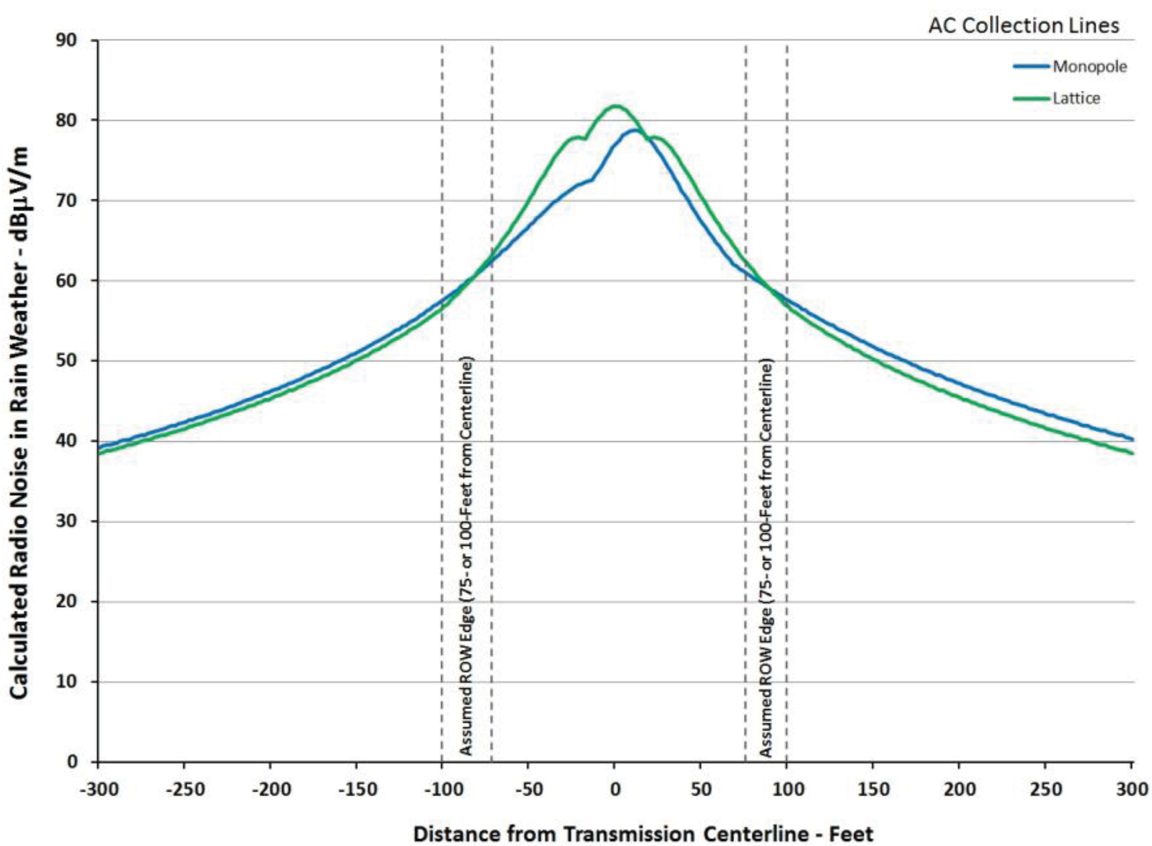


Figure 3.4-30: Calculated Radio Noise for 345kV AC Transmission Lines Associated with the AC Collection System (Rainy Weather)

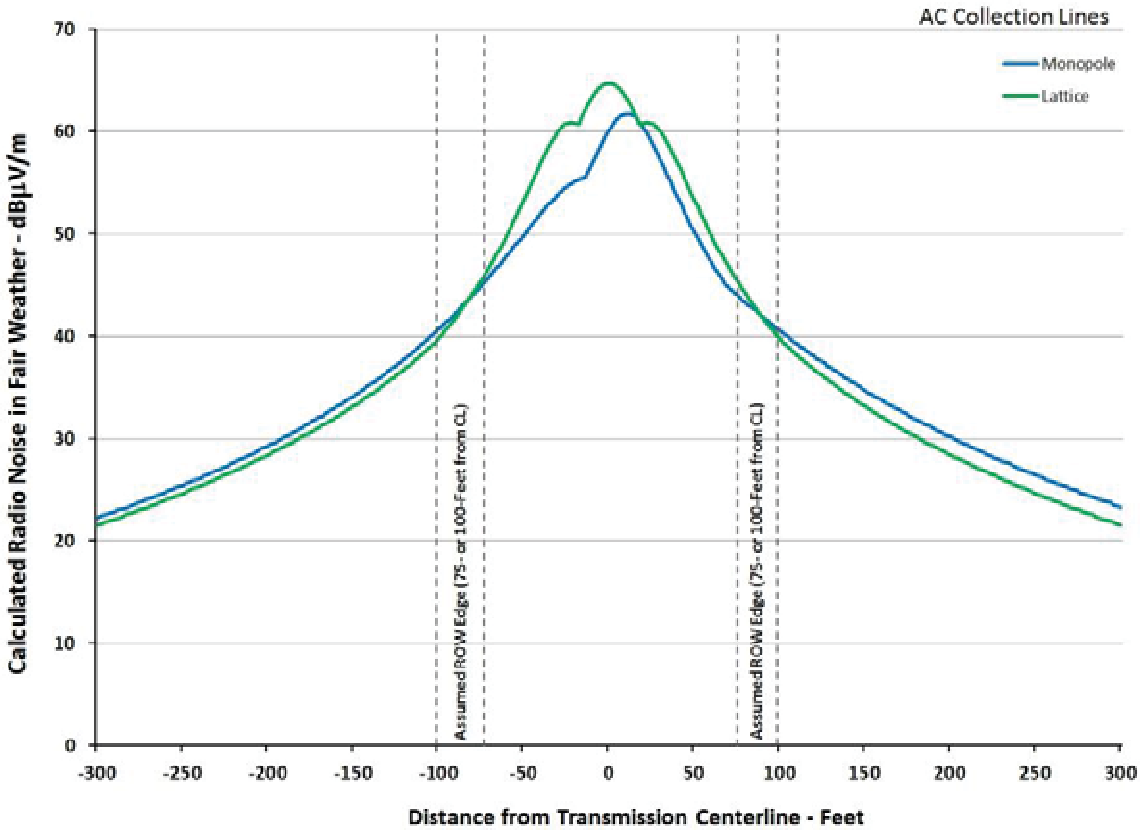


Figure 3.4-31: Calculated Radio Noise for 345kV AC Transmission Lines Associated with the AC Collection System (Fair Weather)

3.4.11.2.2.2.4.1 AC Television Noise Calculation Results

Television noise calculations were performed for both AC transmission line interconnections for rainy weather conditions. Table 3.4-32 presents a summary of the calculated television noise at the ROW edges and for the maximum noise within the ROW for the 75MHz reference level. Calculated television noise levels vary, depending upon the line configuration. Figure 3.4-32 presents a graph of the calculated television noise levels for each AC line configuration in rainy weather.

Table 3.4-32:
Calculated Television Noise for 345kV AC Transmission Line Configurations Associated with the AC Collection System

345kV AC Transmission Line Configuration	Calculated Television Noise (dB:V/m) at 75MHz for Rainy Weather[1]				
	-100 Feet from CL	-75 Feet from CL	Maximum on ROW	+75 Feet from CL	+100 Feet from CL
Single Circuit Monopole	16.8	19.1	31.1	20.7	18.0
Single Circuit Lattice	20.0	22.4	34.1	22.4	20.0

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300 feet on either side of a representative centerline.
1 Edges of the ROW have not been established and are assumed to be either 75 feet or 100 feet from centerline.

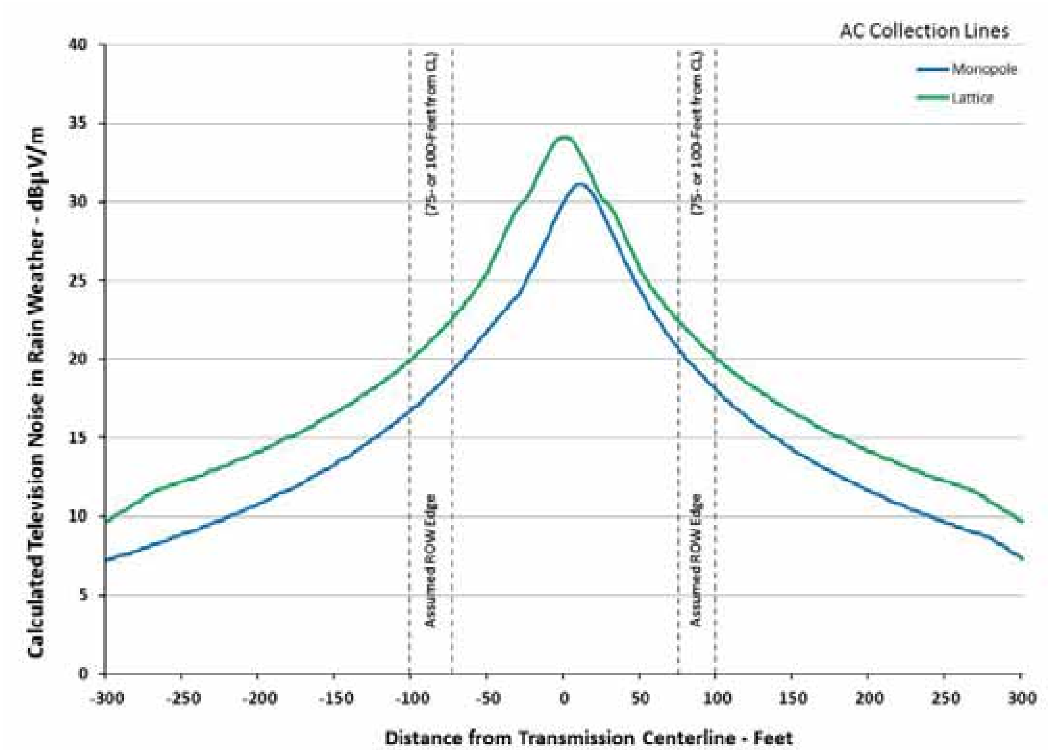


Figure 3.4-32: Calculated Television Noise for 345kV AC Transmission Lines Associated with the AC Collection System (Rainy Weather)

As with radio noise interference, it is difficult to determine whether the television noise level produced by a transmission line would cause unacceptable interference. However, the new digital broadcast system technology for radio and television should provide better coverage and immunity to transmission line noise than analog television signals. No interference resulting from corona-generated noise would be expected for digital signals broadcast at frequencies above 1GHz from satellites (EPRI 2006a).

3.4.11.2.2.2.4.2 Ozone Calculation Results

Ozone levels for both AC transmission line designs were calculated for rainy weather conditions. Table 3.4-33 presents a summary of the calculated maximum ozone concentrations at ground level within 300 feet of the transmission centerline. Maximum ozone levels are far below the EPA standard of 75 ppb for all three line design configurations.

Table 3.4-33:
Calculated Ozone Levels for 345kV AC Transmission Line Configurations Associated with the AC Collection System

AC Transmission Configuration	Calculated Ozone (ppb)
	Maximum within +/-300 Feet of CL
Single Circuit Monopole	0.0
Single Circuit Lattice	0.1

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300 feet on either side of a representative centerline.

3.4.11.2.2.2.5 Summary of Impacts for the AC Collection System

Based on an evaluation of research and guidelines recommended by various agencies, it is unlikely that the AC collection system would pose a known threat to human health (reference Section 3.4.11.2.1.2.2.7). In addition, the likelihood of increased audible noise or interference to AM radio/television reception (due to operation of the line) rising to a level of annoyance is small.

While a variety of electronic devices are known to affect the operation of pacemakers and ICDs, transmission lines have not been reported to produce functional disturbances to these devices. There is a possibility that induced potentials on the leads of these devices by AC electric fields on the ROW could affect the operation of these devices, but the clinical significance of such changes appears small. Persons who are concerned should contact their physician to ascertain the immunity of their device to this potential source of interference.

3.4.11.2.2.3 Decommissioning Impacts

No electrical effects would be associated with the decommissioning of any of the AC collection system. Once decommissioned, no electrical energy would be generated that would create electrical effects such as electric and magnetic fields, audible noise, or radio and television interference.

3.4.11.2.3 HVDC Applicant Proposed Route

Existing electrical facilities (such as overhead transmission lines) are present within each of the proposed transmission routes and regions, some of which already create electrical effects within the environment. Table 3.4-34 presents the number of existing AC transmission lines that parallel the Applicant Proposed Route, as well as nearby communication facilities (which are existing radio-frequency sources) within a 1,000-foot-wide corridor of each Applicant Proposed Route. Table 3.4-34 also presents a summary of the number of existing building structures (residences, agricultural buildings, churches, and schools) within the same 1,000-foot-wide corridor for the Applicant Proposed Route.

Table 3.4-34:
Occurrence of Existing Facilities along the Applicant Proposed Route by Region

Applicant Proposed Route	Parallels Existing AC Transmission Lines (Quantity and Voltage Range)	Existing Building Structures within 1,000-Foot-Wide Corridor (Residential/Agricultural/ Church/School)[1]	Existing Communication Facilities within 1,000-Foot-Wide Corridor (Quantity and Type)[2]
Region 1	4 (69-345kV)	8/24/0/0	0
Region 2	1 (115kV)	26/40/0/0	1 (TV)
Region 3	8 (69-345kV)	114/61/0/0	9 (MT, AS)
Region 4	9 (69-345kV)	151/74/1/0	3 (PM, AS)
Region 5	1 (500kV)	81/41/0/0	0
Region 6	1 (161kV)	26/26/0/0	0
Region 7	1 (161kV)	30/16/1/0	3 (PM, AS)

PM—Private Land Mobile, TV—Analog TV (National Television System Committee), MT—Microwave Tower, AS—Antenna Structure
1 GIS Data Source: Clean Line (2013a, 2013b), Tetra Tech (2014a)
2 GIS Data Source: FCC (2012)

3.4.11.2.3.1 Construction Impacts

No electrical effects would be associated with construction of the Applicant Proposed Route, because the transmission line would not be energized during construction. Electrical facilities need to be energized to create electrical effects such as electric and magnetic fields, audible noise, and radio and television interference.

3.4.11.2.3.2 Operations and Maintenance Impacts

There are two ±600kV HVDC overhead electric transmission line configurations that may be utilized within the seven regions associated with the Applicant Proposed Route: monopole and lattice tower. Figure 3.4-33 presents a diagram of a representative monopole configuration, which is supported on a tubular pole. Figure 3.4-34 presents a diagram of a representative lattice tower configuration. It has not yet been determined which configurations may occur within these regions, so the results of the electrical effects associated with both of these configurations may be applicable to any and/or all of the proposed regions and are therefore assumed to be potentially common impacts to all regions.

Both line designs are bi-polar configurations, located within a 200-foot-wide ROW. Under normal operating conditions, only the main conductor bundles will carry load. However, the HVDC transmission line is designed with two dedicated neutral return (DNR) conductors that could carry load during infrequent situations, such as when a main conductor bundle is de-energized for repair or maintenance. For each of the two transmission line designs (monopole and lattice tower), two different operating conditions were therefore modeled (standard/typical conductor load flow and DNR load flow on both return wires for one polarity).

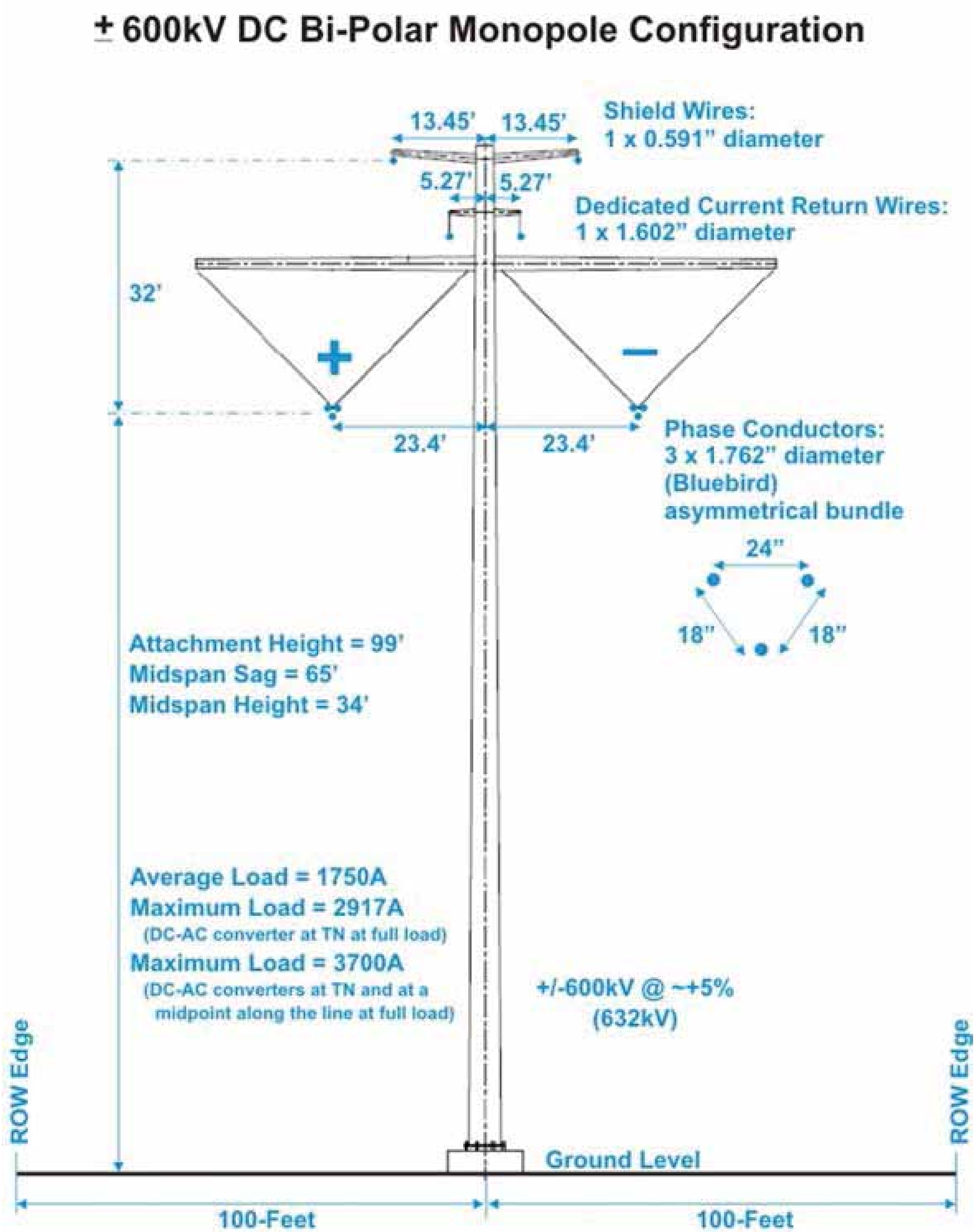
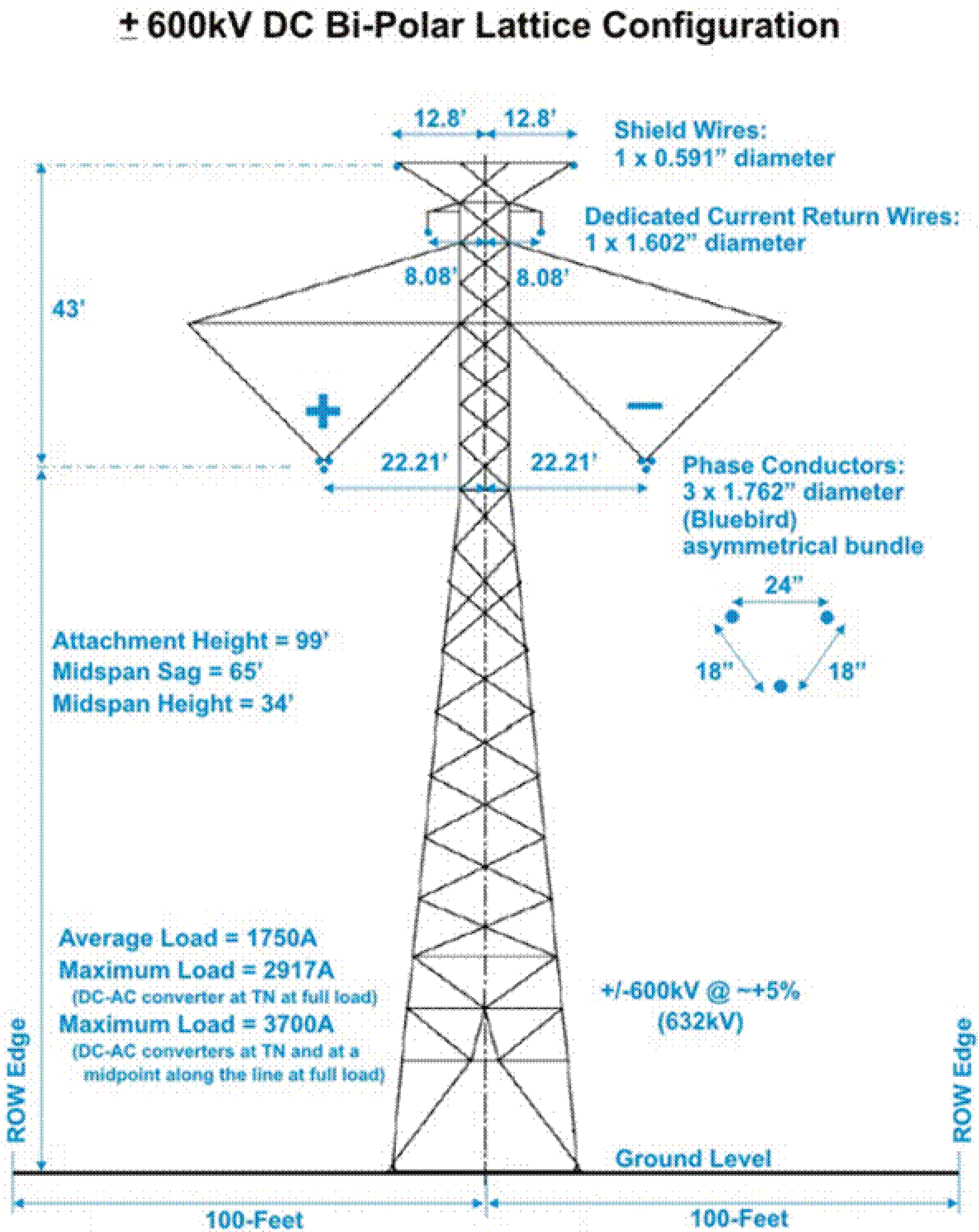


Figure 3.4-33: Proposed ±600kV HVDC Transmission Line Monopole Configuration



1 Figure 3.4-34: Proposed ±600kV HVDC Transmission Line Lattice Tower Configuration

3.4.11.2.3.2.1 DC Electric Field Calculation Results

DC electric field calculations were performed for the two HVDC transmission line configurations. Table 3.4-35 presents a summary of the calculated DC electric field at the ROW edges and for the maximum field within the ROW. Calculated field levels vary, depending upon the line configuration. Figure 3.4-35 presents a graph of the calculated DC electric field for each line configuration using standard and DNR operating conditions with an approximate overvoltage condition of 10 percent at the highest line elevation (3,000 feet).

Table 3.4-35:
Calculated DC Electric Field Values for DC Transmission Line Configurations (Voltage Only)

DC Transmission Line Configuration	Calculated Electric Field (kV/m)		
	-100 Feet from CL	Maximum on ROW	+100 Feet from CL
Monopole—Standard	2.7	+/- 19.4	-2.7
Monopole—DNR	3.3	23.5	0.6
Lattice—Standard	2.6	+/- 19.6	-2.6
Lattice—DNR	3.2	24.3	0.7

CL = Centerline

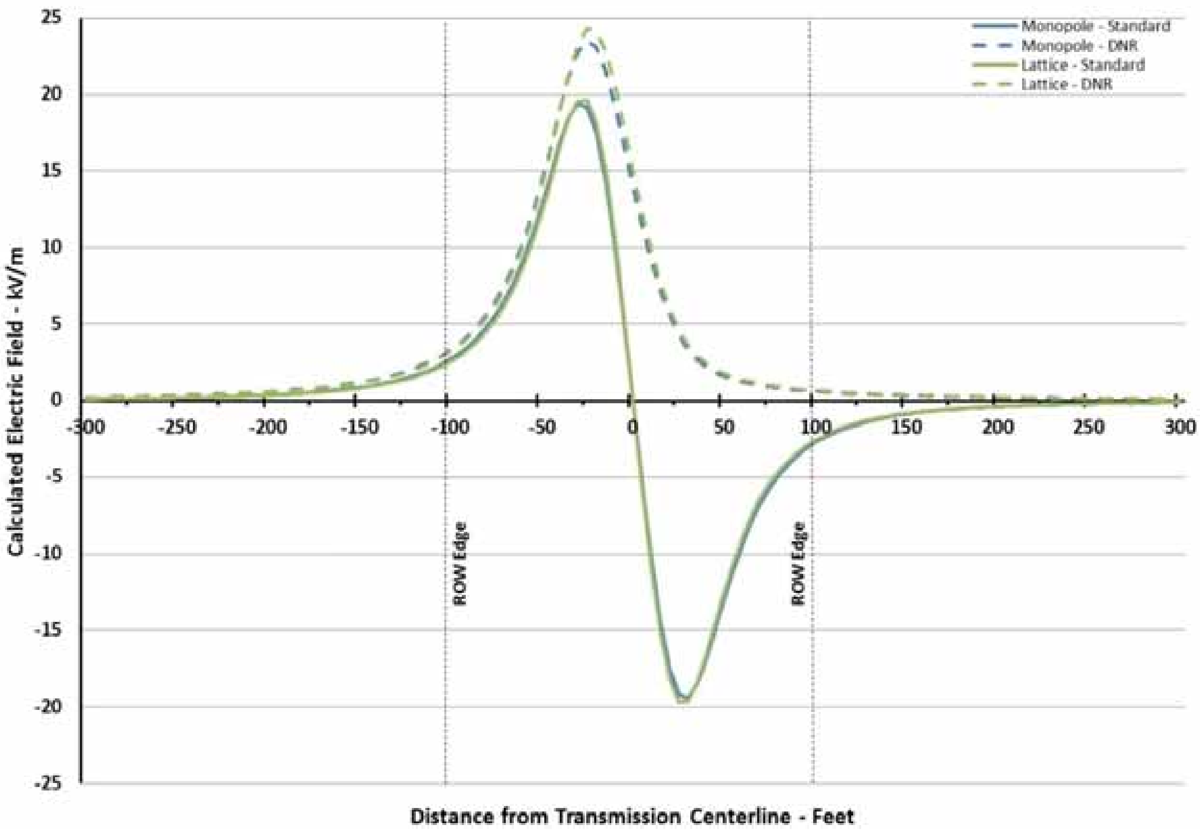


Figure 3.4-35: Calculated DC Electric Fields for ±600kV HVDC Transmission Line

Calculated DC electric field levels at the ROW edges (100 feet from the centerline of the transmission line) for both DC transmission line configurations are below the ICES and ICNIRP public guidelines (5kV/m). However, calculated DC electric field levels exceed the ICES and ICNIRP public guidelines (5kV/m) within the ROW. Calculated DC electric field levels conform to the ACGIH occupational standard (25kV/m) within the ROW for all configurations, but exceed the ICES and ICNIRP occupational standards (20kV/m) for the DNR configurations.

3.4.11.2.3.2.2 DC Magnetic Field Calculation Results

DC magnetic field calculations were performed for both transmission line configurations under three different loading conditions:

- Average loading of 1750 amperes
- Maximum loading of 2917 amperes when only the DC-AC converter at the Tennessee end of the line is supplied full load
- Maximum loading of 3700 amperes when both the DC-AC converter at the Tennessee end of the line and another DC-AC converter at a midpoint along the line are both being supplied full load

Table 3.4-36 presents a summary of the DC calculated magnetic field at the ROW edges and for the maximum field within the ROW. Calculated field levels vary, depending upon the line configuration. Figure 3.4-36 presents a graph of the calculated DC magnetic field for the monopole line configuration using standard and DNR operating conditions and for average and maximum loading conditions. Figure 3.4-37 presents a graph of the calculated DC magnetic field for the lattice tower configuration using standard and DNR operating conditions and for average and maximum loading conditions. In the standard configuration, load flow is balanced in both directions between the positive and negative phases, creating a magnetic field profile which peaks at centerline. In the DNR configuration, return load is split between the two dedicated neutral return conductors, creating a shift in the calculated field to the side more heavily loaded.

Table 3.4-36:
Calculated DC Magnetic Field Levels for DC Transmission Line Configurations

DC Transmission Line Configuration	Calculated Magnetic Field (mG) for Average/Maximum (1750A/2917A/3700A) Load		
	-100 Feet from CL	Maximum on ROW	+100 Feet from CL
Monopole—Standard	51.1/85.2/108.0	354.9/591.5/750.3	51.1/85.2/108.0
Monopole—DNR	46.1/76.8/97.4	219.2/365.4/463.5	30.1/50.2/63.7
Lattice—Standard	48.5/80.9/102.6	360.7/601.2/762.6	48.5/80.9/102.6
Lattice—DNR	51.9/86.6/109.8	237.5/395.9/502.2	34.8/57.9/73.5

CL = Centerline

Calculated DC magnetic field levels at the ROW edges (100 feet from centerline of the transmission line) for both DC transmission line configurations are below guidelines for public exposure (1,180,000mG for ICES and 4,000,000mG for ICNIRP). Calculated DC magnetic field levels are also below the guidelines for implanted medical devices (5,000mG for ACGIH, ICNIRP, and the FDA).

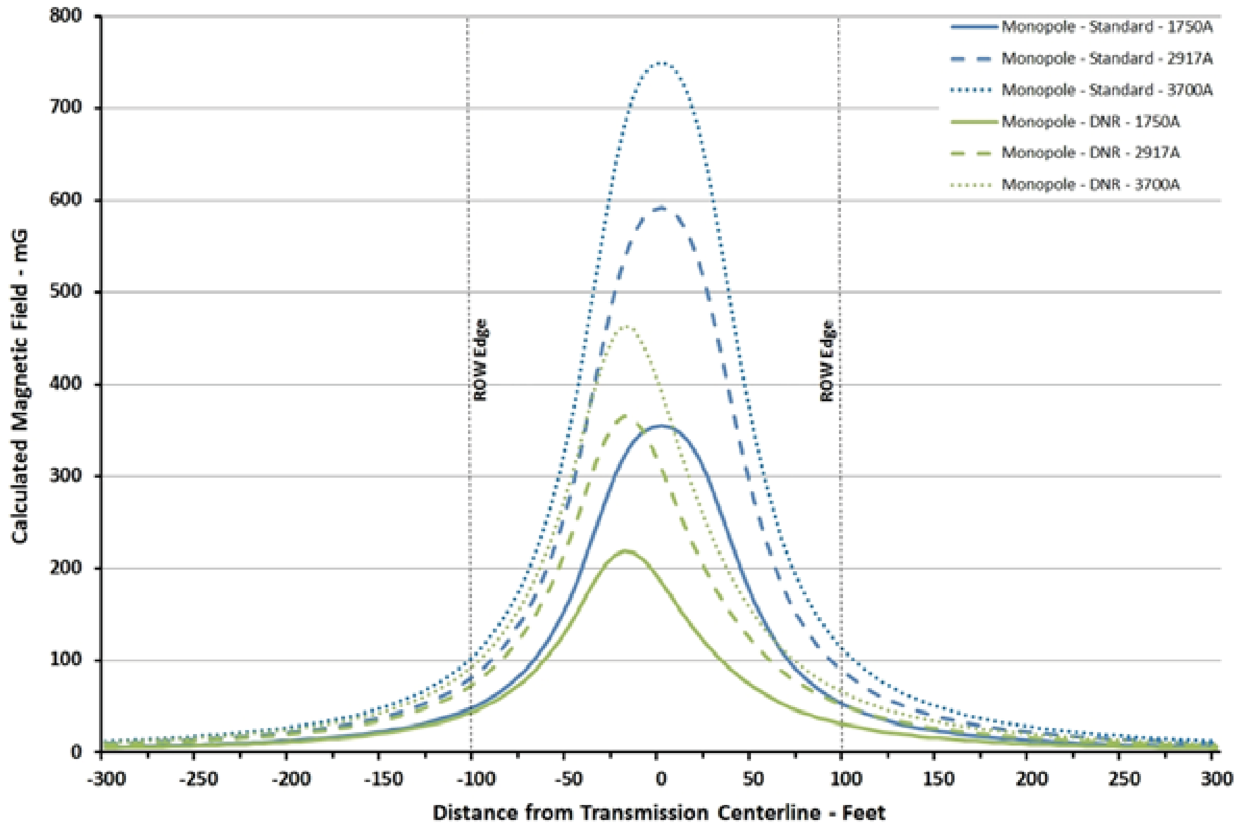


Figure 3.4-36: Calculated DC Magnetic Fields for ±600kV HVDC Transmission Line (Monopole Configuration)

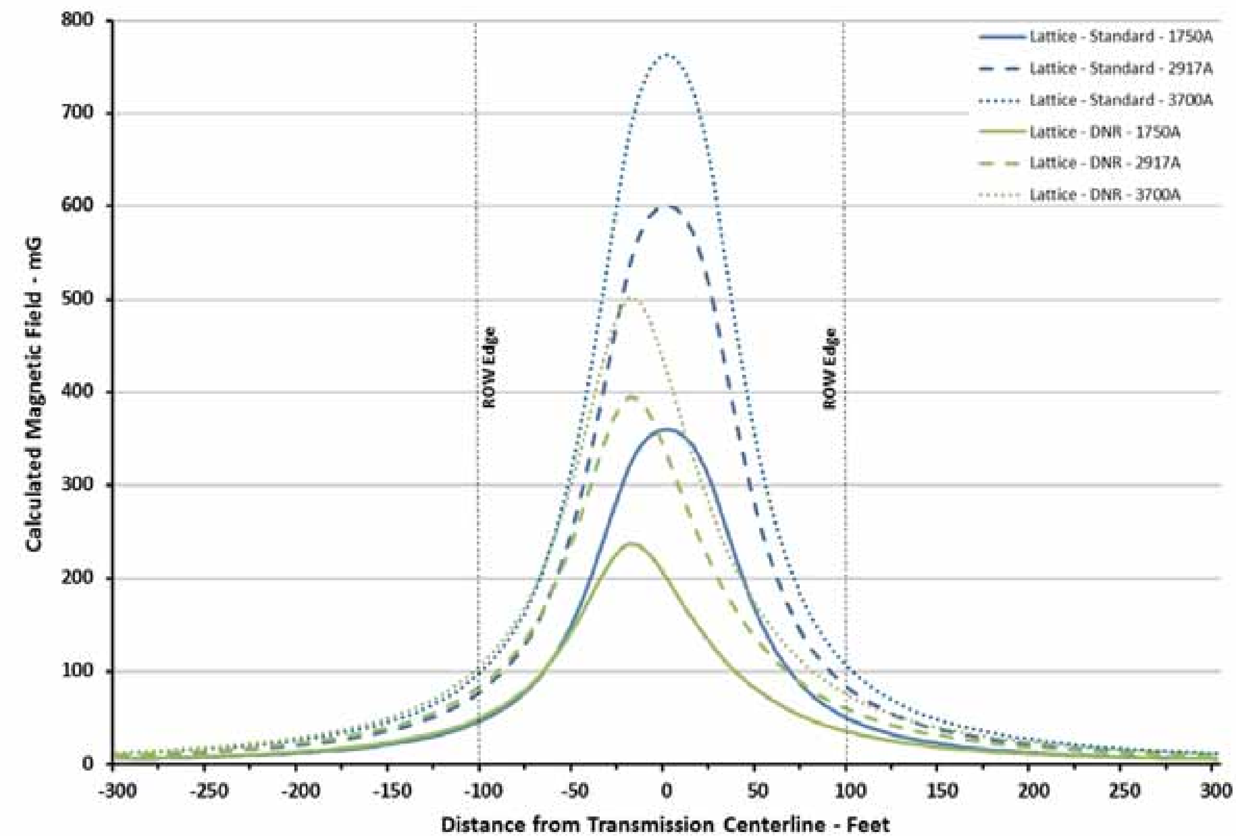


Figure 3.4-37: Calculated DC Magnetic Fields for ±600kV HVDC Transmission Line (Lattice Configuration)

3.4.11.2.3.2.3 DC Audible Noise Calculation Results

Audible noise calculations were performed for both DC transmission line configurations. Table 3.4-37 presents a summary of the calculated day-night (L_{dn}) audible noise at the ROW edges and for the maximum noise level within the ROW. Calculated levels vary, depending upon the line configuration. Figure 3.4-38 presents a graph of the calculated audible noise for each DC transmission line configuration.

Table 3.4-37:
Calculated Audible Noise for DC Transmission Line Configurations

DC Transmission Line Configuration	Calculated Audible Noise (dBA)—L_{dn}		
	-100 Feet from CL	Maximum on ROW	+100 Feet from CL
Monopole—Standard	54.7	57.5	52.8
Monopole—DNR	48.7	51.5	46.8
Lattice—Standard	55.2	58.1	53.4
Lattice—DNR	48.3	51.2	46.5

CL = Centerline

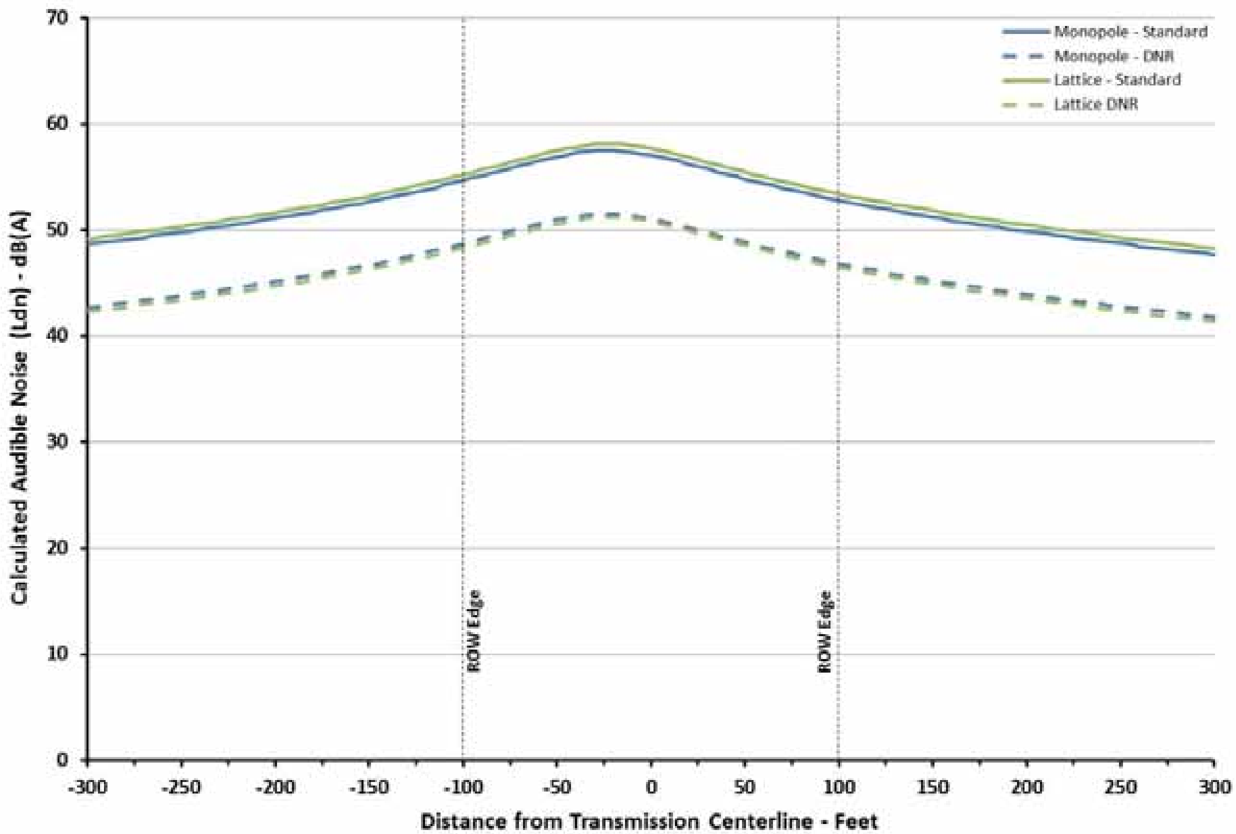


Figure 3.4-38: Calculated Audible Noise Levels (L_{dn}) for ±600kV HVDC Transmission Line

Calculated audible noise levels at the ROW edges (100 feet from centerline of the transmission line) for the standard monopole and lattice line configurations are at or below the EPA guideline for L_{dn} (day-night) noise of 55 dBA (the lattice configuration is slightly higher than the EPA guideline at 55.2 dBA), but calculated audible noise levels assume a 5 percent overvoltage condition at the highest line elevation (3,000 feet). For all configurations utilizing the DNR configuration, calculated audible noise levels are below the EPA standard at either ROW edge (either 75 feet or 100 feet from the transmission line).

Table 3.4-38 presents calculated day-night (L_{dn}) audible noise levels beyond the ROW edges, out to 2,000 feet away from the HVDC transmission line for the four different configurations. Since the elevation of the HVDC transmission line can change from as low an elevation as 200 feet to as high as 3,000 feet above sea level (Regions 1 through 7), audible noise calculations were performed for both the lowest and highest elevations as shown in this table. There is a difference of about a 3 dB in calculated audible noise levels between the lowest and highest elevations. The positive pole results appear on the top rows of this table (with negative distances from centerline), thus resulting in higher calculated audible noise levels nearest this pole.

Table 3.4-38:
Extended Audible Noise Calculation Values for DC Transmission Line Configurations

Distance from Centerline (Feet)	Calculated Audible Noise (dBA)—L_{dn}							
	Monopole—Standard		Monopole—DNR		Lattice—Standard		Lattice—DNR	
	3,000-Foot Elevation	200-Foot Elevation	3,000-Foot Elevation	200-Foot Elevation	3,000-Foot Elevation	200-Foot Elevation	3,000-Foot Elevation	200-Foot Elevation
-2000	29.9	26.7	23.9	20.8	30.4	27.3	23.5	20.4
-1500	34.2	31.1	28.2	25.1	34.7	31.6	27.8	24.7
-1000	39.0	35.9	33.1	29.9	39.6	36.4	32.7	29.5
-500	45.2	42.0	39.2	36.1	45.7	42.6	38.8	35.7
-400	46.8	43.6	40.8	37.7	47.3	44.2	40.4	37.3
-300	48.7	45.6	42.7	39.6	49.2	46.1	42.3	39.2
-200	51.1	48.0	45.2	42.0	51.6	48.5	44.7	41.6
-100	54.7	51.6	48.7	45.6	55.2	52.1	48.3	45.2
0	57.1	53.9	51.1	47.9	57.7	54.6	50.8	47.7
100	52.8	49.7	46.8	43.7	53.4	50.3	46.5	43.4
200	49.9	46.8	43.9	40.8	50.5	47.3	43.6	40.4
300	47.7	44.6	41.8	38.6	48.3	45.2	41.4	38.3
400	46.0	42.9	40.0	36.9	46.6	43.4	39.7	36.5
500	44.5	41.3	38.5	35.4	45.0	41.9	38.1	35.0
1000	38.5	35.4	32.6	29.4	39.1	36.0	32.2	29.1
1500	33.8	30.6	27.8	24.7	34.3	31.2	27.4	24.3
2000	29.5	26.4	23.5	20.4	30.0	26.9	23.1	20.0

3.4.11.2.3.2.4 DC Radio Noise Calculation Results

Radio noise calculations were performed for both DC transmission line designs for rainy weather conditions. Table 3.4-39 presents a summary of the calculated radio noise at the ROW edges and for the maximum noise within the ROW at 500kHz. Calculated radio noise levels vary, depending upon the line configuration. As shown in Table 3.4-39, calculated radio noise levels at 50 feet from the outside conductor are below the IEEE 61 dB:V/m threshold in fair or rainy weather for all configurations. Figure 3.4-39 presents a graph of the calculated radio noise levels for each DC line configuration in rainy weather at the 500kHz reference level.

Table 3.4-39:
Calculated Radio Noise Values for DC Transmission Line Configurations in Rainy Weather

DC Transmission Line Configuration	Calculated Radio Noise (dB:V/m) at 500kHz (Rainy Weather)				
	-100 Feet from CL	-50 Feet from Outside Conductor	Maximum on ROW	+50 Feet from Outside Conductor	+100 Feet from CL
Monopole—Standard	52.3	57.7	68.6	56.4	52.9
Monopole—DNR	47.9	53.5	65.3	54.6	51.3
Lattice—Standard	52.0	57.3	69.0	56.7	52.9
Lattice—DNR	48.6	52.8	65.0	54.5	51.6

CL = Centerline

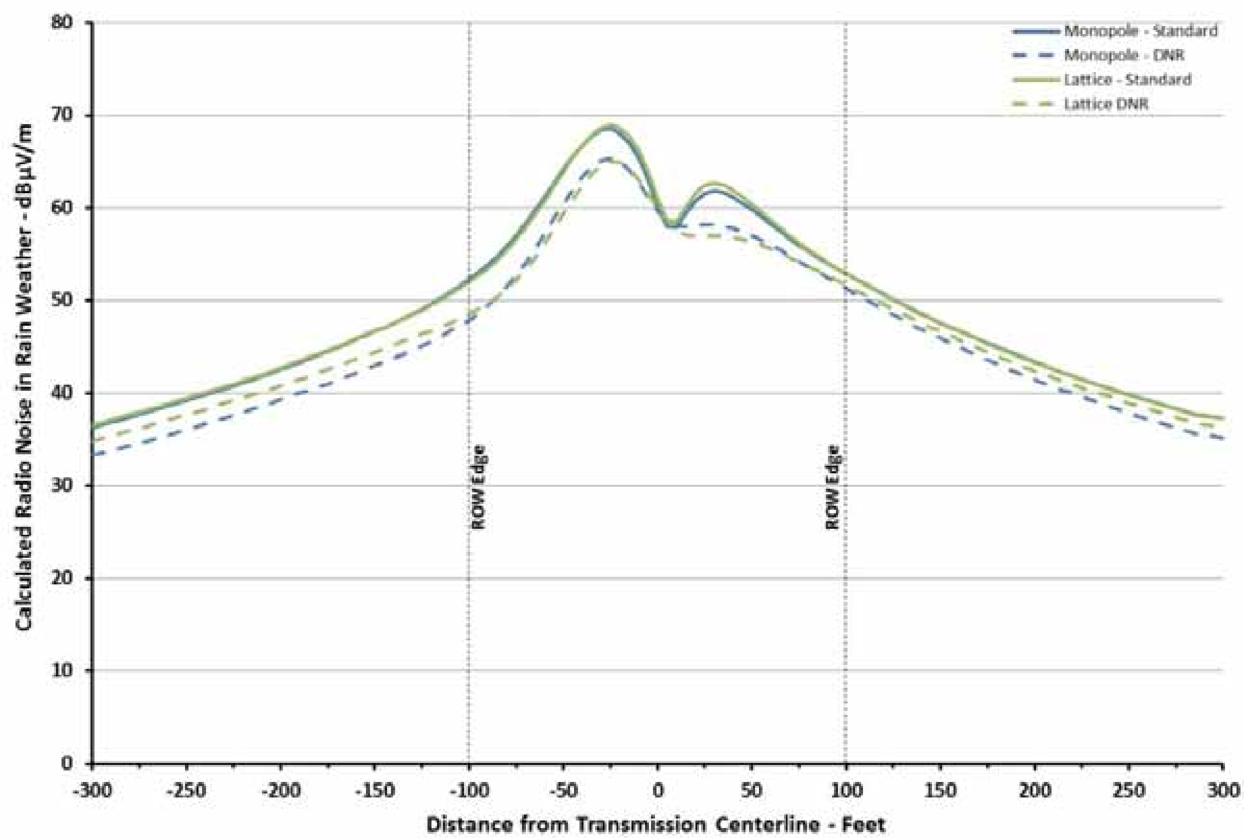


Figure 3.4-39: Calculated Radio Noise for ±600kV HVDC Transmission Line (Rainy Weather)

3.4.11.2.3.2.5 Air Ion Calculation Results

Air ion concentration levels for both DC transmission line configurations and operating conditions were calculated. Table 3.4-40 presents a summary of the calculated air ion concentration levels at the ROW edges and for the maximum field within the ROW.

Table 3.4-40:
Calculated Ion Density Levels for DC Transmission Line Configurations

DC Transmission Line Configuration	Calculated Ion Density Level (ions/cm^3)		
	-100 Feet from CL	Maximum on ROW	+100 Feet from CL
Monopole—Standard	31,300	+/- 284,400	-31,300
Monopole—DNR	41,500	390,700	11,200
Lattice—Standard	29,800	+/-295,700	-29,800
Lattice—DNR	40,100	408,600	12,500

CL = Centerline

Air ion exposures have been extensively studied with no clear evidence of effects. Studies of exposures ranging from ambient levels to levels much higher than those found in proximity of HVDC lines have been made, but findings have often been inconsistent and many studies have reported no effect (Hauth et al. 1997).

3.4.11.2.3.2.6 Overview of DC Electrical Effects Research on Human Health

Research has been conducted in the United States and around the world to determine whether exposure to static DC electric and magnetic fields has human health effects. For DC electric and magnetic fields, studies have shown no consistent evidence of adverse human health effects for exposure to levels comparable to those encountered underneath DC transmission lines. Some DC electric field effects, such as hair sensation (the perception experienced by electrical stimulation of the hair on the arm or head) and spark discharges or micro-shocks (a person touches a grounded object and discharges built-up voltage) may be annoying or uncomfortable to experience (EPRI 2012). The maximum calculated DC electric field within the ROW is about 24.3kV/m. In this level of DC electric field, typically observed perception can include a very slight tingling sensation on the scalp, hair stimulation, and slight feeling on ears and hair (EPRI 1978).

The following discussions report on various organizations and study results concerning DC electrical effects and their conclusions:

- An EPRI State of the Science Report on HVDC transmission lines stated that numerous studies of the effects of DC fields and space charges (air ions) have been made with the general conclusion that there are no significant effects on either humans or animals. In addition, public health surveys and field studies conducted at new HVDC overhead transmission lines indicate that the environment surrounding these lines is not harmful to humans, animals, or crops (EPRI 2010).
- An Oak Ridge National Laboratory review paper summarized that there is no mechanism to explain how exposure to external static fields could produce adverse biological responses. Although the database of studies is small, the experiments overall do not indicate a clear pattern of effect, and provide no basis to conclude that exposure to electric fields, such as those associated with the electric field of a HVDC transmission line, pose health risks (Hauth et al. 1997).
- The WHO published the Environmental Health Criteria 232 (EHC 232) to address the possible health effects of exposure to static electric and magnetic fields. For DC electric fields, this report found that none of the studies conducted to date suggests any untoward health effects, except for possible stress resulting from prolonged exposure to micro-shocks. The WHO did not recommend further research concerning biological effects from exposure to static electric fields. For DC magnetic fields, the WHO officially recognizes the ICNIRP exposure guidelines advice (based upon the health risk assessments published by the WHO and cancer reviews and classifications carried out by the IARC) (WHO 2006).

The HVDC transmission line will produce DC electric and magnetic fields that are similar to those encountered in the natural environment, with magnetic field levels similar to the earth's static geomagnetic field on the ROW (depending upon the line loading—maximum calculated DC magnetic field from the transmission line of about 763mG versus earth's magnetic field of about 510mG in Oklahoma, Arkansas, and Tennessee) and electric field levels outside ROW similar to those produced by atmospheric phenomena. Within the ROW, the maximum calculated DC electric field from the Project transmission line is about 19.4 to 24.3kV/m, which is above some public and occupational thresholds. In this level of electric field, induced currents may create shocks if ungrounded metallic objects are touched. (However, metal buildings and fences on or adjacent to high voltage transmission line easements are typically grounded during transmission line construction.) Outside the ROW, field levels would be even lower. Based upon the reviews of scientific research, it is unlikely that the DC fields from the Project would have adverse effects on human health. Utilities often may supply information on living and working safely around high voltage power lines (BPA 2010, 2007).

Several studies of the effects of DC fields and air ions have been conducted and they all generally conclude that there are no significant effects on either humans or animals from exposure (EPRI 2012, 2010; Charry 1987). Air ion exposures have been extensively studied and the results show no clear evidence of effects. Air ions can be inhaled, and studies have evaluated air ion exposure for respiratory issues. Some reports indicated that exposure (to either positive or negative ions) improved lung function in people with bronchial asthma; other reports suggest that only negative ions improve function and the positive ions aggravate these conditions. While some effects from air ion exposure have been reported, the evidence indicates that such exposures produce no significant or permanent effects on either humans or animals. Many observed effects may be attributed to insufficient control of experimental conditions and other factors. Among studies that reported some effects, there was no indication that the effects were harmful to humans or animals, even at exposure levels much greater than would be found within DC transmission line ROWs (EPRI 2010).

Studies to date have not associated proximity to DC transmission lines or their electric or magnetic fields with an increased risk in autism. Hypersensitivity to noise can be one of the concerns for some children with autism. Engineers take steps in the design of transmission lines to keep noise levels low by using larger or multiple conductors for each phase and hardware with smooth and curved surfaces. In fair weather, the audible noise from a transmission line at a few thousand feet and beyond would not be possible to measure in comparison to background levels. At that distance under rainy conditions, it would be very low as well, much less than the noise of falling rain or wind.

This section is not a comprehensive review of the entire body of evidence, and it excludes consideration of many other relevant published scientific studies. Scientific research utilizes epidemiology studies, animal models, and laboratory studies of basic mechanisms to scientifically evaluate a disease risk. At present there are no U.S. state government or federal government health-based limits established for electric and magnetic fields, and where the proposed Project is to be located, no states have any state-mandated electric and magnetic field limits.

3.4.11.2.3.2.7 Overview of DC Electrical Effects Research on Pacemakers and Implanted Medical Devices

Public concern has been expressed related to the electric and magnetic fields of HVDC transmission lines with the possibility of interference with cardiac pacemakers. Persons with implanted medical devices are constantly exposed to DC electric and magnetic fields from the earth's natural environment. The human body shields implanted medical devices from DC electric fields, protecting the device from naturally occurring electric field interference (EPRI 2012). Medical devices are also designed to withstand electrostatic discharge from DC electric fields. There is also constant exposure from the earth's static magnetic field, which is about 0.51G in the states encompassing Regions 1 through 7. Guidelines for occupational exposure suggest that DC electric field exposure should not exceed 5G for DC magnetic fields for workers with cardiac pacemakers (ACGIH 2010; ICNIRP 2009). The FDA also recommends a limit of 5G for MRI patients with pacemakers (FDA 1998). The potential for pacemaker interference from transmission line fields depends on the manufacturer, model, and implantation method, among other factors.

Other implanted medical devices can include a magnetic valve used in a cranial shunt. Typically, implanted medical devices such as this are set by the doctor within their office or medical facility using a static (DC) magnetic field tool to remotely adjust the valve settings on those implanted devices with adjustable magnetic valves. The presence of strong static (DC) magnetic fields, such as those associated with permanent magnets (such as refrigerator magnets or magnets used in toys), can potentially interact with the programmed settings of a cranial shunt. Patients exposed to stronger static magnetic fields from MRI machines can have even greater chances of interference with cranial shunts. According to some manufacturer's specifications (e.g., Medtronic 2012; Aesculap 2012; Codman 2006; and Sophyusa 2009, 2014), patients with cranial shunts should be able to undergo an MRI up to 3 Tesla (30,000,000mG or 30,000 Gauss) of static magnetic field without experiencing interference with their device. Studies have also been performed about static magnetic fields effects on programmable shunts that are produced by permanent magnets (Liu et al. 2005) and MRI machines (Shellock et al. 2007), as well as numerous other studies (e.g., Miwa et al. 2001; Utsuki et al. 2006; Zuzak et al. 2009; Anderson et al. 2004; Inoue et al. 2005).

Manufacturer's testing of magnetic valves focuses on static magnetic fields rather than on low level AC magnetic fields such as those produced by AC transmission lines. Because adjustable cranial shunts utilize a static magnetic field tool to remotely adjust the settings on the device, AC magnetic fields are not routinely considered for interference evaluation or testing (and testing is not required by the FDA). If low AC magnetic field levels did influence these types of devices, then common appliances (such as hair dryers, shavers, and other household devices) would also be of concern. Medical manufacturers have reported that AC magnetic fields have not caused interference with magnetic shunts (Medtronic 2012). As with any implanted medical device, the user should always consult with their doctor and the device manufacturer to determine safe operational parameters for use of their medical device.

Patients with implanted medical devices should observe certain precautions and need to discuss their treatment with their doctor or physician. In addition, there are a variety of different medical devices that are constantly evolving and changing. It is also impossible to quantify all of the various types of magnetic field sources encountered in people's day-to-day lives. The potential for interference to implanted devices may depend upon a variety of different parameters, including the device manufacturer, model and setting, and implantation method, among other factors. Typically implanted medical devices are set specifically for an individual by their doctor or physician within the doctor's office or medical facility. As with any implanted medical device, the user should always consult with their doctor and the device manufacturer to determine safe operational parameters for use of their specific medical device and associated medical condition.

Medical equipment certified by the U.S. Food and Drug Administration must pass rigorous electromagnetic compatibility testing to gain approval. These assessments allow manufacturers to evaluate the compatibility performance of a medical device and demonstrate that the product achieves an appropriate level of electromagnetic immunity in environments that patients may encounter. These EMF levels are much higher than the Project would produce. For example, for DC magnetic fields, international protocols for implantable cardiac pacemakers, implantable defibrillators and other devices calls for evaluation of static DC magnetic fields up to 1 mT (10,000 mG) (ISO 2012). Three of the major manufacturers of implantable medical devices recommend similar limits for static magnetic field (Medtronic 2013; Boston Scientific 2015; St. Jude Medical 2014).

By comparison, the calculated EMF levels from the proposed transmission lines would be well below these manufacturer's device levels outside the ROW. Within the ROW, calculated DC magnetic fields are also below these levels (> 770 mG). These manufacturers do not cite recommended levels for DC electric field because DC electric fields do not induce internal current on the leads of medical devices. In addition, electric fields are very easily shielded. Electric fields would generally be shielded levels (i.e., lower levels) except directly underneath the line in open areas. For example, the metallic body of the vehicle would provide electric field shielding for occupants inside the vehicle.

Over the past decade or so, major manufacturers of pacemakers and other implantable medical devices have designed these devices to provide shielding and improved filtering from the different types of EMF that arise from many sources in our daily environments. Modern pacemakers are designed to filter out peripheral electrical signals and these electrical filters increase the pacemaker's ability to distinguish extraneous signals from legitimate cardiac signals. In addition, most of the pacemaker circuitry is enclosed within a metallic case that shields the device from external EMF. Based on all of these factors, no interference with medical devices would be expected due to EMF from the Project.

Some types of implanted medical devices (such as metallic stents, joint/metal replacements, etc.) do not incorporate electronic or electrical circuits and do not require power to operate. To date, no adverse interactions related to EMF exposure and metallic implants have been reliably reported or documented.

Hearing aids are another type of medical device used by people. Older hearing aids are analog and amplify all sounds in the same way. Digital hearing aids convert sound waves into digital signals using computer chips with complex amplification processing, and are the most popular form of hearing aid today (FDA 2015a). Digital hearing aids operate within a frequency range of 250Hz–8kHz. For the Project HVDC transmission line, DC magnetic field levels would be comparable to the earth's natural static magnetic field and should not create an interference issue.

In summary, implanted medical devices are shielded by the body from DC electric fields, but even so, the DC magnetic field, even under the line, is too weak to potentially affect the operation of pacemakers and other implanted medical devices.

3.4.11.2.3.2.8 Overview of DC Electrical Effects Research on Plant and Animal Health

Research has been conducted to determine whether exposure to static DC has environmental effects on plant or animal life. Studies have examined the effect of static electric and magnetic field exposure on plant species and found no adverse effects due to DC electric and magnetic field exposure. Studies on some groups of animals also did not find any effect due to DC electric or magnetic fields. The following discussions report on various study results concerning DC electrical effects and their conclusions:

- A 1988 agricultural study performed by Oregon State University monitored beef cattle and crops near the 500kV DC Pacific Intertie transmission line in central Oregon. Researchers established simulated farming and ranching conditions directly under the transmission line and at an identical site 2,000 feet away. For the study, cattle were bred for three seasons, wheat and alfalfa was raised for 2 years, and data from the two sites were then compared. The cattle showed no differences in any health-related measures, including food and water consumption, growth, reproduction, disease, and death rate. Similarly, the wheat and alfalfa grown at the two sites showed no significant differences in growth, yield, or quality (Raleigh 1988).
- The University of Minnesota used records from the Dairy Herd Improvement Association to study the health and productivity of approximately 500 dairy herds—about 24,000 cows—located near a 400kV DC transmission Line

in Minnesota. Researchers examined records from three years before to three years after energization of the transmission line. Herd health and productivity were unchanged over this time, regardless of proximity to the line (Martin et al. 1983).

- Domestic animals grazing near transmission lines are subject to potentially higher levels of DC electric and magnetic field exposure than large game species. Successive offspring of cattle exposed to a 500kV DC transmission line also showed no adverse effects (Angell et al. 1990). No effect was observed in the reproduction of cows and sheep exposed under relatively controlled conditions (Lee et al. 1996).
- A study on cattle and deer herds reported that the animals preferentially aligned themselves along the geomagnetic axis (Begall et al. 2008). Satellite images were used to obtain alignment data for herds over various regions of the earth. A second study (Burda et al. 2009) reported this alignment was disrupted for herds near AC transmission lines. However, a third research group (Hert et al. 2011) was unable to confirm the results using the same satellite-based images. Two different statistical evaluation methods (one evaluation method tried to replicate the original study and the second tried an improved method) did not replicate the same findings.
- A variety of animals can perceive and use the earth's DC magnetic field including birds. The results of decades of homing and migration studies indicate that this is a very complex topic and the mechanisms involved are not yet completely understood (Beason 2005). Different species of birds have different migration patterns (e.g., nocturnally, diurnally, or both) and it appears that there are numerous factors that are used during migration (e.g., landmarks, wind direction, sun, stars, geomagnetism, polarized light). It is now widely accepted that birds have numerous navigational-type problem solving mechanisms available and are capable of using a multiplicity of environmental information for orientation purposes (Southern 1988). One study has shown that higher frequency magnetic fields (50kHz–20MHz) can disrupt the internal magnetic compasses and disorient migratory birds, and birds shielded from these frequencies (but not the earth's field) regained their orientation (Morrison 2014). Since the HVDC transmission line's magnetic field at 1 meter above ground level is comparable to the earth's natural magnetic field (a maximum calculated DC magnetic field from the Project transmission line of about 763mG at 1 meter above ground level versus 510mG for the earth's field), and because distance both farther above and also away from the transmission line would also reduce the DC magnetic field, effects on migratory patterns of birds is not anticipated. Even if the transmission line DC magnetic field were to cause some localized disorientation directly near the line, birds have numerous other environmental factors to use for orientation.

This section provides a review of many of the relevant scientific studies that have been published and is not meant to be a comprehensive review of the entire body of evidence (many other scientific studies have been performed). Based upon a comprehensive review of the scientific literature, the association between DC magnetic fields and adverse effects to plant life and animal health is weak. Overall, studies of DC transmission line environments and DC electric and magnetic fields indicate that the field levels associated with the Project would be unlikely to pose a threat to animals and plants.

3.4.11.2.3.2.9 Grounding and Stray Voltage for DC Fields

For HVDC transmission lines, electric and magnetic fields are static (unchanging). Therefore, electric currents are not induced in conductive objects as they would be near AC transmission lines with alternating fields. For electric fields, an electrical charge can build up on the surface of ungrounded or poorly grounded objects. For example, it is a common occurrence that someone receives a small shock (a discharge of built-up static body voltage) when touching a doorknob after walking across a carpet. Therefore, ungrounded objects within the transmission line ROW may build up a static charge, which is discharged when a path to ground is introduced (such as a person touching an ungrounded object with static charge). The perceived shock (discharge) may range from no sensation to barely perceptible to minor "carpet type" shock, depending upon the quality of grounding (i.e., ground resistance) and the amount of built-up charge on the object (i.e., size of the object) (EPRI 1978). Metal buildings and fences on or adjacent to high voltage transmission line easements are routinely grounded during construction to prevent this occurrence. Also, automobiles, trucks, and farming equipment do not typically accumulate a significant electrical charge since the "carbon black" component in tires is electrically conductive and allows charges to flow to ground, thereby preventing the accumulation of electrical charges on vehicles.

For magnetic fields, the current in the transmission line conductors will create a static magnetic field comparable to the earth's natural magnetic field. Therefore, DC magnetic fields will not create grounding, induced current, or stray voltage issues.

Electric transmission lines can often share utility corridors with pipelines. In these situations, transmission line electrical effects are generally analyzed so that measures can be taken to control the induced voltage on a pipeline to meet the National Association of Corrosion Engineers guideline (NACE 2007). If an electric transmission line route parallels a pipeline, engineers for the Applicant would conduct field investigations to determine any potential safety issues or other design requirements that may result from the presence of the pipeline. The Project would then address those requirements as a part of the detailed transmission line design, including consultation with the pipeline company to determine design requirements specifically related to the presence and location of the pipeline.

Ground return currents are more prevalent on pipelines near HVDC transmission lines whenever the line is operated in a unipolar configuration (using the earth as a path for return current) than in a bi-polar configuration (using dedicated conductors as a path for return current). The Project is designed to operate in a bipolar configuration and also includes a dedicated metallic conductor return configuration in lieu of a ground electrode or earth return system. An HVDC system requires a complete return path for the current. In bi-polar operation, this is accomplished by the current flowing down one pole and returning via the opposite pole in balanced normal operation. However, when one set of pole conductors is not available due to the electrical failure of that pole or maintenance, the current must have a return path for the line to remain in service, which is accomplished through a smaller set of conductors identified as the dedicated metallic return conductors. These conductors would be of sufficient size to carry full load current during any outage of one set of pole conductors and would also accommodate any imbalance in current during normal operation. The dedicated metallic return conductors are located on the transmission structure. During bipolar operation, ground return currents are negligible (Maruvada 2000).

Engineering constraints and obstructions, including oil and gas infrastructure, are also commonly encountered and routinely dealt with during the routing and engineering design processes for electric transmission lines. Oil and gas wells have been identified within the 1,000-foot-wide ROI. In addition, the Applicant has confirmed that, based on current information, there are no existing oil and gas wells or well pads within the 200-foot-wide HVDC ROW, and that future development of wells will not be adversely affected. Although HVDC transmission lines may cause pipeline and well casing corrosion due to stray electric current (by utilizing the earth for transmission/return currents), the Project's dedicated metallic-return design eliminates the risk of stray voltage during operations. The Applicant also stated that there is minimal risk of interference with electronic equipment (since this type of equipment operates at greater frequencies than 60Hz and there are no well pads within the ROW that would utilize this equipment). The transmission line would be designed using adequate minimum clearances so as to not restrict the movement of oilfield equipment, such as drilling rigs, workover rigs, vacuum tracks, tank trucks, and other equipment necessary to operate the oil field facilities. EPM GE-29 states that "Clean Line will work with landowners and operators of oil and gas wells, utilities, and other infrastructure to identify and verify the location of facilities and to minimize adverse impacts. Identification may include use of the One Call system and surveying of existing facilities."

3.4.11.2.3.2.10 Summary of Impacts for the HVDC Transmission Line

Based on an evaluation of research and guidelines recommended by various agencies, it is unlikely that the proposed HVDC transmission line would pose a known threat to human health (see Section 3.4.11.2.3.2.6) along the Applicant Proposed Route. Calculated DC electric fields are above non-regulatory standards for some configurations and operating conditions within the ROW (depending upon ROW width). However, DC electric fields do not induce internal currents on the leads of medical devices. DC magnetic fields on the ROW would be below the levels the manufacturers' cite as capable of affecting the operation of these devices. Persons who are concerned should contact their physician to ascertain the immunity of their medical device to this potential source of interference.

3.4.11.2.3.3 Decommissioning Impacts

No electrical effects would be associated with the decommissioning of the ±600kV HVDC transmission line. Once decommissioned, no electrical energy would be generated that would create electrical effects such as electric and magnetic fields, audible noise, or radio and television interference.

3.4.11.3 Impacts Associated with the DOE Alternatives

This section describes the electrical effects associated with the DOE Alternatives, which includes the Arkansas converter station, the AC transmission line interconnection associated with it, a new substation, and the HVDC alternative routes. Electrical effects would only be present during operation and maintenance of these facilities. Electrical facilities need to be energized to create electrical effects such as electric and magnetic fields, audible noise, and radio and television interference. Electrical effects would not be present during the construction and decommissioning phases of the Project.

Table 3.4-41 presents a summary of the number of existing building structures (residences, agricultural buildings, churches, and schools) within a 1,000-foot-wide corridor for the interconnection route. Currently, no AC transmission lines or communication facilities exist within the siting area.

Table 3.4-41:
Occurrence of Existing Facilities along DOE Alternative Converter Station and AC Interconnection Siting Area

DC Transmission Interconnection Route	Parallels Existing AC Transmission Lines (Quantity and Voltage Range)	Existing Building Structures within 1,000-Foot-Wide Corridor (Residential/Agricultural/Church/ School)[1]	Existing Communication Facilities Within 1,000-Foot-Wide Corridor (Quantity and Type)[2]
Arkansas	0	38/28/1/0	0

1 GIS Data Source: Clean Line (2013a, 2013b), Tetra Tech (2014a)
2 GIS Data Source: FCC (2012)

3.4.11.3.1 Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area

3.4.11.3.1.1 Construction Impacts

No electrical effects would be associated with construction of the Arkansas converter station, because the converter station would not be energized during construction. Electrical facilities need to be energized to create electrical effects such as electric and magnetic fields, audible noise, or radio and television interference.

A new substation will also be constructed where the 500kV AC interconnection line taps the existing Arkansas Nuclear One-Pleasant Hill 500kV line. No electrical effects would be associated with construction of this new substation because the substation would not be energized during construction. Electrical facilities need to be energized to create electrical effects such as electric and magnetic fields, audible noise, or radio and television interference.

3.4.11.3.1.2 Operations and Maintenance Impacts

For the Arkansas converter station and the new substation (where the 500kV AC interconnection line taps the existing Arkansas Nuclear One-Pleasant Hill 500kV line), the dominant sources of electrical effects are the overhead transmission lines entering and exiting the stations. Some types of substation and switching station equipment can potentially be a source of electrical effects (e.g., power transformers can produce audible noise; converter equipment can produce radio noise, etc.). These effects can be reduced or eliminated by the use of filtering equipment, sound walls, and other methods. Because the dominant sources of electrical effects are associated with the overhead transmission lines, an evaluation of electrical effects for the proposed Arkansas converter station and new substation was therefore not performed, except for audible noise as described in Section 3.11.6.

There are two different 500kV AC transmission line configurations associated with the interconnection into the Arkansas converter station. Both line designs are single circuit configurations (i.e., one circuit supported on a single structure). The monopole design is supported on a tubular pole, while the other design is a single circuit supported on a lattice structure. Each transmission line configuration is located within a 150-foot-wide to 200-foot-wide ROW (actual ROW width has not yet been determined). Proposed loading for these lines is 300MW (346 amperes) for average loading and 500MW (577 amperes) for maximum loading. Figures 3.4-40 and 3.4-41 present dimensioned drawings of the two representative 500kV AC transmission line configurations.

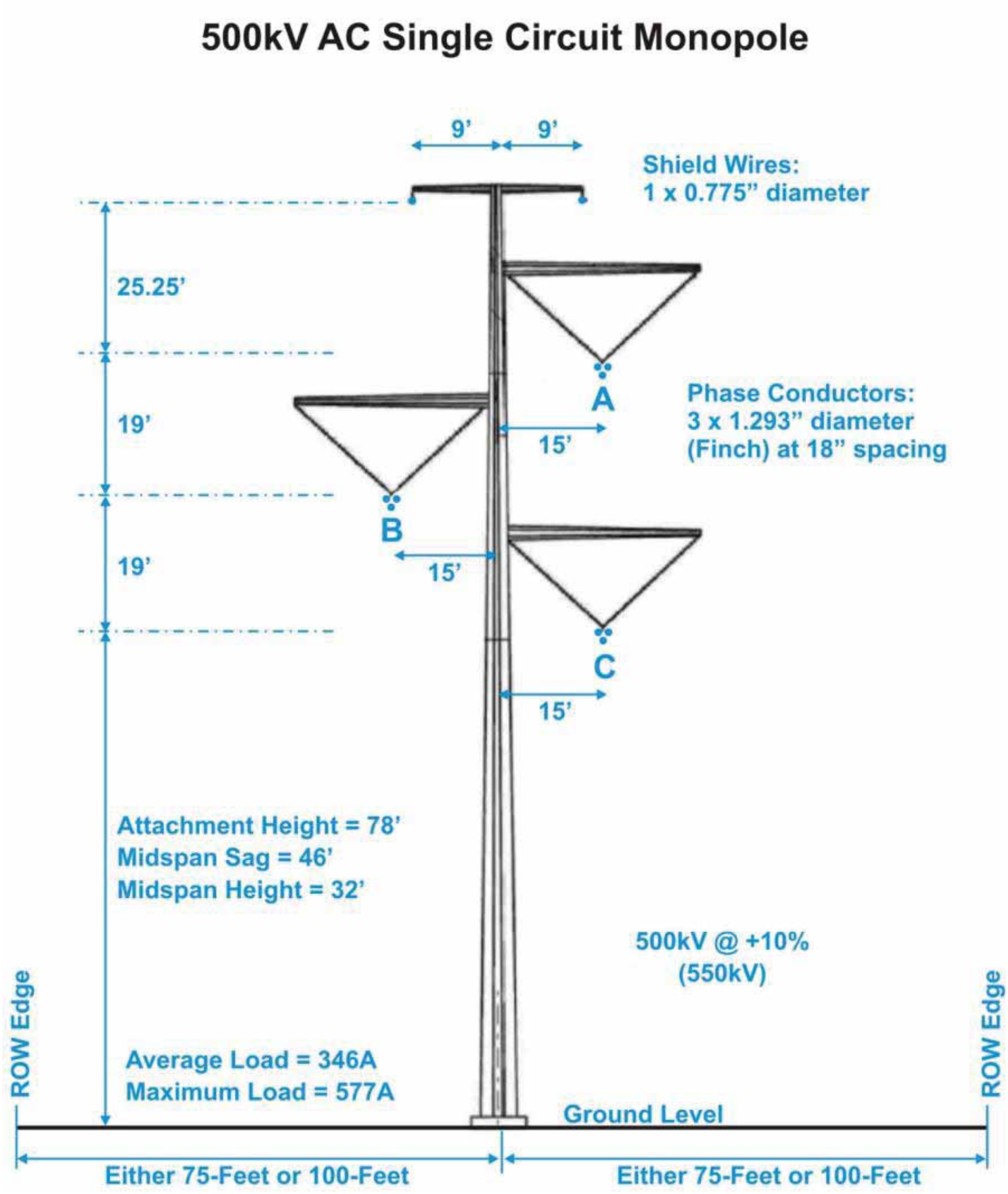


Figure 3.4-40: 500kV AC Transmission Line Single Circuit Monopole Configuration for Interconnection to Arkansas Converter Station

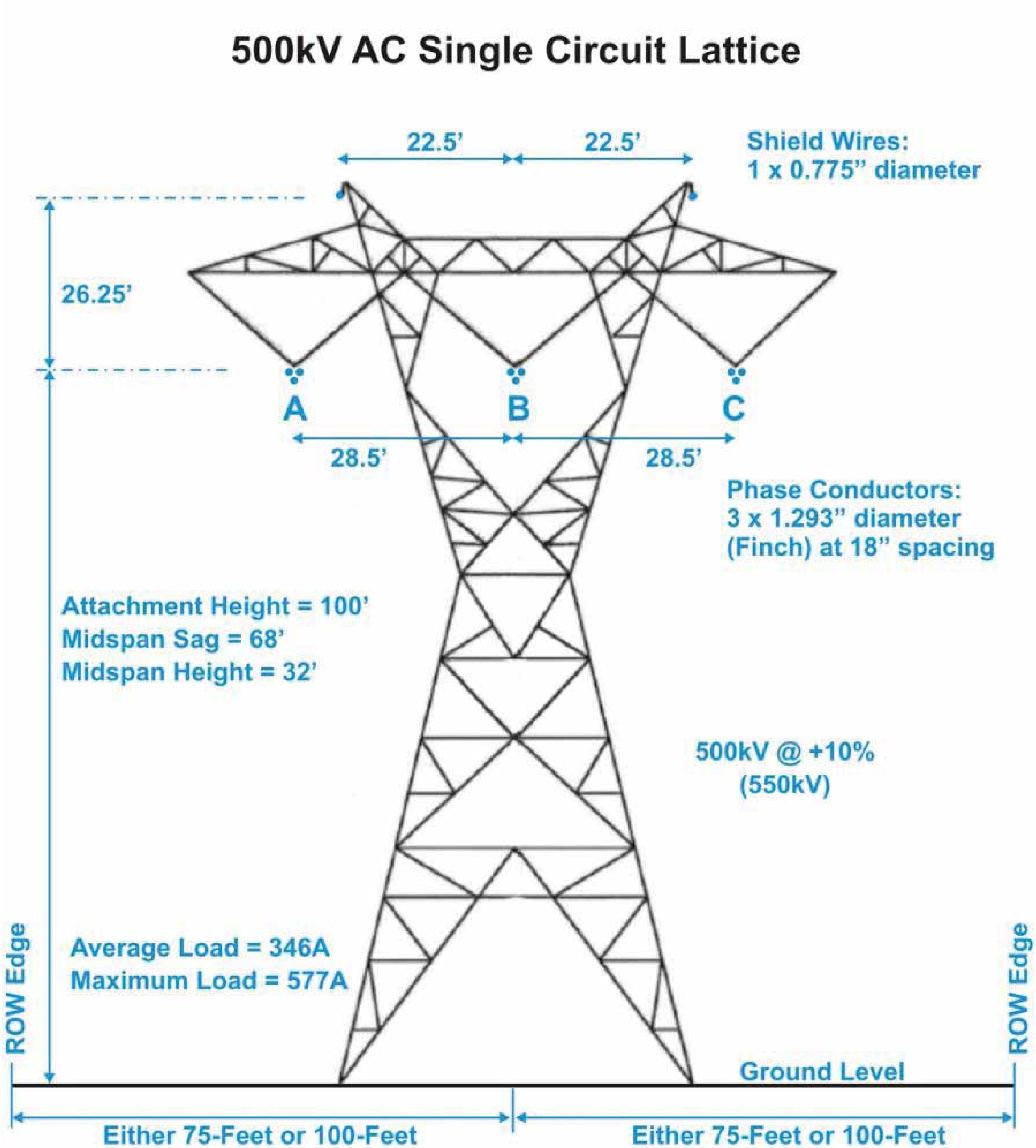


Figure 3.4-41: 500kV AC Transmission Line Double Single Lattice Tower Configuration for Interconnection to Arkansas Converter Station

3.4.11.3.1.2.1 AC Electric Field Calculation Results

AC electric field calculations were performed for the two transmission line configurations. Table 3.4-42 presents a summary of the calculated electric field at the ROW edges and for the maximum field within the ROW. Because the ROW width has not yet been determined, ROW edge values are provided for both possible edge locations (either 75 feet or 100 feet from the transmission centerline). Calculated field levels vary, depending upon the line configuration. Figure 3.4-42 presents a graph of the calculated AC electric field for each line configuration.

Table 3.4-42:
Calculated AC Electric Field Values for AC Transmission Line Interconnections to Arkansas Converter Station

500kV AC Transmission Line Configuration	Calculated AC Electric Field (kV/m)[1]				
	-100 Feet from CL	-75 Feet from CL	Maximum on ROW	+75 Feet from CL	+100 Feet from CL
Single Circuit Monopole	1.1	1.9	10.0	1.5	0.9
Single Circuit Lattice	1.4	3.1	10.2	3.1	1.4

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300-feet on either side of a representative centerline.

1 Edges of the ROW have not been established and are assumed to be either 75 feet or 100 feet from centerline.

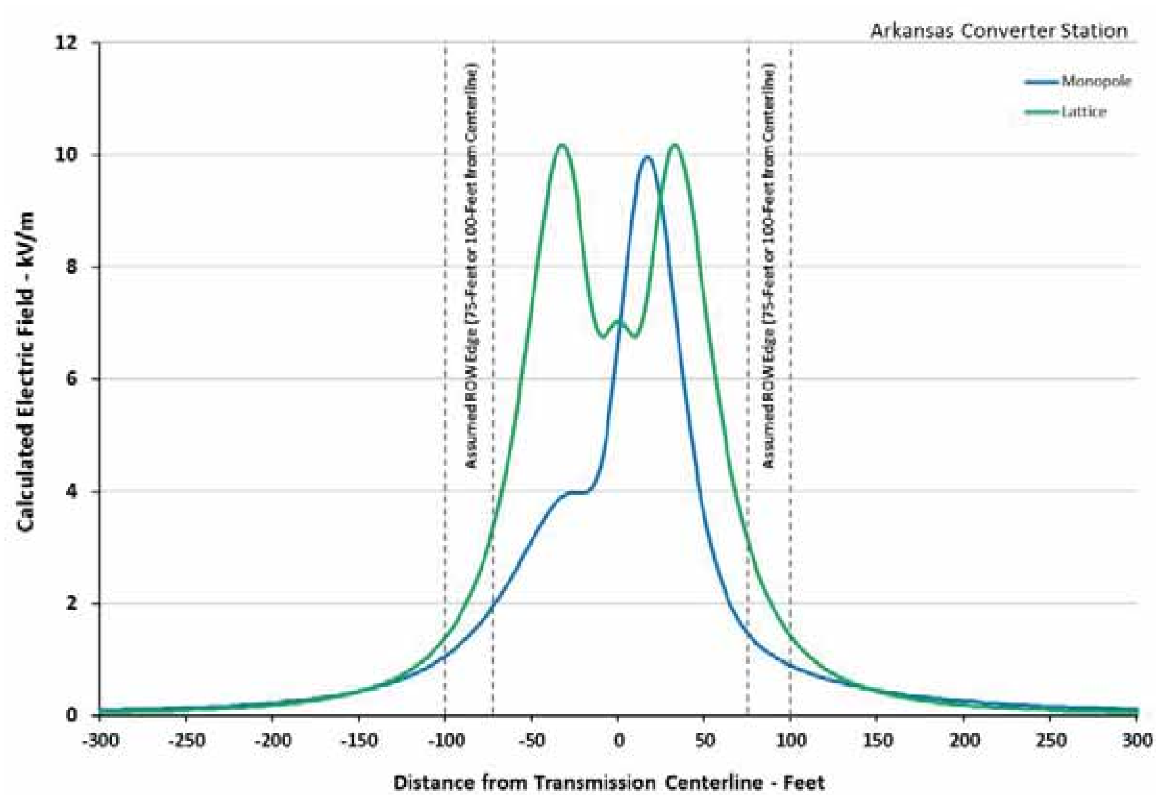


Figure 3.4-42: Calculated AC Electric Fields for 500kV AC Transmission Line Interconnections to Arkansas Converter Station

Calculated electric field levels at the ROW edges (either 75 feet or 100 feet from centerline of the transmission line) for all of the AC transmission line interconnections are below the ICES and ICNIRP guidelines for public exposure (5kV/m and 4.2kV/m respectively). Within the ROW, calculated electric field levels are slightly higher than the ICES guideline of 10kV/m for the single circuit lattice tower configuration. For both configurations, calculated electric field levels exceed the ACGIH guideline of 1kV/m for workers with implanted medical devices within the ROW and at most ROW edges.

3.4.11.3.1.2.2 AC Magnetic Field Calculation Results

AC magnetic field calculations were performed for the two transmission line configurations under two different loading conditions (average and maximum loading of 300MW [346 amperes] and 500MW [577 amperes] respectively). Table 3.4-43 presents a summary of the calculated magnetic field at the ROW edges and for the maximum field within the ROW. Calculated field levels vary, depending upon the line configuration and loading conditions. Figure 3.4-43 presents a graph of the calculated AC magnetic field for each line configuration under average and maximum loading conditions.

Table 3.4-43:
Calculated AC Magnetic Field Values for 500kV AC Transmission Line Interconnections to Arkansas Converter Station

500kV AC Transmission Line Configuration	Calculated AC Magnetic Field (mG) for Average/Maximum Load[1]				
	-100 Feet from CL	-75 Feet from CL	Maximum on ROW	+75 Feet from CL	+100 Feet from CL
Single Circuit Monopole	7.9/13.2	12.1/20.1	50.5/84.2	14.5/24.2	9.0/15.0
Single Circuit Lattice	11.1/18.5	19.4/32.4	78.9/131.6	19.6/32.7	11.3/18.8

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300 feet on either side of a representative centerline.
1 Edges of the ROW have not been established and are assumed to be either 75 feet or 100 feet from centerline.

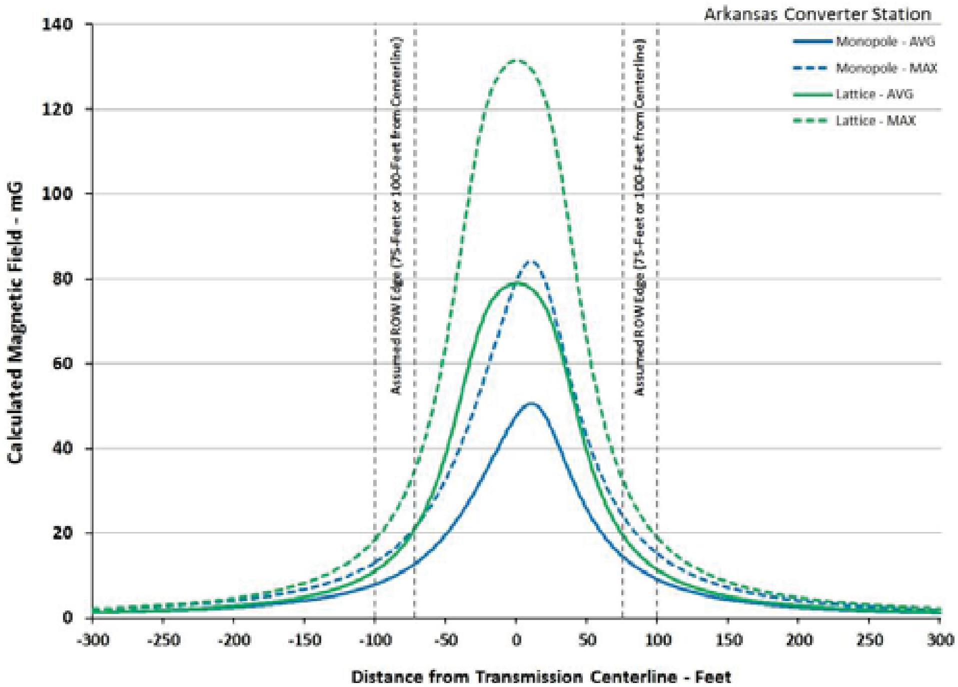


Figure 3.4-43: Calculated AC Magnetic Fields for 500kV AC Transmission Line Interconnections to Arkansas Converter Station (Average and Maximum Loading)

Calculated magnetic field levels at the ROW edges for both AC transmission line interconnection designs are below the ICES and ICNIRP guidelines for public exposure (9,040mG and 2,000mG, respectively). Calculated magnetic field levels within the ROW are also below the ACGIH guideline of 1,000mG for workers with implanted medical devices for both configurations.

3.4.11.3.1.2.3 AC Audible Noise Calculation Results

Audible noise calculations were performed for both AC transmission line interconnection designs. Table 3.4-44 presents a summary of the calculated day-night (L_{dn}) audible noise at the ROW edges and for the maximum noise level within the ROW. Calculated levels vary, depending upon the line configuration. Figure 3.4-44 presents a graph of the calculated audible noise for each AC transmission line configuration.

Table 3.4-44:
Calculated Audible Noise for 500kV AC Transmission Line Interconnections to Arkansas Converter Station

500kV AC Transmission Line Configuration	Calculated Audible Noise (dBA)—L_{dn}[1]				
	-100 Feet from CL	-75 Feet from CL	Maximum on ROW	+75 Feet from CL	+100 Feet from CL
Single Circuit Monopole	54.8	55.8	58.4	56.3	55.3
Single Circuit Lattice	56.7	57.8	60.2	57.8	56.7

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300 feet on either side of a representative centerline.

1 Edges of the ROW have not been established and are assumed to be either 75 feet or 100 feet from centerline.

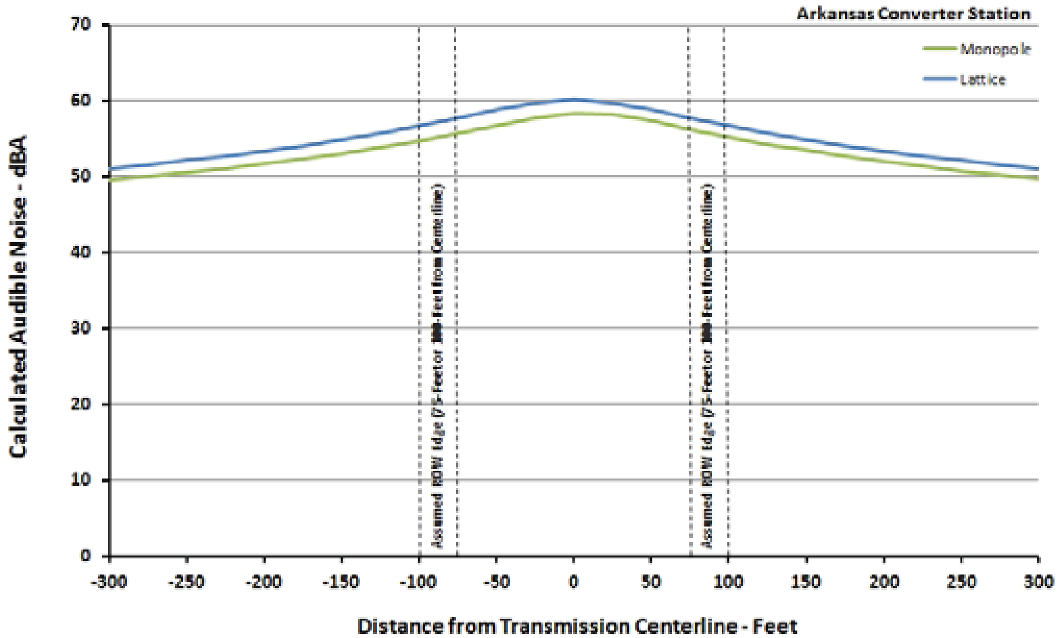


Figure 3.4-44: Calculated Audible Noise Levels (L_{dn}) for 500kV AC Transmission Line Interconnections to Arkansas Converter Station

Calculated audible noise levels at the ROW edges (either 75 feet or 100 feet from centerline of the transmission line) for both AC transmission line interconnections are at or above the EPA guideline for L_{dn} (day-night) noise of 55 dBA (the monopole configuration is just under the EPA guideline at 54.8 dBA for one ROW edge at 100 feet from centerline). Calculated audible noise levels assume an overvoltage condition of 10 percent at the highest line elevation (3,000 feet).

3.4.11.3.1.2.4 AC Radio Noise Calculation Results

Radio noise calculations were performed for both AC transmission line interconnection designs for rainy and fair weather conditions. Table 3.4-45 presents a summary of the calculated radio noise at the ROW edges and for the maximum noise within the ROW at 500kHz for both weather conditions. Table 3.4-45 also presents calculated 500kHz radio noise at 50 feet from the outside conductor for comparison with the IEEE Standard. Calculated radio noise levels vary, depending upon the line configuration and weather conditions. As shown in Table 3.4-45, calculated radio noise levels at 50 feet from the outside conductor comply with the IEEE 61 dB:V/m threshold in fair weather conditions. Figure 3.4-45 presents a graph of the calculated radio noise levels for each AC line configuration in rainy weather, adjusted to the 500kHz reference level. Figure 3.4-46 presents a corresponding graph of the calculated radio noise levels for fair weather (adjusted to the 500kHz reference level).

Table 3.4-45:
Calculated Radio Noise for 500kV AC Transmission Line Interconnections to Arkansas Converter Station

500kV AC Transmission Line Configuration	Calculated Radio Noise (dB:V/m) at 500kHz (Rainy/Fair Weather)[1]						
	-100 Feet from CL	-50 Feet from Outside Conductor	-75 Feet from CL	Maximum on ROW	+75 Feet from CL	+50 Feet from Outside Conductor	+100 Feet from CL
Single Circuit Monopole	65.3/48.3	71.3/54.3	69.5/52.5	85.9/68.9	69.9/52.9	72.5/55.5	65.8/48.8
Single Circuit Lattice	65.8/48.8	71.0/54.0	71.9/54.9	88.1/71.1	71.9/54.9	71.0/54.0	65.8/48.8

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300 feet on either side of a representative centerline.

1 Edges of the ROW have not been established and are assumed to be either 75 feet or 100 feet from centerline

It is difficult to determine whether the radio noise produced by a transmission line or any other source would cause unacceptable interference without knowing broadcast signal strengths at various locations of interest along the possible line routes.

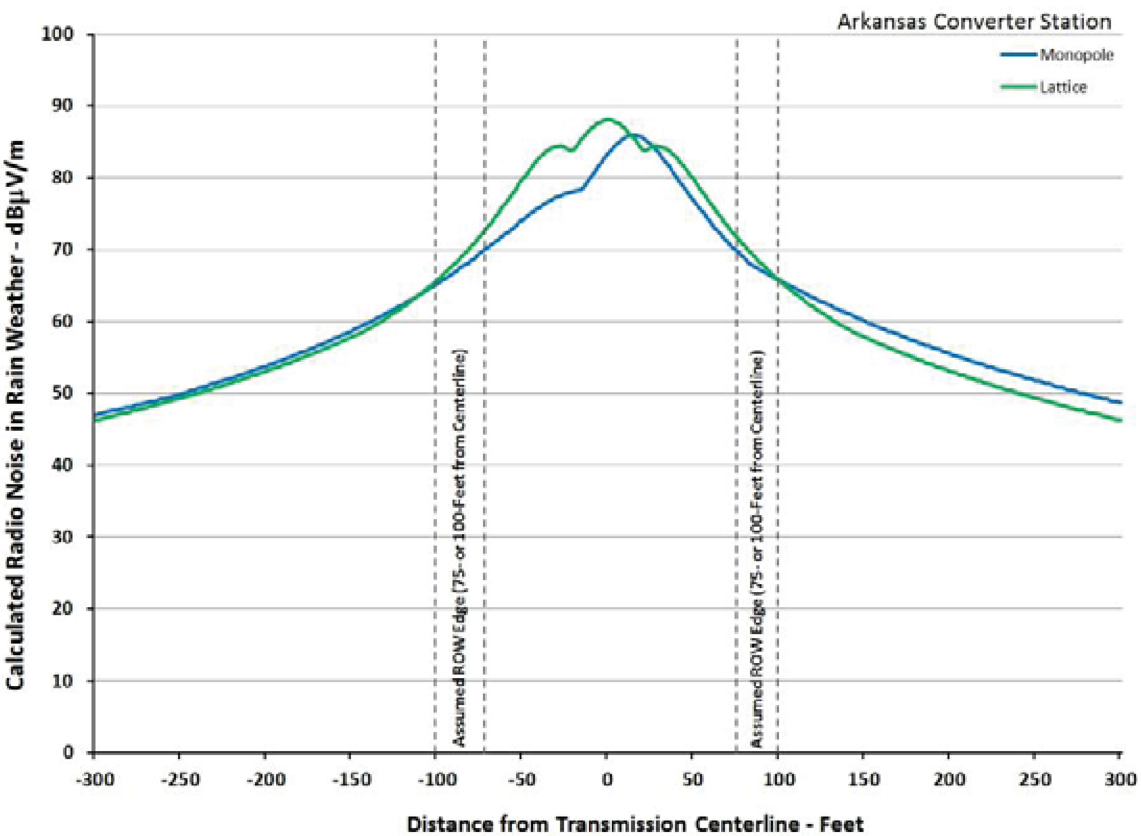


Figure 3.4-45: Calculated Radio Noise for 500kV AC Transmission Line Interconnections to Arkansas Converter Station (Rainy Weather)

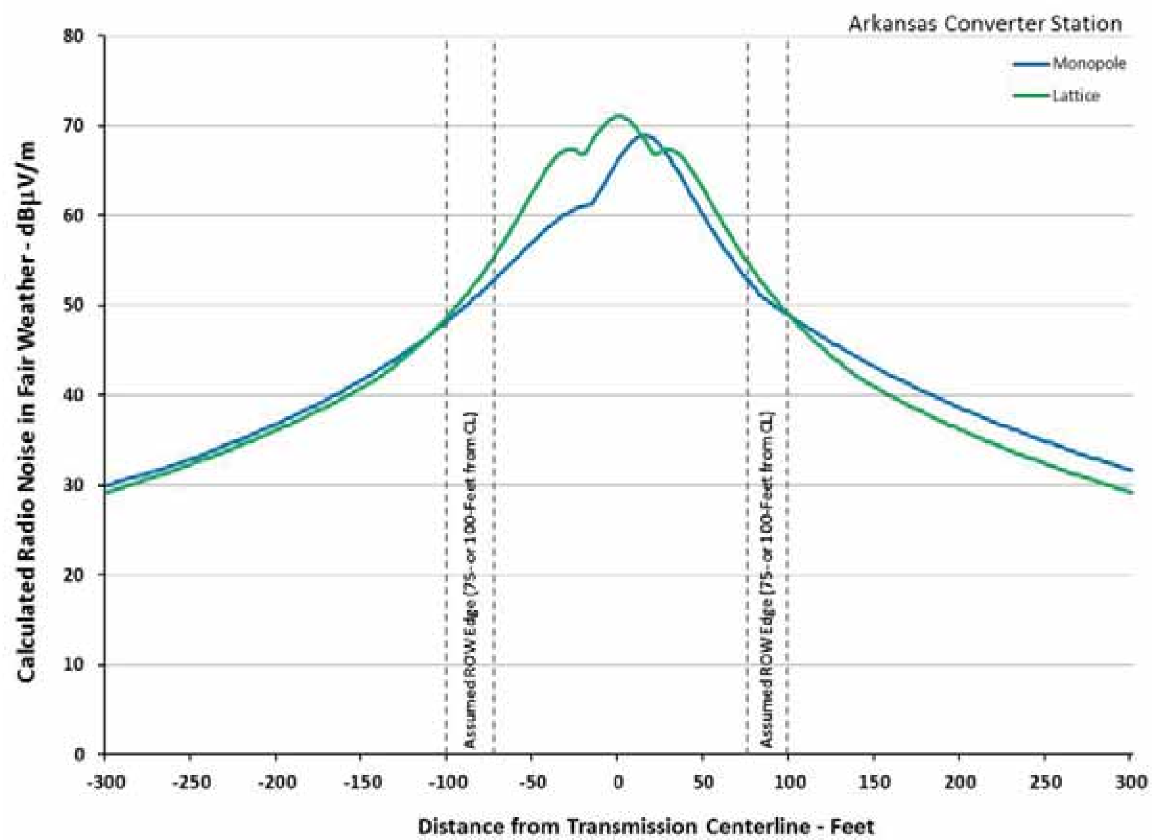


Figure 3.4-46: Calculated Radio Noise for 500kV AC Transmission Line Interconnections to Arkansas Converter Station (Fair Weather)

3.4.11.3.1.2.5 AC Television Noise Calculation Results

Television noise calculations were performed for both AC transmission line interconnections for rainy weather conditions. Table 3.4-46 presents a summary of the calculated television noise at the ROW edges and for the maximum noise within the ROW for the 75MHz reference level. Calculated television noise levels vary, depending upon the line configuration. Figure 3.4-47 presents a graph of the calculated television noise levels for each AC line configuration in rainy weather.

Table 3.4-46:
Calculated Television Noise for 500kV AC Transmission Line Interconnections to Arkansas Converter Station

500kV AC Transmission Line Configuration	Calculated Television Noise (dB:V/m) at 75MHz for Rainy Weather[1]				
	-100 Feet from CL	-75 Feet from CL	Maximum on ROW	+75 Feet from CL	+100 Feet from CL
Single Circuit Monopole	23.9	25.9	38.3	29.1	26.4
Single Circuit Lattice	27.2	29.5	40.5	29.5	27.2

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300 feet on either side of a representative centerline.

1 Edges of the ROW have not been established and are assumed to be either 75 feet or 100 feet from centerline.

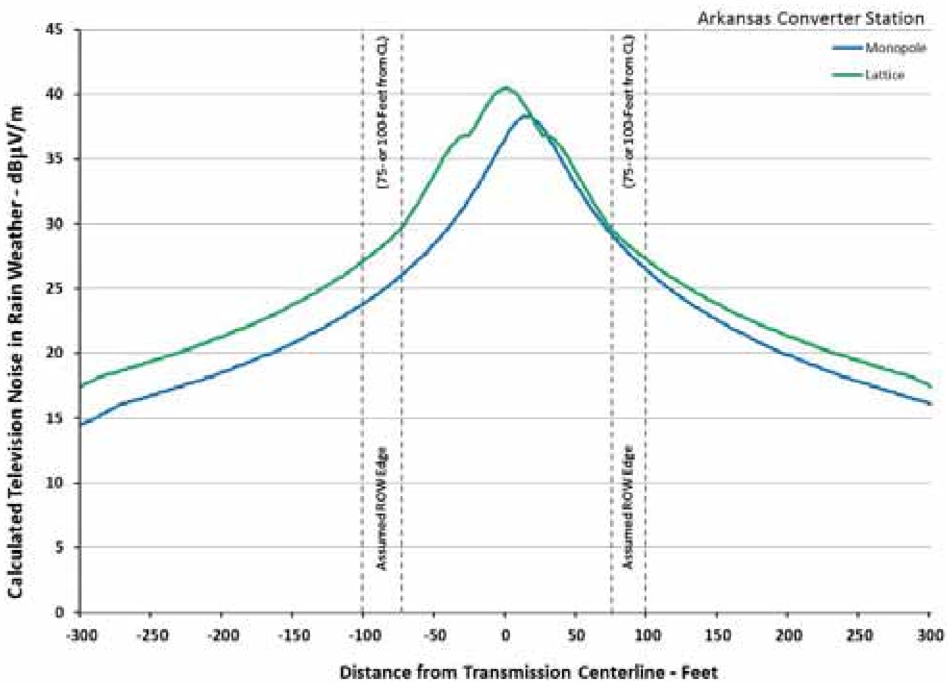


Figure 3.4-47: Calculated Television Noise for 500kV AC Transmission Line Interconnections to Arkansas Converter Station (Rainy Weather)

As with radio noise interference, it is difficult to determine whether the television noise level produced by a transmission line would cause unacceptable interference. However, the new digital broadcast system technology for radio and television should provide better coverage and immunity to transmission line noise than analog television signals. No interference resulting from corona-generated noise would be expected for digital signals broadcast at frequencies above 1GHz from satellites (EPRI 2006a).

3.4.11.3.1.2.6 Ozone Calculation Results

Ozone levels for both AC transmission line interconnections were calculated for rainy weather conditions. Table 3.4-47 presents a summary of the calculated maximum ozone concentrations at ground level within 300 feet of the transmission centerline. Maximum ozone levels are far below the EPA standard of 75 ppb for all three line design configurations.

Table 3.4-47:
Calculated Ozone Levels for 500kV AC Transmission Line Interconnections to Arkansas Converter Station

500kV AC Transmission Line Configuration	Calculated Ozone (ppb)
	Maximum within +/-300 Feet of CL
Single Circuit Monopole	0.1
Single Circuit Lattice	0.2

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300 feet on either side of a representative centerline.

3.4.11.3.1.3 Decommissioning Impacts

There are no electrical effects associated with the decommissioning of the Arkansas converter station, the 500kV AC transmission line interconnections, or the new substation. Once decommissioned, there would be no electrical energy to create electrical effects such as electric and magnetic fields, audible noise, and radio and television interference.

3.4.11.3.2 HVDC Alternative Routes

This section describes the electrical effects associated with the HVDC alternative routes. Electrical effects would only be present during operation and maintenance of the transmission line. Electrical facilities need to be energized to create electrical effects such as electric and magnetic fields, audible noise, and radio and television interference. Electrical effects would not be present during the construction and decommissioning phases of the Project.

Existing facilities are present within these alternative transmission line routes, some of which already create electrical effects within the environment. Table 3.4-48 presents the number of existing AC transmission lines that parallel alternative HVDC transmission line routes as well as nearby communication facilities (which are existing radio-frequency sources) within a 1,000-foot-wide corridor for each proposed route alternative. Table 3.4-48 also presents a summary of the number of existing building structures (residences, agricultural buildings, churches, and schools) within the same 1,000-foot-wide corridor for each HVDC transmission line alternative route.

Table 3.4-48:
Occurrence of Existing Facilities along HVDC Alternative Routes

HVDC Alternative Route	Parallels Existing AC Transmission Lines (Quantity and Voltage Range)	Existing Building Structures within 1,000-Foot-Wide Corridor (Residential/ Agricultural/Church/School)[1]	Existing Communication Facilities Within 1,000-Foot-Wide Corridor (Quantity and Type)[2]
Region 1			
Alternative Route 1-A	2 (115-345kV)	7/38/1/0	1 (PM)
Alternative Route 1-B	2 (69-345kV)	3/15/0/0	0
Alternative Route 1-C	1 (69kV)	6/16/0/0	0
Alternative Route 1-D	1 (69kV)	9/12/0/0	0
Region 2			
Alternative Route 2-A	1 (115kV)	5/6/0/0	0
Alternative Route 2-B	1 (115kV)	2/10/0/0	0
Region 3			
Alternative Route 3-A	0	13/13/0/0	0
Alternative Route 3-B	1 (69kV)	26/29/0/0	0
Alternative Route 3-C	6 (115-161kV)	102/69/0/0	5 (CM, AS)
Alternative Route 3-D	3 (115-161kV)	40/8/0/0	0
Alternative Route 3-E	4 (69-161kV)	20/0/0/0	0
Region 4			
Alternative Route 4-A	1 (69kV)	103/77/0/0	0
Alternative Route 4-B	1 (69kV)	107/89/0/0	0
Alternative Route 4-C	0	6/0/0/0	0
Alternative Route 4-D	0	67/54/1/0	0
Alternative Route 4-E	4 (161kV)	61/40/0/0	4 (MT)

Table 3.4-48:
Occurrence of Existing Facilities along HVDC Alternative Routes

HVDC Alternative Route	Parallels Existing AC Transmission Lines (Quantity and Voltage Range)	Existing Building Structures within 1,000-Foot-Wide Corridor (Residential/ Agricultural/Church/School)[1]	Existing Communication Facilities Within 1,000-Foot-Wide Corridor (Quantity and Type)[2]
Region 5			
Alternative Route 5-A	0	19/15/0/0	0
Alternative Route 5-B	2 (138-500kV)	54/55/1/0	2 (PM)
Alternative Route 5-C	0	11/3/0/0	0
Alternative Route 5-D	1 (500kV)	50/8/0/0	2 (PM, AS)
Alternative Route 5-E	2 (138-500kV)	24/15/1/0	0
Alternative Route 5-F	2 (138-500kV)	20/8/0/0	0
Region 6			
Alternative Route 6-A	0	6/0/0/0	0
Alternative Route 6-B	1 (161kV)	2/1/0/0	0
Alternative Route 6-C	0	16/1/0/0	0
Alternative Route 6-D	0	0/0/0/0	0
Region 7			
Alternative Route 7-A	1 (500kV)	12/6/0/0	1 (CM)
Alternative Route 7-B	0	10/2/0/0	1 (PM)
Alternative Route 7-C	2 (161kV)	44/16/2/0	2 (PM,AS)
Alternative Route 7-D	1 (500kV)	30/4/0/0	0

PM—Private Land Mobile, TV—TV National Television System Committee (NTSC), MT-Microwave Tower, AS—Antenna Structure, CM—Commercial Land Mobile

1 GIS Data Source: Clean Line (2013a, 2013b), Tetra Tech (2014a))

2 GIS Data Source: FCC (2012)

3.4.11.3.2.1 Construction Impacts

No electrical effects would be associated with construction of the ±600kV HVDC overhead electric transmission line along any of the HVDC alternative routes, because these facilities would not be energized during construction.

3.4.11.3.2.2 Operations and Maintenance Impacts

Section 3.4.11.2.3 describes the results of the modeling calculations for electrical effects for the two proposed DC transmission line configurations.

3.4.11.3.2.2.1 Summary of Impacts for the DOE Alternative Transmission Lines

Based on an evaluation of research and guidelines recommended by various agencies, it is unlikely that the DOE alternative transmission lines would pose a known threat to human health (reference Section 3.4.11.2.1.2.2.7). In addition, the likelihood of annoyance to landowners by audible noise from the line or interference to AM radio or television reception is small.

While a variety of electronic devices are known to affect the operation of pacemakers and ICDs, transmission lines have not been reported to produce functional disturbances to these devices. There is a possibility that induced potentials on the leads of these devices by AC electric fields on the ROW could affect the operation of these devices, but the clinical significance of such changes appears small. Persons who are concerned should contact their physician to ascertain the immunity of their device to this potential source of interference.

3.4.11.3.2.3 Decommissioning Impacts

No electrical effects would be associated with the decommissioning of the ±600kV HVDC overhead electric transmission line. Once decommissioned, no electrical energy would be generated that would create electrical effects such as electric and magnetic fields, audible noise, and radio and television interference.

3.4.11.4 Best Management Practices

Based upon the EPMs already proposed by the Applicant, no BMPs are suggested.

Concerns were raised in public comments on the Draft EIS that EMP hardening of the transmission lines should be considered to protect them from solar flares or a nuclear weapon. While this issue is not directly related to electrical effects, environmental or man-made pulses of this type could possibly have an effect on the converter station electrical equipment rather than the transmission line itself. Natural events or intentional destructive acts could potentially impact the system. DOE has identified a BMP to develop and implement a Health and Safety Plan that includes overall natural disaster and emergency responder contact procedures (Section 3.8.5.2).

3.4.11.5 Unavoidable and Adverse Impacts

Impacts concerning electrical effects are discussed in Section 3.4.6. Unavoidable and potentially adverse impacts are the electrical effects (electric and magnetic fields, radio and television noise, audible noise, ozone, and air ions) associated with the operation of overhead HVDC and/or AC transmission lines. These effects are present within, and to a more limited extent outside of, the transmission line ROW. Outside of the ROW, calculated electrical effects for the Project are generally limited to levels that comply with associated standards and guidelines.

3.4.11.6 Irreversible and Irretrievable Commitment of Resources

No irreversible or irretrievable commitment of resources associated with electrical effects and the Project.

3.4.11.7 Relationship between Local Short-term Uses and Long-term Productivity

No short-term uses or resource removal exist that would affect long-term productivity associated with electrical effects from the Project.

3.4.11.8 Impacts from Connected Actions

3.4.11.8.1 Wind Energy Generation

Electricity for numerous wind energy generation facilities may be transported across the ±600kV HVDC overhead electric transmission line. Electrical equipment associated with wind farms includes wind turbine generators (rotor blades connected to a turbine generator/drive train and supported on a steel tower approximately 200 to 330 feet above ground level), underground collection cables to carry lower-voltage electricity from individual wind turbine generators to an electric transformer (usually located within a substation), electric transformers (to convert lower-voltage electricity to higher-voltage), and AC transmission lines to connect the wind power generation to the electrical grid. Often substations will also contain circuit breakers, capacitor banks, relaying equipment, high voltage bus work, metal clad switchgear, and related electrical equipment.

An evaluation of the electrical effects associated with wind energy generation facilities only includes AC magnetic fields. No DC electric or magnetic fields from Project sources are present, since the wind farm electrical system is strictly an AC system. Because the wind turbine generator is housed within a steel structure, and the collection cables are located either within the steel tower structure or underground (i.e., shielded); there are no AC corona effects (audible noise, radio and television noise, and ozone generation) associated with this equipment. Likewise, there are no AC electric field effects. While audible noise and interference may be present from the generator itself and/or the turning rotor blades, this does not result from the flow of electricity and is therefore not an electrical effect. The only remaining electrical effect under consideration then is the AC magnetic field.

A wind turbine generator is located at the top of the steel support tower, typically 200 to 300 feet (or more) above ground level, and housed within the structural steel tower. This arrangement results in very low (if any) magnetic field at ground level due to the generator (McCallum et al. 2014). The collection cables are located either within the steel support tower or collocated together within an underground duct. Placing the cables in close proximity to each other increases the magnetic field cancellation between cables (because the magnetic field produced by a set of conductors is proportional to the average spacing between conductors) (EPRI 1999), so a magnetic field may be present directly above an underground cable (depending upon a number of parameters, including the loading, phase configuration, grounding configuration, and depth of the cables). Nevertheless, the magnetic field will typically decrease very quickly with distance away from cable (Naikun 2014), much more so than from overhead transmission lines. Magnetic fields from these cables will usually be located within the wind farm facility (connecting the wind farm turbines to the substation), so it is not anticipated that significant magnetic fields will be associated with the wind farm generation system itself outside the ROI (SCC 2011; Rideout et al. 2010; Fortin et al. 2013).

For substations, the dominant sources of electrical effects are the overhead transmission lines entering and exiting the substations (which are addressed within the AC collection system). Some types of substation equipment can potentially be a source of electrical effects (for example, power transformers can produce audible noise). These effects can be reduced or eliminated by the use of filtering equipment, sound walls, and other methods. Because the dominant sources of electrical effects are associated with the overhead transmission lines, not substation equipment, an evaluation of electrical effects for substations associated with wind generation facilities was not performed.

3.4.11.8.2 Optima Substation

For substations, the dominant sources of electrical effects are the overhead transmission lines entering and exiting the stations. Some types of substation equipment can potentially be a source of electrical effects (for example, power transformers can produce audible noise, and converter equipment can produce radio noise, etc.).

3.4.11.8.3 TVA Upgrades

Upgrades required to interconnect into the TVA transmission grid could contribute to AC electric fields, AC magnetic fields, audible noise caused by corona discharge from the transmission line conductors, radio and television noise interference, and ozone. These effects are associated with energized AC transmission lines so electrical effects of concern would not occur during construction of the required TVA upgrades.

Electrical impacts from the new TVA 500kV transmission line would be expected to be similar to those described for the 500kV AC transmission lines associated with the Tennessee and Arkansas converter stations (Sections 3.4.11.2.1.2.2 and 3.4.11.3.1). Lower impacts would be expected from the TVA upgrades to transmissions lines because the 161kV transmission lines that would be affected already exist. Impacts at or near ground level can vary substantially based on the height of the transmission structure and on the structure/line configuration as well as the electrical energy transmitted. The loading would also impact magnetic field levels.

Upgrades to substation equipment would also be made for the TVA interconnection, which would include modifications to existing substations on the terminal ends of the new line and upgrading terminal equipment at three existing 500kV and three existing 161kV substations (reference Section 2.5.2 for a complete description of these upgrades). For substations, the dominant sources of electrical effects are typically the overhead transmission lines entering and exiting the substations (rather than substation equipment). However, some types of substation equipment can potentially be a source of electrical effects (for example, power transformers can produce long-term audible noise). These long-term effects can be reduced or eliminated by the use of filtering equipment, sound walls, and other methods. Because the dominant sources of electrical effects are typically associated with the overhead transmission lines, not substation equipment, an evaluation of electrical effects for substation upgrades associated with the TVA interconnection was not performed.

3.4.11.9 Impacts Associated with the No Action Alternative

Under the No Action Alternative, DOE assumes for analytical purposes that the Project would not move forward. The existing electrical environment would remain in its present condition. DC electric and magnetic fields would always be present because of other existing facilities and natural sources. If the ±600kV HVDC overhead electric transmission line is not constructed, then no additional DC electric or magnetic fields would be introduced along any of the Project routes. Because AC electric fields, audible noise, and radio and television interference attributable to corona activity from overhead AC power lines already exist along portions of the Project routes, and voltage on a power line is held relatively constant, these existing electrical effects would remain unchanged. AC magnetic fields attributable to existing overhead AC power lines vary with loading on each of the lines and would continue to do so.

Contents

Tables

Figures Presented in Appendix A

3.5 Environmental Justice

This section presents the affected environment and provides an assessment of the potential for disproportionately high and adverse environmental or human health effects on minority and/or low-income populations from the Plains & Eastern Project, in accordance with Executive Order (EO) 12898.

Minority populations include individuals who are Black or African American, American Indian and Alaska Native, Asian, Native Hawaiian and other Pacific Islander, other non-white race, or persons of two or more races and Hispanic or Latino. Low-income populations include individuals living below the poverty line, as defined by the U.S. Census Bureau.

3.5.1 Regulatory Background

Environmental justice laws and regulations relevant to the resources in the ROI are summarized in Table 3.5-1.

Table 3.5-1:
Legal Authorities Addressing Environmental Justice

Statute/Regulation	Applicability to the Project
Federal	
EO 12898 (59 FR 7629): Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations as amended by EO 12948	Requires each federal agency to make the achievement of environmental justice part of its mission by identifying and addressing disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations. The EO further directs agencies to conduct their programs and activities in a manner that does not have the effect of excluding persons from participation in them, denying persons the benefits of them, or subjecting persons to discrimination because of their race, color, or national origin.

3.5.2 Data Sources

This environmental justice analysis uses the U.S. Census Bureau 2010 Census of Population and Housing and the 2011 American Community Survey Demographic and Housing Estimates for population and income data for Census Block and Block Groups that are wholly or partially within the ROI. The data used were the most current data available during the preparation of the EIS. Subsequently, 2013 Census data were released during the preparation of the Final EIS. An analysis of the 2013 data shows while small changes in minority and low-income populations occurred, no substantial changes occurred between the 2011 and 2013 data that would change the conclusion regarding environmental justice impacts.

The U.S. Census Bureau has defined levels of statistical geographic entities to present data from the decennial census and American Community Survey. Counties are divided into Census Tracts, Census Tracts into Census Block Groups, and Census Block Groups into Census Blocks, the smallest statistical area the Census uses to report sample data. Figure 3.5-1 in Appendix A shows the Census Block Groups with low income populations in the ROI.

3.5.3 Region of Influence

The ROI for environmental justice considers the area where potential impacts could occur. The ROI for identifying low-income and minority populations consists of Census Block Groups or Census Blocks, respectively, within the counties intersected by the Project as described in Section 3.1. Census Blocks within the ROI are used to identify potential minority populations while Census Block Groups are used to identify potential low-income populations.

Census Block Groups are used in the analysis of low-income populations because income data are not collected/not available at the Census Block level. Poverty thresholds are based on the Office of Management and Budget's Statistical Policy Directive 14.

Census Blocks are statistical areas bounded by visible features, such as streets, roads, streams, and railroad tracks, and by nonvisible boundaries, such as property lines and city, township, school district, and county limits and short line-of-sight extensions of streets and roads.

Census Block Groups are generally defined to contain between 600 and 3,000 people and usually cover a contiguous area. Census Block Groups do not cross state, county, or census tract boundaries, but may cross boundaries of any other geographic entity. Census data on income are reported only for a sample of the population and therefore are reported only at the Census Block Group level.

3.5.3.1 Region of Influence for the Applicant Proposed Project

The environmental justice ROI for the Applicant Proposed Project consists of Census Blocks and Census Block Groups in the counties where the proposed facilities would be located. The ROI is divided into seven regions for the purposes of this analysis. Table 3.5-2 presents the counties within the environmental justice ROI.

Table 3.5-2:
Counties Potentially Affected by the Applicant Proposed Project by Region

Region	State	County[1]
1	Oklahoma	Cimarron, Texas, Beaver, Harper
	Texas	Hansford, Ochiltree, Sherman
2	Oklahoma	Woodward, Major, Garfield
3	Oklahoma	Garfield[2], Kingfisher, Logan, Payne, Lincoln, Creek, Okmulgee, Muskogee[2]
4	Oklahoma	Muskogee[2], Sequoyah
	Arkansas	Crawford, Franklin, Johnson, Pope[1]
5	Arkansas	Pope[2], Conway, Faulkner, Van Buren, Cleburne, White, Jackson
6	Arkansas	Jackson[2], Poinsett[2], Cross
7	Arkansas	Poinsett, Mississippi
	Tennessee	Tipton, Shelby

1 Counties are generally listed from west to east by region.
2 Counties located in more than one region.

Several route variations to the Applicant Proposed Route in Regions 2–7 were developed in response to public comments on the Draft EIS and are described in Appendix M and summarized in Sections 2.4.2.1–2.4.2.7. Assessments of the impacts related to the route variations by Project region, including accompanying HVDC alternative route adjustments, are provided below. The variations are presented graphically in Exhibit 1 of Appendix M.

3.5.3.2 Region of Influence for the DOE Alternatives

The ROI for the DOE Alternatives consist of the same counties as those listed for the Applicant Proposed Project.

3.5.3.3 Region of Influence for Connected Actions

3.5.3.3.1 Wind Energy Generation

Census Block Groups are used for the wind energy generation analysis because the exact location of wind farms and turbines has not been identified; therefore, larger geographic units for the environmental justice analysis were used. The ROI for wind energy generation includes Census Block Groups within the counties that contain WDZs. These counties include Beaver, Cimarron, and Texas counties in Oklahoma and Hansford, Ochiltree, and Sherman counties in Texas.

3.5.3.3.2 Optima Substation

The ROI for the future Optima Substation includes Census Blocks and Census Block Groups in Texas County, Oklahoma.

3.5.3.3.3 TVA Upgrades

The ROI for evaluation of impacts on environmental justice from the TVA upgrades is the same as that identified in Section 3.1.1.

3.5.4 Affected Environment

The affected environment for environmental justice analysis includes Census Blocks and Census Block Groups (described in Section 3.5.3) in Texas, Oklahoma, Arkansas, and Tennessee. The sections below identify low-income and minority populations within the affected environment.

For the analysis in this EIS, a population is defined as minority population in terms of race and ethnicity if 50 percent or more of the population within the Census Block is minority or if the Census Block population has a “meaningfully greater” percentage of minorities compared to the entire county. For this analysis “meaningfully greater” is defined as 10 percentage points higher than the minority population of the whole county.

Low-income populations are identified as low-income populations if 20 percent or more of the households within the Census Block Group live below the poverty level. Poverty thresholds vary based on the size of the family and age of its members, but do not vary based on geographic region. The weighted average threshold ranges from $11,484 for a one-person household to $46,572 for a household with nine or more family members (GIS Data Source: USCB 2011).

3.5.4.1 Texas

The 2-mile-wide corridor for the AC collection system routes in Texas includes 246 Census Blocks and 5 Census Block Groups in three counties in Texas. A majority of the Census Blocks and Census Block Groups have demographics similar to their respective counties.

Table 3.5-3 presents data on Census Blocks with identified minority populations, and Table 3.5-4 presents data on Census Block Groups with identified low-income populations.

No route variations were proposed in Texas.

Table 3.5-3:
Race and Ethnicity Comparison for Census Blocks in the AC Collection System Routes in Texas

Census Block by County[1]	Total Population	Minority	AC Collection System Route
Ochiltree	10,147	49.80%	
Census Tract 950100, Block 2036	11	54.50%	NE-2, SE-3
Sherman	3,019	40.60%	
Census Tract 650200, Block 1179	12	100.00%	SW-2

1 Blocks presented represent identified minority populations as defined in Section 3.5.4.
Source: USCB (2011)

Table 3.5-4:
Poverty Status for Census Block Groups in the AC Collection System Routes in Texas

Census Block Group[1]	Total Households	Percentage of People Below Poverty	Household Median Income	AC Collection System Route
Hansford	1,895	13.3	$52,610	
Census Tract 9503, Block Group 1	417	28.5	$40,179	SE-1

1 Block Groups presented represent identified low-income and minority populations as defined in Section 3.5.4.
GIS Data Source: USCB (2011)

Two Census Blocks in the AC collection system routes were identified as having minority populations that are 50 percent or more of the population within the Census Block (Table 3.5-3). One Census Block Group was identified as having populations (Table 3.5-4) of low income and poverty.

3.5.4.2 Oklahoma

The 1,000-foot-wide corridor for the Applicant Proposed Route includes 891 Census Blocks and 51 Census Block Groups in 15 counties in Oklahoma. A majority of the Census Blocks and Census Block Groups have demographics similar to their respective counties and are predominantly white.

Nine route variations to the Applicant Proposed Route were developed in Oklahoma in response to public comments on the Draft EIS. Only three Census Blocks in Region 4, Link 3, Variation 2, were identified as having minority populations. The route variations are described in Appendix M and summarized in Sections 2.4.2.1–2.4.2.7. The variations are illustrated in Exhibit 1 of Appendix M.

- Region 2, Link 1, Variation 1—The location is in Woodward County. The variation is located in five of the same Census Blocks as the Applicant Proposed Route and two additional Census Blocks not included in the Applicant Proposed Route. The variation is located in the same Census Block Groups as the Applicant Proposed Route.
- Region 2, Link 2, Variation 2—The location is in Major County. The variation is located in the same Census Blocks as the Applicant Proposed Route and five additional Census Blocks not included in the Applicant Proposed Route. The variation is located in the same Census Block Group as the Applicant Proposed Route.
- Region 3, Link 1, Variation 2—The location is in Payne County. The variation is located in the same Census Blocks and Census Block Groups as the Applicant Proposed Route.
- Region 3, Link 1 and 2, Variation 1—The location is in Payne County. The variation is located in the same Census Blocks and Census Block Groups as the Applicant Proposed Route.
- Region 3, Link 4, Variation 1—The location is in Lincoln County. The variation is located in the same Census Blocks and Census Block Groups as the Applicant Proposed Route.

- Region 3, Link 4, Variation 2—The location is in Creek County. The variation is located in the same Census Blocks and Census Block Groups as the Applicant Proposed Route.
- Region 3, Link 5, Variation 2—The location is in Muskogee County. The variation is located in the same Census Blocks and Census Block Groups as the Applicant Proposed Route and one additional Census Block not included in the Applicant Proposed Route.
- Region 4, Link 3, Variation 1—The location is in Sequoyah County. The variation is located in the same Census Blocks and Census Block Groups as the Applicant Proposed Route.
- Region 4, Link 3, Variation 2—The location is in Sequoyah County. The variation is located in six of the same Census Blocks as the Applicant Proposed Route and eight additional Census Blocks not included in the Applicant Proposed Route. Three of the eight additional Census Blocks contained minority populations. The variation is located in the same Census Block Group as the Applicant Proposed Route.

The 2-mile-wide corridor for the AC Collection System Route includes 1,075 Census Blocks and eight Census Block Groups in Beaver, Cimarron, and Texas counties in Oklahoma. The population in all three counties is predominantly white. Of the three counties, Texas County has the highest minority population with more than 40 percent of the county's population identifying as Hispanic.

Nineteen Census Blocks and one Census Block Group were identified in the Oklahoma Converter Station Siting Area.

Table 3.5-5 presents data on Census Blocks with identified minority populations and Table 3.5-6 presents data on Census Block Groups with identified low-income populations.

Table 3.5-5:
Race and Ethnicity Comparison for Census Blocks in the ROI in Oklahoma

Census Block by County[1]	Total Population	Minority	Project Feature
Creek	69,450	21.60%	
Census Tract 0211.02, Block 2087	11	54.60%	Applicant Proposed Route (Region 3)
Muskogee	70,593	41.30%	
Census Tract 0011.00, Block 1086	17	64.70%	Applicant Proposed Route (Region 3)
Census Tract 0011.00, Block 1130	28	57.20%	Applicant Proposed Route (Region 3)
Census Tract 0011.00, Block 1148	25	64.00%	Applicant Proposed Route (Region 3)
Census Tract 0011.00, Block 1275	13	100.00%	Applicant Proposed Route (Region 3)
Census Tract 0011.00, Block 2038	19	57.90%	Applicant Proposed Route (Region 3)
Census Tract 0011.00, Block 2107	10	70.00%	Applicant Proposed Route (Region 3)
Census Tract 0013.00, Block 4107	26	53.80%	Applicant Proposed Route (Region 3)
Census Tract 0016.00, Block 3147	27	77.80%	Applicant Proposed Route (Region 3), Alternative Route 3-D
Census Tract 0016.00, Block 3148	10	90.00%	Applicant Proposed Route (Region 3)
Okmulgee	39,766	35.00%	
Census Tract 0006.00, Block 2121	20	45.00%	Applicant Proposed Route (Region 3)
Sequoyah	42,074	68.50%	
Census Tract 0301.01, Block 3193	1	100	Applicant Proposed Route (Region 4)
Census Tract 0301.01, Block 3196	71	64.79	Applicant Proposed Route (Region 4)

Table 3.5-5:
Race and Ethnicity Comparison for Census Blocks in the ROI in Oklahoma

Census Block by County[1]	Total Population	Minority	Project Feature
Census Tract 0302.02, Block 2049	36	52.78	Applicant Proposed Route (Region 4)
Census Tract 0301.04, Block 3080	20	50.00%	Applicant Proposed Route (Region 4)
Census Tract 0302.02, Block 2110	96	50.90%	Applicant Proposed Route (Region 4)
Census Tract 0302.02, Block 2135	22	50.00%	Applicant Proposed Route (Region 4)
Woodward	20,105	16.70%	
Census Tract 9532.00, Block 1130	25	40.00%	Applicant Proposed Route (Region 2)
Texas County	20,218	46.10%	
Census Tract 9506.00, Block 5069	10	50.00%	AC Collection System Route NE-1
Census Tract 9507.00, Block 2435	19	57.90%	AC Collection System Route E-2, NW-1
Census Tract 9507.00, Block 2614	11	72.70%	AC Collection System Route E-1
Census Tract 9507.00, Block 2735	11	63.60%	AC Collection System Route E-2, AC E-3, AC SE-1, AC SE-3
Census Tract 9507.00, Block 2774	13	100.00%	AC Collection System Route E-1
Census Tract 9507.00, Block 2798	10	50.00%	AC Collection System Route E-1
Census Tract 9507.00, Block 2811	10	50.00%	AC Collection System Route E-1
Census Tract 9507.00, Block 2813	10	100.00%	AC Collection System Route E-1
Census Tract 9507.00, Block 2825	11	100.00%	AC Collection System Route E-1
Census Tract 9507.00, Block 2826	13	100.00%	AC Collection System Route E-1

1 Blocks presented represent identified minority populations as defined in Section 3.5.4. Project features not listed indicate that no minority populations were identified within that project feature. For example, the Oklahoma Converter Station is not listed because no minority populations were identified within the Oklahoma Converter Station Siting Area.

Source: USCB (2011)

Table 3.5-6:
Poverty Status for Census Block Groups in the ROI in Oklahoma

Census Block Group[1]	Total Households	Percentage of People Below Poverty	Household Median Income	Project Features
Creek	26,373	14.2	$42,950	
Census Tract 210, Block Group 1	393	24.4	$36,250	Applicant Proposed Route (Region 3), AC Collection System Route 3-C
Major	3,185	10.4	$48,012	
Census Tract 9553, Block Group 2	450	22.4	$49,074	Applicant Proposed Route (Region 2)
Muskogee	27,056	21.1	$37,990	
Census Tract 12, Block Group 2	214	25.2	$22,016	Applicant Proposed Route (Region 3)
Census Tract 14, Block Group 5	553	24.1	$39,015	Applicant Proposed Route (Region 3)
Census Tract 15, Block Group 1	489	23.3	$39,207	Applicant Proposed Route (Region 3), Alternative Route 3-C, AR 3-D, AR 3-E
Okmulgee	15,193	19.4	$39,324	
Census Tract 7, Block Group 1	494	21.3	$57,083	Applicant Proposed Route (Region 3), Alternative Route 3-C

Table 3.5-6:
Poverty Status for Census Block Groups in the ROI in Oklahoma

Census Block Group[1]	Total Households	Percentage of People Below Poverty	Household Median Income	Project Features
Sequoyah	15,520	19.0	$38,292	
Census Tract 302.02, Block Group 2	849	21.4	$36,111	Applicant Proposed Route (Region 4), Alternative Route 4-A, AR 4-B
Texas	7,122	14.6	$46,631	
Census Tract 9509, Block Group 1	630	22.2	$40,833	AC Collection System Route NE-1, AC NW-2

1 Block Groups presented represent identified low-income populations as defined in Section 3.5.4. Project features not listed indicate that no low-income and minority populations were identified within that project feature. For example, the Oklahoma Converter Station is not listed because no low-income and minority populations were identified within the Oklahoma Converter Station Siting Area.
Source: USCB (2011)

Eighteen Census Blocks in the Applicant Proposed Route and one Census Block in the HVDC alternative routes were identified as having greater minority populations (Table 3.5-5). Seven Census Block Groups in the Applicant Proposed Route and three Census Block Groups in the HVDC alternative routes were identified as having low-income populations in terms of income and poverty (Table 3.5-6). Ten Census Blocks were identified in the AC collection system routes as having a greater minority population (Table 3.5-5). One Census Block Group was identified in the AC collection system routes as having low-income populations in terms of income and poverty (Table 3.5-6).

Only one of the 19 Census Blocks in the Oklahoma Converter Station Siting Area in Texas County, Oklahoma, was populated. There are no minority or low-income populations in the Oklahoma Converter Station Siting Area.

3.5.4.3 Arkansas

The 1,000-foot-wide corridor for the Applicant Proposed Route and HVDC Alternative Routes includes 597 Census Blocks and 51 Census Block Groups in 13 counties in Arkansas. A majority of the Census Blocks have demographics similar to their respective counties and is predominantly white.

Thirteen route variations to the Applicant Proposed Route were developed in Arkansas in response to public comments on the Draft EIS. No new Census Blocks or Census Block Groups in the route variations were identified as having minority or low-income populations. The route variations are described in Appendix M and summarized in Sections 2.4.2.1–2.4.2.7. The variations are illustrated in Exhibit 1 of Appendix M.

- Region 4, Link 3—The location is in Crawford County. The variation is located in four of the same Census Blocks as the original Applicant Proposed Route and six additional Census Blocks not included in the original Applicant Proposed Route. The variation is located in the same Census Block Groups as the original Applicant Proposed Route.
- Region 4, Link 6, Variation 1—The location is in Crawford County. The variation is located in the same Census Blocks and Census Block Groups as the original Applicant Proposed Route.
- Region 4, Link 6, Variation 2—The location is in Crawford County. The variation is located in the same Census Blocks and Census Block Groups as the original Applicant Proposed Route.

- Region 4, Link 6, Variation 3—The location is in Crawford County. The variation is located in the same Census Blocks and Census Block Groups as the original Applicant Proposed Route.
- Region 4, Link 9, Variation 1—The location is in Pope County. The variation is located in the same Census Blocks and Census Block Groups as the original Applicant Proposed Route.
- Region 5, Link 1, Variation 2—The location is in Pope County. The variation is located in the same Census Blocks as the original Applicant Proposed Route and one additional Census Block not included in the original Applicant Proposed Route. The variation is located in the same Census Block Groups as the original Applicant Proposed Route.
- Region 5, Link 2, Variation 2—The location is in Pope County. The variation is located in the same Census Blocks and Census Block Groups as the original Applicant Proposed Route.
- Region 5, Link 2 and 3, Variation 1—The location is in Pope County. The variation is located in the same Census Blocks and Census Block Groups as the original Applicant Proposed Route.
- Region 5, Link 3 and 4, Variation 2—The location is in Van Buren County. The variation is located in the same Census Blocks and Census Block Groups as the original Applicant Proposed Route.
- Region 5, Link 7, Variation 1—The location is in White County. The variation is located in the same Census Blocks and Census Block Groups as the original Applicant Proposed Route.
- Region 6, Link 2, Variation 1—The location is in Jackson County. The variation is located in the same Census Blocks and Census Block Groups as the original Applicant Proposed Route.
- Region 7, Link 1, Variation 1—The location is in Mississippi County. The variation is located in the same Census Blocks and Census Block Groups as the original Applicant Proposed Route.
- Region 7, Link 1, Variation 2—The location is in Mississippi County. The variation is located in one of the same Census Blocks as the original Applicant Proposed Route and four additional Census Blocks not included in the original Applicant Proposed Route. The variation is located in the same Census Block Groups as the original Applicant Proposed Route.

One hundred thirty Census Blocks and two Census Block Groups occur in the Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area.

Table 3.5-7 presents data on Census Blocks with identified minority populations and Table 3.5-8 presents data on Census Block Groups with identified low-income populations.

Table 3.5-7:
Race and Ethnicity Comparison for Census Blocks in the ROI in Arkansas

Census Block by County[1]	Total Population	Minority	Project Features
Cleburne	25,788	4.30%	
Census Tract 4805.02, Block 1020	53	15.10%	Applicant Proposed Route (Region 5)
Conway	21,164	17.70%	
Census Tract 9501.00, Block 2036	53	39.60%	Applicant Proposed Route (Region 5)
Census Tract 9502.00, Block 1088	55	40.00%	Applicant Proposed Route (Region 5)
Census Tract 9502.00, Block 1099	51	29.40%	Applicant Proposed Route (Region 5)
Cross	17,992	25.70%	
Census Tract 9502.00, Block 2041	20	80.00%	Applicant Proposed Route (Region 6)

Table 3.5-7:
Race and Ethnicity Comparison for Census Blocks in the ROI in Arkansas

Census Block by County[1]	Total Population	Minority	Project Features
Franklin	18,157	6.30%	
Census Tract 9501.00, Block 2194	19	36.90%	Applicant Proposed Route (Region 4)
Census Tract 9501.00, Block 2081	17	76.50%	Alternative Route 4-D
Jackson	17,969	21.10%	
Census Tract 4804.00, Block 3084	15	60.00%	Applicant Proposed Route (Region 6)
Johnson	25,408	16.10%	
Census Tract 9518.00, Block 1019	10	50.00%	Applicant Proposed Route (Region 4)
Pope	61,166	12.80%	
Census Tract 9510.00, Block 2037	16	37.50%	Applicant Proposed Route (Region 5)
Van Buren	17,255	5.70%	
Census Tract 4604.00, Block 3055	11	18.20%	Applicant Proposed Route (Region 5)

1 Blocks presented represent identified minority populations as defined in Section 3.5.4. Project features not listed indicate that no minority populations were identified within that project feature.
Source: USCB (2011)

Table 3.5-8:
Poverty Status for Census Block Groups in the ROI in Arkansas

Census Block Group[1]	Total Households	Percentage of People Below Poverty	Household Median Income	Project Features
Conway	8,137	21.9	$31,890	
Census Tract 9501, Block Group 1	580	22.9	$53,056	Applicant Proposed Route (Region 5), Alternative Route 5-B
Census Tract 9502, Block Group 1	455	20.7	$43,917	Applicant Proposed Route (Region 5)
Crawford	23,174	17.6	$40,409	
Census Tract 204.2, Block Group 3	329	28.6	$49,792	Applicant Proposed Route (Region 4)
Census Tract 206, Block Group 5	549	28.1	$36,098	Applicant Proposed Route (Region 4)
Cross	6,823	16.7	$38,432	
Census Tract 9501, Block Group 1	554	32.9	$41,696	Applicant Proposed Route (Region 6)
Census Tract 9502, Block Group 1	459	22.9	$37,632	Applicant Proposed Route (Region 6)
Census Tract 9502, Block Group 2	370	21.1	$37,098	Applicant Proposed Route (Region 6), Alternative Route 6-D
Census Tract 9503, Block Group 1	321	24.0	$43,466	Applicant Proposed Route (Region 6)
Franklin	6,763	20.1	$34,819	
Census Tract 9502, Block Group 1	756	20.8	$39,274	Applicant Proposed Route (Region 4), Alternative Route 4-B, AR 4-E
Census Tract 9502, Block Group 2	398	54.5	$20,000	Applicant Proposed Route (Region 4)

Table 3.5-8:
Poverty Status for Census Block Groups in the ROI in Arkansas

Census Block Group[1]	Total Households	Percentage of People Below Poverty	Household Median Income	Project Features
Jackson	6,383	25.1	$31,352	
Census Tract 4805, Block Group 1	721	25.0	$39,836	Applicant Proposed Route (Region 5), Alternative Route 5-D
Mississippi	17,136	26.1	$34,267	
Census Tract 113, Block Group 2	597	20.8	$38,056	Applicant Proposed Route (Region 7), Alternative Route 7-A
Poinsett	9,427	26.0	$31,939	
Census Tract 4902, Block Group 1	375	21.6	$51,435	Applicant Proposed Route (Region 6), Alternative Route 6-C, AR 6-D
Pope	22,599	18.9	$40,325	
Census Tract 9507, Block Group 2	463	23.1	$21,518	Applicant Proposed Route (Region 5), Alternative Route 5-A
Census Tract 9510, Block Group 1	713	23.6	$55,163	Applicant Proposed Route (Region 5), Alternative Route 5-B, Arkansas Converter Station
Census Tract 9510, Block Group 2	987	23.0	$41,007	Applicant Proposed Route (Region 5), Alternative Route 5-A
Van Buren	7,097	24.9	$32,906	
Census Tract 4604, Block Group 2	421	23.0	$34,844	Applicant Proposed Route (Region 5), Alternative Route 5-E
Census Tract 4604, Block Group 3	442	20.6	$55,476	Applicant Proposed Route (Region 5), Alternative Route 5-E
White	29,529	16.4	$41,618	
Census Tract 702, Block Group 2	737	25.1	$42,550	Applicant Proposed Route (Region 5), Alternative Route 5-B, AR 5-C, AR 5-E, AR 5-F

1 Block Groups presented represent identified low-income populations as defined in Section 3.5.4. Project features not listed indicate that no low-income and minority populations were identified within that project feature. Poverty statuses for Cleburne, Cross, and Johnson counties in Arkansas are not included because there were no Census Block Groups identified within the ROI with 20 percent or more of households below the poverty level.

GIS Data Source: USCB (2011)

Ten Census Blocks in the Applicant Proposed Route and one Census Block in the HVDC alternative routes were identified as having a greater minority population (Table 3.5-7) and 19 Census Block Groups in the Applicant Proposed Route and 12 Census Block Groups in the HVDC alternative routes were identified as having low-income populations (Table 3.5-8).

One Census Block in the Arkansas Converter Station Alternative Siting Area and new substation in Pope County was identified as having minority populations (Table 3.5-7), and three Census Block Groups were identified as having low-income populations (Table 3.5-8).

3.5.4.4 Tennessee

The 1,000-foot-wide corridor for the Applicant Proposed Route includes 33 Census Blocks and 8 Census Block Groups in two counties in Tennessee. A majority of the 33 Census Blocks have demographics similar to their respective counties.

One route variation to the Applicant Proposed Route was developed in Tennessee in response to public comments on the Draft EIS. No new Census Blocks or Census Block Groups in the route variations were identified as having minority or low-income populations. The route variation is described in Appendix M and summarized in Section 2.4.2.7. The variation is illustrated in Exhibit 1 of Appendix M:

- Region 7, Link 5 and 4, Variation 1—The location is in Shelby County. The variation is located in the same Census Blocks and Census Block Groups as the Applicant Proposed Route.

Table 3.5-9 presents data on Census Blocks with identified minority populations and Table 3.5-10 presents data on Census Block Groups with identified low-income populations.

Table 3.5-9:
Race and Ethnicity Comparison for Census Blocks in the ROI in Tennessee

Census Block by County[1]	Total Population	Minority	Project Features
Tipton	60,462	23.60%	
Census Tract 0401.00, Block 2001	307	54.00%	Applicant Proposed Route (Region 7), Alternative Route 7-A, AR 7-B, AR 7-C
Census Tract 0401.00, Block 3014	190	34.20%	Applicant Proposed Route (Region 7), Alternative Route 7-C
Census Tract 0403.03, Block 3006	63	65.10%	Applicant Proposed Route (Region 7), Alternative Route 7-C

1 Blocks presented represent identified minority populations as defined in Section 3.5.4. Project features not listed indicate that no minority populations were identified within that project feature.
Source: USCB (2011)

Table 3.5-10:
Poverty Status for Census Block Groups in the ROI in Tennessee

Census Block Group[1]	Total Households	Percentage of People Below Poverty	Household Median Income	Project Features
Shelby	340,394	20.1	$46,102	
Census Tract 202.10, Block Group 3	848	20.2	$32,933	Applicant Proposed Route (Region 7), Alternative Route 7-B, AR 7-C, Tennessee Converter Station
Tipton	21,578	15.3	$50,869	
Census Tract 401,Block Group 2	394	31.5	$46,722	Applicant Proposed Route (Region 7), Alternative Route 7-A, AR 7-B, AR 7-C

1 Block Groups presented represent identified low-income populations as defined in Section 3.5.4. Project features not listed indicate that no low-income populations were identified within that project feature.
GIS Data Source: USCB (2011)

Three Census Blocks in the Applicant Proposed Route and HVDC Alternative Routes were identified as having a greater minority population (Table 3.5-9), and two Census Block Groups were identified as having low-income populations (Table 3.5-10).

No Census Blocks were identified as having minority populations within the Tennessee Converter Station Siting Area in Shelby County, Tennessee, and one Census Block Group was identified as having low-income populations (Table 3.5-10).

3.5.5 Regional Description

The following includes demographic and economic profiles of the counties within the Project. Table 3.5-11 presents demographic and economic profile of the counties and regions.

3.5.5.1 Region 1

Region 1, located in the Oklahoma Panhandle in Hansford, Ochiltree, and Sherman counties in Texas and Cimarron, Texas, Beaver, and Harper counties in Oklahoma, includes the Applicant Proposed Route and HVDC Alternative Routes I-A through I-D. Figure 3.5-1a in Appendix A shows Census Block Groups containing low-income populations within Region 1.

3.5.5.2 Region 2

Region 2, located in the Oklahoma Central Great Plains in Woodward, Major, and Garfield counties in Oklahoma, includes Applicant Proposed Route and HVDC Alternative Routes 2-A through 2-B. Figure 3.5-1b in Appendix A shows Census Block Groups containing low-income populations within Region 2.

3.5.5.3 Region 3

Region 3, located in the Oklahoma Cross Timbers in Kingfisher, Logan, Payne, Lincoln, Creek, Okmulgee, and Muskogee counties in Oklahoma, includes Applicant Proposed Route and HVDC Alternative Routes 3-A through 3-E. Figure 3.5-1c in Appendix A shows Census Block Groups containing low-income populations within Region 3.

3.5.5.4 Region 4

Region 4, located in the Arkansas River Valley in Sequoyah County in Oklahoma and Crawford, Franklin, and Johnson counties in Arkansas, includes Applicant Proposed Route and HVDC Alternative Routes 4-A through 4-E as well as the Lee Creek Variation. Figure 3.5-1d in Appendix A shows Census Block Groups containing low-income populations within Region 4.

3.5.5.5 Region 5

Region 5, located in Central Arkansas in Pope, Conway, Van Buren, Cleburne, Faulkner, White, and Jackson counties in Arkansas, includes Applicant Proposed Route and HVDC Alternative Routes 5-A through 5-F. Figure 3.5-1e in Appendix A shows Census Block Groups containing low-income populations within Region 5.

3.5.5.6 Region 6

Region 6, located in the Cache River, Crowley's Ridge Area, and St. Francis Channel in Poinsett and Cross counties in Arkansas, includes Applicant Proposed Route and HVDC Alternative Routes 6-A through 6-D. Figure 3.5-1f in Appendix A shows Census Block Groups containing low-income populations within Region 6.

Table 3.5-11:
Demographic and Economic Profile of Counties and Regions

Region	County	2011 Total Population	White (%)	Black or African American (%)	American Indian and Alaska Native (%)	Asian (%)	Native Hawaiian and Other Pacific Islander Alone (%)	Some Other Race Alone (%)	Two or More Races (%)	Hispanic (%)	Minority (%)	Total Households	Percentage of Households Below Poverty (%)	Household Median Income ($)
1	Hansford, TX	5,524	55.72	0.52	0.00	0.69	0.27	0.00	1.00	41.80	44.28	1,895	13.30	$52,610
	Ochiltree, TX	10,147	50.17	0.41	0.55	0.33	0.00	0.00	1.80	46.73	49.83	3,735	21.60	$49,794
	Sherman, TX	3,019	59.42	0.53	0.00	0.26	0.00	0.00	0.76	39.02	40.58	1,015	14.00	$49,135
	Cimarron, OK	2,486	78.28	0.56	0.36	0.32	0.00	0.00	0.80	19.67	21.72	1,095	23.70	$35,440
	Texas, OK	20,218	53.89	1.10	0.47	1.54	0.00	0.15	2.00	40.84	46.11	7,122	14.60	$46,631
	Beaver, OK	5,586	77.93	0.64	1.02	0.18	0.00	0.00	1.79	18.44	22.07	2,150	13.20	$47,386
	Harper, OK	3,641	81.87	0.03	0.52	0.44	0.00	0.00	1.18	15.96	18.13	1,542	11.60	$44,850
	Region 1 Total	50,621	59.54	0.71	0.47	0.84	0.03	0.06	1.64	36.72	40.46	18,554	15.97	$47,386
2	Woodward, OK	20,105	83.42	1.05	2.67	0.79	0.01	0.37	2.05	9.63	16.58	7,558	12.40	$51,087
	Major, OK	7,530	88.07	0.28	2.67	0.40	0.00	0.49	1.24	6.85	11.93	3,185	10.40	$56,641
	Garfield, OK[1]	59,680	81.14	2.53	2.24	0.92	1.57	0.07	3.07	8.46	18.86	24,022	16.30	$41,688
	Region 2 Total	87,315	82.27	1.99	2.38	0.85	1.07	0.17	2.68	8.59	17.73	34,765	14.91	$51,087
3	Kingfisher, OK	14,928	80.73	1.25	3.76	0.11	0.04	0.00	1.43	12.67	19.27	5,662	10.40	$59,071
	Logan, OK	40,863	78.79	8.96	3.24	0.48	0.08	0.01	3.37	5.08	21.21	14,553	14.80	$50,249
	Payne, OK	76,291	79.79	3.46	3.46	3.57	0.02	0.08	3.12	3.87	17.59	29,731	23.20	$35,716
	Lincoln, OK	33,964	84.38	2.03	5.22	0.13	0.00	0.08	5.56	2.60	15.62	12,912	14.80	$41,763
	Creek, OK	69,450	78.53	2.08	6.38	0.42	0.15	0.10	9.16	3.16	21.47	26,373	14.20	$53,450
	Okmulgee, OK	39,766	64.94	8.70	12.49	0.17	0.04	0.05	10.21	3.40	35.06	15,193	19.40	$39,324
	Muskogee, OK[1]	70,593	58.72	11.36	13.30	0.58	0.00	0.03	10.93	5.10	41.30	27,056	21.10	$37,990
	Region 3 Total	345,855	73.90	5.81	7.26	1.09	0.05	0.06	6.94	4.32	25.52	131,480	18.22	$41,763

Table 3.5-11:
Demographic and Economic Profile of Counties and Regions

Region	County	2011 Total Population	White (%)	Black or African American (%)	American Indian and Alaska Native (%)	Asian (%)	Native Hawaiian and Other Pacific Islander Alone (%)	Some Other Race Alone (%)	Two or More Races (%)	Hispanic (%)	Minority (%)	Total Households	Percentage of Households Below Poverty (%)	Household Median Income ($)
4	Sequoyah, OK	42,074	65.32	1.88	10.11	0.54	0.00	0.00	18.58	3.56	34.68	15,520	19.00	$38,292
	Crawford, AR	61,336	86.89	1.36	1.11	1.49	0.00	0.07	3.11	5.98	13.11	23,174	17.60	$40,409
	Franklin, AR	18,157	93.72	0.78	0.76	0.24	0.00	0.00	2.39	2.11	6.28	6,763	20.10	$34,819
	Johnson, AR	25,408	83.87	1.50	0.98	0.32	0.13	0.02	1.33	11.85	16.13	9,626	19.90	$31,400
	Region 4 Total	146,975	81.04	1.46	3.62	0.86	0.02	0.03	7.14	5.82	18.96	55,083	18.70	$36,556
5	Pope, AR[1]	61,166	87.28	3.17	0.41	0.91	0.00	0.11	1.76	6.36	12.72	22,599	18.90	$40,325
	Conway, AR	21,164	82.36	11.85	0.64	0.16	0.00	0.00	1.41	3.58	17.64	8,137	21.90	$31,890
	Van Buren, AR	17,255	94.24	1.08	0.82	0.05	0.00	0.14	1.17	2.50	5.76	7,097	24.90	$32,906
	Cleburne, AR	25,788	95.70	0.42	0.48	0.00	0.03	0.00	1.40	1.95	4.30	10,678	16.60	$38,510
	Faulkner, AR	111,058	82.73	10.20	0.41	1.16	0.01	0.17	1.53	3.78	17.27	41,540	15.40	$47,649
	White, AR	76,041	89.81	4.00	0.22	0.31	0.02	0.03	1.98	3.63	10.19	29,529	16.40	$41,618
	Jackson, AR[1]	17,969	78.78	16.73	0.47	0.12	0.02	0.02	1.54	2.33	21.22	6,383	15.40	$31,352
	Region 5 Total	330,441	86.58	6.69	0.41	0.65	0.01	0.09	1.64	3.92	13.42	125,963	17.32	$38,510
6	Poinsett, AR[1]	24,622	89.04	6.86	0.22	0.09	0.11	0.02	1.45	2.21	10.96	9,427	26.00	$31,939
	Cross, AR	17,992	74.25	22.33	0.44	0.61	0.00	0.00	0.96	1.42	25.75	6,823	16.70	$38,432
	Region 6 Total	42,614	82.79	13.39	0.31	0.31	0.06	0.01	1.24	1.87	17.21	16,250	22.10	$35,186
7	Mississippi, AR	46,608	60.72	33.88	0.06	0.56	0.00	0.00	1.22	3.56	39.28	17,136	26.10	$34,267
	Shelby, TN	925,673	39.25	51.47	0.10	2.32	0.03	0.13	1.32	5.38	60.75	340,394	20.10	$46,102
	Tipton, TN	60,462	76.45	18.30	0.36	0.72	0.43	0.37	1.28	2.15	23.60	21,578	15.30	$50,869
	Region 7 Total	1,032,743	42.40	48.73	0.12	2.15	0.05	0.14	1.32	5.10	57.61	379,108	20.10	$46,102

1 Counties located in more than one region. These counties are assigned to one region for the purposes of analysis. Garfield and Muskogee counties, Oklahoma, and Pope County, Arkansas, are assigned to the region that includes the majority of the HVDC transmission line located in that county. The length of transmission line in Jackson and Poinsett counties, Arkansas, is fairly evenly divided between two regions. These counties are included in the first region from east to west. This distribution of counties by region is used throughout the following analysis.

Source: USCB (2011); GIS Data Source: USCB (2011).

3.5.5.7 Region 7

Region 7, located in the Arkansas Mississippi River Delta and Tennessee in Mississippi County in Arkansas, and Shelby and Tipton counties in Tennessee, includes Applicant Proposed Route and HVDC Alternative Routes 7-A through 7-D. Figure 3.5-1f in Appendix A shows Census Block Groups containing low-income populations within Region 7.

3.5.5.8 Connected Actions

3.5.5.8.1 Wind Energy Generation

Table 3.5-12 presents data on Census Block Groups with identified minority populations within the WDZs. Table 3.5-13 presents data on Census Block Groups with identified low-income populations within the WDZs.

Table 3.5-12:
Race and Ethnicity Comparison for Census Block Groups within the WDZs

Census Block Group by County[1]	Total Population	Minority	WDZ
Beaver County	5,586	27.87%	J, K
Census Tract 9516, Block Group 3	680	49.26%	J
Texas County	33,964	41.86%	A, B, C, D, E, F, G, H, I, J
Census Tract 9507, Block Group 2	1,593	79.66%	D, E, F, J
Census Tract 9509, Block Group 1	1,566	88.51%	E
Census Tract 9509, Block Group 5	1,797	103.06%	E
Census Tract 9510, Block Group 2	845	92.19%	F
Hansford County	5,524	57.86%	A, B, C, L
Census Tract 9503, Block Group 1	1,063	69.33%	A, L
Census Tract 9503, Block Group 3	1,728	73.03%	L
Ochiltree County	10,147	71.38%	A, K, L
Census Tract 9503, Block Group 2	2,031	98.97%	A
Census Tract 9503, Block Group 3	879	93.97%	A
Census Tract 9504, Block Group 3	2,430	81.69%	A

1 Block Groups presented represent identified minority populations. For Wind Energy Generation, a population is defined as minority population if 50 percent or more of the population within the Block Group is minority or if the Block Group population has a “meaningfully greater” minority population compared to the whole county. Source: USCB (2011)

Table 3.5-13:
Poverty Status for Census Block Groups in the WDZs

Census Block Group by County1	Total Households	Percentage of People Below Poverty	WDZ
Texas County	7,122	14.4%	A, B, C, D, E, F, G, H, I, J
Census Tract 9506, Block Group 4	342	20.5%	I
Census Tract 9509, Block Group 1	630	22.2%	E
Census Tract 9509, Block Group 5	552	23.4%	E
Hansford County	1,895	13.2%	A, B, C, L
Census Tract 9503, Block Group 1	417	28.5%	A, L

Table 3.5-13:
Poverty Status for Census Block Groups in the WDZs

Census Block Group by County1	Total Households	Percentage of People Below Poverty	WDZ
Ochiltree County	3,735	16.9%	A, K, L
Census Tract 9503, Block Group 1	314	21.7%	A
Census Tract 9503, Block Group 2	679	29.9%	A

1 Block Groups presented represent identified low-income populations. Low-income populations are identified as low-income if 20 percent or more of the households within the Block Group live below the poverty level.
GIS Data Source: USCB (2011)

3.5.5.8.1.1 WDZ-A

WDZ-A contains a portion of 10 Census Block Groups in Hansford and Ochiltree counties, Texas. Of the 10 Census Block Groups in WDZ-A, two Census Block Groups were identified as having both minority and low-income populations (i.e., Census Block Group populations were greater than 50 percent minority and people living in poverty exceeded 20 percent), two Census Block Groups were identified as having only minority populations, and one Census Block Group was identified as having only low-income populations (Tables 3.5-12 and 3.5-13).

3.5.5.8.1.2 WDZ-B

WDZ-B contains one Census Block Group in Hansford County, Texas. No potential minority or low-income populations were identified in the WDZ-B (Tables 3.5-12 and 3.5-13).

3.5.5.8.1.3 WDZ-C

WDZ-C contains a portion of two Census Block Groups in Hansford and Sherman counties, Texas. No potential minority or low-income populations were identified in the WDZ-C (Tables 3.5-12 and 3.5-13).

3.5.5.8.1.4 WDZ-D

WDZ-D contains one Census Block Group in Texas County, Oklahoma. One Census Block Group was identified as a minority population within the Census Block Group exceeding 50 percent (Table 3.5-12). No low-income populations were identified in WDZ-D (Table 3.5-13).

3.5.5.8.1.5 WDZ-E

WDZ-E contains a portion of three Census Block Groups in Texas County, Oklahoma. Of the three Census Block Groups in the WDZ-E, two Census Block Groups were identified as having both minority and low-income populations (i.e., Census Block Group populations were greater than 50 percent minority and people living in poverty exceeded 20 percent), and one Census Block Group was identified as having only minority populations (Tables 3.5-12 and 3.5-13).

3.5.5.8.1.6 WDZ-F

WDZ-F contains all or a portion of eight Census Block Groups in Hansford and Sherman counties, Texas. Of the eight Census Block Groups in WDZ-F, two Census Block Groups were identified as having minority populations (Table 3.5-12). No low-income populations were identified in WDZ-F (Table 3.5-13).

3.5.5.8.1.7 WDZ-G

The WDZ-G contains a portion of two Census Block Groups in Cimarron and Texas counties, Oklahoma. No minority or low-income populations were identified in the WDZ-G (Tables 3.5-12 and 3.5-13).

3.5.5.8.1.8 WDZ-H

The WDZ-H contains one Census Block Group in Texas County, Oklahoma. No minority or low-income populations were identified in WDZ-H.

3.5.5.8.1.9 WDZ-I

The WDZ-I contains all or a portion of five Census Block Groups in Texas County, Oklahoma. Of the five Census Block Groups in WDZ-I no minority populations were identified (Table 3.5-12). One Census Block Group was identified as a low-income population in WDZ-I (Table 3.5-13).

3.5.5.8.1.10 WDZ-J

WDZ-J contains all or a portion of three Census Block Groups in Beaver and Texas counties, Oklahoma. Of the three Census Block Groups in WDZ-J, two Census Block Groups were identified as having only minority populations (Table 3.5-12). No low-income populations were identified in WDZ-J (Table 3.5-13).

3.5.5.8.1.11 WDZ-K

WDZ-K contains a portion of three Census Block Groups in Beaver and Ochiltree counties, Texas. No minority or low-income populations were identified in WDZ-K.

3.5.5.8.1.12 WDZ-L

WDZ-L contains a portion of four Census Block Groups in Hansford and Ochiltree counties, Texas. Of the four Census Block Groups in the WDZ-L, one Census Block Group was identified as having both minority and low-income populations (i.e., Census Block Group populations were greater than 50 percent minority and people living in poverty exceeded 20 percent) and one Census Block Group was identified as having only minority populations (Tables 3.5-12 and 3.5-13).

3.5.5.8.2 Optima Substation

The ROI for the future Optima Substation includes Census Blocks and Census Block Groups in Texas County, Oklahoma. The affected environment for the future Optima Substation would be similar to the affected environment discussed in Section 3.5.4.2.

3.5.5.8.3 TVA Upgrades

The ROI for the direct assignment facilities (which are included in the Applicant Proposed Project) would occur within the Tennessee Converter Station Siting Area and more specifically within the Shelby Substation. The ROI for the network upgrades, and in particular TVA's future 500kV transmission line, cannot be fully determined at this time. The new 500kV transmission line would be constructed in western Tennessee. The upgrades to existing facilities would mostly be in western and central Tennessee. Upgrades to existing infrastructure would include upgrading terminal equipment at three existing 500kV substations and six existing 161kV substations, making appropriate upgrades to increase heights on 16 existing 161kV transmission lines to increase line ratings, and replacing the conductors on eight existing 161kV transmission lines. Identification of potential low-income and minority populations by Census Blocks or Block Groups is not possible without more detailed information about the locations of the TVA upgrades. Where possible, general impacts associated with the required TVA upgrades are discussed in the impact sections that follow.

3.5.6 Environmental Justice Impacts

This section discusses potential impacts to minority or low-income populations from the construction and operation of the Project.

3.5.6.1 Methodology

Identifying whether disproportionately high and adverse human health or environmental effects on minority and/or low-income populations would occur typically involves identifying whether minority and/or low-income communities are present and whether the effects identified are predominantly borne by such populations. Minority populations and low-income populations are defined in Section 3.5.4.

The approach used to assess environmental justice concerns is consistent with guidance provided by the White House Council on Environmental Quality (CEQ) (1997): "Environmental Justice: Guidance Under the National Environmental Policy Act" and the 1998 EPA guidance: "Final Guidance for Incorporating Environmental Justice Concerns in EPA's NEPA Compliance Analyses" (EPA 1998).

Impacts can result if the proposed activities cause disproportionately high and adverse human health or environmental effects to minority and/or low-income populations. The environmental impacts from most projects tend to be highly concentrated at the actual project site and tend to decrease with distance from the project site. The environmental justice analysis for the Project examines Census Blocks and Census Block Groups in areas crossed by and in the immediate vicinity of the Project as described in Section 3.5.3. All resource areas analyzed in this EIS have been included in the environmental justice analysis. While impacts from the majority of the resource areas can be measured by proximity to the Project, special attention is given to the effects on human health in local communities. Disproportionately high and adverse human health effects are identified by assessing the following factors:

- Whether the health effects, which may be measured in risks or rates, are adverse and significant (as defined by NEPA) or above generally accepted norms. Adverse health effects may include bodily impairment, infirmity, illness, or death.
- Whether the risk or rate of exposure to a minority or low-income population to an environmental hazard exceeds the risk or rate to the general population.
- Whether adverse health effects occur in a minority or low-income population because of multiple exposures to environmental hazards.

The Applicant would implement the EPMs listed in Appendix F as part of the Project to avoid or minimize potential impacts to environmental resources from construction, operations and maintenance, and/or decommissioning.

3.5.6.2 Impacts Associated with the Applicant Proposed Project

Impacts associated with the Applicant Proposed Project include those from construction, operations and maintenance, and decommissioning of the converter stations, AC transmission lines, and HVDC transmission lines and do not differ significantly. Based on the analysis of impacts for resource areas, few long-term significant impacts from construction, operation and maintenance, and decommissioning activities are expected.

Construction-related impacts could include removal of residential landscaping, power outages or damage to existing utility structures, potential groundwater contamination from excavation and handling of hazardous materials, increases in local traffic at some highway crossings and noise, and fugitive dusts. These impacts would be temporary and localized.

Unavoidable adverse impacts could occur during construction, operations and maintenance, and decommissioning of the Project. These impacts would be expected after implementation of the EPMs and those BMPs that DOE includes in a ROD or participation agreement; however, in all cases, the impacts would have been minimized through implementation of these measures. Unavoidable adverse impacts that could occur for each environmental resource are provided in Chapter 3.

Long-term impacts could include the decrease in the long-term productivity of soils if they are not reclaimed to their existing quality condition; decrease in long-term productivity of recreational areas; increase in economic productivity; and impairment of long-term visual resources where trees or areas of thick vegetation are removed and will take years to grow back. Soil impacts are discussed in Section 3.6, Recreation resources are discussed in Section 3.12, Socioeconomics are discussed in Section 3.13, and Visual resources are discussed in Section 3.18.

Decommissioning-related impacts could include removal of residential landscaping, power outages or damage to existing utility structures, potential groundwater contamination from excavation and handling of hazardous materials, increases in local traffic at some highway crossings and noise, and fugitive dusts. These impacts would be temporary and localized, and are not expected to be high. Decommissioning would remove the long-term visual impacts related to the presence of transmission structures.

Impacts may occur in areas where minority and/or low-income populations were identified; however, it is expected that any impacts would affect all populations in the ROI equally. Therefore, no unavoidable adverse impacts would be disproportionately borne by minority and/or low-income populations as a result of the Project. No long-term significant impacts were discernable to agricultural resources; air quality and climate change; electrical environment; geology, paleontology, soils, and minerals; groundwater; health, safety, and intentional destructive acts; historic and cultural resources; land use; and noise. As shown in Section 3.8, there are no long-term health and safety impacts to any population.

3.5.6.2.1 Converter Stations and AC Interconnection Siting Areas

Section 3.5.4 presents the affected environmental justice characteristics for the Oklahoma Converter Station Siting Area and Tennessee Converter Station Siting Area and AC Interconnection Tie. No minority or low-income populations were identified in the Oklahoma Converter Station Siting Area. No minority populations were identified in the Tennessee Converter Station Siting Area. One Census Block Group in Shelby County contained low-income populations. Impacts from construction, operations and maintenance, and decommissioning activities would be the same as those discussed in Section 3.5.6.2.

3.5.6.2.2 AC Collection System

Section 3.5.4 presents the affected environmental justice characteristics for the AC collection system. Table 3.5-14 lists the AC collection system routes, counties crossed, and counties where minority or low-income populations were identified. Impacts from construction, operation and maintenance, and decommissioning activities would be the same as those discussed in Section 3.5.6.2.

Table 3.5-14:
AC Collection System Route Corridors and Counties where Minority or Low-Income Populations were Identified

AC Collection System Route	Counties Crossed	Counties where Minority or Low-income Populations were Identified
E-1	Oklahoma—Texas and Beaver	Oklahoma—Texas
E-2	Oklahoma—Texas and Beaver	Oklahoma—Texas
E-3	Oklahoma—Texas and Beaver	Oklahoma—Texas
NE-1	Oklahoma—Texas	Oklahoma—Texas
NE-2	Oklahoma—Texas	Oklahoma—Texas
NW-1	Oklahoma—Texas and Cimarron	Oklahoma—Texas
NW-2	Oklahoma—Texas and Cimarron	Oklahoma—Texas
SE-1	Oklahoma—Texas	Oklahoma—Texas
	Texas—Hansford and Ochiltree	Texas—Hansford and Ochiltree
SE-2	Oklahoma—Texas	Oklahoma—Texas
	Texas—Hansford	Texas—Hansford
SE-3	Oklahoma—Texas	Oklahoma—Texas
	Texas—Ochiltree	Texas—Ochiltree
SW-1	Oklahoma—Texas	Oklahoma—Texas
	Texas—Hansford	Texas—Hansford
SW-2	Oklahoma—Texas	Oklahoma—Texas
	Texas—Hansford and Sherman	Texas—Hansford
W-1	Oklahoma—Texas	Oklahoma—Texas

3.5.6.2.3 Applicant Proposed Route

Section 3.5.4 presents the affected environmental justice characteristics for the Applicant Proposed Route in Regions 1-7. Table 3.5-15 lists the HVDC applicant proposed route by region, counties crossed, and counties where minority or low-income populations were identified. Impacts from construction, operation and maintenance, and decommissioning activities would be the same as those discussed in Section 3.5.6.2.

Table 3.5-15:
Applicant Proposed Route and Counties where Minority or Low-Income Populations were Identified

Region	Counties Crossed	Counties where Minority or Low-income Populations were Identified
Region 1	Oklahoma—Texas, Beaver, and Harper	Oklahoma—Texas County
Region 2	Oklahoma—Woodward, Major, and Garfield	Oklahoma—Woodward and Major
Region 3	Oklahoma—Garfield, Kingfisher, Logan, Payne, Lincoln, Creek, Okmulgee, and Muskogee	Oklahoma—Okmulgee and Muskogee

Table 3.5-15:
Applicant Proposed Route and Counties where Minority or Low-Income Populations were Identified

Region	Counties Crossed	Counties where Minority or Low-income Populations were Identified
Region 4	Oklahoma—Muskogee and Sequoyah	Oklahoma—Muskogee and Sequoyah
	Arkansas—Crawford, Franklin, Johnson, and Pope	Arkansas—Crawford, Franklin, Johnson, and Pope
Region 5	Arkansas—Pope, Conway, Van Buren, Cleburne, White, and Jackson	Arkansas—Pope, Conway, Van Buren, Cleburne, White, and Jackson
Region 6	Arkansas—Jackson, Cross, and Poinsett	Arkansas—Jackson, Cross, and Poinsett
Region 7	Arkansas—Poinsett and Mississippi	Arkansas—Poinsett and Mississippi
	Tennessee—Tipton and Shelby	Tennessee—Tipton and Shelby

3.5.6.3 Impacts Associated with the DOE Alternatives

Impacts associated with the DOE Alternatives would be the same as those discussed in Section 3.5.6.2 for the Applicant Proposed Project.

3.5.6.3.1 Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area

Section 3.5.4 presents the affected environmental justice characteristics for the Arkansas Converter Station and AC Interconnection Siting Areas. Only one Census Block in Pope County had minority and low-income populations. Impacts from construction, operations and maintenance, and decommissioning activities would be the same as those discussed in Section 3.5.6.2.

3.5.6.3.2 HVDC Alternative Routes

Section 3.5.4 presents the affected environmental justice characteristics for the HVDC Alternative routes. Table 3.5-16 lists the counties crossed and the counties where minority or low-income populations were identified for the HVDC alternative routes. Impacts from construction, operation and maintenance, and decommissioning activities under all alternatives would be the same as those discussed in Section 3.5.6.2.

Table 3.5-16:
HVDC Alternative Routes and Counties where Minority or Low-Income Populations were Identified

HVDC Alternative Route	Counties Crossed	Counties where Minority or Low-income Populations were Identified
Region I		
1-A	Oklahoma—Texas, Beaver, Harper, and Woodward	Oklahoma—Texas and Woodward
1-B	Oklahoma—Texas and Beaver	Oklahoma—Texas
1-C	Oklahoma—Texas and Beaver	Oklahoma—Texas
1-D	Oklahoma—Beaver and Harper	None
Region 2		
2-A	Oklahoma—Woodward, Major, and Garfield	Oklahoma—Woodward and Major
2-B	Oklahoma—Major and Garfield	Oklahoma—Major
Region 3		
3-A	Oklahoma—Garfield, Logan, and Payne	None
3-B	Oklahoma—Garfield, Kingfisher, Logan, and Payne	None
3-C	Oklahoma—Payne, Lincoln, Creek, Okmulgee, and Muskogee	Oklahoma—Okmulgee and Muskogee
3-D	Oklahoma—Muskogee	Oklahoma—Muskogee
3-E	Oklahoma—Muskogee	Oklahoma—Muskogee
Region 4		
4-A	Oklahoma—Sequoyah	Oklahoma—Sequoyah
	Arkansas—Crawford and Franklin	Arkansas—Crawford and Franklin
4-B	Oklahoma—Sequoyah	Oklahoma—Sequoyah
	Arkansas—Crawford and Franklin	Arkansas—Crawford and Franklin
4-C	Arkansas—Crawford	Arkansas—Crawford
4-D	Arkansas—Crawford and Franklin	Arkansas—Crawford and Franklin
4-E	Arkansas—Franklin, Johnson, and Pope	Arkansas—Franklin, Johnson, and Pope
Region 5		
5-A	Arkansas—Pope	Arkansas—Pope
5-B	Arkansas—Pope, Conway, Faulkner, and White counties	Arkansas—Pope, Conway, and White
5-C	Arkansas—White	Arkansas—White
5-D	Arkansas—White and Jackson	Arkansas—White and Jackson
5-E	Arkansas—Van Buren, Faulkner, and White	Arkansas—Van Buren and White
5-F	Arkansas—Cleburne and White	Arkansas—Cleburne and White
Region 6		
6-A	Arkansas—Jackson and Poinsett	Arkansas—Jackson and Poinsett
6-B	Arkansas—Jackson and Poinsett	Arkansas—Jackson and Poinsett
6-C	Arkansas—Poinsett	Arkansas—Poinsett
6-D	Arkansas—Cross and Poinsett	Arkansas—Cross and Poinsett
Region 7		
7-A	Arkansas—Poinsett and Mississippi	Arkansas—Poinsett and Mississippi
	Tennessee—Tipton	Tennessee—Tipton
7-B	Tennessee—Tipton and Shelby	Tennessee—Tipton and Shelby
7-C	Tennessee—Tipton and Shelby	Tennessee—Tipton and Shelby
7-D	Tennessee—Tipton and Shelby	Tennessee—Tipton and Shelby

3.5.6.4 Communities of Shared Interest

The term ‘community of shared interest’ is used to refer to geographically dispersed individuals who could experience common conditions of environmental impacts. The National Agricultural Workers Survey for fiscal years 2001 and 2002 found that 83 percent of crop workers in the United States identified themselves as members of a Hispanic group and that 78 percent of crop workers were born outside the United States, primarily in Mexico (75 percent of all crop workers) (DOL 2005). This survey also found that 30 percent of all farm workers had total family incomes below federal poverty guidelines.

The potential effects of construction on agriculture production are addressed in Section 3.2, and the potential effects to the agricultural sector and employment are discussed in Section 3.13. Operation of the Project has the potential to disproportionately affect minority and low-income farm workers. Viewed in terms of agricultural operations in the potentially affected counties, however, total estimated construction disturbance represents a very small percentage and is not likely to noticeably impact agricultural production or employment or cause adverse impacts to human health or the environment.

3.5.6.5 Best Management Practices

No BMPs have been identified. The Applicant would implement the EPMs listed in Appendix F to avoid or minimize potential impacts to environmental resources from construction, operations and maintenance, and/or decommissioning of the Project.

3.5.6.6 Unavoidable Adverse Impacts

No unavoidable adverse impacts would be disproportionately borne by minority and/or low-income populations as a result of the Project.

3.5.6.7 Irreversible and Irretrievable Commitment of Resources

No irreversible or irretrievable commitment of resources was identified.

3.5.6.8 Relationship between Local Short-term Uses and Long-term Productivity

Because the EIS did not identify any disproportionately high and adverse impacts to low-income or minority populations, there would be no short-term or long-term impact to these populations.

3.5.6.9 Impacts from Connected Actions

3.5.6.9.1 Wind Energy Generation

Section 3.5.3.3.1 presents the affected environmental justice characteristics for wind energy generation. Environmental justice areas were identified in 7 of the 12 WDZs. Tables 3.5-12 and 3.5-13 lists Census Block Groups where minority or low-income populations were identified within WDZs.

Based on the analysis of impacts for resource areas, few long term impacts from construction and operations and maintenance activities are expected.

Impacts related to the construction of wind farms would be short term and could include noise impacts from machinery and blasting, increased levels of fugitive dust and increases in local traffic. Impacts related to operations and maintenance could include visual, noise, or shadow flicker.

In areas where minority and/or low-income populations were identified, it is expected that any impacts would affect all populations in the ROI equally. No high or adverse impacts were discernible to agricultural resources; air quality and climate change; electrical environment; geology, paleontology, soils, and minerals; groundwater; health, safety, and intentional destructive acts; historic and cultural resources; land use; and noise. As shown in Section 3.8, there are no long term impacts to any population.

3.5.6.9.2 Optima Substation

Section 3.5.5.8.2 presents the affected environmental justice characteristics for the future Optima Substation. The future Optima Substation is anticipated to be located within the Oklahoma AC Interconnection Siting Area in Texas County, Oklahoma. Impacts associated with the future Optima Substation would be the same as those discussed in Section 3.5.6.2 for the Applicant Proposed Project.

3.5.6.9.3 TVA Upgrades

Identification of potential low-income and minority populations by county would require more detailed information about the potential locations of the TVA upgrades. Some of the affected counties may have qualifying minority and low-income populations that could raise environmental justice concerns. Depending on location, construction of the new electric transmission line that would be required may have greater potential to affect qualifying minority and low-income populations than required upgrades to existing facilities.

3.5.6.10 Impacts Associated with the No Action Alternative

Under the No Action Alternative, DOE assumes for analytical purposes that the Project would not move forward, so no disproportionately high and adverse effects to low-income and minority populations would result from activities related to construction, operations and maintenance, or decommissioning.

Contents

Tables

Figures Presented in Appendix A

3.6 Geology, Paleontology, Minerals, and Soils

This section is divided under two major headings: geology, paleontology, and mineral resources (section 3.6.1) and soils (section 3.6.2). The reason for the separation is that the affected environment and impacts associated with soils—such as farmland, erosion, and compaction—are generally much different than those for geology (e.g. geologic hazards such as earthquakes and karst).

3.6.1 Geology, Paleontology, and Minerals

3.6.1.1 Regulatory Background

One federal law related to geology, paleontology, minerals, or soils that could affect the proposed Project or the manner in which it would be implemented is listed in (Table 3.6.1-1). No applicable state or local quantitative geological or soil regulations exist for the states of Oklahoma, Arkansas, Tennessee, or Texas. Seismic activity prone areas, such as Shelby County, Tennessee, are in the process of evaluating the adoption of the 2009 National Earthquake Hazards Reduction Program Recommended Provisions for Seismic Regulations for New Buildings and Other Structures (FEMA 2009) or other applicable regulations.

Table 3.6.1-1:
Federal Law Associated with Geological Resources

Statute/Regulation	Key Elements
National Earthquake Hazards Reduction Program Reauthorization Act of 2004 (42 USC 7701 *et seq.*)	The purpose of the National Earthquake Hazards Reduction Program Reauthorization Act of 2004 (42 USC 7701 et seq.) is to reduce the risks to life and property from future earthquakes in the United States through the establishment and maintenance of an effective earthquake hazards reduction program. The Act supports the development of standards and technology for buildings and structures to withstand damage from earthquakes.

3.6.1.2 Data Sources

Data sources include published maps and reports and internet websites of the U.S. Geological Survey (USGS), Oklahoma Geological Survey, Arkansas Geological Survey, and Federal Emergency Management Agency (FEMA). Digital information on faults, earthquakes, landslides, karst features, soil liquefaction, and seismicity was obtained from USGS datasets and maps (GIS Data Sources: EIA 2011a, 2011b; Tobin and Weary 2004, USGS 2005a, 2005b, 2008a, 2008b, 2014, 2010; CUSEC 2008; NRCS 2006, 2013; EPA 2014b; Garrity and Soller 2009). Other data sources included academic and professional journals and publications. Reference citations are provided within the text and a complete listing of each reference is provided in Chapter 6. A summary description of the reference sources follows:

- The probabilistic seismic hazard analyses incorporate estimates of the magnitude and location of all likely earthquakes, how often these earthquakes would occur, and the strength of ground shaking they would cause (USGS 2010a, 2010b; USGS and TBEG 2006).
- Karst areas were identified based on information from USGS.
- FEMA Hazus Program Liquefaction Susceptibility Maps (GIS Data Source: CUSEC 2008) were used to determine liquefaction susceptibility.
- USGS-prepared Landslide Inventory Maps (GIS Data Source: USGS 2001) were used to evaluate geologic formations or groups of formations as having high, moderate, or low landslide susceptibility.

- The potential for impacts to mineral resource accessibility and fossil resources was determined as follows. Mineral resources were mapped to determine whether the Project might impact accessibility to existing and potential extraction operations. The primary mineral resources produced in the region are fossil fuels including oil, natural gas, and coal. Additional minerals mined in the region include limestone, building stone, sand and gravel, gypsum, clay and shale, granite, volcanic ash, Tripoli, salt, bentonite, iron ore, and chat.
- The BLM and local natural history museums (Clean Line 2014) were contacted regarding potential significant fossil finds/beds.

3.6.1.3 Region of Influence

3.6.1.3.1 Region of Influence for the Project

The ROI for paleontology resources is the same as the description provided in Section 3.1.1.

Specific to geologic and mineral resources, the ROI was increased, and the following areas for Project components were evaluated to provide an indication of surrounding mineral resource operations to evaluate potential impacts related to the potential future expansion of mineral mines and oil and gas drilling operations that might encroach on the Project:

- Oil and gas wells and mines: a 4,000-foot-wide corridor along the HVDC transmission lines
- Oil and gas wells and mines: a 1,500-foot-wide buffer surrounding the converter station siting areas

3.6.1.3.2 Region of Influence for Connected Actions

The geology, minerals, and paleontology ROI for wind energy generation, the future Optima substation, and the TVA upgrades is described in Section 3.1.1.

3.6.1.4 Affected Environment

Several route variations to the Applicant Proposed Route in Regions 2–7 were developed in response to public comments on the Draft EIS, and are described in Appendix M and summarized in Sections 2.4.2.1–2.4.2.7. Assessments of the impacts related to the route variations by Project region, including accompanying HVDC alternative route adjustments, are provided below. The variations are presented graphically in Exhibit 1 of Appendix M.

3.6.1.4.1 Physiography and Surface Geology

The Project traverses three physiographic divisions: the Interior Plains, Ouachita-Ozark Highlands, and the Atlantic Plain (GIS Data Source: NRCS 2006). The Interior Plains Division encompasses the Oklahoma converter station and AC interconnection in Region 1; the HVDC transmission line in Regions 1, 2, and part of 3; and the AC collection system in Region 1.

The Interior Plains Division is characterized by thick layers of sediments that accumulated in shallow seas that once covered large areas of North America. These sediments were buried and lithified (transformed into stone) into marine shales, limestones, and sandstones. They were subsequently uplifted, and rocks and sediments that were deposited earlier were exposed and eroded. Uplift processes include the gentle arching of broad areas, and mountain building, whereby rocks were intensely folded, faulted, and thrust upward. The majority of the region has low relief, reflecting more than 500 million years of relative tectonic stability, and is drained by tributaries of either the Mississippi or Missouri River system (Fenneman 1928).

The Arkansas converter station and AC interconnection, and the HVDC transmission line in the remainder of Region 3, Region 4, and the majority of Region 5, are within the Ouachita-Ozark Highlands Division, which includes the Osage Cuestas Lower Boston Mountains, Lower Boston Mountains, and Arkansas Valley Hills. The Oucahita-Ozark Highlands Division contains ancient eroded mountains surrounded by nearly flat-lying sedimentary rocks and deposits of the Interior and Atlantic Plains divisions. Unlike the relatively young rocks that characterize neighboring physiographic provinces, the rocky outcrops that make up the core of the Ouachita-Ozark Highlands consist of Paleozoic-age carbonate and other marine sedimentary rocks (Foti and Bukenhofer 1998).

The Tennessee Converter Station Siting Area and AC Interconnection Tie and the HVDC transmission line in Regions 5, 6, and the western portion of Region 7 are within the Atlantic Plain Division. The Atlantic Plain Division consists of an intra-continental rift zone, centered under the New Madrid Fault, covered by thick layers of sedimentary and volcanic debris thousands of feet thick (Foti and Bukenhofer 1998). The Atlantic Plain Division slopes gently seaward from the Inland Highlands in a series of terraces, continuing far into the Atlantic and Gulf of Mexico, where it forms the continental shelf. The Atlantic Plain Division is the flattest physiographic region traversed by the Project.

3.6.1.4.2 Bedrock Geology and Paleontological Resources

This section discusses the bedrock geology and paleontological resources throughout the ROI and focuses primarily on the upper strata of bedrock and fossils formed during the Quaternary Period, the most recent geological period in Earth's history, which is divided into the Pleistocene and Holocene epochs.

Oklahoma and Texas

The Oklahoma converter station and AC interconnection; the AC collection system routes; and the HVDC transmission line in Regions 1, 2, 3, and the western part of Region 4 are located in Oklahoma and Texas and have similar geology (GIS Data Source: Garrity and Soller 2009).

Clay, silt, sand, and gravel from Pleistocene and Holocene deposits are typically unconsolidated and range in depth from 25 to 100 feet thick. Modern floodplains consist mainly of alluvium deposited during the Holocene Epoch. Quaternary river-borne sediments decrease in grain size from west to east across Oklahoma; gravel, commonly mixed with river sands in the west, is abraded so much during transport that it is almost absent in the east. Eolian (wind carried) sediments characterize Quaternary deposits in sand dunes in western Oklahoma and occur primarily on the northern sides of major rivers (Johnson 2008).

The Anadarko Shelf and northern portion of the Anadarko Basin underlie the AC collection system routes and HVDC transmission line in Regions 1 and 2. The Cherokee Platform underlies the HVDC transmission line that traverses Region 3. The western portion of the Anadarko Basin consists of Tertiary river and windblown deposits of sand, clay, gravel, and caliche deposited from ancient rivers draining the Rocky Mountains, generally 200 to 600 feet thick. The eastern portion of the Anadarko Basin and the western Cherokee Platform consists of Permian, shallow-marine, deltaic, and alluvial deposits of predominately red sandstone and shale, with conspicuous outcrops of white gypsum and thick salt deposits in the subsurface of the Anadarko, generally 1,000 to 6,500 feet thick (Johnson 2008).

The upper portion of the eastern Anadarko Basin and the lower portion of the western Cherokee Platform consist of marine red sandstone and shale with some thin beds of limestone. The eastern Cherokee Platform consists of Pennsylvanian marine shale, with interbedded sandstone, limestone, and coal, commonly 2,000 to 5,000 feet thick. The Ozark Uplift underlies western portion of the HVDC transmission line traverse in Region 4. The Uplift is typified by mostly marine Mississippian shale and sandstone commonly 1,000 to 6,000 feet thick, but up to 10,000 feet thick in the Ouachita Mountains, as well as Silurian-Devonian marine chert, shale, and sandstone in 500- to 1,500-foot-thick units (Johnson 2008). Shale plays (defined geographic areas containing an organic-rich, fine-grained sedimentary rock with unique characteristics) in the ROI are shown on Figure 3.6-1 (located in Appendix A).

Arkansas and Tennessee

The state of Arkansas is broken into different geological regions, two of which are traversed by the ROI: the Ozark Plateaus and the Mississippi Embayment and Gulf Coastal Plain (GIS Data Source: EPA 2010). The eastern portion of the HVDC transmission line in Region 4, the western section of Region 5, and the Arkansas converter station occur within the Ozark Plateau. This area is generally flat-lying Paleozoic-age strata divided into three plateau surfaces. The plateau that the ROI traverses is the Boston Mountains, the southernmost and highest plateau in the Ozark Region. Pennsylvanian age shales, siltstones, and sandstones dominate the bedrock (McFarland 1998).

The Tennessee Converter Station Siting Area and AC Interconnection Tie, and the HVDC transmission line in eastern part of Region 5 and in Regions 6 and 7 are in the Mississippi Embayment and Gulf Coastal Plain. The Mississippi River Alluvial Plain (within the Mississippi Embayment) consists of recent sedimentary deposits with small areas of igneous intrusions. Cretaceous sedimentary deposits are exposed in southwestern Arkansas and represent shallow, marginal, and often restricted marine environments. This region's upper strata are dominated by Quaternary terrace and alluvial deposits (McFarland 1998).

3.6.1.4.3 Geologic Hazards

3.6.1.4.3.1 Seismic Hazards

Seismicity refers to the intensity and the geographic and historical distribution of earthquakes (USGS 2013; GIS Data Source: USGS 2008a). This analysis includes earthquakes of magnitude (M) 3.5 or greater that have occurred within 50 miles of the ROI over the last 150 years (USGS 2013; GIS Data Source: USGS 2008a). Earthquake damage is a function of magnitude and proximity to vulnerable structures/features. While earthquakes of M3.5 to M4.0 may not be noticed by most people, they can cause minor damage (e.g., cracks in mortar or stone cladding) to structures within a few miles. Earthquakes of M4.0 to M4.9 are typically felt and can cause slight damage, overturn unstable objects, and trigger landslides on extremely unstable slopes. Earthquakes of M5.0 to M5.9 will cause slight to moderate damage in well-built ordinary structures and considerable damage in poorly built or badly designed structures (USGS 2013).

Recently, an increase in seismic events within 50 miles of the ROI has occurred (more than 250 since 2005, with approximately 100 greater than M3.5, compared to 67 between 1980 and 2005 and 33 between 1863 and 1980). Most are low intensity (less than M4.0) and located around the Woodford shale in Oklahoma and Fayetteville shale in Arkansas. Recent USGS research (USGS 2014) has confirmed that the increased frequency of these seismic events may be at least partially caused by hydraulic fracturing (the fracturing of rock by a pressurized liquid) and enhanced recovery operations in some areas.

The probabilistic seismic hazard analyses data used to assess the ROI incorporate estimates of the magnitude and location of all likely earthquakes, how often these earthquakes occur, and the strength of ground shaking that they cause. The data are time independent, represent a long-term average hazard, and are not affected by when the last earthquake rupture occurred (USGS 2010a, 2010b, USGS and TBEG 2010). The USGS Seismic Hazard Mapping Program (GIS Data Source: USGS 2008a) expresses the probabilistic seismic hazard analyses for the peak ground acceleration (PGA) as a factor of gravity (g), with a 10 percent probability of exceedance within a 50-year period. PGA is defined as a measure of earthquake acceleration on the ground. It is not a measure of the total energy (magnitude or size) of the earthquake, but rather of how hard the earth shakes in a given geographic area (the intensity). In this analysis, PGA is expressed in g (the acceleration due to Earth's gravity, equivalent to g-force).

3.6.1.4.3.2 Landslides

The primary cause of landslides is gravity acting on an over-steepened slope. Other contributing factors include intense or prolonged rainfall, earthquakes, rapidly melting snow, volcanic activity, and various human actions. USGS prepared Landslide Inventory Maps (GIS Data Source: USGS 2001) that DOE used to evaluate the ROI by evaluating geologic formations or groups of formations as having high, medium, or low landslide susceptibility.

Landslide incidence is defined as the number of landslides that have occurred in a given geographic area. Landslide susceptibility is defined as the probable degree of slope failure. The landslide susceptibility/incidence map for the ROI is shown in Figure 3.6-3 in Appendix A. The map units are divided into three incidence categories according to the percentage of the area affected by landslides:

- Low (less than 1.5 percent of area has experienced landslides)
- Moderate (1.5 percent to 15 percent area has experienced landslides)
- High (greater than 15 percent of area has experienced landslides)

Low, moderate, and high susceptibility are delimited by the same percentages as those used to define the incidence categories. Susceptibility is not indicated where it is the same as or lower than incidence. The map units are divided into three additional incidence/susceptibility categories:

- Moderate susceptibility/low incidence
- High susceptibility/low incidence
- High susceptibility/moderate incidence

3.6.1.4.3.3 Subsidence

Subsidence hazards involve either the sudden collapse of the ground to form a depression or the slow movement downward or compaction of the sediments near the earth’s surface. The most common types of subsidence are subsidence due to erosion of soil or rock and collapses involving the dissolution of carbonate rocks (limestones) beneath the surface. Subsidence in the ROI can occur in areas of karst geologic formations, or elsewhere, as result of drainage of wet soils.

The presence of karst formations can contribute to land subsidence. Karst is distinctive topography in which the landscape is largely shaped by the dissolving action of water on carbonate and evaporative rock (usually limestone, dolomite, or marble). Karst terrain is characterized by disappearing streams, springs, caves, and sinkholes (Epstein et al 2005). Karst areas were identified for the ROI based on information from USGS (GIS Data Source: Tobin and Weary 2004). Karst areas for the ROI are shown on Figure 3.6-4 in Appendix A.

3.6.1.4.3.4 Soil Liquefaction

Liquefaction may occur when loose, cohesionless, and water-saturated soils lose strength and stiffness in response to stress, such as the ground shaking from an earthquake, causing the soil to behave like a liquid (NRCS 2014). Liquefaction potential in a soil layer increases with decreasing fines content and plasticity of the soil. Liquefaction is more likely to occur in soil/sediment layers with at least 80 to 85 percent saturation and located within 50 feet of the ground surface.

State geologists for Arkansas, Tennessee, and the six other states surrounding the New Madrid Seismic Zone developed Liquefaction Susceptibility Maps for the FEMA Hazus program (GIS Data Source: CUSEC 2008). The maps include six categories for Liquefaction Susceptibility: None, Very Low, Low, Moderate, High, and Very High. Data are not available for portions of the ROI located in Oklahoma and Texas. However, soil liquefaction is less likely in these states because of lower probable PGA. Liquefaction susceptibility for the ROI is shown in Figure 3.6-5 (located in Appendix A).

3.6.1.4.3.5 Paleontological Resources

Fossils would be more likely encountered in areas of shallow bedrock. Quaternary rocks may contain fossils of wood, clams, snails, horses, camels, bison, and mammoths. Tertiary rocks may contain abundant fossils of mammals, including the remains of horses, camels, mastodons, and rhinoceroses. Petrified wood can also be found in these rocks. Lake sediments can contain fossil snails, clams, and algae. Cretaceous, Jurassic, and Triassic rocks may contain abundant fossils, including large oysters, echinoids (sea biscuits), clams, and snails, as well as shark teeth and the occasional remains of large reptiles, such as crocodiles, mosasaurs, and plesiosaurs. Permian rocks may contain fossils of amphibians and reptiles as well as vertebrate footprints.

3.6.1.4.3.6 Mineral Resources

In the ROI, the primary mineral resource production is from fossil fuels, oil, natural gas, and coal. Additional minerals mined include limestone, building stone, sand and gravel, gypsum, clay and shale, granite, volcanic ash, Tripoli, salt, bentonite, iron ore, and chat. Portions of the Project traverse significant oil and natural gas fields, particularly the Anadarko Basin and Arkoma Basin (GIS Data Source: USGS 2005b).

The western portion of the ROI (particularly in Regions 4 and 5) is located within a part of the United States that is experiencing a boom in natural gas production because of the use of hydraulic fracturing and horizontal drilling technologies. This new technology has made the recovery of shale gas economically viable. Mineral resources within the ROI are shown on Figure 3.6-6 (located in Appendix A).

3.6.1.5 Regional Description

3.6.1.5.1 Region 1

Geologic hazards and mineral resources within the ROI in Region 1 for the HVDC alternative routes and AC collection system route alternatives are summarized in Table 3.6.1-2. Tables throughout the regional description sections that follow show only the information that is relevant for each. For example, because landslide potential is low, and no seismic fault lines, mines, or shale gas plays are located in Region 1, these are not shown in the table. Soil liquefaction is unlikely in the ROI because of the low probable PGA.

Table 3.6.1-2:
Geologic Hazards and Mineral Resources—Region 1

Hazard/Mineral Resource	HVDC Alternative Routes				APR Total	Oklahoma Converter Station
	AR 1-A	AR 1-B	AR 1-C	AR 1-D		
Geologic Hazard						
3.5–3.9 Earthquakes (number)[1]	1	1	1	1	1	0
4.0+ Earthquakes (number)[1]	2	1	1	1	2	1
Karst Formation (acres and percentage of entire ROI)[2]	1,215 (8%)	2,202 (35%)	1,203 (19%)	0 (0%)	3,474 (25%)	626 (100%)
Shallow Bedrock (acres and percentage of entire ROI)[3]	2,852 (19%)	515 (8%)	341 (5%)	225 (5%)	1,681 (12%)	264 (42%)
Mineral Resources						
Oil and Gas Wells[4]	19	11	8	5	33	0
Mineral Resources[5]	3	6	2	1	9	0

Hazard/Mineral	AC Collection System Routes												
Resource	E-1	E-2	E-3	NE-1	NE-2	NW-1	NW-2	SE-1	SE-2	SE-3	SW-1	SW-2	W-1
Geologic Hazard													
3.5 - 3.9 Earthquakes[1] (number)	0	0	0	0	0	0	0	1	0	1	0	2	0
4.0 + Earthquakes[1] (number)	1	1	1	1	1	1	1	1	1	1	1	1	1

Hazard/Mineral	AC Collection System Routes												
Resource	E-1	E-2	E-3	NE-1	NE-2	NW-1	NW-2	SE-1	SE-2	SE-3	SW-1	SW-2	W-1
Karst Formation (acres and percentage of entire ROI)[2]	11,404 (29%)	37,409 (71%)	30,576 (57%)	25,271 (63%)	17,079 (49%)	28,979 (43%)	61,241 (83%)	33,789 (64%)	18,926 (100%)	48,940 (76%)	19,142 (100%)	13,176 (27%)	7,686 (27%)
Shallow Bedrock (acres and percentage of entire ROI)[3]	7,015 (18%)	3,713 (7%)	6,176 (12%)	3,517 (9%)	5,326 (15%)	4,240 (6%)	3,950 (5%)	4,270 (8%)	1,927 (10%)	3,825 (6%)	1,986 (10%)	5,787 (12%)	2,522 (9%)
Mineral Resources													
Oil and Gas Wells[4]	12	19	15	0	0	4	0	0	0	43	0	0	0
Mineral Resources[5]	4	8	8	8	7	9	7	5	1	7	1	3	6

GIS Data Sources:
1 USGS (2008a)
2 Tobin and Weary (2004)
3 NRCS (2013)
4 OCC (2013)
5 USGS (2005b)

No known fossil bed sites were identified in the ROI in Region 1. Fossils would be more likely encountered in areas of shallow bedrock, which underlies 12 percent of the Applicant Proposed Route and 5 to 19 percent of the HVDC alternative routes. Shallow bedrock underlies 5 to 18 percent of the AC collection system routes.

No route variations were proposed in Region 1.

3.6.1.5.2 Region 2

Geologic hazards and mineral resources within the ROI in Region 2 are summarized in Table 3.6.1-3. Soil liquefaction is unlikely in the ROI because of the low probable PGA.

Table 3.6.1-3:
Geologic Hazards and Mineral Resources within the ROI—Region 2

Hazard/Mineral Resource[1a]	HVDC Alternative Route		APR Total
	AR 2-A	AR 2-B	
Geologic Hazards			
3.5–3.9 Earthquakes(number)[1]	6	27	28
4.0+ Earthquakes (number)[1]	1	4	5
Karst Formation (acres and percentage of entire ROI)[2]	1,531 (22%)	0 (0%)	941 (7%)
Shallow Bedrock (acres and percentage of entire ROI)[3]	2,703 (39%)	1,504 (41%)	2,336 (18%)
Mineral Resources			
Oil and Gas Wells[4]	0	3	5
Mineral Resources[5]	0	0	1
Shale Gas Plays (acres and percentage of entire ROI)[6]	0 (0%)	0 (0%)	2,609 (20%)

1a The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
GIS Data Sources:
1 USGS (2008a)
2 Tobin and Weary (2004)
3 NRCS 2013
4 OCC 2013
5 USGS 2005b
6 EIA (2011a)

No known fossil bed sites were identified in the ROI in Region 2. Fossils would be more likely encountered in areas of shallow bedrock, which occur in isolated areas in 18 percent of the Applicant Proposed Route and in all segments of the HVDC alternative route ROIs (39 to 41 percent).

Two route variations to the Applicant Proposed Route were developed in Region 2 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.2. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route, and the geologic hazards and mineral resources would remain consistent within the ROI.

3.6.1.5.3 Region 3

Geologic hazards and mineral resources within Region 3 are summarized in Table 3.6.1-4. The ROI in Region 3 has a higher number of recorded seismic events than other regions, particularly where it crosses the Nemaha uplift and energy productions areas of the Woodford shale. Soil liquefaction is unlikely in the ROI because of the low probable PGA. Three percent of the ROI for the Applicant Proposed Route is within an area of high susceptibility to landslides. HVDC Alternative Routes AR 3-C and AR 3-D also include areas of high susceptibility to landslides.

Table 3.6.1-4:
Geologic Hazards and Mineral Resources within the ROI—Region 3

Hazard/Mineral Resource[1a]	HVDC Alternative Route					APR Total
	AR 3-A	AR 3-B	AR 3-C	AR 3-D	AR 3-E	
Geologic Hazards						
3.5–3.9 Earthquakes (number)[1]	44	45	43	3	0	47
4.0+ Earthquakes (number)[1]	9	9	9	0	0	9
Seismic Fault Lines (number)[2]	0	0	0	0	0	1
High Susceptibility to Landslides and Low Incidence (acres and percentage of ROI)[3]	0 (0%)	0 (0%)	605 (41%)	605 (13%)	0 (0%)	611 (3%)
Shallow Bedrock (acres and percentage of ROI)[4]	3,426 (74%)	4,264 (73%)	7,435 (50%)	1,615 (34%)	580 (54%)	11,092 (56%)
Mineral Resources						
Oil and Gas Wells[5]	7	7	15	0	0	120
Mineral Resources[6]	0	0	2	0	0	10

1a The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
GIS Data Sources:
1 USGS (2008a)
2 USGS (2005a)
3 USGS (2001)
4 NRCS 2013
5 OCC 2013
6 USGS 2005b

No known fossil bed sites were identified in ROI in Region 3. Occurrences of shallow bedrock occur in all segments of the Applicant Proposed Route and HVDC alternative routes.

The Ripley Quarry, a crushed stone quarry, is located within the Region 3 ROI. Based on aerial reconnaissance (Clean Line 2013), the quarry does not currently appear to be active. The Applicant Proposed Route and HVDC alternative routes intersect up to 10 mineral resource locations.

Five route variations to the Applicant Proposed Route were developed in Region 3 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.3. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route, and the geologic hazards and mineral resources would remain consistent within the ROI.

3.6.1.5.4 Region 4

Geologic hazards and mineral resources within the ROI in Region 4 are summarized in Table 3.6.1-5. Although the ROI in Region 4 is an area of low earthquake activity, four active surface faults are located within the ROI. Approximately 20 percent of the soils within the ROI in Arkansas have high liquefaction susceptibility, but none have very high liquefaction susceptibility. As previously discussed, soil liquefaction data are not available for Oklahoma.

Table 3.6.1-5:
Geologic Hazards and Mineral Resources within the ROI—Region 4

Hazard/Mineral Resource[1a]	HVDC Alternative Routes					APR Total
	AR 4-A	AR 4-B	AR 4-C	AR 4-D	AR 4-E	
Geologic Hazards						
3.5–3.9 Earthquakes (number)[1]	0	1	0	0	16	16
4.0+ Earthquakes (number)[1]	0	0	0	0	3	3
Seismic Fault Lines (number)[2]	2	2	0	1	0	4
Karst Formation (acres and percentage of ROI)[3]	4,251 (59%)	5,233 (54%)	425 (100%)	2,753 (89%)	0 (0%)	3,356 (22%)
High-Very High Soil Liquefaction Potential (acres and percentage of ROI)[4]	0 (0%)	0 (0%)	160 (38%)	28 (1%)	475 (11%)	2,151 (14%)
Shallow Bedrock (acres and percentage of ROI)[5]	6,080 (85%)	7,706 (80%)	425 (100%)	2,711 (87%)	2,646 (59%)	9,679 (63%)
Mineral Resources						
Oil and Gas Wells[6]	18	48	4	12	76	181
Mineral Resources[7]	1	1	0	0	2	3
Shale Gas Plays (acres and percentage of ROI)[8]	2,870 (40%)	4,743 (49%)	425 (100%)	3,106 (100%)	4,491 (100%)	9,618 (62%)

1a The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
GIS Data Sources:
1 USGS (2008a)
2 USGS (2005a)
3 Tobin and Weary (2004), USFWS (2010)
4 CUSEC (2008)
5 NRCS 2013
6 OCC 2013 and AOGC 2014
7 USGS 2005b
8 EIA (2011a)

No known fossil bed sites were identified in the ROI in Region 4, but fossils would be more likely encountered in areas of shallow bedrock. Intersected shale gas plays and oil and gas wells are primarily located in the eastern part of Region 4.

Seven route variations to the Applicant Proposed Route were developed in Region 4 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.4. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route, and the geologic hazards and mineral resources would remain consistent with the corresponding ROI.

3.6.1.5.5 Region 5

Geologic hazards and mineral resources within Region 5 are summarized in Table 3.6.1-6. The ROI in Region 5 is an area of low to moderate earthquake activity with seven active surface faults. An unclassified fault crosses the south quarter of the Arkansas converter station alternative (GIS Data Source: Garrity and Soller 2009). Earthquake hazard transitions from low to moderate with eastward progression within the Region 5 ROI. Soils with high liquefaction susceptibility are mostly located in the easternmost portion of the ROI. Approximately 9 percent of the soils within the siting area for the Arkansas Converter Station Alternative have high liquefaction potential, but there are no soils with a very high liquefaction potential.

Table 3.6.1-6:
Geologic Hazards and Mineral within the ROI—Region 5

Hazard/Mineral Resource[1a]	HVDC Alternative Route						APR Total	Arkansas Converter Station
	AR 5-A	AR 5-B	AR 5-C	AR 5-D	AR 5-E	AR 5-F		
Geologic Hazards								
3.5–3.9 Earthquakes (number)[1]	23	23	21	27	22	22	29	23
4.0+ Earthquakes (number)[1]	9	9	9	11	9	9	11	9
Seismic Fault Lines (number)[2]	0	1	0	1	1	0	2	1
High Susceptibility to Landslides and Low Incidence (acres and percentage of ROI)[3]	0 (0%)	0 (0%)	0 (0%)	761 (29%)	0 (0%)	0 (0%)	559 (49%)	0 (0%)
Karst Formation (acres and percentage of ROI)[4]	0 (0%)	0 (0%)	0 (0%)	1,930 (73%)	0 (0%)	0 (0%)	1,535 (11%)	0 (0%)
High-Very High Soil Liquefaction Potential (acres and percentage of ROI)[5]	0 (0%)	305 (4%)	0 (0%)	862 (32%)	0 (0%)	0 (0%)	1,316 (10%)	31 (9%)
Shallow Bedrock (acres and percentage of ROI)[6]	1,289 (83%)	7,985 (92%)	1,032 (91%)	2,085 (78%)	4,197 (94%)	2,516 (92%)	11,962 (87%)	282 (79%)
Mineral Resources								
Oil and Gas Wells[7]	14	212	65	5	103	57	282	3
Mineral Resources[8]	0	4	0	0	2	2	0	0
Shale Gas Plays (acres and percentage of ROI)[9]	1,553 (100%)	8,686 (100%)	1,137 (100%)	2,547 (96%)	4,449 (100%)	2,748 (100%)	13,128 (95%)	360 (100%)

1a The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
GIS Data Sources:
1 USGS (2008a)
2 USGS (2005a)
3 USGS (2001)
4 Tobin and Weary (2004), USFWS (2010)
5 CUSEC (2008)
6 NRCS (2013)
7 AOGC (2014)
8 USGS (2005b)
9 EIA (2011a)

Forty-nine percent of the Applicant Proposed Route ROI is within an area of high susceptibility to landslides. The Arkansas Converter Station Siting Area is characterized by moderate susceptibility to landsliding and low incidence.

Eleven percent of Applicant Proposed Route ROI and 73 percent of HVDC Alternative Route 5-D ROI is located within karst formations. No karst formations have been identified for the remainder of the HVDC Alternative Route ROIs in Region 5 or in the Arkansas Converter Station Alternative Siting Area, so the susceptibility for land subsidence as a result of karst formations is low.

No known fossil bed sites were identified in the ROI in Region 5. Fossils would be more likely encountered in areas of shallow bedrock.

Five route variations to the Applicant Proposed Route were developed in Region 5 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.5. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route, and the geologic hazards and mineral resources would remain consistent within the ROI. Applicant Proposed Route Link 2, Variation 2, would cross fewer oil and gas wells (one versus three) than the original Applicant Proposed Route Link 2.

3.6.1.5.6 Region 6

Geologic hazards and mineral resources within Region 6 are summarized in Table 3.6.1-7. The earthquake hazard transitions from low to moderate to moderate to high with eastward progression along the ROI in Region 6. The easternmost portion of the Applicant Proposed Route ROI and HVDC Alternative Routes 6-C and 6-D are located within moderate to high seismic hazard areas and are closer to the New Madrid Seismic Zone. Ninety-four percent of the soils have high to very high liquefaction susceptibility in the Region 6 ROI.

Table 3.6.1-7:
Geologic Hazards and Mineral Resources within the ROI—Region 6

Hazard/Mineral Resource[1a]	HVDC Alternative Routes				APR Total
	AR 6-A	AR 6-B	AR 6-C	AR 6-D	
Geologic Hazards					
3.5–3.9 Earthquakes (number)[1]	6	6	10	9	11
4.0+ Earthquakes (number)[1]	3	3	6	6	6
High-Very High Soil Liquefaction Potential (acres and percentage of ROI)[2]	1,982 (100%)	1,724 (100%)	2,550 (89%)	1,134 (100%)	6,233 (94%)
Shallow Bedrock (acres and percentage of ROI)[3]	1,180 (60%)	983 (57%)	1,329 (47%)	15 (1%)	3,095 (47%)

1a The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
GIS Data Sources:
1 USGS (2008a)
2 CUSEC (2008)
3 NRCS (2013)

No known fossil bed sites were identified in the Cretaceous-age rocks of the Region 6 ROI. Shallow bedrock is present in 47 percent of the Region 6 ROI. The ROI in Region 6 does not contain mineral resources.

One route variation was developed in Region 6 in response to public comments on the Draft EIS to parallel more parcel boundaries in order to minimize impacts to agricultural operations. The variation is illustrated in Exhibit 1 of Appendix M. The variation represents a minor adjustment to the Applicant Proposed Route, and the geologic hazards and mineral resources would remain consistent with those described for Region 6.

3.6.1.5.7 Region 7

Geologic hazards and mineral resources within Region 7 are summarized in Table 3.6.1-8. The ROI in Region 7 is an area of moderate to high seismic hazard, although there are no active surface faults located within the ROI. The PGA for HVDC Alternative Route 7-A is higher at 20 to 30 percent because it is closer to the New Madrid Seismic Zone. Approximately 99 percent of the soils in the ROI in Region 7 have high to very high liquefaction. Soils within the Tennessee Converter Station Siting Area and AC Interconnection Tie have high liquefaction susceptibility.

In the ROI in Region 7, high susceptibility to landslides is present in most areas with incidence ranging from low to moderate. Moderate incidence occurs along HVDC Alternative Route 7-D. The Tennessee Converter Station Siting Area and AC Interconnection Tie has a moderate incidence rate and a high susceptibility to landsliding because of the underlying lower Paleozoic interbedded shale and limestone and the localized significant slopes.

Table 3.6.1-8:
Geologic Hazards and Mineral Resources within the ROI—Region 7

Hazard/Mineral Resource[1a]	HVDC Alternative Route				APR Total	Tennessee Converter Station Siting Area
	AR 7-A	AR 7-B	AR 7-C	AR 7-D		
Geologic Hazards						
3.5–3.9 Earthquakes (number)[1]	17	11	11	11	11	11
4. + Earthquakes (number)[1]	7	7	7	7	7	7
High Susceptibility to Landslides and Low Incidence (acres and percentage of ROI)[2]	2,947 (56%)	203 (19%)	203 (7%)	0 (0%)	2,328 (45%)	0 (0%)
High Susceptibility to Landslides and Moderate Incidence (acres and percentage of ROI)[2]	0 (0%)	0 (0%)	1,240 (43%)	551 (69%)	504 (10%)	218 (100%)
High Susceptibility to Landslides and High Incidence (acres and percentage of ROI)[2]	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
High-Very High Soil Liquefaction Potential (acres and percentage of ROI)[3]	5,181 (99%)	1,056 (100%)	2,887 (100%)	803 (100%)	5,165 (99%)	218 (100%)
Shallow Bedrock (acres and percentage of ROI)[4]	0 (0%)	91 (9%)	664 (23%)	83 (10%)	205 (4%)	48 (22%)
Mineral Resources						
Mineral Resources[5]	1	0	0	0	1	0

1a The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
GIS Data Sources:
1 USGS (2008a)
2 USGS (2001)
3 CUSEC (2008)
4 NRCS 2013
5 USGS (2005b)

No known fossil bed sites were identified in Region 7. Shallow bedrock is limited to isolated areas of the Applicant Proposed Route and HVDC Alternative Routes 7-B, 7-C, and 7-D. About 22 percent of the Tennessee Converter Station Siting Area and AC Interconnection Tie is underlain by shallow bedrock.

Three route variations to the Applicant Proposed Route were developed in Region 7 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.7. The variations are illustrated in Exhibit 1 of Appendix M. The geologic hazards and mineral resources would remain consistent with those described for Region 7.

3.6.1.5.8 Connected Actions

3.6.1.5.8.1 Wind Energy Generation

3.6.1.5.8.1.1 Physiography, and Surface and Bedrock Geology

The WDZs are located in the Interior Plains Division in the vicinity of the AC collection system and the western part of Region 1. Elevations range from 950 feet above mean sea level (AMSL) to 4,800 feet AMSL. Three ecoregions with varying physiographic characteristics and surface geology are associated with the WDZs as described below:

- Canadian Cimarron Breaks—Nearly level, rolling, or hummocky plains. Elevation ranges from 2,400 to 4,800 feet AMSL. Local relief ranges from 10 to 120 feet. Surface geology consists of widely mantled Quaternary alluvium underlain by sand, gravel, silt, clay, and caliche (all WDZs except WDZ-L).
- Canadian Cimarron High Plains—Dissected canyons, hills, escarpments, buttes, terraces, and along rivers, dunes. Elevation ranges from 1,900 to 3,450 feet AMSL. Local relief ranges from 100 to 400 feet. Surface geology consists of Quaternary alluvium, colluvium, terrace deposits, and loess. Widely underlain by sand, gravel, silt, and clay (all WDZs except WDZ-L).
- Rolling Sand Plains—Gently undulating to hummocky, sandy plains with sand hills, depressions, and stabilized, partially stabilized, or active sand dunes. Locally, blow-outs occur. Small wetlands are found between dunes where the water table is high. Drainage networks are not well established. Elevation ranges from 2,400 to 4,800 feet AMSL. Local relief ranges from 10 to 120 feet. Surface geology consists of Quaternary sand and silt deposits that were laid down by rivers, and subsequently reworked by wind (WDZ-G and WDZ-I).
- The Anadarko Shelf and northern portion of the Anadarko Basin underlie the WDZs. Surface bedrock and geologic formations include undifferentiated Pleistocene and Pliocene deposits, undifferentiated Permian shale, sandstone and siltstone; Quaternary alluvial and playa deposits, Quaternary Blackwater Draw Formation Sand, Tertiary interbedded sand, siltstone, clay, gravel lenses, caliche, and thin limestone of the Ogallala formation; and undifferentiated Mesozoic shale and sandstone.

3.6.1.5.8.2 Geologic Hazards, and Paleontological and Mineral Resources

Geologic hazards and mineral resources within the WDZs are summarized in Table 3.6.1-9. The WDZs are all located in an area of low earthquake activity and do not contain active surface faults. In the WDZs, incidence and susceptibility to landslides are both low because of the area's primarily flat topography. The WDZs are located in an area with numerous karst formations. Soil liquefaction is unlikely because of the low probable PGA.

Table 3.6.1-9:
Geologic Hazards and Mineral Resources within the ROI—Wind Development Zones

Hazard/Mineral Resource	WDZ											
	A	B	C	D	E	F	G	H	I	J	K	L
Area (acres)	109,747	125,479	161,048	69,189	47,092	112,461	187,315	116,226	105,203	92,567	92,894	165,848
Geologic Hazards												
3.5–3.9 Earthquakes[1] (number)	1	2	2	0	0	1	1	0	0	0	1	3
4. + Earthquakes (number)[1]	1	1	1	1	1	1	0	0	1	1	1	1
Karst Formation (acres)[2]	93,920 (86%)	53,123 (42%)	140,395 (87%)	35,765 (52%)	184 (<1%)	0 (0%)	119,576 (64%)	66,643	39,207 (57%)	17,560 (19%)	28,947 (31%)	118,751 (72%)
Shallow Bedrock (acres)[3]	4,762 (4%)	2,306 (2%)	6,565 (4%)	8,037 (12%)	4,318 (9%)	6,631 (6%)	1,117 (1%)	7,892 (7%)	202 (<1%)	9,772 (11%)	0 (0%)	11,911 (7%)

Table 3.6.1-9:
Geologic Hazards and Mineral Resources within the ROI—Wind Development Zones

Hazard/Mineral Resource	WDZ											
	A	B	C	D	E	F	G	H	I	J	K	L
Mineral Resources												
Oil and Gas Wells[4]	0	0	0	0	0	0	32	0	1	75	62	0
Mineral Resources[5]	0	0	0	8	8	15	2	18	4	14	11	0

GIS Data Sources:
1 USGS (2008a)
2 Tobin and Weary (2004)
3 NRCS (2013)
4 AOGC (2014)
5 USGS (2005b)

No known fossil bed sites were identified in the WDZs. The approximate percentages of shallow bedrock contained within the WDZs range from 0 to 12 percent.

3.6.1.5.8.3 Optima Substation

The general geologic and related features in the area of the future Optima substation are the same as described for the western area of Region 1. Seismicity characteristics are low. The entire Optima substation is within karst, and shallow bedrock is present in 15 acres (9 percent of the 160-acre site). Mineral resources are not present in the siting area.

3.6.1.5.8.4 TVA Upgrades

The ROI for the direct assignment facilities (which are included in the Applicant Proposed Project) would occur within the Tennessee Converter Station Siting Area and more specifically within the Shelby Substation. The ROI for the network upgrades, and in particular TVA's future 500kV transmission line, cannot be fully determined at this time. The 500kV transmission line would be constructed in western Tennessee in the Gulf Coastal Plain region. The upgrades to existing facilities would mostly be in western and central Tennessee. Mineral resources in this area, as in the eastern portion of Region 7 described above, are limited, and karst formations are not present. Upgrades to existing infrastructure would include upgrading terminal equipment at three existing 500kV substations and six existing 161kV substations, making appropriate upgrades to increase heights on 16 existing 161kV transmission lines to increase line ratings, and replacing the conductors on eight existing 161kV transmission lines. Where possible, general impacts associated with the required TVA upgrades are discussed in the impact sections that follow.

3.6.1.6 Impacts to Geology, Paleontology, and Minerals

3.6.1.6.1 Methodology

The impact analysis area for geologic, mineral, and paleontological resources includes the Project components. Analysis was based on review of publicly available government documents and published literature as well as comments from scoping as described in Table 3.6.1-10.

Table 3.6.1-10:
Impacts Analysis Considerations and Relevant Assumptions

Resource Topic	Analysis Considerations and Relevant Assumptions
Geologic Hazards	Evaluate potential impact to the Project from geologic hazards that include seismicity, landslides, subsidence related to karst, and liquefaction. Evaluate risk to nearby populations from any increases in geologic hazards caused by the Project. Major assumptions in the analysis of the risk to the Project because of geological hazards include the following: • The location of active faults is based on information available from GIS Data Source: USGS (2008). Ground motion estimates are based on recent updates of the USGS seismic hazard mapping by the USGS. Quaternary faults are numerous in the impact analysis area, and may rupture at any time. Only those faults that have moved in the last 15,000 years, however, are considered to be active as determined by the GIS Data Source: USGS (2008). • Landslide risk information is based on landslide maps, landslide incident and susceptibility areas, and USGS-prepared Landslide Inventory Maps (GIS Data Source: USGS 2001).
Mineral Resources	Analyze the Applicant Proposed Route and HVDC Alternative Routes with regard to potential interference with existing mineral extraction operations, reduced access to underlying minerals, and interference with future mineral extraction operations.
Paleontological Resources	Evaluate the potential for loss of important fossils because of the following activities or conditions: • Ground-disturbing activities such as clearing, grading, and foundation excavation • Operations and maintenance activities that would require disturbance of previously undisturbed areas within the established ROW

The following impacts could occur as result of the construction, operations and maintenance, and decommissioning of the Project components:

- Damage or interruption of services from seismicity, landslides, subsidence, or liquefaction generated during ground-disturbing activities; or damage from these hazards that interferes with construction of the Project
- Loss or inaccessibility of mineral resources of economic value for future use
- Loss or damage to scientifically important paleontological resources

The Applicant would adopt the EPMs listed in Appendix F. EPMs that would specifically avoid or minimize the potential for impacts on geology, paleontology, and minerals are listed below:

- GE-1: Clean Line will train personnel on health, safety, and environmental matters. Training will include practices, techniques, and protocols required by federal and state regulations and applicable permits.
- GE-9: Clean Line will avoid and/or minimize damage to drainage features and other improvements such as ditches, culverts, levees, tiles, and terraces; however, if these features or improvements are inadvertently damaged, they will be repaired and or restored.
- GE-27: Clean Line will minimize compaction of soils and rutting through appropriate use of construction equipment (e.g., low ground pressure equipment and temporary equipment mats).
- GE-29: Clean Line will work with landowners and operators of active oil and gas wells, utilities, and other infrastructure to identify and verify the location of facilities and to minimize adverse impacts. Identification may include use of the One Call system and surveying of existing facilities.
- GEO-1: Clean Line will stabilize slopes exposed by its activities to minimize erosion.
- LU-1: Clean Line will work with landowners and operators to ensure that access is maintained as needed to existing operations (e.g., to oil/gas wells, private lands, agricultural areas, pastures, hunting leases).

- LU-4: Clean Line will coordinate with landowners to site access roads and temporary work areas to avoid and/or minimize impacts to existing operations and structures.

In addition, Clean Line will develop the following plans to avoid or minimize effects to geology, paleontology, and minerals from construction, operations and maintenance, or decommissioning as appropriate:

- Blasting Plan: This plan will describe measures designed to minimize adverse effects due to blasting.
- Storm Water Pollution Prevention Plan (SWPPP): This plan, consistent with federal and state regulations, will described the practices, measures, and monitoring programs to control sedimentation, erosion, and runoff from disturbed areas. The SWPPP will be required to minimize adverse effects from erosion during ground disturbing activity.
- Restoration Plan: This plan will describe post-construction activities to reclaim disturbed areas. This plan will be required to minimize adverse effects associated with areas (particularly slopes) exposed during construction.

3.6.1.6.1.1 Impacts Common to All Alternatives

3.6.1.6.1.1.1 Construction Phase

The following impacts could occur as result of the construction of the Project:

- Damage or interruption of services resulting from seismicity, landslides, subsidence, or liquefaction generated during ground-disturbing activities
- Loss or damage to scientifically important paleontological resources
- Loss or inaccessibility of mineral resources of economic value for future use

In addition, geologic hazards could affect construction and use of access roads, but to a small extent given the simplicity of road construction. Construction and use of access roads is not likely to affect access to mineral resources, though pre-planning for the road routes would need to occur to avoid crossing locations of existing mineral resources (i.e., oil or gas well locations, or other actively mined sites).

Seismic Hazards

While it is not likely that services would be damaged or interrupted by seismic activity, the Applicant would construct Project components to withstand probable seismic events within the seismic risk zones crossed and comply with all applicable federal and state regulations and requirements to prevent accidents and ensure adequate protection for the public and the Project.

Landslides

While it is not likely that services would be damaged or interrupted by landslides, the Applicant would design Project components to avoid loading of slopes. Where unstable slopes cannot be avoided, construction activities, including vegetation clearing and alteration of surface drainage patterns, may increase landslide risk. Erosion control measures and monitoring programs to control sedimentation, erosion, and runoff from disturbed areas would be implemented per the Project SWPPP. In addition, areas subjected to clearing and grading would be stabilized and/or revegetated consistent with the Applicant's Restoration Plan and landowner or land manager requirements. Implementation of EPMs GE-9, GE-27, and GEO-1 would serve to maintain slope stability. If transmission structures or new roads are sited on steep slopes, an excavated bench would be created to increase foundation stability.

Blasting

During construction, blasting may be necessary in areas of shallow bedrock. Softer sedimentary rocks can generally be removed without blasting, but if blasting is required as determined by a geotechnical study (to be completed as part of the engineering design), a Blasting Plan would be developed. Blasting and removal of shallow bedrock has the potential to impact paleontological resources and would be avoided or minimized during engineering design.

Subsidence

The Applicant would complete geologic/geotechnical investigations during engineering design to reduce the potential for impacts related to karst. The presence of karst can cause subsidence that could damage Project infrastructure and result in the temporary failure of the electric transmission system. The placement of Project components would be governed in part by site conditions and construction requirements, which would minimize the risks associated with constructing the Project across karst. In general, placement of Project infrastructure would avoid areas of identified karst if feasible. If it is not feasible to avoid karst in some areas, measures such as specialized foundation design, filling of subsidence areas, and/or more frequent monitoring protocols would be implemented as appropriate.

Liquefaction

The Applicant would complete geologic/geotechnical investigations during the engineering design in the areas identified as containing high susceptibility to soil liquefaction to reduce potential impacts to the Project components. Areas of high liquefaction potential might increase the risk of damage to Project infrastructure from earthquakes and subsequent destabilization of underlying soils. The placement of Project components would be governed in part by site conditions and construction requirements, which would minimize risks related to soil liquefaction. If it is not feasible to avoid areas of high liquefaction, measures such as specialized foundation design, specialized fill materials, and additional monitoring protocols following seismic events would be implemented as appropriate.

Paleontological Resources

A direct impact to fossil resources would be loss during ground-disturbing activities such as clearing, grading, and excavation. These impacts could occur where fossils are at or near the ground surface in rock outcrops and/or areas of shallow bedrock. Indirect impacts during construction would include erosion of fossil beds due to slope re-grading and vegetation clearing or the unauthorized collection of scientifically important fossils by construction workers or the public due to increased access to fossils along the ROW. These impacts could occur where fossils are at or near the ground surface in rock outcrops and/or areas of shallow bedrock. Grading activities would be limited to the minimum amount needed to create safe working surfaces, and foundation excavations would typically be made using a power drill or auger, which would reduce the potential for impact to paleontological resources.

Mineral Resources

A direct impact to mineral resources would occur if construction activities were to interfere with ongoing mineral extraction operations, reduce access to underlying resources, or interfere with future access to mineral extraction operations. Impacts to mineral resources would be avoided or minimized during the design phase of the Project by avoiding mineral resource features and maintaining access to identified mineral resources. EPMs LU-1, GE-29, and LU-4 would be implemented to avoid or minimize potential impacts to mineral resources from construction. These EPMs would also be implemented for subsurface collection systems and any other infrastructure for oil and gas wells that may be within and near the ROW. Therefore, these collection systems would not be impacted during grading activities associated with the Project. Micrositing of the lines and structures would be employed when necessary to allow adequate access to existing infrastructure. New oil and gas wells would be prohibited within the ROW;

however, drilling rigs could drill at an adjacent location. The Applicant would allow access roads to oil and gas wells or other mineral resources to cross the ROW.

3.6.1.6.1.1.2 Operations and Maintenance Phase

Overall impacts during the operations and maintenance phase of the Project would be similar, but would have a much smaller degree of impact as the construction phase. Seismic activity could impact Project infrastructure and cause service interruptions. Design standards for specific seismic concerns would avoid and minimize such impacts. The engineering design would avoid or minimize potential effects from karst. No blasting would take place during operation and maintenance of the Project. Project infrastructure would avoid impacts to active mineral resources features and would not preclude development of underground mineral resources in most cases.

3.6.1.6.1.1.3 Decommissioning Phase

During the removal of Project components, some ground disturbance would occur from the use of machinery such as bulldozers to demolish facility buildings or cranes used to deconstruct the transmission structures. However, ground disturbance would be limited to near surface depths in areas previously disturbed during the construction and operation phases. EPMs used during construction would be applied during decommissioning, and the amount of ground disturbance associated with decommissioning would be less than during construction. Overall impacts during the decommissioning phase of the Project would be similar as the construction phase. Because the Project infrastructure would be removed, there would be complete access to mineral resources.

3.6.1.6.2 Impacts Associated with the Applicant Proposed Project

In general, the Applicant Proposed Project would not affect geologic features or resources of the area. Construction activities would require the removal or surface disturbance of small amounts of near-surface materials. This would have no measurable impact on geologic resources or features for any of the components of the Applicant Proposed Project. Similarly, the Project would have minimal impact on paleontology or mineral resources. However, geologic hazards could cause potential impacts to the Project depending on the final location of the specific facilities in relationship to these hazards. The implementation of EPMs and appropriate engineering design would reduce or eliminate impacts from such hazards.

3.6.1.6.2.1 Converter Stations and AC Interconnection Siting Areas

3.6.1.6.2.1.1 Construction Impacts

3.6.1.6.2.1.1.1 Oklahoma Converter Station Siting Area and AC Interconnection Siting Area

Subsidence from karst is a possible geologic hazard of concern within the Oklahoma Converter Station Siting Area. Implementation of EPMs and appropriate engineering design, including geotechnical investigations, would avoid or minimize the potential for impacts from karst. No known fossil bed sites were identified in the Oklahoma Converter Station Siting Area. About 40 percent of the siting area is located in the shallow bedrock, however, so grading and excavation activities could cause direct impacts to paleontological resources if fossils are at or near the ground surface in rock outcrops and/or areas of shallow bedrock.

3.6.1.6.2.1.1.2 Tennessee Converter Station Siting Area and AC Interconnection Tie

The Tennessee Converter Station Siting Area is located adjacent to the existing TVA Shelby Substation, and the 500 kV AC interconnection ties are expected to be contained entirely within the converter station and substation footprints. The Tennessee converter station and AC interconnection would be constructed to withstand probable seismic events in the moderate to high seismic hazard zones. They would be constructed in accordance with applicable federal and state regulations and requirements to prevent accidents and to ensure adequate protection for the public and the Project components. All of the soils within the Tennessee Converter Station Siting Area have high liquefaction potential, which could contribute to unstable conditions and potential structural damage during seismic events. Appropriate placement of Project components following completion of geologic/geotechnical investigations during engineering design would minimize risks related to soil liquefaction.

The Applicant would implement EPMs GE-9, GE-27, and GEO-1 to minimize the direct effects of landslides in this area of moderate susceptibility and low incidence. About 22 percent of the siting area is located in shallow bedrock, and blasting may be required. Impacts would be minimized by appropriate engineering design and through implementation of the Blasting Plan.

3.6.1.6.2.1.2 Operations and Maintenance Impacts

3.6.1.6.2.1.2.1 Oklahoma Converter Station Siting Area and AC Interconnection Siting Area

Impacts from geological hazards or to mineral resources are not anticipated during operations and maintenance because the area is located in an area of low seismic risk, soil liquefaction risk is expected to be low, and no mineral resources are located within the siting area.

3.6.1.6.2.1.2.2 Tennessee Converter Station Siting Area and AC Interconnection Tie

The Project components would be operated and maintained in an area of moderate to high seismic hazard, and expected ground motions from an earthquake would be moderate to high given the proximity of the New Madrid Seismic Zone. Damage from earthquakes would be negligible to minimal in structures designed in accordance with seismic protection standards. The Project components would be constructed to withstand probable seismic events and constructed in accordance applicable federal and state regulations to prevent accidents and to ensure adequate protection for the public and the Project.

Soils within the siting area have high liquefaction potential. Geotechnical investigations would be completed in these areas during engineering design. The placement of Project components would be governed in part by site conditions, construction requirements, and EPMs, which would minimize risks related to soil liquefaction.

3.6.1.6.2.1.3 Decommissioning Impacts

Impacts from decommissioning are described in Section 3.6.1.6.1.

3.6.1.6.2.2 AC Collection System

3.6.1.6.2.2.1 Construction Impacts

In the area of the AC collection system, the excavation and drilling required for the foundations of the transmission structures would permanently impact the geologic formation underneath the structure footprint to depths ranging from 30 to 45 feet. Specific foundation depths would depend on the specific geotechnical conditions and the engineering design. The area of potential impact to a geologic formation represents a very small portion of the total area of the geologic formation. The total areal extent of transmission structure footprints for the AC collection system routes are estimated to range from 1.7 acres (AC Collection System Route SE-2) to 7.1 acres (AC Collection System Route NW-2), which is a conservative estimate of the areal extent of affected geologic formations.

Table 3.6.1-11 summarizes the geologic hazards and mineral resources that could potentially impact or be impacted by the AC collection system routes.

Table 3.6.1-11:
Geological Hazards and Mineral Resources Impacts—AC Collection System Routes

Route	Analysis Area (acres)	Geologic Hazard (within 200 feet of representative centerline)		Mineral Resources (based on representative centerline)[3]
		Karst Formation[1]	Shallow Bedrock[2]	
E-1	708	198 acres	138 acres	Intersects 1 mineral resource. 12 oil and gas wells and 4 mineral resources within 2 miles.
E-2	974	682 acres	81 acres	19 oil and gas wells and 8 mineral resources are located within 2 miles of the representative centerline.
E-3	977	577 acres	117 acres	15 oil and gas wells and 8 mineral resources are located within 2 miles of the representative centerline.
NE-1	730	463 acres	63 acres	8 mineral resources are located within 2 miles of the representative centerline.
NE-2	637	300 acres	119 acres	7 mineral resources are located within 2 miles of the representative centerline.
NW-1	1,265	510 acres	64 acres	4 oil and gas wells and 9 mineral resources are located within 2 miles of the representative centerline.
NW-2	1,365	1,125 acres	71 acres	7 mineral resources are located within 2 miles of the representative centerline.
SE-1	979	611 acres	69 acres	5 oil and gas wells are located within 2 miles of the representative centerline.
SE-2	325	325 acres	66 acres	1 mineral resource is located within 2 miles of the representative centerline.
SE-3	1,194	901 acres	81 acres	144 acres of shale gas play are traversed by the alternative representative centerline; 43 oil and gas wells and 7 mineral resources located within 2 miles of the representative centerline.
SW-1	326	326 acres	66 acres	3 mineral resources are located within 2 miles of the representative centerline.
SW-2	901	213 acres	86 acres	3 mineral resources are within 2 miles of the representative centerline.
W-1	508	128 acres	43 acres	6 mineral resources are within 2 miles of the representative centerline.

GIS Data Sources:
1 Tobin and Weary (2004)
2 NRCS (2013)
3 USGS (2005b) (metallic and non-metallic mineral resources); EIA (2011a); OCC (2013)

The AC collection system is located in Region 1, which, west to east, is an area of low earthquake activity and does not contain active surface faults. The USGS seismic hazard mapping indicates that in areas crossed by the Project in Region 1, the likelihood of ground movement that could be triggered by a maximum credible earthquake is expected to be low. Incidence and susceptibility to landslides are low for the AC collection system. Soil liquefaction is generally not a concern in this portion of the Project due to the low seismic activity and low PGA. Based on the existing conditions, earthquakes, landslides, and liquefaction are not anticipated to impact the AC collection system routes.

Karst covers about 60 percent of the AC collection system route representative ROWs. The final location of a ROW would be designed to avoid or minimize impacts to karst areas. Shallow bedrock underlies 5 to 20 percent of each AC collection system route ROW, and blasting may be necessary in this area.

Only the AC Collection System Routes E-1 and SE-3 representative centerlines traverse mineral resources (mineral deposit and shale gas play). EPMs LU-1, GE-29, and LU-4 would be implemented to avoid or minimize potential impacts to mineral resources.

3.6.1.6.2.2.2 Operations and Maintenance Impacts

Impacts to geology, paleontology, and mineral resources resulting from the operation and maintenance of the AC Collection System Routes would be minor during construction because ground disturbing activities would be comparatively negligible. The implementation of EPMs and appropriate engineering design would minimize or prevent impacts from geologic hazards during operation and maintenance. With implementation of EPMs (LU-1, GE-29, and LU-4) potential impacts to mineral resources would be avoided or minimized.

3.6.1.6.2.2.3 Decommissioning Impacts

Impacts from decommissioning are described in Section 3.6.1.6.1.

3.6.1.6.2.3 HVDC Applicant Proposed Route

Assessments of the impacts related to the route variations in Regions 2–7, including accompanying HVDC alternative route adjustments, are described at the end of applicable sections.

3.6.1.6.2.3.1 Construction Impacts

Table 3.6.1-12 summarizes geologic hazards and mineral resources that could be potentially impacted by or impact the Applicant Proposed Route. The excavation and drilling required for the foundations of the transmission structures would permanently impact the geologic formation underneath the transmission structure footprint to depths ranging from 15 to 30 feet in most areas of the Applicant Proposed Route. In the area of the Mississippi River crossing, foundation depths could reach 17 to 158 feet deep for lattice structures and 26 to 115 feet for pole structures. The area of potential impact to a geologic formation represents a very small portion of the total area of the geologic formation. In areas of karst formations, excavation and drilling could potentially create new preferential flow pathways, which could increase the risk of introducing constituents into the karst system that could eventually impact groundwater quality. The total estimated transmission structure footprints by region range from 5.4 to 20.4 acres, which is a conservative estimate of the areal extent of affected geologic formation. In total, the tower footprints would affect about 90.6 acres of geologic formation for the entire Applicant Proposed Route.

Table 3.6.1-12:
Geologic and Mineral Resources Impacts—200-Foot-Wide Representative ROW of the Applicant Proposed Route

Parameter[1a]	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6	Region 7
Impact Area (acres)	2,826	2,589	3,950	3,088	2,760	1,331	1,048
Seismicity[1]	No active faults; low ground motion potential (PGA of 1% of gravity)	No active faults; low ground motion potential (PGA of 1–2% of gravity)	1 active fault; low ground motion potential (PGA of 2–3% of gravity)	3 active faults; low ground motion potential (PGA of 2–4% of gravity)	2 active faults; low to moderate ground motion potential (PGA of 4–10% of gravity)	0 active faults; low to high ground motion potential (PGA of 10–30% of gravity)	0 active faults; moderate to high ground motion potential (PGA of 15–30% of gravity)
Landslides[2]	Incidence and susceptibility to landslides are both low	Incidence and susceptibility to landslides are both low	High susceptibility, Low incidence (122 acres or 3%) Moderate susceptibility, Low incidence (204 acres or 5%)	Moderate susceptibility, Low incidence (2,650 acres or 86%)	High susceptibility, Low incidence (112 acres or 4%) Moderate susceptibility, Low incidence (2,513 acres or 91%)	Incidence and susceptibility to landslides are both low	High susceptibility, Moderate incidence (100 acres or 10%) High susceptibility, Low incidence (468 acres or 45%) Low incidence (480 acres or 46%)
Subsidence (karst)[3]	690 acres (24%)	189 acres (7%)	No Karst	678 acres (22%)	308 (11%)	No Karst	No Karst
Liquefaction[4]	Low	Low	Low	High (431 acres or 14%) Moderate (163 acres or 5%) Very Low (1,430 acres or 46%)	High (262 acres or 9%) Very Low (2,498 acres or 91%)	Very High (358 acres or 27%) High (889 acres or 67%) Moderate (84 acres or 6%)	Very High (737 acres or 70%) High (296 acres or 28%)
Mineral Resources (shale gas plays acres, oil/gas wells)[5]	No Resources	521 acres (20%)	12 oil/gas wells	1,929 acres (62%), 6 oil/gas wells	2,778 acres (95%), 10 oil/gas wells	No mineral resources	No mineral resources
Shallow Bedrock[6]	328 acres (12%)	775 acres (30%)	2,227 acres (56%)	1,974 acres (64%)	2,398 acres (87%)	622 acres (46%)	54 acres (5%)

1a The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
GIS Data Sources:
1 Garrity and Soller (2009) and USGS (2008b)
2 USGS (2001)
3 Tobin and Weary (2004)
4 CUSEC (2008)
5 OCC (2013), AOGC (2014), USGS (2005b), EIA (2011a). Oil and gas wells and mineral resources are present in the larger ROI (EIA 2011a).
6 NRCS (2013). Shallow bedrock is present in 18% of the larger ROI.

This page intentionally left blank.

3.6.1.6.2.3.1.1 Seismicity

No active faults are present in Regions 1 and 2, and expected ground motions from an earthquake would be low, so seismicity impacts are expected to be minimal in the representative ROW for the Applicant Proposed Route. Although one active fault is present in Region 3 and three active surface faults are present in Region 4, the expected ground motions from an earthquake would be low. Two active surface faults transect the Applicant Proposed Route in Region 5 and expected ground motions from an earthquake would be low to moderate. Earthquake hazard transitions from low to moderate with eastward progression along Region 5. No active surface faults are present in Region 6, and expected ground motions from an earthquake would be low to high. From west to east within Region 6, the earthquake hazard transitions from low to moderate and from moderate to high. The Applicant Proposed Route in the easternmost portion of Region 6 is located within moderate to high seismic hazard that is closer to the New Madrid Seismic Zone. No active surface faults are present in Region 7, but expected ground motions from an earthquake would be moderate to high given the proximity of the New Madrid Seismic Zone.

The route variations have the same characteristic seismicity as the original Applicant Proposed Route.

With proper engineering design, impacts from seismicity are anticipated to be minimal for the Applicant Proposed Route. The Project would be constructed to withstand probable seismic events within the seismic risk zones crossed and constructed in accordance with all applicable federal and state regulations to prevent accidents and to ensure adequate protection for the public and the Project.

3.6.1.6.2.3.1.2 Soil Liquefaction

Soil liquefaction is unlikely in Regions 1 and 2 because of the low probable PGA. Approximately 15 percent of the soils within the Applicant Proposed Route representative ROW in Region 4 have high liquefaction susceptibility and approximately 4 percent of the soils within the easternmost portion of the Applicant Proposed Route in Region 5 have high liquefaction susceptibility. Approximately 90 percent of the soils within the Region 6 Applicant Proposed Route representative ROW have high liquefaction susceptibility; and approximately 98 percent of the soils within the Region 7 Applicant Proposed Route have high or very high liquefaction susceptibility. The proper placement of Project components following completion of geologic/geotechnical investigations performed during engineering design would minimize risks related to soil liquefaction.

The route variations have the same soil liquefaction susceptibility as the original Applicant Proposed Route.

3.6.1.6.2.3.1.3 Landslides

Regions 1 and 2 have a generally low incidence and low susceptibility to landslides, so impacts to the Project from landslides are not anticipated. The Applicant Proposed Route in Region 3 has low incidence for landslides, but susceptibility ranges from low to high. Region 4 is characterized by moderate susceptibility to landsliding and low incidence. Region 5 is characterized by moderate susceptibility to landsliding and low incidence with the exception of the very easternmost area of the region, where landslides are low incidence and high susceptibility. In Region 6, incidence and susceptibility to landslides are both low. High susceptibility areas are located in most areas of the Applicant Proposed Route in Region 7. Implementation of EPMs and appropriate engineering design would minimize impacts from areas susceptible to landslides.

The route variations generally have the same landslide incidence and susceptibility as the original Applicant Proposed Route. The Region 7 variation, Applicant Proposed Route Link 1, Variation 1, contains a greater acreage of land classified as having high susceptibility to landslides.

3.6.1.6.2.3.1.4 Karst Formations

Karst is present over about 25 percent of the Applicant Proposed Route representative ROW in Region 1. Isolated areas of karst occur in the western area of Region 2 of the Applicant Proposed Route. The remainder of the Applicant Proposed Route in Region 2 does not contain identified karst formations and therefore has a low susceptibility related land subsidence. Region 3 does not contain any identified karst formations. Region 4 contains karst formations in the western area of the Applicant Proposed Route (12 percent of the representative ROW). The Applicant Proposed Route contains isolated pockets of karst in Region 5 in the easternmost area. Regions 6 and 7 do not contain karst formations. Karst is present in a larger percentage of the ROI than the impact areas in Regions 2 and 4; and that karst is present in the ROI in Region 5 but is not present in the impact area for Region 5. Depending on the final location of the Applicant Proposed Route in these regions, impacts to karst might be expected to vary from what is presented in the table. EPMs and appropriate engineering design would focus on avoiding karst and maintaining ground disturbance over as small an area as possible to reduce impacts.

The route variations have similar amounts of karst as the original Applicant Proposed Route. The original Applicant Proposed route contains slightly less acreage of karst compared to the Region 2 variation, Link 2, Variation 2, as well as the Region 4 variation, Link 3, Variation 2.

3.6.1.6.2.3.1.5 Shallow Bedrock

Shallow bedrock underlies 12 percent of the Applicant Proposed Route representative ROW in Region 1 and 30 percent in Region 2. Shallow bedrock is present within 56 percent of the Applicant Proposed Route representative ROW in Region 3; within 63 percent of the Applicant Proposed Route representative ROW in Region 4; within 87 percent in Region 5; within 46 percent in Region 6; and within 4 percent in Region 7. Blasting may be required in these areas and impacts would be minimized by following provisions of the Blasting Plan. Depending on the final location of the Applicant Proposed Route, impacts in areas of shallow bedrock might be expected to vary from what is presented in the table.

The route variations generally have similar amounts of shallow bedrock as the original Applicant Proposed Route. The Applicant Proposed Route contains slightly greater acreage of shallow bedrock compared to the Applicant Proposed Route variations in Region 3 (Link 1 and Link 2, Variation 1), and less acreage of shallow bedrock compared to Region 3 (Link 1, Variation 2), Region 4 (Link 3, Variation 3), Region 5 (Link1, Variation 2, and Link 2, Variation 2), and Region 6 (Link 2, Variation 1).

3.6.1.6.2.3.1.6 Paleontological Resources

Although no known fossil bed sites were identified in the representative ROW in any of the Applicant Proposed Route Regions, shallow bedrock is present throughout the Project and there is the potential for fossil resources to be impacted. Areas of the Project that have a high percentage of shallow bedrock would have a greater potential for impacting paleontological resources. The Applicant would avoid or minimize impacts on paleontological resources by training personnel in the practices, techniques, and protocols required by federal and state regulations and applicable permits (GE-1).

Given the similar amounts and type of shallow bedrock, the route variations would be expected to contain similar paleontological resources as the original Applicant Proposed Route.

3.6.1.6.2.3.1.7 Mineral Resources

The Applicant Proposed Route in Region 1 traverses no shale gas plays within the representative ROW. Shale gas plays (1,428 acres) are traversed in Region 2. The route does not traverse any oil and gas wells in Regions 1 and 2. The Applicant Proposed Route representative ROW in Region 3 traverses 12 oil and gas wells. The potential for impact to oil and gas operations is greatest in Regions 4 and 5. Given the ongoing development of the Fayetteville shale, the presence of oil and gas wells and other related infrastructure could be frequent. For example, as described in Section 3.6.1.5., within the 4,000-foot-wide corridor along the Applicant Proposed Route there are 181 and 282 oil and gas wells in Region 4 and Region 5, respectively. The Applicant Proposed Route representative ROW in Region 4 would traverse just six oil and gas wells and 1,929 acres of shale gas play, and in Region 5, would traverse only 10 oil and gas wells and 2,778 acres of shale gas play (Table 3.6.1-12). However, in some areas, the prevalence of oil and gas wells, combined with other gas development infrastructure (well pads, access roads, compressor stations, and gathering and transmission pipelines), would make implementation of EPMs LU-1, GE-29, and LU-4 of critical importance during routing and engineering surveys to determine the least disruptive route within the 1,000-foot-wide corridor. The Applicant used LiDar, field survey, and infrastructure and mineral rights data sets to further refine and microsite the route to avoid mineral resources. As currently understood from the most current and comprehensive data available, through the use of micrositing the representative ROW would avoid all existing oil and gas wells or well pads. Should additional information be discovered, the Applicant would microsite as needed to minimize impacts to existing mineral resources and operations. No mineral resources are traversed by the Applicant Proposed Route representative ROWs for Regions 6 and 7, so no impacts to mineral resources are indicated. EPMs LU-1, GE-29, and LU-4 would be implemented to minimize impacts to mineral resources.

The route variations have similar amounts of mineral resources and oil and gas wells as the original Applicant Proposed Route and do not traverse mines.

3.6.1.6.2.3.2 Operations and Maintenance Impacts

Impacts from the Applicant Proposed Route during operations and maintenance would be less than impacts described during construction. Once construction has been completed, blasting would not occur and other soil-disturbing activities would be negligible; thus, impacts to fossils and karst are not anticipated. Operations and maintenance activities would not increase the risk of landslides.

Given the implementation of the appropriate EPMs and engineering design, the Applicant Proposed Route is not anticipated to be impacted by seismicity, subsidence, liquefaction, or landslides that results in damage to Project infrastructure or interruption of service; the Applicant Proposed Route would not adversely impact access to mineral resources; and impacts to paleontological resources would be minimized. Regions 6 and 7 are located in an area of low to high seismic risk and high potential for liquefaction; therefore, there is still potential that seismicity and liquefaction could impact Project infrastructure; however, EPMs and appropriate engineering design would reduce the risk.

3.6.1.6.2.3.3 Decommissioning Impacts

Impacts from decommissioning are described in Section 3.6.1.6.1. Because minor ground disturbance associated with construction and operations and maintenance would no longer be necessary and because structure foundations would only be removed below ground level, the potential to affect paleontological resources would be reduced.

3.6.1.6.3 Impacts Associated with the DOE Alternatives

3.6.1.6.3.1 Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area

3.6.1.6.3.1.1 Construction Impacts

The Arkansas converter station and AC interconnection would be located near the New Madrid Seismic Zone in an area of low to moderate seismic hazard. Nine percent of the soils within the siting area for the Arkansas converter station have high liquefaction potential, and about 47 percent of the soils within the AC interconnection have high liquefaction potential. To reduce impacts from seismic hazard and liquefaction, the Applicant would implement the same measures as described for the Tennessee Converter Station Siting Area and AC Interconnection Siting Area.

The Arkansas Converter Station and AC Interconnection Siting Areas do not contain karst, so no impacts from karst are anticipated during construction. The areas have moderate susceptibility and low incidence with respect to landslides. Potential landslide impacts would be reduced or mitigated using the same techniques as described for the Tennessee Converter Station Siting Area and AC Interconnection Tie.

Approximately 79 percent of the Arkansas Converter Station Siting Area is underlain by shallow bedrock (Table 3.6.1-6). Impacts from blasting would be minimized by following provisions of the Blasting Plan.

A new substation would also be required at the point where the 500kV AC interconnection line taps the existing Arkansas Nuclear One-Pleasant Hill 500kV line. The footprint of this substation is estimated to be between 25 and 35 acres, with an additional 5 acres for temporary materials staging and equipment storage. The substation is within the AC Interconnection Siting Area and thus high liquefaction potential, low to moderate seismicity, and moderate susceptibility to landslides have the potential to impact the new substation. The same measures as described for the Tennessee Converter Station Siting area and AC Interconnection Tie would be implemented. The placement of Project components would be governed in part by site conditions, construction requirements, and EPMs, which would minimize risks related to soil liquefaction, seismicity, and landslides.

Shale gas play is located within the Arkansas Converter Station and AC Interconnection Siting areas; three oil and gas wells were identified within the Arkansas Converter Station Siting Area. EPMs LU-1, GE-29, and LU-4 would be implemented to avoid or minimize potential impacts to mineral resources from construction.

3.6.1.6.3.1.2 Operations and Maintenance Impacts

The Arkansas Converter Station Siting Area and AC Interconnection Siting Area have moderate susceptibility and low incidence with respect to landslides. If operations and maintenance activity is conducted on unstable slopes, including vegetation clearing and alteration of surface-drainage patterns, landslide risk would be increased. Effects would be minimized utilizing the same measures as described for the Tennessee Converter Station Siting Area and AC Interconnection Tie. The Project components would be operated and maintained in an area of low to moderate seismic hazard. The soils within the siting areas have high liquefaction potential. Impacts from seismic hazards and liquefaction would be minimized utilizing the same measures as described for the Tennessee Converter Station Siting Area and AC Interconnection Tie.

Once construction has been completed, blasting and other soil-disturbing activities would be negligible, so impacts to fossils are not anticipated. The siting areas do contain oil and gas wells or other mineral resources; however, impacts to mineral resources are not expected during operations.

3.6.1.6.3.1.3 Decommissioning Impacts

Impacts from decommissioning are described in Section 3.6.1.6.1.

3.6.1.6.3.2 HVDC Alternative Routes

3.6.1.6.3.2.1 Construction Impacts

3.6.1.6.3.2.1.1 Region 1

Table 3.6.1-13 summarizes relevant analysis considerations for geologic and mineral resources that could potentially impact or be impacted by all the Region 1 HVDC alternative routes compared to the corresponding Applicant Proposed Route links. HVDC alternative route impacts in Region 1 related to active faults, ground motion potential, landslides, and mineral resources are comparatively the same as the Applicant Proposed Route, and these geologic hazards are not presented in Table 3.6.1-13.

Table 3.6.1-13:
Geological and Mineral Resources within the 200-Foot-Wide Representative ROW—Region 1

Parameter	Impact Area (acres)	Subsidence (acres of karst)[1]	Shallow Bedrock[2]	Impacts Comparison with Applicant Proposed Route Corresponding Links
AR 1-A[3]	3,004	244 (8%)	582 (19%)	Greater impact to karst formations and shallow bedrock.
Corresponding APR Links 2, 3,4, 5	2,778	No karst	299 (10%)	NA
AR 1-B[3]	1,268	437 (34%)	100 (8%)	Lesser impact to karst formation and more impact to shallow bedrock.
Corresponding APR Links 2, 3	1,316	643 (49%)	40 (3%)	NA
AR 1-C[3]	1,272	242 (19%)	63 (5%)	Lesser impact to karst formations and more impact to shallow bedrock.
Corresponding APR Links 2, 3	1,316	643 (48%)	40 (3%)	NA
AR 1-D[3]	819	No karst	46 (6%)	More impact to shallow bedrock.
Corresponding APR Links 3, 4	823	No karst	25 (3%)	NA

GIS Data Sources:
1 Tobin and Weary (2004)
2 NRCS (2013)
3 Oil and gas wells and mineral resources are present in the larger ROI area (GIS Data Sources: USGS [2005a] and OCC [2013]).

Representative ROWs in Region 1, except for Alternative Route 1-D and Applicant Proposed Route Links 1 and 2, have isolated areas of karst formations. The presence of karst and potential need for blasting in areas of shallow bedrock would require the use of EPMs and appropriate engineering design to reduce the potential for impacts. No known fossil bed sites were identified in Region 1. No mineral resources are traversed in Region 1. However, oil and gas wells and mineral resources are present in the larger ROI areas for all of the HVDC alternative routes and corresponding Applicant

Proposed Route links. Depending on the final route locations, mineral resources have the potential to be affected in these areas.

3.6.1.6.3.2.1.2 Region 2

Table 3.6.1-14 summarizes relevant analysis considerations for geologic and mineral resources that could potentially impact or be impacted by the HVDC alternative routes compared to the corresponding Applicant Proposed Route links. HVDC alternative route impacts in Region 2 related to active faults, ground motion potential, landslides, and soil liquefaction are comparatively the same as the Applicant Proposed Route, and these geologic hazards are not presented in Table 3.6.1-14.

Table 3.6.1-14:
Geological and Mineral Resources within the 200-Foot-Wide Representative ROW—Region 2

Parameter	Impact Area (acres)	Subsidence[1] (acres of karst)	Mineral Resources (acres of shale gas play)[2]	Shallow Bedrock (acres)[3]	Impact Comparison with Applicant Proposed Route Corresponding Links
AR 2-A	1,396	310 (22%)	0 (0%)	0 (0%)	More impact to karst formation less impact to shallow bedrock, and less impact to shale gas deposits.
Corresponding APR Link 2	1,331	189 (14%)	521 (39%)	296 (22%)	NA
AR 2-B	728	0 (0%)	0 (0%)	550 (76%)	More impact to soils with shallow bedrock and less impact to karst formations.
Corresponding APR Link 3	764	0 (0%)	0 (0%)	180 (24%)	NA

GIS Data Sources:
1 Tobin and Weary (2004)
2 EIA (2011a)
3 NRCS (2013). In HVDC Alternative Route 2-A, shallow bedrock is present in 22% of the larger ROI in HVDC Alternative Route 2-A, and in HVDC Alternative Route 2-B, shallow bedrock is present in 41% of the larger ROI.

Isolated areas of karst formations (22 percent of the total area of the representative ROW) occur in HVDC Alternative Route 2-A and Applicant Proposed Route Link 2 (14 percent). The remainder of Region 2 does not contain identified karst formations and therefore has a low susceptibility for land subsidence as a result of karst formations. There is potential for direct impacts to paleontological resources in areas of shallow bedrock (76 percent for HVDC Alternative Route 2-B). Shale gas plays are traversed along the Applicant Proposed Route Link 2, but are not traversed along the corresponding HDVC Alternative Route 2-A. There are no other mineral resources traversed in the Region 2 representative ROWs.

3.6.1.6.3.2.1.3 Region 3

Table 3.6.1-15 summarizes relevant analysis considerations for geologic and mineral resources that could potentially impact or be impacted by the Region 3 HVDC alternative routes compared to the corresponding Applicant Proposed Route links. There are no karst formations present in any of the routes of Region 3, and soil liquefaction is unlikely because of the low probable PGA. All HVDC alternative route impacts in Region 3 related to these geologic hazards are therefore comparatively the same as the Applicant Proposed Route, and these geologic hazards are not presented in Table 3.6.1-15.

Table 3.6.1-15:
Geological and Mineral Resources within the 200-Foot-Wide Representative ROW—Region 3

Parameter[1a]	Representative ROW Impact Area (acres)	Seismicity[1]	Landslides[2, 2a]	Mineral Resources (acres of shale gas play)[3]	Shallow Bedrock (acres)[4]	Impact Comparison with Applicant Proposed Route Corresponding Links
AR 3-A	919	No active faults; low ground motion potential (PGA of 2–3% of gravity)	Incidence and susceptibility to landslides are both low	0 (0%)	681 (74%)	Crosses nearly the same amount of shallow bedrock.
Corresponding APR Link 1	977	Same as AR 3-A	Same as AR 3-A	0 (0%)	696 (71%) —greater impact	NA
AR 3-B	1,167	Same as AR 3-A	Same as AR 3-A	0 (0%)	852 (73%)	Crosses nearly the same amount of shallow bedrock.
Corresponding APR Links 1,2, 3	1,221	Same as AR 3-A	Same as AR 3-A	0 (0%)	838 (21%) —less impact	NA
AR 3-C	2,968	Same as AR 3-A	Low incidence mod-high susceptibility (318 acres and 11%)	0 (0%)	1,481 (50%)	Crosses nearly the same amounts of shallow bedrock and landslide susceptibility is nearly the same.
Corresponding APR Links 3, 4, 5, 6	2,896	Same as AR 3-A	Low incidence and mod-high susceptibility (326 acres and 11%)	12 oil/gas wells - greater impact	1,490 (51%) —greater impact	NA
AR 3-D	959	Same as AR 3-A	Low incidence, mod-high susceptibility (318 acres and 33%)	0 (0%)	320 (33%)	Crosses more amounts of shallow bedrock; landslide susceptibility is nearly the same.
Corresponding APR Links 5,6	857	1 active fault; low ground motion potential—greater impact	Low incidence, mod-high susceptibility (326 acres and 38%)	0 (0%)	268 (31%) —less impact	NA
AR 3-E	208	Same as AR 3-A	100% of route is low incidence and moderate susceptibility (208 acres and 100%)	0 (0%)	112 (54%)	Crosses nearly the same amounts of shallow bedrock; landslide susceptibility is nearly the same.
Corresponding APR Links 6	190	Same as AR 3-A	Same as AR 3-E	0 (0%)	98 (52%) —less impact	

1a The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
2a High susceptibility and low incidence is 41% in the larger ROI for HVDC Alternative Route 3-C.
GIS Data Sources:
1 Garrity and Soller (2009), USGS (2008b)
2 USGS (2001)
3 OCC (2013), EIA (2011a)
4 NRCS (2013)

This page intentionally left blank.

Although one active fault is present in Region 3, the earthquake and seismic activity are low within Region 3 and potential related impacts are expected to be minimal. HVDC Alternative Routes 3-C, 3-D, and 3-E, are located in areas with low incidence for landslides, but where susceptibility ranges from low to high. There are no appreciable differences (Table 3.6.1-15) between the Region 3 HVDC alternative routes and corresponding Applicant Proposed Route links in terms of the low potential seismic ground motion and landslide risks.

Shallow bedrock is present along all routes, and blasting may be required in these areas. There is potential for direct impacts to paleontological resources in areas of shallow bedrock (33 to 74 percent for the HVDC Alternative Routes). All of the alternative routes in Region 3 traverse shale gas plays, but no other mineral resources are traversed.

As described in Appendix M and summarized in Section 2.4.2.3, a route adjustment was developed for HVDC Alternative Route 3-A to maintain an end-to-end route with Applicant Proposed Route Link 1, Variation 2, and Links 1 and 2, Variation 1. The geologic hazards and mineral resources for this route adjustment would be the same as for the original HVDC Alternative Route 3-A.

3.6.1.6.3.2.1.4 Region 4

Table 3.6.1-16 summarizes relevant analysis considerations for geologic and mineral resources that could potentially impact or be impacted by the Region 4 HVDC alternative routes compared to the corresponding Applicant Proposed Route links. Four active surface faults are present in Region 4, but expected ground motions from an earthquake would be low and any related impacts would be minimal. HVDC Alternative Routes 4C, 4-D, and 4-E and the corresponding Applicant Proposed Route links contain areas of high liquefaction susceptibility. The appropriate placement of project components during engineering design would minimize risks related to soil liquefaction.

Region 4 is characterized by moderate susceptibility to landsliding and low incidence. HVDC Alternative Routes 4-A through 4-D representative ROWs contain greater amount of landslide hazard than the corresponding Applicant Proposed Route links. HVDC Alternative Routes 4-A and 4-B have isolated areas of karst formations covering about 59 and 54 percent of the respective representative ROWs. The corresponding links of the Applicant Proposed Route have slightly lower amounts of karst formations within the representative ROWs.

Shallow bedrock is present along all alternative routes, and blasting may be required in these areas. There is potential for direct impacts to paleontological resources in areas of shallow bedrock (57 to 100 percent for the HVDC Alternative Routes in Region 3). Oil and gas wells and shale gas plays are traversed in Region 4.

3.6.1.6.3.2.1.5 Region 5

Table 3.6.1-17 summarizes relevant analysis considerations for geologic and mineral resources that could potentially impact or be impacted by the Region 5 HVDC alternative routes compared to the corresponding Applicant Proposed Route links. There are no karst formations present in all route areas of Region 5, so karst is not presented in Table 3.6.1-17. However, karst is present in the larger ROIs for HVDC Alternative Route 5-D (73 percent of ROI) and the Applicant Proposed Route (11 percent of ROI).

This page intentionally left blank.

Table 3.6.1-16:
Geological and Mineral Resources within the 200-Foot-Wide Representative ROW—Region 4

Parameter	Representative ROW Impact Area (acres)	Seismicity[1]	Landslides[2]	Subsidence (acres of karst)[3]	Liquefaction susceptibility (acres)[4]	Mineral Resources (shale gas plays acres, oil/gas wells)[5]	Shallow Bedrock[6] (acres)	Impact Comparison with Applicant Proposed Route Corresponding Links
AR 4-A	1,426	2 active faults; low ground motion potential (PGA of 2–3% of gravity)	Low incidence and moderate susceptibility (1,426 acres and 100%)	847 (59%)	69 (5%) (moderate)	572 acres (40%)	1,228 (86%)	Crosses more shallow bedrock and more karst formations; fewer potential shale gas deposits; and lower number of oil and gas wells.
Corresponding APR Links 3, 4, 5, 6	1,475	2 active faults; low ground motion potential	Low incidence and moderate susceptibility (1,202 acres and 81%)—less impact	415 (13%) —less impact	431(29%) (high); 139 (9%) (moderate)–greater impact due to high susceptibility areas	622 acres (42%), 4 oil/gas wells—greater impact	946 (64%) —less impact	NA
AR 4-B	1,920	2 active faults; low ground motion potential I (PGA of 2–3% of gravity)	Low incidence and moderate susceptibility (1,920 acres and 100%)	1,043 (54%)	No moderate or high susceptibility areas	948 acres (49%), 6 oil/gas wells	1,542 (80%)	Crosses more shallow bedrock and more karst formations and fewer potential shale gas deposits and is less susceptible to liquefaction.
Corresponding APR Links 2, 3, 4, 5, 6, 7, 8	1,988	2 active faults; low ground motion potential	Low incidence and moderate susceptibility (1,550 acres and 78%);—less impact	518 (17%) —less impact	405 (20%) (high); 163 (8%) (mod)—greater impact	1,032 acres (52%), 6 oil/gas wells—greater impact	1,334 (67%) —less impact	NA
AR 4-C	83	0 active faults; low ground motion potential I (PGA of 3% of gravity)	Low incidence and moderate susceptibility (83 acres and 100%)	83 (100%)	32 (39%) (high)	83 acres (100%)	83 (100%)	Crosses more shallow bedrock, more potential shale gas deposits, and more karst formations and is more susceptible to liquefaction.
Corresponding APR Link 5	53	0 active faults; low ground motion potential	Low incidence and moderate susceptibility (53 acres and 100%)	53 (100%) – less impact	2 (4%) (high)—less impact	53 acres (100%) —less impact	53 (100%) —less impact	NA

Table 3.6.1-16:
Geological and Mineral Resources within the 200-Foot-Wide Representative ROW—Region 4

Parameter	Representative ROW Impact Area (acres)	Seismicity[1]	Landslides[2]	Subsidence (acres of karst)[3]	Liquefaction susceptibility (acres)[4]	Mineral Resources (shale gas plays acres, oil/gas wells)[5]	Shallow Bedrock[6] (acres)	Impact Comparison with Applicant Proposed Route Corresponding Links
AR 4-D	618	1 active faults; low ground motion potential (PGA of 3% of gravity)	Low incidence and moderate susceptibility (618 acres and 100%)	550 (89%)	4 (high) (<1%); 69 (11%) (mod)	618 acres (100%)	545 (88%)	Crosses fewer potential shale gas deposits and oil and gas wells and more shallow bedrock and is more susceptible to landslides and less susceptible to liquefaction.
Corresponding APR Links 4, 5, 6	619	1 active faults; low ground motion potential	Low incidence and moderate susceptibility (346 acres and 56%); —less impact	215 (70%)	340 (55%) (high); 139 (22%) (mod)—greater impact	619 acres (100%), 4 oil/gas wells—greater impact	286 (46%) —less impact	NA
AR 4-E	897	0 active faults; low ground motion potential (PGA of 3–4% of gravity)	Moderate susceptibility, and low incidence (267 acres and 30%)	No karst	96 (11%) (high)	897 acres (100%), 6 oil/gas wells	513 (57%)	Crosses fewer potential shale gas deposits, more oil and gas wells, and less shallow bedrock and is more susceptible to liquefaction and less susceptible to landslides.
Corresponding APR Links 8, 9	947	1 active faults; low ground motion potential - greater impact	Moderate susceptibility, and low incidence (906 acres and 96%)—greater impact	No karst	No moderate or high susceptibility areas)—less impact	947 acres (100%), 2 oil/gas wells - greater impact	550 (58%) — greater impact	NA

GIS Data Sources:
1 Garrity and Soller (2009), USGS (2008b)
2 USGS (2001)
3 Tobin and Weary (2004)
4 CUSEC (2008)
5 OCC (2013), AOGC (2014), USGS (2005b), EIA (2011a)
6 NRCS (2013)

Table 3.6.1-17:
Geological and Mineral Resources within the 200-Foot-Wide Representative ROW—Region 5

Parameter[1a]	Representative ROW Impact Area (acres)	Seismicity[1]	Landslides[2]	Subsidence[3] (acres of karst)	Liquefaction[4]	Mineral Resources (shale gas plays acres, oil/gas wells)[5]	Shallow Bedrock (acres)[6]	Impact Comparison with Applicant Proposed Route Corresponding Links
AR 5-A	308	0 active faults; low ground motion potential (PGA of 4–5% of gravity)	Low incidence and moderate susceptibility	No Karst	Very low	308 acres (100%), 2 oil/gas wells	256 (86%)	Crosses less shallow bedrock, and more oil and gas wells.
Corr. APR Links 1	300	Same as corresponding AR	Same as corresponding AR	No Karst	Very low	300 acres (100%)	267 (89%)	NA
AR 5-B	1,732	1 active faults; low to moderate ground motion potential (PGA of 5–9% of gravity)	Low incidence and moderate susceptibility	No Karst	Very low	1,732 acres (100%), 4 oil/gas wells	1,591 (92%)	Crosses lower number of oil and gas wells, more shallow bedrock/restrictive layers, and more potential shale gas deposits and is slightly less susceptible to liquefaction.
Corr. APR Links 3, 4, 5, 6	1,641	Same as corresponding AR	Same as corresponding AR	No Karst	High (23 acres and 1%)	1,641 acres (100%), 10 oil/gas wells	1,519 (93%)	NA
AR 5-C	225	0 active faults; low to moderate ground motion potential (PGA of 10% of gravity)	Low incidence and moderate susceptibility	No Karst	Very low	225 acres (100%), 2 oil/gas wells	205 (91%)	Crosses more potential shale gas deposits; fewer oil and gas wells, and more shallow bedrock.
Corr. APR Links 6	109	Same as corresponding AR	Same as corresponding AR	No Karst	Very low	109 acres (100%), 4 oil/gas wells	83 (76%)	NA
AR 5-D	530	1 active faults; low to moderate ground motion potential (PGA of 10% of gravity)	High susceptibility, Moderate incidence (153 acres and 29%), Low incidence (93 acres and 18%), Moderate susceptibility, Low incidence (284 acres and 54%)	389 (73%)	High (179 acres and 34%)	515 acres (97%)	416 (78%)	Crosses more land with a high susceptibility to landslides, more potential shale gas deposits, and more shallow bedrock.

Table 3.6.1-17:
Geological and Mineral Resources within the 200-Foot-Wide Representative ROW—Region 5

Parameter[1a]	Representative ROW Impact Area (acres)	Seismicity[1]	Landslides[2]	Subsidence[3] (acres of karst)	Liquefaction[4]	Mineral Resources (shale gas plays acres, oil/gas wells)[5]	Shallow Bedrock (acres)[6]	Impact Comparison with Applicant Proposed Route Corresponding Links
Corr. APR Link 9	500	Same as corresponding AR	High susceptibility, Low incidence (112 acres and 22%), Moderate susceptibility, Low incidence (253 acres and 51%)	308 (62%)	Very low	375 acres (75%)	332 (66%)	NA
AR 5-E	885	1 active faults; low to moderate ground motion potential (PGA of 7–9% of gravity)	Low incidence and moderate susceptibility	No Karst	Very low	885 acres (100%), 4 oil/gas wells	837 (95%)	Crosses more potential shale gas deposits, less oil and gas wells, and more shallow bedrock.
Corr. APR Links 4, 5, 6	811	Same as corresponding AR	Same as corresponding AR	No Karst	Very low	811 acres (100%), 8 oil/gas wells	766 (94%)	NA
AR 5-F	544	0 active faults; low to moderate ground motion potential (PGA of 8–9% of gravity)	Low incidence and moderate susceptibility	No Karst	Very low	544 acres (100%), 2 oil/gas wells	501 (92%)	Crosses more potential shale gas deposits, more oil and gas wells, and more shallow bedrock.
Corr. APR Links 5, 6	459	Same as corresponding AR	Same as corresponding AR	No Karst	Very low	459 acres (100%)	416 (91%)	NA

1a The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
GIS Data Sources:
1 Garrity and Soller (2009), USGS (2008b)
2 USGS (2001)
3 Tobin and Weary (2004)
4 CUSEC (2008)
5 AOGC (2014), USGS (2005b) (metallic and non-metallic mineral resources), EIA (2011a)
6 NRCS (2013)

Active surface faults are present in Region 5 along HVDC Alternative Routes 5-B, 5-D, and 5-E, and expected ground motions from an earthquake would be low to moderate. Earthquake hazard transitions from low to moderate with eastward progression along the region, and seismicity impacts are expected to be minimal for all Region 5 alternatives. High liquefaction susceptibility is present in HVDC Alternative Route 5-D. The corresponding Applicant Proposed Route representative ROW is located in areas that have no high liquefaction susceptibility.

Region 5 is characterized by moderate susceptibility to landsliding and low incidence with the exception of the representative ROW for HVDC Alternative Route 5-D, for which landslides are low incidence and high susceptibility. Shallow bedrock is present along all routes (78 to 95 percent), and blasting may be required in these areas. There is also potential for direct impacts to paleontological resources in areas of shallow bedrock. Mineral resources and shale gas plays are traversed by both HVDC alternative routes and corresponding Applicant Proposed Project links.

As described in Appendix M and summarized in Section 2.4.2.5, a route adjustment was developed for HVDC Alternative Route 5-B to maintain an end-to-end route with Applicant Proposed Route Links 2 and 3, Variation 1. The geologic hazards and mineral resources for this route adjustment would be similar to the original HVDC Alternative Route 5-B.

As described in Appendix M and summarized in Section 2.4.2.5, a route variation was developed for HVDC Alternative Route 5-E in response to public comments on the Draft EIS to maintain continuity with Applicant Proposed Route Links 3 and 4, Variation 2. The geologic hazards and mineral resources for this route adjustment would be similar to the original HVDC Alternative Route 5-E.

3.6.1.6.3.2.1.6 Region 6

Table 3.6.1-18 summarizes relevant analysis considerations for geologic and mineral resources that could potentially impact or be impacted by the Region 6 HVDC alternative routes compared with the corresponding Applicant Proposed Route links. Because no active faults or karst formations occur, and landslides risks are low, these geologic hazards are not presented in Table 3.6.1-18.

From west to east within Region 6, the earthquake hazard transitions from low-moderate to moderate-high. HVDC Alternative Routes 6-C and 6-D, as well as the Applicant Proposed Route corresponding links, on the easternmost portion of Region 6 are located within moderate to high seismic hazard and are closer to the New Madrid Seismic Zone. Seismicity impacts are expected to be minimal for the four HVDC alternative routes and corresponding Applicant Proposed Route Links 2, 3, 4, 6, and 7. Most of the soils in both the HVDC alternative routes and Applicant Proposed Route representative ROWs have high liquefaction susceptibility.

Shallow bedrock is present along all routes in Region 6 (2 to 61 percent), and blasting may be required in these areas. There are only slight differences between the Region 6 alternative routes in terms of geologic hazards; and the HVDC alternative routes, compared to Applicant Proposed Route Links 2, 3, 4, 6, and 7, would have nearly the same impacts. There is also potential for direct impacts to paleontological resources in areas of shallow bedrock. HVDC Alternative Route 6-A traverses only one oil and gas well (listed as inactive).

As described in Appendix M and summarized in Section 2.4.2.6, a route adjustment was developed for HVDC Alternative Route 6-A to maintain an end-to-end route with Applicant Proposed Route Link 2, Variation 1. The geologic hazards and mineral resources for this route adjustment would be similar to the original HVDC Alternative Route 6-A.

This page intentionally left blank.

Table 3.6.1-18:
Geological and Mineral Resources within the 200-Foot-Wide Representative ROW—Region 6

Parameter[1a]	Representative ROW Impact Area (acres)	Seismicity[1]	Liquefaction[2]	Mineral Resources[3]	Shallow Bedrock[4] (acres)	Impact Comparison with Applicant Proposed Route Corresponding Links
AR 6-A	396	0 active faults; low to moderate ground motion potential (PGA of 10 to 20% of gravity)	High (396 acres and 100%)	1 oil/gas well (inactive)	238 (60%)	Nearly the same impacts with less impact to shallow bedrock.
Corresponding APR Links 2,3,4	433	Same as AR 6-A	High (433 acres and 100%)	None—less impact	278 (64%)—greater impact	NA
AR 6-B	344	0 active faults; low to moderate ground motion potential (PGA of 10 to 15% of gravity)	High (344 acres and 100%)	None	209 (61%)	Nearly the same impacts with somewhat greater impact to shallow bedrock.
Corresponding APR Link 3	236	Same as AR 6-B	High (236 acres and 100%)	Same as AR 6-B	173 (73%)—less impact	NA
AR 6-C	566	0 active faults; moderate to high ground motion potential (PGA of 20 to 30% of gravity)	High (264 acres and 47%), Moderate (61 acres and 11%) Very High (241 acres and 43%)	None	262 (46%)	Nearly the same impacts with slightly less impact to soil liquefaction and shallow bedrock.
Corresponding APR Links 6,7	606	Same as AR 6-C	High (260 acres and 43%), Moderate (84 acres and 14%), Very High (262 acres and 43%)—greater impact	Same as AR 6-C	291 (48%)—greater impact	NA
AR 6-D	209	0 active faults; high ground motion potential (PGA of 30% of gravity)	Very high (209 acres and 100%)	None	4 (2%)	Nearly the same impacts.
Corresponding APR Link 7	224	Same as AR 6-D.	Very high (224 acres and 100%)	Same as AR 6-D	0 (0%)—less impact	

1a The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
GIS Data Sources:
1 Garrity and Soller (2009), USGS (2008b)
2 CUSEC (2008)
3 AOGC (2014), USGS (2005b) (metallic and non-metallic mineral resources), EIA (2011a)
4 NRCS (2013)

This page intentionally left blank.

3.6.1.6.3.2.1.7 Region 7

Table 3.6.1-19 summarizes relevant analysis considerations for geologic and mineral resources that could potentially impact or be impacted by construction of the HVDC transmission line within the alternative routes in Region 7. Because no karst formations or mineral resources occur in Region 7, they are not presented in Table 3.6.1-19.

No active surface faults are present in Region 7, and expected ground motions from an earthquake would be moderate to high. Expected ground motion for HVDC Alternative Route-7A and the corresponding Applicant Proposed Route links is the highest of the HVDC alternative routes because it is closest to the New Madrid Seismic Zone. Susceptibility to liquefaction is high to very high for all HVDC alternative routes and the corresponding Applicant Proposed Route links.

High susceptibility areas for landslides are located in all of the HVDC alternative routes. Landslide incidence varies from low to moderate. Moderate incidence occurs along HVDC Alternative Routes 7-C and 7-D. The Applicant Proposed Route in Region 7 has somewhat less impact to high susceptibility areas for landslides than the HVDC alternative routes. Landslide hazards would be minimized in the same manner described for the Applicant Proposed Route. Shallow bedrock is present along routes HVDC Alternative Route 7-B, 7-C, and 7-D, with slightly more shallow bedrock present in the corresponding Applicant Proposed Route links for 7-B and 7-D. Blasting may be required in these areas. The HVDC alternative routes and corresponding Applicant Proposed Route Links 1, 3, 4, and 5 would have nearly the same overall impacts in terms of geologic hazards.

There is also potential for direct impacts to paleontological resources in areas of shallow bedrock during grading and excavation activities. Mineral resources were not identified within the representative ROWs in Region 7.

3.6.1.6.3.2.2 Operations and Maintenance Impacts

Impacts to and from geologic hazards during operations and maintenance would be the same as described in 3.6.1.6.2 for the Applicant Proposed Route.

3.6.1.6.3.2.3 Decommissioning Impacts

Impacts to and from geologic hazards during decommissioning would be the same as described in 3.6.1.6.2 for the Applicant Proposed Route.

3.6.1.6.4 Best Management Practices

No BMPs are recommended because implementation of the EPMs and appropriate engineering design methods is anticipated to avoid and minimize impacts related to geologic hazards, paleontological resources, and mineral resources.

3.6.1.6.5 Unavoidable Adverse Impacts

Appropriate engineering design and adherence to applicable design standards would reduce the risk from geological hazards, but damage to Project components could occur if a rare, major geologic event such as a large magnitude earthquake or landslide occurred.

Despite EPMs and appropriate engineering design, scientifically valuable fossils may be disturbed and lost during construction activities. If this occurred, the small loss of fossil material would be offset to a degree by material that is recovered and preserved for scientific study purposes.

This page intentionally left blank.

Table 3.6.1-19:
Geological and Mineral Resources within the 200-Foot-Wide Representative ROW—Region 7

Parameter	Impact Area (acres)	Seismicity[1]	Landslides[2]	Liquefaction[3]	Shallow Bedrock (acres)[4]	Impact Comparison with Applicant Proposed Route Corresponding Links
AR 7-A	1,052	0 active faults; moderate to high ground motion potential (PGA of 20 to 30% of gravity)	High susceptibility, low incidence (594 acres and 56%)	Very high (1,052 acres and 100%)	0 (0%)	Nearly the same impacts with somewhat more impact to potential landslide areas.
Corresponding APR Link 1	698	Same as AR 7-A.	High susceptibility, low incidence (414 acres and 59%)—less impact	Very high (698 acres and 100%)	0 (0%)	NA
AR 7-B	210	0 active faults; moderate to high ground motion potential (PGA of 20% of gravity)	High susceptibility, low incidence (39 acres and 19%)	High (165 acres and 79%); very high (45 acres and 21%)	13 (6%)	Nearly the same impacts with somewhat more impact to landslide and soil liquefaction areas; and less impact to shallow bedrock.
Corresponding APR Links 3,4	205	Same as AR 7-B	High susceptibility, low incidence (27 acres and 13%)—less impact	High (178 acres and 87%); very high (27 acres and 13%)—less impact	33 (16%)—greater impact	NA
AR 7-C	579	0 active faults; moderate ground motion potential (PGA of 15 to 20% of gravity)	High susceptibility, low incidence (39 acres and 7%)	High (416 acres and 72%), Very High (162 acres and 28%)	134 (23%)	Crosses more shallow bedrock, and is more susceptible to liquefaction and landslides. Slightly lower overall seismicity (PGA).
Corresponding APR Links 3,4,5	323	0 active faults; moderate ground motion potential (PGA of 20% of gravity) – slightly higher seismicity	High susceptibility, low incidence (27 acres and 8%); high susceptibility, moderate incidence (100 acres and 31%); low incidence (196 acres and 61%)—less impact	High (296 acres and 92%), very high (27 acres and 8%)—less impact	54 (17%)—less impact	NA
AR 7-D	160	0 active faults; moderate ground motion potential (PGA of 20% of gravity)	High susceptibility, moderate incidence (110 acres and 69%)	High (160 acres and 100%)	14 (9%)	Crosses less shallow bedrock, and is somewhat more susceptible to landslides.
Corresponding APR Links 4,5	157	Same as AR 7-D	High susceptibility, moderate incidence (100 acres and 64%)—less impact	High (157 acres and 100%)	35 (22%)—greater impact	NA

GIS Data Sources:
1 Garrity and Soller (2009), USGS (2008b)
2 USGS (2001)
3 CUSEC (2008)
4 NRCS (2013)

This page intentionally left blank.

Mineral resources may exist below the surface within the Project ROWs and/or converter station sites, in which case some resources could be less accessible for the life of the Project. The types of mineral resources that would be more affected are near-surface mineral material deposits (e.g., common sand, gravel, and stone). Oil and gas resources would be less affected because recovery of the resources would be possible, even with a minimum stand-off of 250 feet from the edge of the route ROWs and converter station sites using a vertically installed well, without the use of directional drilling. With directional drilling, such areas could be accessed at considerable distance from the Project.

3.6.1.6.6 Irreversible and Irretrievable Commitment of Resources

Because paleontological resources are nonrenewable, any impacts would render the resource disturbance irreversible and the integrity of the resource irretrievable.

3.6.1.6.7 Relationship between Local Short-term Uses and Long-term Productivity

No relationships exist between local short-term uses and long-term productivity for geological hazards. Short-term impacts associated with the exposure of any scientifically important fossils from Project activities would not adversely impact the long-term potential for discovery of potential fossil resources. Any short-term effects to access to mineral resources are not expected to cause long-term impairment to the productivity of mineral resources.

3.6.1.6.8 Impacts from Connected Actions

3.6.1.6.8.1 Wind Energy Generation

3.6.1.6.8.1.1 Construction Impacts

No impacts from seismic hazards, landslides, or soil liquefaction were identified, and no impacts to mineral resources are anticipated from construction activities in the WDZs. Subsidence from karst is a possible geologic hazard of concern within the WDZs. The approximate percentages of karst contained within the WDZs range from 0 to 87 percent. Appropriate engineering design and proper placement of wind farm infrastructure would typically be implemented to minimize the risks associated with constructing wind farms across karst. However, complete avoidance of karst is not possible, and the risk to wind farm components from subsidence would still exist. Additionally, the excavation and drilling required for the foundations of the wind turbines could create new preferential flow pathways, which could increase the risk of introducing constituents into the karst system that could eventually impact groundwater quality.

Although no known fossil bed sites were identified in the wind energy generation ROI, grading and excavation activities have the potential to cause direct impacts to paleontological resources. These impacts could occur if fossils are at or near the ground surface in rock outcrops and/or areas of shallow bedrock. Grading activities would typically be limited to the minimum amount needed to create safe working surfaces. Foundation excavations would typically be made using power drill or augers; blasting would typically only be used where necessary and in accordance with wind developer's Blasting Plan. Typically, project personnel would be trained in the practices, techniques, and protocols required by federal and state regulations and applicable permits. Training of personnel if required would increase the likelihood that any unique fossils exposed during an excavation would be identified and the necessary steps taken to preserve them.

Wind turbines and other infrastructure would be dispersed within the wind farms, such that alternative placement of drilling equipment would be possible, if required, and access to oil, gas, and mineral resources should not be greatly diminished. Additionally, turbines and associated facilities are often microsited to avoid sensitive land uses, or as preferred by the participating landowners in lease provisions. Impacts on mineral resources extraction during construction are anticipated to be minor.

3.6.1.6.8.1.2 Operations and Maintenance Impacts

During operations and maintenance, impacts to wind farm facilities from seismicity are not anticipated, because the area is located in an area of low seismic risk, so soil liquefaction risk is also expected to be low. Wind farm facilities would not likely be affected by karst because the engineering design and placement of facilities to minimize risks from karst would typically be put in-place during construction. However, due to the prevalence of karst in the area the risk for subsidence does exist. Impacts to mineral resource accessibility would not be expected if protective measures described for the construction phase were put in place; and the locations of the facilities would be designed to avoid mineral resources to the extent possible. Blasting would not occur and other soil disturbing activities would be negligible, so no impacts to fossils would be expected.

3.6.1.6.8.1.3 Decommissioning Impacts

Any risks to the wind farm facilities associated with identified geologic hazards would be removed when the facilities were decommissioned. Some ground disturbance would occur from the use of machinery such as bulldozers to demolish facility buildings or cranes used to deconstruct the wind turbines. However, ground disturbance would be limited to the near surface in previously disturbed areas. Decommissioning would not impact karst because protective measures used during construction would also be applied during decommissioning and the amount of ground disturbance associated with decommissioning would be less than during construction. Access to oil and gas or mineral resources would no longer be potentially affected by the presence of the facilities.

3.6.1.6.8.2 Optima Substation

Seismicity characteristics for the future Optima substation are low and similar to those described in Region 1. The area is within karst; and shallow bedrock is present in 15 acres (9 percent of the 160-acre siting area). Mineral resources are not present. Potential effects from karst associated with subsidence could be avoided or minimized through appropriate engineering design. Potential effects to fossil resources would be avoided or minimized through limiting the area of disturbance during construction activities.

3.6.1.6.8.3 TVA Upgrades

Like the Project, the required TVA upgrades would not be expected to increase geologic hazards, except potentially landslide hazards. Depending on the location of the new transmission line, the potential to impact landslide risks could occur during construction. Impacts from upgrades to existing transmission lines and substations are expected to minimal or non-existent.

Grading and excavation activities have the potential to uncover and impact paleontological resources. If paleontological resources are similar to those analyzed for the Project, the potential associated with the TVA upgrades would be expected to be minimal. Some impacts to paleontological resources could occur during construction of the new 500kV transmission line.

The required TVA upgrades would be unlikely to affect mineral resources because they would not affect new areas of potential mineral resources. Effects could occur if construction of the new transmission line impeded access to mineral resources. Recoverable mineral resources in western Tennessee are relatively limited and these effects would likely be minor.

3.6.1.6.9 Impacts Associated with the No Action Alternative

Under the No Action Alternative, the Project would not be constructed and geology, paleontology, and mineral resources would not be impacted. Areas of geologic hazard would not be impacted, nor would these hazards impact Project infrastructure.

3.6.2 Soils

3.6.2.1 Regulatory Background

Soil resources are managed through a broad set of regulations, guidelines, and formal planning processes. These controls and directions are administered through federal, state, or local units of government. Through state and local agency offices, the NRCS administers soil conservation programs on private lands. In addition, the NRCS inventories Prime and Unique Farmlands, as identified in 7 CFR Part 657 and further described in Table 3.6.2-1. Prime Farmland in the ROI is shown on Figure 3.6-7 (located in Appendix A).

Table 3.6.2-1:
Federal and State Laws and Regulations Associated with Soils Resources

Statute/Regulation	Key Elements
Federal	
FPPA (7 CFR Part 657)	The FPPA authorizes the USDA to develop criteria for identifying the effects of federal programs on the direct or indirect conversion of farmland to nonagricultural uses. For the purposes of the law, federal programs include construction projects sponsored or financed in whole or part by the federal government and the management of federal lands. Federal agencies are directed to (1) use the developed criteria, (2) identify and take into account the adverse effects of federal programs on the preservation of farmland, (3) consider appropriate alternative actions that could minimize potential adverse effects to farmland, and (4) ensure that such federal programs, to the extent practicable, are compatible with state and local units of government, as well as private programs and policies, so that farmland is protected (NRCS 2014a). Farmland protected by the FPPA is either (1) prime or unique farmland, which is not already committed to urban development or water storage, or (2) other farmland, which is of statewide or local importance as determined by the appropriate state or local governmental agency with the concurrence of the Secretary of Agriculture. Farmland subject to FPPA is not required to be currently used for cropland. Farmland can be forestland, pastureland, cropland, or other land (NRCS 2014a). The county soil survey provided by the NRCS determines which soils are protected. The DOE has consulted with the Oklahoma, Arkansas, and Tennessee NRCS offices concerning impacts to farmland protected under the Farmland Protection Policy Act (FPPA) and has received a determination from the agencies that the transmission lines do not irreversibly convert farmland (Saronga 2014, Adams 2014, Baker 2014). This determination has been further confirmed with the NRCS National Leader for FPPA. It should be noted, however, that this determination does not apply to the converter stations, which would potentially convert farmland and would require a Form AD-1006 to be submitted for evaluation. Once the exact locations of Project components have been determined, a farmland conversion assessment would be completed by the NRCS for any remaining components for which the NRCS has not yet issued a determination. The assessment would require the NRCS to complete a Farmland Conversion Impact Rating worksheet, Form AD-1006. The purpose of the FPPA is to minimize the impact that federal programs have on the unnecessary and irreversible conversion of farmland to nonagricultural uses. However, the FPPA does not authorize the federal government to regulate the use of private or nonfederal land or in any way affect the property rights of owners. As such, the FPPA does not regulate farmland, but is a mechanism for the reporting and documentation of farmland conversion activities and is used to alert decision makers in cases of farmland conversion concerns.

Table 3.6.2-1:
Federal and State Laws and Regulations Associated with Soils Resources

Statute/Regulation	Key Elements
National Pollutant Discharge Elimination System (NPDES) stormwater program	Soil erosion is governed by regulations contained in EPA's stormwater management regulations, derived as part of the Clean Water Act. Under the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) stormwater program requires operators of construction sites 1 acre or larger (including smaller sites that are part of a larger common plan of development) to obtain authorization to discharge stormwater under an NPDES construction stormwater permit. The development and implementation of SWPPPs is the focus of NPDES stormwater permits for regulated construction activities. Stormwater permits would be required for the Project from federal, state, and local agencies based on specific jurisdictional authority.

3.6.2.2 Data Sources

Soil information and data from the NRCS Soil Survey Geographic (SSURGO) database (GIS Data Source: NRCS 2013) were obtained to determine soil characteristics and potential soil hazards. General regional soil information was obtained from the NRCS (GIS Data Source: Jin et al. 2013) Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin (GIS Data Source: NRCS 2006). Soil information for prime farmlands and for farmland soils of state and local importance was obtained from the SSURGO database (GIS Data Source: NRCS 2013). It should be noted that soil information is not available for unique farmland in the SSURGO database and that coordination with state agencies is ongoing to obtain this information as further discussed in Section 3.2. Information and data regarding potential soil contamination are based on available information from regulatory databases including EPA's Facility Registry Service (FRS) Database (GIS Data Source: EPA 2014b).

NRCS soil surveys (typically one per county) are mapped independently, and soil scientists that map the survey areas sometimes apply the available soil categories differently. For example, two soil map units on either side of a county boundary may be mapped with slightly different prime farmland categories. Therefore, slight variations in the consistency of the impacts to designated farmland across counties could occur. Such variations are not expected to be significant in terms of the overall analysis.

The description of each region below was derived from the broad landform characteristic areas that NRCS denotes as major land resource areas (MLRAs). The more detailed discussion of soils in Regions 1 through 7 follow the NRCS soil taxonomy/classification system that includes six ranking categories (in descending rank): order, suborder, great group, subgroup, family, and series. The soils descriptions are presented broadly by soil order to allow for a meaningful characterization of the ROI without describing the more than 3,000 individual soils series that exist in the ROI. Exceptions have been made for specific convertor station site areas where more detailed information is provided.

Throughout this section, characteristics that may indicate potential impacts or differentiate between the Applicant Proposed Project and DOE Alternatives are presented in tables, while other factors are omitted.

3.6.2.3 Region of Influence

3.6.2.3.1 Region of Influence for the Project

The ROI for soils is the same as the description provided in Section 3.1.1.

3.6.2.3.2 Region of Influence for Connected Actions

The ROI for soils for wind energy development, the future Optima substation, and TVA upgrades is described in Section 3.1.1.

3.6.2.4 Affected Environment

Soil characteristics across Regions 1 through 7 are influenced by the semi-arid conditions in the west and humid conditions in the east. Landforms in Oklahoma include rolling hills, plateaus, and ridgetops dissected by drainages and river valleys. Landforms in Arkansas include large areas of the eroded mountainous areas of the Ozarks. Landforms in eastern Arkansas and Tennessee (Region 7) are dominated by loess uplands and floodplain areas of the Mississippi River Valley. Figure 3.6-8 in Appendix A shows the MLRAs traversed by the Project.

Several route variations to the Applicant Proposed Route in Regions 2–7 were developed in response to public comments on the Draft EIS and are described in Appendix M and summarized in Sections 2.4.2.1–2.4.2.7. These variations also required adjustments to four of the HVDC alternative routes so that these routes could connect with the Applicant Proposed Route. These variations represent minor adjustments to the Applicant Proposed Route and the soils resources would remain consistent within the ROI. The variations are presented graphically in Exhibit 1 of Appendix M.

3.6.2.4.1 Designated Farmland

Designated farmland within the ROI includes NRCS categories including the “prime farmland” categories, and the category of “state and local importance.” No designated “unique farmland” is mapped in the Project ROI. Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, oilseed, and other agricultural crops with minimum inputs of fuel, fertilizer, pesticides, and labor, and without intolerable soil erosion as determined by the USDA. Prime farmland can include land that possesses these characteristics but is being used currently to produce livestock and timber. Urbanized land and open water are excluded from prime farmland. Prime farmland typically contains few or no rocks, is permeable to water and air, is not excessively erodible or saturated with water for long periods, and is not subject to frequent, prolonged flooding during the growing season. Soils that do not meet the above criteria may be considered prime farmland if the limiting factor is mitigated (e.g., using artificial drainage or irrigation). Farmland of state and local Importance is identified by the associated state and local conservation agencies and officials.

3.6.2.4.2 Soil Limitations

The affected environment section provides a general baseline for the soil limitations parameters to set the stage for the more detailed discussion in the impacts section. Soil limitations of concern are described in greater detail in Section 3.6.2.6 of the impacts analysis. Important soil limitation characteristics used to describe the affected environment include the following:

3.6.2.4.2.1.1 Hydric Soils

Hydric soils are defined as “soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part” (59 FR 16835, July 13, 1994). Soils that are artificially drained or protected from flooding (e.g., by levees) are considered hydric if the soil in its undisturbed state would meet the definition of a hydric soil. Hydric soils are typically associated with jurisdictional wetlands, which must meet three required criteria: hydric soils, wetland hydrology, and hydrophytic vegetation, except in “difficult wetland situations" where not all criteria are evident. These situations are defined in the regional interim supplements to the USACE's Wetland Delineation Manual (Environmental Laboratory 1987).

3.6.2.4.2.1.2 Erosion Potential

Erosion is a continuing natural process that can be accelerated by human disturbances. Factors that influence soil erosion include soil texture, structure, length and percent of slope, vegetative cover, and rainfall or wind intensity. Soils most susceptible to erosion by wind or water are typified by bare or sparse vegetative cover, non-cohesive soil particles with low infiltration rates, and moderate to steep slopes. Wind erosion processes are less affected by slope angles but highly influenced by wind intensity.

Soils with a severe water erosion potential indicate that erosion is very likely and that erosion control measures are advisable. Very severe water erosion potential indicates that significant erosion is expected, loss of soil productivity and off-site damage are likely, and erosion-control measures are costly and generally impractical.

3.6.2.4.2.1.3 Compaction Potential

Soil compaction is the process by which soil pore air space is reduced in size because of physical pressure exerted on the soil surface. Compaction results in soil conditions that reduce infiltration, permeability, and gaseous and nutrient exchange rates of the soil. Physical resistance to root growth can occur with high soil bulk densities. Soil compaction changes the soil structure by reducing the porosity and increasing the bearing strength of the soil. As a result, the ability to receive water is reduced, leading to an overall reduction in the moisture-holding capacity of the soil. The degree of compaction depends on the moisture content at the time of compaction and soil texture. Compaction decreases infiltration and thus increases runoff and the hazard of water erosion. Fine-textured soils with poor internal drainage are the most susceptible to compaction. Sandy loam, loam, and sandy clay loam soils compact more easily than silt, silt loam, silty clay loam, silty clay, or clay soils.

Soil compaction and displacement reduces water infiltration and often diverts lateral movement of the water within the soil. These conditions not only lead to increased erosion and sedimentation potential but could contribute to higher stormwater runoff from normal peak flows. The movement of heavy construction equipment, soil mixing or displacement from grading/excavation activities, or rutting from equipment or vehicle traffic could result in soil compaction and damage to soil structure.

3.6.2.4.2.1.4 Corrosion

Soils that are rated as having a risk of corrosion for "uncoated steel" or concrete are directly related to the susceptibility of uncoated steel or concrete to corrode when in contact with the soil (GIS Data Source: NRCS 2013). Corrosion is generally defined as the soil property that would create conditions for potential damage to these construction materials. Soil properties contributing to risk of corrosion to uncoated steel include high acidity, texture, existence of soluble salts, and a pH of 4.0 or less. Soil properties contributing to risk of corrosion to concrete include high acidity, texture, existence of soluble salts, and the presence of gypsum or other sulfate minerals.

3.6.2.4.2.1.5 Restrictive Layer

A "restrictive layer" is a nearly continuous layer that has one or more physical, chemical, or thermal properties that significantly impede the movement of water and air through the soil or that restrict roots or otherwise provides an unfavorable root environment (GIS Data Source: NRCS 2013). Examples are bedrock, cemented layers, dense layers, and frozen layers. Soils that are rated as having a restrictive layer are shallow soils that have a lithic, paralithic, or other restrictive soil layer within 60 inches of the soil surface. A shallow restrictive layer can affect land development and is also is indicative of potential reclamation concerns. The restrictive layer for the ROI is shown on Figure 3.6-9 (located in Appendix A).

3.6.2.4.2.1.6 Steep Slopes

Slopes were evaluated for slopes from 15 to 30 percent and for slopes greater than 30 percent. These slope ranges were selected because the operation of rubber-tired equipment becomes hazardous when the slope approaches and exceeds 30 percent. In addition, soil erosion concerns are generally greater as slopes become steeper. The two ranges provide a broad indication of locations that might present construction and operational limitations related to ground vehicle maneuverability, development limitations, and potential erosion concerns.

3.6.2.4.2.1.7 Large Stones

Soils with a high percentage of cobbles and stones in the soil profile can present significant problems with surface reclamation because they hold less available water for plant growth and generally require broadcast seeding methods.

3.6.2.4.2.2 Soil Contamination

Areas of potential soil contamination are identified within the ROI based on searches of the EPA FRS Database (GIS Data Source: EPA 2014b). The database integrates information from a variety of sources about facilities that are required to report activity about hazardous waste, toxic and air releases, Superfund sites, and water discharge permits to a state or federal system. Most of the EPA tracked sites are indicative of inventoried sites that have permits or are otherwise under regulatory authority, but do not raise a red flag in terms of existing contamination issues. The affected environment evaluation provides a broad evaluation and identifies sites that might raise such a concern. More detailed evaluation of individual sites that might raise contamination issues for the Project is included in the impacts section. EPA Sites in the ROI are shown on Figure 3.6-10 (located in Appendix A). The FRS database categories identified in the ROI include the following (which are identified by region in Section 3.6.2.5):

- LUST–ARRA—The Leaking Underground Storage Tank (LUST)–American Recovery and Reinvestment Act (ARRA) system collects data on LUST releases that are tracked by ARRA performance measures or for which ARRA funds are being spent. Data are collected for each release, including identification, performance measures, reference information, and location information.
- TCEQ—Texas Commission on Environmental Quality (TCEQ) Alternative Capacity Requirement (ACR)—The TCEQ ACR is a computer application that allows the TCEQ to use a single centralized area to record common information, such as the company names, addresses, and telephone numbers of entities the TCEQ regulates. It also contains additional information about permits, registrations, authorizations, etc. including their status.
- RCRAInfo—Hazardous waste information is contained in the Resource Conservation and Recovery Act Information (RCRAInfo), a national program management and inventory system about hazardous waste handlers. In general, all generators, transporters, treaters, storers, and disposers of hazardous waste are required to provide information about their activities to state environmental agencies. This regulation is governed by the Resource Conservation and Recovery Act (RCRA), as amended by the Hazardous and Solid Waste Amendments of 1984.
- NPDES—The EPA's Office of Wastewater Management leads and manages the NPDES permit program in partnership with EPA Regional Offices, states, tribes, and other stakeholders.

- Permit Data Summary (PDS)—PDS is an Arkansas system maintaining data on air quality, mining, tires, solid waste, tank, water and hazardous waste, as well as inspections, invoicing and complaints.
- BR—The EPA Hazardous Waste Report (Biennial Report or “BR”) collects data on the generation, management, and minimization of hazardous waste.
- eGRID—The Emissions & Generation Resource Integrated Database (eGRID) is a comprehensive source of data on the environmental characteristics of almost all electric power generated in the United States.
- EIA—U.S. Energy Information Administration (EIA)-860—The survey Form EIA-860 collects generator-level specific information about existing and planned generators and associated environmental equipment at electric power plants with 1MW or greater of combined nameplate capacity.
- TRI—The Toxics Release Inventory (TRI) tracks the management of more than 650 toxic chemicals that pose a threat to human health and the environment. U.S. facilities in certain industry sectors that manufacture, process, or otherwise use these chemicals in amounts above established levels must report how each chemical is managed through recycling, energy recovery, treatment, and releases to the environment. A “release” of a chemical means that it is emitted to the air or water, or placed in some type of land disposal.
- ICIS—The Integrated Compliance Information System (ICIS) is a web-based system that provides information for the Federal Enforcement and Compliance and the NPDES programs.
- CERCLA—EPA administers the Superfund program in cooperation with individual states and tribal governments. The Comprehensive Environmental Response, Compensation, and Liability Information System database provides information regarding these Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or otherwise named Superfund sites.
- NCDB—National Compliance Data Base (NCDB) supports implementation of the Federal Insecticide, Fungicide, and Rodenticide Act and the Toxic Substances Control Act. The system tracks inspections in regions and states with cooperative agreements, enforcement actions, and settlements.
- SSTS—Section Seven Tracking System (SSTS) tracks the registration of all pesticide-producing establishments and tracks annually the types and amounts of pesticides, active ingredients, and related devices that are produced, sold, or distributed.

3.6.2.5 Regional Description

3.6.2.5.1 Region 1

Southern High Plains, Northern Part MLRA

The western portion of the ROI in Region 1, including the Oklahoma Converter Station Siting Area, Oklahoma AC Transmission Interconnection Siting Area, and AC collection system routes, is located in the Southern High Plains, Northern Part MLRA. This area is characterized by open plains on an elevated plateau cut by draws with moderate to very steep slopes (GIS Data Source: NRCS 2006). The narrow floodplains generally trend from southwest to northeast. Interspersed playa basins are also present in the MLRA and can range from 5 acres to more than 100 acres. Topographical relief is generally nearly level to very gently sloping and elevations increase gradually from southeast to northeast. Almost all of the MLRA is agricultural; nearly one-fifth of the area is irrigated.

Soil resource concerns in the MLRA are wind erosion, water erosion, maintenance of the content of soil organic matter and productivity, and management of soil moisture. Conservation practices on cropland generally include systems of crop residue management (especially no-till systems that reduce the need for tillage), cover crops, windbreaks, vegetative wind barriers, wind stripcropping, and nutrient management. The dominant conservation practice on rangeland is prescribed grazing.

Alfisols and mollisols are the predominant soil orders in the MLRA. These soils are characterized by a mesic soil temperature regime, an ustic soil moisture regime, and mixed minerology. The mesic soil temperature regime has mean annual soil temperatures of 8 degrees centigrade (°C) or more, but less than 15°C, and the difference between mean summer and mean winter soil temperatures is greater than 5°C at 50 centimeters (cm) below the surface (Plant and Soil Sciences eLibrary 2014). The ustic soil moisture regime indicates a semiarid climate. The soils are generally very deep, well drained, and loamy. These soils are present as loess and loamy material on plains, sandy eolian material on sandhills, and as loess on ridges and side slopes adjacent to drainage ways. Soils in the area are also present as lacustrine deposits on playa floors.

Southern High Plains, Breaks MLRA

The central portion of ROI in Region 1 is located in the Southern High Plains, Breaks MLRA. The MLRA is characterized by very steep escarpments, very gently sloping to moderately sloping plains, strongly sloping hills and ridges, and integrated drainage networks along the Canadian and Beaver rivers (GIS Data Source: NRCS 2006). The landscape has undulating to hilly topography and well developed, dendritic drainage systems. Elevations increase in the MLRA from the southeast to northwest.

Soil resource concerns in the MLRA are wind erosion, water erosion, maintenance of the content of soil organic matter and productivity of the soils, and management of soil moisture. Soil conservation practices on cropland generally include systems of crop residue management (especially no-till systems that reduce the need for tillage), cover crops, windbreaks, vegetative wind barriers, wind stripcropping, and nutrient management. The most important conservation practice on rangeland is prescribed grazing.

Alfisols, inceptisols, and mollisols are the predominant soil orders in the MLRA. These soils are characterized by a thermic soil temperature regime, an ustic soil moisture regime, and mixed or carbonatic mineralogy (GIS Data Source: NRCS 2006). The soils are shallow to very deep, well drained, and generally loamy or sandy. The thermic soil temperature regime has mean annual soil temperatures of 15°C or more, but less than 22°C; and a difference between mean summer and mean winter soil temperatures of greater than 5°C at 50 cm below the surface (Plant and Soil Sciences eLibrary 2014). The soils are present as loamy sediments, old alluvium, and weathered caliche on plains and loamy material on stream terraces. Soils are also present in alluvium on floodplains, in mixed alluvium and colluvium on backslopes, and along footslopes on escarpments and hillslopes. Area soils also form in sandy and gravelly old alluvium on knobs and hillslopes, in older loamy alluvium on hillslopes, and in coarse-textured sediments on floodplains. Weathered caliche soils are found on hills, ridges, and escarpments, and in wind-reworked sandy alluvium on dunes.

Central Rolling Red Plains, Eastern Part MLRA

The eastern portion of the ROI in Region 1 is located in the Central Rolling Red Plains, Eastern Part MLRA. This area is characterized by smooth to rolling hills and valleys that are moderately dissected. The rolling plains contain prominent ridges and valleys, some local areas of badlands, and numerous stream terraces. Elevations in the area are around 2,000 feet in Oklahoma.

Soil resources concerns include water erosion and conservation of soil moisture on cultivated soils and on overgrazed rangeland. Conservation practices on cropland generally include contour farming and crop residue management. Soil conservation practices on rangeland generally include proper grazing use, fencing, and development of watering facilities (GIS Data Source: NRCS 2006).

Alfisols, inceptisols, and mollisols are the predominant soil orders in the MLRA (GIS Data Source: NRCS 2006). These soils are characterized by a thermic soil temperature regime, an ustic soil moisture regime, and mixed or smectitic mineralogy (i.e., involving the family of clays that swell when immersed in water). The soils are generally moderately deep to very deep, are well drained and moderately well drained, and loamy or clayey. Soils are present as bedrock residuum on hills and ridges, loamy alluvium on stream terraces, and in mixed alluvium and colluvium on hills and stream terraces and in valleys. Soils are also present in sandy eolian deposits on dunes adjacent to the major rivers.

3.6.2.5.1.1 Designated Farmland

The percentage of designated farmland within the ROI of Region 1 is provided in Table 3.6.2-2.

Table 3.6.2-2:
Designated Farmland in Region 1 (Percentage of ROI)

Project Component	Total Acres within ROI	Prime Farmland (%)	Prime Farmland if Protected[1] (%)	Total Designated Farmland[2] (%)
Oklahoma Convertor Station Siting Area	626	0	0	0
Oklahoma AC Interconnection	871	8	0	8
AC Collection System	597,006	42	0	42
E-1	39,340	19	0	19
E-2	52,982	49	0	49
E-3	53,520	43	0	43
NE-1	40,359	53	0	53
NE-2	35,204	37	0	37
NW-1	68,166	49	0	49
NW-2	73,897	52	0	52
SE-1	53,085	48	<1	48
SE-2	18,926	57	0	57
SE-3	64,513	55	0	55
SW-1	19,142	11	0	11
SW-2	49,362	11	0	11
W-1	28,510	35	0	36
AR 1-A	15,036	27	0	27
AR 1-B	6,363	46	0	46
AR 1-C	6,377	54	0	54
AR 1-D	4,097	40	0	40
APR	14,143	50	0	50

GIS Data Source: NRCS (2013)
1 Prime farmland if protected from flooding or not frequently flooded during the growing season (NRCS 2013).
2 Total designated farmland categories that are present ("prime farmland" and "prime farmland if protected" are the only categories present in the Region 1 ROI).

3.6.2.5.1.2 Soil Limitations

Existing soil hazards within the ROI in Region 1 are summarized in Table 3.6.2-3 by Project component.

Table 3.6.2-3:
Soil Limitations in Region 1 (Percentage of ROI)

Project Component	High Compaction Potential [1]	Moderate to High Wind Erosion Potential[2]	High Water Erosion Potential [3]	Corrosion Potential[4]	Hydric Soils[5]	Restrictive Layer [6]	15 to 30 Percent Slopes	>30 Percent Slopes
Oklahoma Convertor Station Siting Area	100	100	0	0	0	42	0	0
Oklahoma AC Interconnection	100	92	0	0	0	39	0	0
AC Collection System	93	56	0	24	<1	9	<1	<1
E-1	95	80	0	11	<1	18	<1	0
E-2	99	49	0	26	0	7	0	0
E-3	97	53	0	12	0	12	0	0
NE-1	95	47	0	6	1	9	0	0
NE-2	96	63	0	2	<1	15	0	0
NW-1	95	51	0	27	<1	6	0	0
NW-2	88	48	0	30	<1	5	0	0
SE-1	89	48	0	46	0	8	1	0
SE-2	93	39	0	54	0	10	4	0
SE-3	99	43	0	44	0	6	0	0
SW-1	77	73	0	7	<1	10	4	0
SW-2	89	87	0	20	<1	12	6	<1
W-1	92	65	0	7	<1	9	0	0
AR 1-A	90	69	<1	8	0	19	5	0
AR 1-B	98	51	0	12	0	8	0	0
AR 1-C	99	46	0	13	0	5	0	0
AR 1-D	94	74	<1	26	0	6	<1	0
APR	91	51	<1	26	0	12	2	0

GIS Data Source: NRCS (2013)

1 SSURGO severe rutting hazard.
2 SSURGO Wind Erosion Groups: 1–3 and 4L.
3 SSURGO Kf > 0.4.
4 SSURGO High steel or concrete potential.
5 SSURGO Hydric Condition (includes only entirely hydric soils and not partially hydric soils).
6 Bedrock < 60 inches from ground surface.

3.6.2.5.1.3 Soil Contamination

No areas of potential soil contamination were identified within the most Project components based on EPA FRS database information (GIS Data Source: EPA 2014b). Eleven facilities/sites were identified in the AC collection system routes, including two LUST–ARRA sites, two NPDES sites, one RCRAInfo site, and six TCEQ ACR sites. The NPDES and RCRAInfo sites are indicative of permits being granted for the discharge of stormwater and generation, and handling or transport of hazardous substances. The TCEQ ACR sites indicate entities under TCEQ regulation such as for permits, registrations, and other authorizations. The LUST-ARRA sites indicate identified leaking underground storage tank sites that are under regulatory oversight for cleanup and closure activities. The presence of these sites on the database are simply indicative of a records inventory of such regulated sites and do not raise a concern at this time in regards to potential areas of soil contamination.

3.6.2.5.2 Region 2

Central Rolling Red Plains, Eastern Part MLRA

The western portion of the ROI in Region 2 is located in the Central Rolling Red Plains, Eastern Part MLRA, and the predominant soils orders are alfisols, inceptisols, and mollisols. These are described above under Region 1.

Central Rolling Red Prairies MLRA

The eastern portion of the ROI in Region 2 is in the Central Rolling Red Prairies MLRA. The area is characterized by dark red Permian rocks that are exposed dominantly on gently sloping plains dissected by rivers flowing from northwest to southeast. Elevation ranges from about 850 to 1,500 feet.

Agricultural uses dominate the area. Soil resource concerns on cropland include water erosion, surface compaction, conservation of soil moisture, and maintenance of the content of organic matter in the soils. Soil conservation practices on cropland generally include high residue crops in the cropping system; systems of crop residue management, such as no-till and strip-till; conservation crop rotations; and nutrient management. Conservation practices on grassland generally include brush management and proper grazing use.

Mollisols are the predominant soil order in the MLRA. Mollisols have a thermic soil temperature regime, an ustic soil moisture regime, and mixed, siliceous, or smectitic mineralogy. These soils generally are shallow to very deep, are well drained, and generally are loamy or clayey (GIS Data Source: NRCS 2006). The soils are present in clayey and loamy alluvium of Pleistocene age on plains, in Permian sandstone residuum on ridges and hillslopes, in Permian shale residuum on hillslopes, and in Holocene alluvium on floodplains.

3.6.2.5.2.1 Designated Farmland

The percentage of designated farmland within the ROI is provided in Table 3.6.2-4. Two route variations were developed in Region 2 in response to public comments on the Draft EIS. The ROI for Applicant Proposed Route Link 1, Variation 1, has 14 acres of designated farmland. The ROI for Applicant Proposed Route Link 2, Variation 2, has 659 acres of designated farmland. The variations are illustrated in Exhibit 1 of Appendix M.

Table 3.6.2-4:
Designated Farmland in Region 2 (Percentage of ROI)

Project Component[1]	Total Acres in ROI	Prime Farmland (%)	Total Designated Farmland (%)[2]
AR 2-A	6,992	25	25
AR 2-B	3,631	48	48
APR	12,932	22	22

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
2 Total designated farmland categories that are present ("prime farmland" is the only category contained in the Region 2 ROI).
GIS Data Source: NRCS (2013)

3.6.2.5.2.2 Soil Limitations

Existing soil limitations within Region 2 are summarized in Table 3.6.2-5 by Project component. Two route variations were developed in Region 2 in response to public comments on the Draft EIS. The ROI for Applicant Proposed Route Link 1, Variation 1, has 54 acres of soils with high wind erosion potential. The ROI for Applicant Proposed Route Link 1, Variation 2, would have the following soils acreages: 45 acres with high water erosion potential, 114 acres with high wind erosion potential, and 149 acres with high susceptibility to compaction. The variations are illustrated in Exhibit 1 of Appendix M.

Table 3.6.2-5:
Soil Limitations in Region 2 (Percentage of ROI)

Project Component[1a]	High Compaction Potential[1]	Moderate to High Wind Erosion Potential[2]	High Water Erosion Potential [3]	Corrosion Potential[4]	Restrictive Layer[5]	15 to 30 Percent Slopes
AR 2-A	63	78	15	26	39	9
AR 2-B	81	38	12	29	41	<1
APR	40	74	8	16	18	4

1a The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.

GIS Data Source: NRCS (2013)
1 SSURGO severe rutting hazard.
2 SSURGO Wind Erosion Groups: 1–3 and 4L.
3 SSURGO Kf > 0.4.
4 SSURGO High Concrete or Steel Corrosion Potential.
5 SSURGO restrictive layer < 60 inches from ground surface.

3.6.2.5.2.3 Soil Contamination

No areas of potential soil contamination were identified within the Region 2 ROI based on EPA FRS database information. There are no listed sites in the ROIs of the two route variations.

3.6.2.5.3 Region 3

Central Rolling Red Prairies MLRA

The ROI in western Region 3 crosses two portions of the Central Rolling Red Prairies MLRA, and mollisols is the dominant soil order. These are described above under Region 2.

North Cross Timbers MLRA

The ROI in west-central Region 3 crosses two portions of the North Cross Timbers MLRA. This area is characterized by rolling to hilly uplands with hilltop summits that are nearly level to strongly rolling and divides that are narrow to moderately broad. Stream valleys in the MLRA are narrow and have steep gradients, and bedrock outcrops occur on both hilltops and hillsides (GIS Data Source: NRCS 2006). Elevation ranges from 985 to 1,300 feet. Large valleys can be 165 feet or more below the adjacent uplands.

Soil resource concerns are water erosion, surface compaction, moisture conservation, and conservation of organic matter. Soil conservation practices on cropland generally include terraces, grassed waterways, nutrient management, grade-control structures, and conservation tillage. Conservation practices on rangeland generally include brush management, fencing, nutrient management, proper grazing, and range planting.

Alfisols, entisols, mollisols, and inceptisols are the predominant soil orders in the MLRA. The soils have a thermic soil temperature regime, an ustic or udic soil moisture regime, and mixed, siliceous, or smectitic mineralogy. Udic soil moisture is characteristic of a humid or subhumid climate (Plant and Soil Sciences eLibrary 2014). Soils are generally shallow to very deep, somewhat excessively drained to somewhat poorly drained and loamy or clayey. Area soils are present in alluvium on stream terraces, in bedrock residuum on hills, in colluvium and/or bedrock residuum on footslopes, and in alluvium on floodplains (GIS Data Source: NRCS 2006).

Cherokee Prairies MLRA

The ROI in central Region 3 crosses two portions of the Cherokee Prairies MLRA. The area is characterized by gently sloping to rolling dissected plains with elevations ranging from 330 to 1,310 feet. Even though the area is thoroughly dissected, major valleys generally are less than 8 feet below the adjacent uplands (GIS Data Source: NRCS 2006).

Soil resource concerns on cropland are water erosion, maintenance of the content of organic matter in soils, surface compaction, and low pH in the soils. Soil conservation practices on cropland generally include high residue crops in the cropping system, systems of crop residue management (such as no-till, strip-till, and mulch-till systems), a combination of gradient terraces and grassed waterways, contour farming, conservation crop rotations, and nutrient management. Conservation practices on rangeland generally include prescribed grazing and brush management.

Mollisols and alfisols are the predominant soil orders in the MLRA. The soils have a thermic soil temperature regime, an aquic or udic soil moisture regime, and mixed or smectitic mineralogy. The aquic soil moisture regime indicates soils that are saturated with water long enough to cause oxygen depletion. The soils generally are moderately deep to very deep, well-drained to poorly drained, and loamy or clayey. Soils in the area are present in alluvium on flood plains, in bedrock residuum on uplands, and in colluvium mixed with bedrock residuum. Soils are also present in old alluvium on plains and in alluvium on flood plains and stream terraces.

Arkansas Valley and Ridges, Western Part MLRA

The ROI in east-central Region 3 also crosses the Arkansas Valley and Ridges, Western Part MLRA. The topography of the area is characterized by long, narrow sandstone-capped ridges that trend northeastward. The ridges are dissected by valleys cut by streams at right angles to the ridges; the valleys and scarp areas generally are cut into less resistant shale units (GIS Data Source: NRCS 2006). Elevation ranges from 550 feet to 1,500 feet.

Strip-mining of coal is common throughout the area and has affected soil resources. Stabilizing strip-mine spoil and reclaiming mined areas are major soil management concerns; and efforts to maintain pasture and forest productivity are ongoing (GIS Data Source: NRCS 2006).

Udalfs or udepts soils are predominant in the MLRA. These soils have a thermic soil temperature regime, a udic soil moisture regime, and mixed or siliceous mineralogy. The soils include moderately deep soils and are gently sloping to steep, formed on ridgetops, shoulder slopes, and side slopes. Other soils in the area are very deep, gently sloping to sloping, and are formed on the side slopes of valleys. Deep, gently sloping to steep soils are formed on side slopes and footslopes; and shallow, sloping to steep soils are formed on narrow ridgetops and upper shoulder slopes. Very deep, gently sloping to steep soils formed on terraces along streams. Nearly level to sloping soils formed along floodplains throughout the area (GIS Data Source: NRCS 2006).

Boston Mountains MLRA

The eastern end of the ROI in Region 3 crosses the Boston Mountains MLRA. This MLRA marks the southern extent of the Ozarks and is an old plateau that has been deeply eroded. Ridgetops are narrow and rolling and valley walls are steep. Elevation ranges from 660 feet on the lowest valley floors to 2,625 feet on the highest ridge crests.

Soil resource concerns in this area are gully and streambank erosion and soil contaminants from applications of animal waste. Soil conservation practices on cropland include critical area planting, protection of streambanks and shorelines, riparian forest buffers, forage harvest management, soil nutrient management, waste utilization, brush management, grade-stabilization structures, and prescribed grazing (GIS Data Source: NRCS 2006).

Ultisols and inceptisols are the predominant soil orders in the MLRA. The soils dominantly have a thermic soil temperature regime, a udic soil moisture regime, and mixed or siliceous mineralogy. The soils are shallow to very deep, generally well drained, and loamy. Soils in the area are formed in residuum on hills, plateaus, and mountains, in alluvium or colluvium over residuum, and in alluvium or colluvium on hills and terraces.

3.6.2.5.3.1 Designated Farmland

The percentage of designated farmland within the ROI of Region 3 is provided in Table 3.6.2-6. Five route variations were developed for the Applicant Proposed Route in Region 3 in response to public comments on the Draft EIS. The ROI for Link 1, Variation 2, has 194 acres of designated farmland. The ROI for Links 1 and 2, Variation 1, has 167 acres of designated farmland. It should be noted that a route adjustment was made for HVDC Alternative Route 3-A to maintain continuity with the proposed variation. HVDC Alternate Route 3-A has 38 acres in designated farmland. The ROI for Link 4, Variation 1, has 19 acres, and the ROI for Link 4, Variation 2, has 90 acres of designated farmland. The ROI for Link 5, Variation 2, has 266 acres of designated farmland. The variations are illustrated in Exhibit 1 of Appendix M.

Table 3.6.2-6:
Designated Farmland in Region 3 (Percentage of ROI)

Project Component	Total Acres in ROI	Prime Farmland (%)	Total Designated Farmland (%)[1]
AR 3-A	4,612	38	38
AR 3-B	5,851	40	40
AR 3-C	14,860	53	53
AR 3-D	4,814	70	70
AR 3-E	1,073	52	52
APR	19,760	50	50

GIS Data Source: NRCS (2013)
1 Total designated farmland categories that are present ("prime farmland" is the only category present in the Region 3 ROI).

3.6.2.5.3.2 Soil Limitations

Existing soil limitations within Region 3 are summarized in Table 3.6.2-7 by Project component. Five route variations were developed for the Applicant Proposed Route in Region 3 in response to public comments on the Draft EIS. The ROI for Link 1, Variation 2, has acreage that includes 19 acres with high water erosion potential, 37 acres with high wind erosion potential, and 75 acres of soils with high compaction potential. The ROI for Links 1 and 2, Variation 1, has acreage that includes 23 acres with high water erosion potential, 12 acres with high wind erosion potential, and 53 acres of soils with high compaction potential. It should be noted that a route adjustment was made for HVDC Alternative Route 3-A to maintain continuity with the proposed variation. The ROI for Link 4, Variation 1, has acreage that includes 4 acres with high water erosion potential and 20 acres of soils with high compaction potential. The ROI for Link 4, Variation 2, has acreage that includes 7 acres with high water erosion potential, 10 acres with high wind erosion potential, and 10 acres of soils with high compaction potential. Link 5, Variation 2, has acreage that includes 11 acres with high water erosion potential, 3 acres with high wind erosion potential, and 58 acres of soils with high compaction potential. The variations are illustrated in Exhibit 1 in Appendix M.

3.6.2.5.3.3 Soil Contamination

Three facilities/sites that are required to report activity to a state or federal system were identified within the ROI based on EPA FRS database information. They include an EPA Hazardous Waste Report BR site and two RCRAInfo sites. The BR site is indicative of EPA data reporting of generation, minimization, and management of hazardous waste. There are no listed sites in the ROIs of the five route variations.

Table 3.6.2-7:
Soil Limitations in Region 3 (Percentage of ROI)

Project Component[1a]	High Compaction Potential[1]	Moderate to High Wind Erosion Potential[2]	High Water Erosion Potential[3]	Corrosion Potential[4]	Stony/ Rocky Soil[5]	Hydric Soils[6]	Restrictive Layer[7]	15 to 30 Percent Slopes	>30 Percent Slopes
AR 3-A	86	28	23	43	0	<1	69	5	<1
AR 3-B	87	27	24	46	0	<1	66	4	<1
AR 3-C	75	25	33	48	12	<1	50	12	0
AR 3-D	100	11	55	70	<1	0	34	7	0
AR 3-E	99	13	33	76	0	0	54	28	0
APR	79	22	34	55	9	0	53	10	<1

1a The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
GIS Data Source: NRCS (2013)
1 SSURGO severe rutting hazard.
2 SSURGO Wind Erosion Groups: 1–3 and 4L.
3 SSURGO Kf > 0.4.
4 SSURGO High concrete or steel corrosion potential.
5 SSURGO soils characterized as stony, cobbly, channery, flaggy, bouldery, and bedrock.
6 SSURGO Hydric Condition (includes only entirely hydric soils and not partially hydric soils).
7 Restrictive layer is < 60 inches from ground surface.

3.6.2.5.4 Region 4

Boston Mountains MLRA

The ROI crosses one MLRA, the Boston Mountains MLRA, and ultisols and inceptisols soil orders are predominant. These are described above under Region 3.

3.6.2.5.4.1 Designated Farmland

The percentage of designated farmland within the ROI of Region 4 is provided in Table 3.6.2-8. Seven route variations were developed for the Applicant Proposed Route in Region 4 in response to public comments on the Draft EIS. The ROI for Link 3, Variation 1, has 137 acres of designated farmland; and the ROI for Link 3, Variation 2, has 273 acres of designated farmland. The ROI for Link 3, Variation 3, has 18 acres in designated farmland. The ROI for Link 6, Variation 1, has 54 acres of designated farmland. The ROI for Link 6, Variation 2, has 200 acres of designated farmland. The ROI for Link 6, Variation 3, has 27 acres of designated farmland. The ROI for Link 9, Variation 1, has 720 acres of designated farmland. The variations are illustrated in Exhibit 1 of Appendix M.

Table 3.6.2-8:
Designated Farmland in Region 4 (Percentage of ROI)

Project Component[1a]	Total Acres in ROI	Prime Farmland (%)	Prime Farmland if Drained[1] (%)	Prime Farmland if Drained[2] (%)	Prime Farmland if Protected[3] (%)	Farmland of State and Local Importance[4] (%)	Total Designated Farmland [5] (%)
AR 4-A	7,160	19	0	4	3	4	23
AR 4-B	9,610	16	0	<1	<1	3	19
AR 4-C	425	13	0	0	0	9	22
AR 4-D	3,106	27	0	<1	<1	6	32
AR 4-E	4,491	42	0	<1	1	9	53
APR	15,414	35	<1	<1	1	8	45

1a The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
GIS Data Source: NRCS (2013)
1 Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season.
2 Prime farmland if protected from flooding or not frequently flooded during the growing season.
3 Prime farmland if drained with no other qualifications.
4 This is land, in addition to prime and unique farmland, that is of statewide importance for the production of food, feed, fiber, forage, and oil seed crops. Criteria for defining and delineating this land are to be determined by the appropriate state agency or agencies.
5 Total of designated farmland categories present in the Region 4 ROI.

3.6.2.5.4.2 Soil Limitations

Existing soil limitations within the ROI are summarized in Table 3.6.2-9 by Project component. Seven route variations were developed for the Applicant Proposed Route in Region 4 in response to public comments on the Draft EIS. The ROI for Link 3, Variation 1, has acreage that includes 21 acres with high water erosion potential, 5 acres with high wind erosion potential, and 42 acres of soils with high compaction potential. The ROI for Link 3, Variation 2, has acreage that includes 48 acres with high water erosion potential, 88 acres of stony soils, 10 acres of soils, 5 acres with slopes greater than 20 percent, and 81 acres with high compaction potential. The ROI for Link 3, Variation 3, has acreage that includes 12 acres with high wind erosion potential, 55 acres of stony soils, 20 acres with slopes greater than 20 percent, and 12 acres of soils with high compaction potential. The ROI for Link 6, Variation 1, has acreage that includes 10 acres with high wind erosion potential, 24 acres of stony soils, and 2 acres with slopes greater than 20 percent. The ROI for Link 6, Variation 2, has acreage that includes 32 acres with high water erosion potential, 23 acres with high wind erosion potential, 39 acres of hydric soils, and 54 acres of soils with high compaction potential. The ROI for Link 6, Variation 3, has acreage that includes 3 acres with high wind erosion potential, 13 acres of stony soils, 9 acres with slopes greater than 20 percent, and 5 acres of soils with high compaction potential. The ROI for Link 9, Variation 1, has acreage that includes 18 acres with high water erosion potential, 48 acres with high wind erosion potential, 5 acres with slopes greater than 20 percent, and 59 acres of soils with high compaction potential. The variations are illustrated in Exhibit 1 of Appendix M.

Table 3.6.2-9:
Soil Limitations in Region 4 (Percentage of ROI)

Project Component[1a]	High Compaction Potential[1]	Moderate to High Wind Erosion Potential[2]	High Water Erosion Potential[3]	Corrosion Potential[4]	Stony/Rocky Soils[5]	Hydric Soils[6]	Restrictive Layer[7]	15 to 30 Percent Slopes	>30 Percent Slopes
AR 4-A	24	22	7	75	54	10	84	52	<1
AR 4-B	21	21	6	65	53	6	79	53	1
AR 4-C	32	19	17	64	49	0	100	49	0
AR 4-D	19	42	6	58	32	10	87	29	1
AR 4-E	21	48	15	33	27	1	59	12	1
APR	42	29	22	63	33	5	58	25	2

1a The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
GIS Data Source: NRCS (2013)
1 SSURGO severe rutting hazard.
2 SSURGO Wind Erosion Groups: 1–3 and 4L.
3 SSURGO Kf > 0.4.
4 SURGO high concrete or steel corrosion potential.
5 SSURGO soils characterized as stony, cobbly, flaggy, channery, bouldery, and bedrock.
6 SSURGO Hydric Condition (includes only entirely hydric soils and not partially hydric soils).
7 SSURGO restrictive layer <60 inches from ground surface.

3.6.2.5.4.3 Soil Contamination

Nine facilities that are required to report activity to a state or federal system were identified within the Region 4 ROI based on EPA FRS database information. The facilities include an EPA Hazardous Waste Report BR site, a RCRAInfo site, an eGRID site, an EIA-860 site, an NPDES site, and a PDS site. eGRID and EIA-860 sites indicate that data exist for electric power generation sites in the area, with one site generating more than 1MW.

There are no listed sites in the ROIs of the seven route variations.

3.6.2.5.5 Region 5

Boston Mountains MLRA

Region 5 is entirely located within the Boston Mountains MLRA. This MLRA and its associated soils are described in above in Region 4.

A more detailed description of soils in the area of the Arkansas Convertor Station Alternative Siting Area includes three soil associations: Nell-Enders Mountainburg, Mountainburg Linker, and Leadvale–Taft (NRCS 2014b). Nells–Enders Mountainburg soils are well drained, gently sloping to very steep, deep and shallow, loamy soils that are gravelly or stony, and are often found on hills or mountains. The soils formed in loamy and clayey residuum weathered from sandstone and shale. The soils are unsuited for crop cultivation and have a high shrink swell potential; and have a shallow depth to bedrock. Mountainburg Linker soils are well drained, nearly level to moderately deep, loamy soils; some gravelly or stony. These soils are often located on hills or mountains, and are formed in loamy and residuum weathered from level-bedded sandstone. The Leadvale-Taft soils are moderately well-drained and somewhat poorly drained, level to gently sloping, deep, loamy soils with fragipans. These soils are often found on old stream terraces in broad valleys, and are formed in loamy sediment weathered from sandstone and shale washed from local uplands. The primary limitations associated with these soils are slow permeability and erosion hazards.

3.6.2.5.5.1 Designated Farmland

The percentage of designated farmland in the ROI in Region 5 is provided in Table 3.6.2-10. Five route variations were developed for the Applicant Proposed Route in Region 5 in response to public comments on the Draft EIS. The ROI for Link 1, Variation 2, has 157 acres of designated farmland. The ROI for Link 2, Variation 2, does not have any designated farmland. The ROI for Links 2 and 3, Variation 1, has 240 acres in designated farmland. It should be noted that a route adjustment was made for HVDC Alternative Route 5-B to maintain continuity with this variation. The ROI for Links 3 and 4, Variation 2, has 17 acres of designated farmland. It should be noted that a route adjustment was made for HVDC Alternative Route 5-E to maintain continuity with this variation. The ROI for Link 7, Variation 1, has 78 acres of designated farmland. The variations are illustrated in Exhibit 1 of Appendix M.

Table 3.6.2-10:
Designated Farmland in Region 5 (Percentage of ROI)

Project Component[1a]	Total Acres in ROI	Prime Farmland (%)	Prime Farmland if Drained[1] (%)	Prime Farmland if Drained[2] (%)	Prime Farmland if Protected[3] (%)	Farmland of State and Local Importance[4] (%)	Total Designated Farmland[5] (%)
AR 5-A	1,553	41	0	0	0	2	43
AR 5-B	8,686	47	<1	0	0	4	51
AR 5-C	1,137	69	1	0	0	4	74
AR 5-D	2,660	36	0	4	6	<1	46
AR 5-E	4,449	51	1	0	0	5	57
AR 5-F	2,748	53	1	0	0	8	62
APR	13,777	32	<1	2	1	3	38
Arkansas Converter Station Siting Area	360	32	8	0	0	13	53
Arkansas AC Interconnection	662	48	30	0	0	22	97

1a The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
GIS Data Source: NRCS (2013)
1 Prime farmland if drained with no other qualifications.
2 Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season.
3 Prime farmland if protected from flooding or not frequently flooded during the growing season.
4 This is land, in addition to prime and unique farmland, that is of statewide importance for the production of food, feed, fiber, forage, and oil seed crops. Criteria for defining and delineating this land are to be determined by the appropriate state agency or agencies.
5 Total designated farmland categories present in the Region 5 ROI.

3.6.2.5.5.2 Soil Limitations

Existing soil limitations within the ROI in Region 5 are summarized in Table 3.6.2-11 by Project component. Five route variations were developed for the Applicant Proposed Route in Region 5 in response to public comments on the Draft EIS. The ROI for Link 1, Variation 2, has acreage that includes 2 acres with high water erosion potential, 32 acres with high wind erosion potential, 12 acres of stony soils, 9 acres with slopes greater than 20 percent, and 6 acres of soils with high compaction potential. The ROI for Link 2, Variation 2, has acreage that includes 26 acres with high wind erosion potential, 37 acres of stony soils, and 50 acres with slopes greater than 20 percent. The ROI for Links 2 and 3, Variation 1, has acreage that includes 25 acres with high wind erosion potential, 15 acres with slopes greater than 20 percent, 21 acres of stony soils, and 11 acres of soils with high compaction potential. It should be noted that a route adjustment was made for HVDC Alternative Route 5-B to maintain continuity with this variation. The ROI for Links 3 and 4, Variation 2, has acreage that includes 52 acres with high wind erosion potential, 8 acres with slopes greater than 20 percent, 46 acres of stony soils, and 3 acres of soils with high compaction potential. It should be noted that a route adjustment was made for HVDC Alternative Route 5-E to maintain continuity with this variation. The ROI for Link 7, Variation 1, has acreage that includes 15 acres with high wind erosion potential, 4 acres with slopes greater than 20 percent, and 4 acres of stony soils. The variations are illustrated in Exhibit 1 of Appendix M.

Table 3.6.2-11:
Soil Limitations in Region 5 (Percentage of ROI)

Project Component Area[1a]	High Compaction Potential[1]	Moderate to High Wind Erosion Potential[2]	High Water Erosion Potential[3]	Corrosion Potential[4]	Stony Soil[5]	Hydric Soils[6]	Restrictive Layer[7]	15 to 30 Percent Slopes	>30 Percent Slopes
AR 5-A	13	46	8	38	32	0	83	30	0
AR 5-B	20	60	14	32	16	0	92	16	0
AR 5-C	31	47	22	26	21	0	91	10	0
AR 5-D	45	19	30	58	36	8	78	13	0
AR 5-E	25	58	19	37	16	0	94	11	0
AR 5-F	35	53	24	50	13	0	92	10	0
APR	22	46	12	57	31	4	87	19	1
Arkansas Converter Station Siting Area	37	47	27	8	49	0	79	15	0
Arkansas Interconnect	99	24	50	37	1	0	62	0	0

1a The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
GIS Data Source: NRCS (2013)
1 SSURGO severe rutting hazard.
2 SSURGO Wind Erosion Groups: 1–3 and 4L.
3 SSURGO Kf > 0.4.
4 SSURGO high concrete or steel corrosion potential.
5 SSURGO soils characterized as stony, cobbly, flaggy, channery, bouldery, and bedrock.
6 SSURGO Hydric Condition (includes only entirely hydric soils and not partially hydric soils).
7 SSURGO restrictive layer < 60 inches from ground surface.

3.6.2.5.5.3 Soil Contamination

Thirteen facilities that are required to report activity to a state or federal system were identified within the ROI based on EPA FRS database information. They include an NPDES site and 12 PDS sites. Two sites, both NPDES sites, were identified in the Arkansas Interconnection Siting Area. Another site is located just outside the siting area boundary and is both a RCRA and NPDES site. The ROIs for the five route variations do not contain any listed sites.

3.6.2.5.6 Region 6

Southern Mississippi River Alluvium MLRA

The ROI crosses two areas of the southern Mississippi River Alluvium MLRA characterized as the alluvial plain along the lower Mississippi River, south of its confluence with the Ohio River. The landforms in the area are level or depressional to very gently undulating alluvial plains, backswamps, oxbows, natural levees, and terraces. Landform shapes range from convex on natural levees and undulating terraces to concave in oxbows (GIS Data Source: NRCS 2006). Average elevations gradually rise from the south/southeast to the northwest.

Most of this area is used for cropland and about 29 percent of this MLRA is not protected from flooding (including most areas of forested wetlands), and flooding occurs occasionally or frequently in these unprotected areas. Levees protect nearly all of the cropland, urban land, and grassland from flooding. Networks of drainage canals and ditches help to remove excess surface water from the cropland. Soil resource concerns are control of surface water, management of soil moisture, and maintenance of the content of organic matter and productivity of the soils. Conservation practices on cropland generally include nutrient management, crop residue management, and alternative tillage systems, especially no-till systems that reduce the cost of tillage. In many areas land leveling or shaping optimizes the control of surface water and the potential for soil erosion (GIS Data Source: NRCS 2006).

Alfisols, vertisols, inceptisols, and entisols are the predominant soil orders in the MLRA. The soils temperature regime is thermic, has an aquic soil moisture regime, has smectitic clay mineralogy, and mixed sand and silt fraction mineralogy. The soils are very deep, dominantly poorly drained and somewhat poorly drained, and dominantly loamy or clayey. Soils are present in areas of alluvial flats and backswamps of Holocene to late Pleistocene age, nearly level to gently sloping soils in natural levees of Holocene age, nearly level to gently undulating, sandy soils in levee splays and point bars of Holocene age, and nearly level to gently undulating in terraces of Pleistocene age.

Southern Mississippi Valley Loess MLRA

This area is characterized by sharply dissected plains that have a loess mantle that is thick at the valley wall but thins rapidly as distance from the valley wall increases (GIS Data Source: NRCS 2006). Valley sides are hilly to steep, especially in the western part of the MLRA. Intervening ridges generally are narrow and rolling, but some of the interfluves between the upper reaches of the valleys are broad and flat. Stream valleys are narrow in the upper reaches but broaden rapidly downstream and have wide flat flood plains and meandering stream channels. Elevation ranges from 80 to 600 feet.

Soil resource concerns are water erosion, maintenance of the content of organic matter and productivity of the soils, and management of soil moisture. Water erosion is a hazard in sloping areas that are bare because of tree harvesting. Soil conservation practices on forestland generally include systems of tree residue management and reforestation. Conservation practices on cropland generally include crop residue management, which increases the content of organic matter in the soils, and applications of lime in areas of low pH. Many of the soils remain wet or have a high water table for some or most of the year.

Alfisols, entisols, inceptisols, and ultisols are the predominant soil orders in the MLRA. The soils in the area are very deep or deep, are medium textured, and have a thermic soil temperature regime, audic soil moisture regime, and mixed mineralogy. Well drained, nearly level to very steep soils are on uplands. Nearly level to steep, well-drained soils and moderately well drained and somewhat poorly drained soils and moderately well drained soils, and well-drained soils formed in thick deposits of loess. Nearly level to gently sloping, somewhat poorly drained soils, moderately well drained soils, well drained to somewhat poorly drained soils, and well drained soils formed in deposits of loess 2 to 4 feet thick. Nearly level and very gently sloping, somewhat poorly drained and poorly drained soils, somewhat poorly drained soils, somewhat poorly drained soils, and somewhat poorly drained soils formed in a thin mantle of loess over loamy alluvium or mixed loess and loamy alluvium. Deep, gently sloping, well drained soils, somewhat poorly drained soils, and somewhat poorly drained soils formed in silty material or in a mantle of loess and the underlying late Pleistocene loamy terrace material. In the eastern part of the area, where the loess mantle thins, well drained soils and moderately well drained soils, all of which are gently sloping to steep, are on ridgetops and side slopes. Well drained soils moderately well drained soils, and somewhat poorly drained soils are on floodplains.

3.6.2.5.6.1 Designated Farmland

Percentages of designated farmland in the affected environment ROI for Region 6 are provided in Table 3.6.2-12. One route variation was developed for the Applicant Proposed Route in Region 6 in response to public comments on the Draft EIS. The ROI for Link 2, Variation 1, has 87 acres of designated farmland. It should be noted that a route adjustment was made for HVDC Alternative Route 6-A to maintain continuity with this variation. The variations are illustrated in Exhibit 1 of Appendix M.

Table 3.6.2-12:
Designated Farmland in Region 6 (Percentage of ROI)

Project Component Area[1a]	Total Acres in ROI	Prime Farmland (%)	Prime Farmland if Drained[1] (%)	Prime Farmland if Drained[2] (%)	Prime Farmland if Protected[3] (%)	Farmland of State and Local Importance[4] (%)	Total Designated Farmland[5] (%)
AR 6-A	1,982	28	22	2	6	6	65
AR 6-B	1,724	37	24	11	9	2	61
AR 6-C	2,857	29	33	10	0	10	81
AR 6-D	1,134	8	24	17	8	21	79
APR	6,652	23	31	4	4	20	82

1a The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
GIS Data Source: NRCS (2013)
1 Prime farmland if drained with no other qualifications.
2 Prime farmland if drained <u>and</u> either protected from flooding or not frequently flooded during the growing season.
3 Prime farmland if protected from flooding or not frequently flooded during the growing season.
4 This is land, in addition to prime and unique farmland, that is of statewide importance for the production of food, feed, fiber, forage, and oil seed crops. Criteria for defining and delineating this land are to be determined by the appropriate state agency or agencies.
5 Total designated farmland categories present in the Region 5 ROI.

3.6.2.5.6.2 Soil Limitations

Existing soil limitations within the ROI in Region 6 are summarized in Table 3.6.2-13 by Project component. One route variation was developed in Region 6 in response to public comments on the Draft EIS. Applicant Proposed Route Link 2, Variation 1, has acreage that includes 47 acres with high water erosion potential, 10 acres with high wind erosion potential, and 47 acres of soils with high compaction potential. It should be noted that a route adjustment was made for HVDC Alternative Route 6-A to maintain continuity with Applicant Proposed Route Link 2, Variation 1. The variations are illustrated in Exhibit 1 of Appendix M.

Table 3.6.2-13:
Soil Limitations in Region 6 (Percentage of ROI)

Project Component Area	High Compaction Potential[1]	Moderate to High Wind Erosion Potential[2]	High Water Erosion Potential[3]	Corrosion Potential[4]	Stony/Rocky Soil[5]	Hydric Soils[6]	Restrictive Layer[7]	15 to 30 Percent Slopes	>30 Percent Slopes
AR 6-A	94	26	73	93	0	37	60	0	0
AR 6-B	93	16	83	92	0	17	57	0	0
AR 6-C	93	0	81	67	0	22	47	7	0
AR 6-D	78	0	26	51	0	60	1	0	0
APR	92	10	58	70	0	30	47	2	0

1a The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
GIS Data Source: NRCS (2013)
1 SSURGO severe rutting potential.
2 SSURGO Wind Erosion Groups: 1–3 and 4L.
3 SSURGO Kf > 0.4.
4 SSURGO high concrete or steel corrosion potential.
5 SSURGO soils characterized as cobbly, stony, flaggy, channery, bouldery, and bedrock.
6 SSURGO Hydric Condition (includes only entirely hydric soils and not partially hydric soils).
7 SSURGO restrictive layer < 60 inches from ground surface.

3.6.2.5.6.3 Soil Contamination

No areas of potential soil contamination were identified within the Region 6 ROI based on EPA FRS database information. The ROI for the one route variation does not contain any listed sites.

3.6.2.5.7 Region 7

Southern Mississippi River Alluvium MLRA

The ROI in Region 7 crosses the Southern Mississippi River Alluvium MLRA, and alfisols, vertisols, inceptisols, and entisols are the dominant soil orders. These are described above under Region 6.

Southern Mississippi Valley Loess MLRA

The ROI in Region 7 crosses the Southern Mississippi Valley Loess MLRA, and alfisols, entisols, inceptisols, and utisols are the dominant soil orders. These are described above under Region 6.

The soils located within the Shelby Convertor Station Siting Area are classified in the Memphis-Adler association. These soils consist of very deep moderately to somewhat poorly drained soils that formed in thick loess, silty alluvium, or water reworked loess deposits on broad nearly level to strongly sloping uplands and stream terraces.

3.6.2.5.7.1 Designated Farmland

Percentages of designated farmland in the affected environment ROI for Region 7 are provided in Table 3.6.2-14. Three route variations were developed for the Applicant Proposed Route in Region 7 in response to public comments on the Draft EIS. The ROI for Link 1, Variation 1, does not have any designated farmland. The ROI for Link 1, Variation 2, has 42 acres of designated farmland. The ROI for Link 5, Variation 1, has 42 acres of designated farmland. The variations are illustrated in Exhibit 1 in Appendix M.

Table 3.6.2-14:
Designated Farmland in Region 7 (Percentage of ROI)

Project Component Area[1a]	Total Acres in ROI	Prime Farmland (%)	Prime Farmland if Drained[1] (%)	Prime Farmland if Drained[2] (%)	Prime Farmland if Protected[3] (%)	Farmland of State and Local Importance[4] (%)	Total Designated Farmland[5] (%)
AR 7-A	5,259	10	22	35	29	1	96
AR 7-B	1,055	49	0	0	0	0	49
AR 7-C	2,887	65	0	0	0	0	65
AR 7-D	803	54	0	0	0	0	54
APR	5,226	25	19	20	14	2	80
Tennessee Converter Station Siting Area[6]	218	68	0	0	0	0	68

1a The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
GIS Data Source: NRCS (2013).
1 Prime farmland if drained with no other qualifications.
2 Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season.
3 Prime farmland if protected from flooding or not frequently flooded during the growing season.
4 This is land, in addition to prime and unique farmland, that is of statewide importance for the production of food, feed, fiber, forage, and oil seed crops. Criteria for defining and delineating this land are to be determined by the appropriate state agency or agencies.
5 Total designated farmland categories present in the Region 7 ROI.
6 The Tennessee AC Interconnection would be located within the siting area.

3.6.2.5.7.2 Soil Limitations

Existing soil limitations within the ROI for Region 7 are summarized in Table 3.6.2-15 by Project component. Three route variations were developed for the Applicant Proposed Route in Region 7 in response to public comments on the Draft EIS. The ROI for Link 1, Variation 1, has acreage that includes 17 acres of hydric soils and 17 acres of soils with high compaction potential. The ROI for Link 1, Variation 2, has acreage that includes 20 acres with high water erosion potential, 31 acres with high wind erosion potential, 5 acres with slopes greater than 20 percent, 22 acres of hydric soils, and 84 acres of soils with high compaction potential. The ROI for Link 5, Variation 1, has acreage that includes 17 acres with high water erosion potential and 17 acres of soils with high compaction potential. All three variations generally have the same land uses in the ROI as does the original Applicant Proposed Route. The variations are illustrated in Exhibit 1 of Appendix M.

Table 3.6.2-15:
Soil Limitations in Region 7 (Percentage of ROI)

Project Component Area[1a]	High Compaction Potential[1]	Moderate to High Wind Erosion Potential[2]	High Water Erosion Potential[3]	Corrosion Potential[4]	Hydric Soils[5]	Restrictive Layer[6]	15 to 30 Percent Slopes	>30 Percent Slopes
AR 7-A	92	18	18	67	33	0	0	0
AR 7-B	97	0	84	17	18	9	22	5
AR 7-C	99	0	94	50	18	23	8	2
AR 7-D	100	0	98	8	3	10	15	0
APR	90	9	38	44	32	4	7	1
Tennessee Converter Station Siting Area	99	0	95	0	11	22	12	0

1a The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.

GIS Data Source: NRCS (2013)

1 SSURGO severe rutting hazard.

2 SSURGO Wind Erosion Groups: 1–3 and 4L.

3 SSURGO Kf > 0.4.

4 SSURGO high steel or concrete corrosion potential.

5 SSURGO Hydric Condition (includes only entirely hydric soils and not partially hydric soils).

6 SSURGO restrictive layer < 60 inches from ground surface.

3.6.2.5.7.3 Soil Contamination

Two facilities that are required to report activity to a state or federal system were identified within the Region 6 ROI based on EPA FRS database information. The facilities are two PDS sites. Seven facilities are located in the area of the Tennessee Converter Station Siting Area including five PDS sites, one NPDES site, and one TRI site. One listed site is in the ROI for Applicant Proposed Route Link 1, Variation 2. No sites were identified within the Tennessee Converter Station Siting Area.

3.6.2.5.8 Connected Actions

3.6.2.5.8.1 Wind Energy Generation

Southern High Plains, Northern Part MLRA

Wind energy generation in the WDZs would occur in the Southern High Plains and Northern Part MLRA. Alfisols and mollisols are the dominant soil orders. These are described above under Region 1.

3.6.2.5.8.1.1 Designated Farmland

Percentages of designated farmland in the WDZs are provided in Table 3.6.2-16. Farmland of state and local important is not designated or present in the WDZs in Oklahoma and is not included in the table.

Table 3.6.2-16:
Designated Farmland in WDZs (Percentage of ROI)

WDZ	Total Acres in WDZ ROI	Prime Farmland (%)	Prime Farmland if Protected[1] (%)	Total Designated Farmland[2] (%)
A	109,747	68	0	68
B	125,479	59	<1	59
C	161,048	49	<1	49
D	69,189	45	0	45
E	47,092	75	0	75
F	112,461	51	0	51
G	187,315	60	0	60
H	116,226	43	0	43
I	105,203	59	0	59
J	92,567	32	0	32
K	92,894	85	0	85
L	165,848	73	0	73

GIS Data Source: NRCS (2013)
1 Prime farmland if protected from flooding or not frequently flooded during the growing season.
2 Total designated farmland categories present in the WDZ.

3.6.2.5.8.1.2 Soil Limitations

Existing soil limitations within the WDZ ROIs are summarized in Table 3.6.2-17 by Project component.

Table 3.6.2-17:
Soil Limitations in WDZs (Percentage of ROI)

WDZ	High Compaction Potential[1]	Moderate to High Wind Erosion Potential[2]	Corrosion Potential[3]	Hydric Soils[4]	Restrictive Layer[5]	15 to 30 Percent Slopes	>30 Percent Slopes
A	25	25	67	0	4	2	0
B	81	35	70	0	2	3	0
C	37	46	49	<1	4	3	<1
D	18	55	1	<1	12	0	0
E	10	25	2	<1	9	0	0
F	11	49	8	<1	6	7	0
G	21	40	45	<1	1	<1	0
H	8	57	26	<1	7	0	0
I	7	41	1	1	<1	0	0
J	64	60	17	0	11	<1	0
K	53	15	38	0	0	0	0
L	23	19	66	0	7	3	0

GIS Data Source: NRCS (2013)
1 SSURGO severe rutting hazard.
2 SSURGO Wind Erosion Groups: 1–3 and 4L.
3 SSURGO high steel or concrete corrosion potential.
4 SSURGO Hydric Condition (includes only entirely hydric soils and not partially hydric soils).
5 SSURGO restrictive layer < 60 inches from ground surface.

3.6.2.5.8.1.3 Soil Contamination

Facilities that are required to report activity to a state or federal system for the WDZ boundaries are listed in Table 3.6.2-18. The presence of most of these sites on the databases indicate a records inventory of such regulated sites and do not raise a concern at this time in regards to potential areas of soil contamination. Exceptions include the CERCLA site located in the city of Perryton, Texas (WDZ-A), and the LUST-ARRA sites located in Hardesty, Oklahoma (WDZ-D). These sites are indicated to be in some stage of clean-up under regulatory authority.

Table 3.6.2-18:
FRS Sites in WDZs

WDZ	Total Number of Sites	Sites
A	83 (74 in the vicinity of Perryton, TX)	NPDES (2);ICIS (10); RCRAinfo (34); CERCLIS (City of Perryton Well No. 2); SPCC (1); TCEQ ACR (35)
B	11	NPDES (5); ICIS (1); TCEQ ACR (5)
C	26	NPDES (9); RCRinfo (2); Toxic Substances Control Act (1); TRI (1); TCEQ ACR (13)
D	2	LUST-ARRA (2)
E	3	ICIS (2); NPDES (1)
F	19 (16 within Texhoma, OK)	NPDES (9): ICIS (6); TRI (1); NCDB (3)
G	3	BR (1), RCRAinfo (1); NPDES (1)
H	None	NA
I	16	NPDES (5); ICIS (6); RCRAinfo (1); NCDB (3); SSTS (1)
J	None	NA
K	None	NA
L	11	NPDES (2); TCEQ ACR (9)

GIS Data Source: EPA (2014b)

3.6.2.5.8.2 Optima Substation

General soil characteristics are the same as those described for the western area of Region 1. The future Optima substation is composed of 7.5 acres (5 percent of the 160-acre site) of prime farmland. Fifteen acres (9 percent of the site) is within areas susceptible to high compaction; and 153 acres (95 percent of the site) is within areas of moderate to high wind erosion potential.

3.6.2.5.8.3 TVA Upgrades

The ROI for the direct assignment facilities (which are included in the Applicant Proposed Project) would occur within the Tennessee Converter Station Siting Area and more specifically within the Shelby Substation. The region of influence for the network upgrades, and in particular TVA's future 500kV transmission line, cannot be fully determined at this time. The new 500kV transmission line would be constructed in West Tennessee where designated farmland is extensive. Upgrades to existing infrastructure would include upgrading terminal equipment at three existing 500kV substations and six existing 161kV substations, making appropriate upgrades to increase heights on 16 existing 161kV transmission lines to increase line ratings, and replacing the conductors on eight existing 161kV transmission lines.

3.6.2.6 Impacts to Soils

3.6.2.6.1 Methodology

Impacts to soils from HVDC transmission lines were analyzed based on a 200-foot-wide representative ROW (see Section 3.1). Other Project components were analyzed based on the ROI, recognizing that the actual construction footprints would be smaller than the ROI. Areas of potential disturbance (which would affect soils) are provided in Appendix F for transmission tower footprints, tensioning and pulling sites, access roads, multi-use construction staging yards, and fiber optic regeneration sites. Because specific locations have not been identified for these Project features, an evaluation of designated farmland, soil limitation parameters, and potential contaminated sites is not possible at this time.

3.6.2.6.1.1 Impacts Common to All Project Components

Temporary and short-term impacts to soils would occur during construction, long-term impacts during operations and maintenance, and temporary and short-term impacts during decommissioning. The implementation of EPMs and associated management plans would minimize or avoid impacts to soils and reduce long-term and permanent effects to the extent practicable. Potential impacts from Project activities are discussed below.

Vegetation Removal

Vegetation would be cut and/or removed during construction for equipment access, safe construction purposes and to ensure long-term electrical safety clearances, maintenance, and reliability of the transmission lines. Vegetation would also be removed as necessary for construction and operation of the converter stations. Vegetation removal could indirectly affect soils by increasing potential for wind and water erosion, reducing water and nutrient holding capacity, impacting porosity, and reducing a soil's ability to filter sediments. Removal of trees could alter soil moisture by decreasing evapotranspiration rates and may increase soil temperature because of a lack of shade. Erosion may result in loss of valuable topsoil from its original location through wind and/or water erosion. Reestablishing soil-protective vegetation cover would be performed to minimize and avoid soil erosion. Vegetation removal and vegetation maintenance would be ongoing during the operation phase of the Project for the safe operation of the transmission lines. Specific impacts to vegetation are discussed in Section 3.17.

Maintenance activities for operation and maintenance of facilities would be similar to activities during construction but generally smaller in scale and more localized and infrequent. The ROW would be maintained during operations and maintenance in accordance with a TVMP developed for the Project, consistent with NERC standards. The TVMP may require additional analysis under NEPA depending on whether and under what conditions DOE decides to participate in the Project. The wire zone typically consists of low-growing grasses, legumes, herbs, crops, ferns, and shrubs where the conductor is 50 feet or less from the ground, to prevent accidental grounding contact with conductors. The border zone (i.e., to the edge of the ROW) is managed to consist of tall shrubs or short trees (up to 25 feet in height at maturity), grasses, and forbs. In most areas, standard utility practices consistent with the TVMP, such as tree-trimming and/or brush removal, would be used to maintain vegetation on the ROW.

Grading and Excavation

Grading can directly affect surface soils, resulting in soil mixing and increased wind and water erosion potential. The Project has the potential to cause soil mixing where grading or excavation is required. The mixing of topsoil with subsoil during these activities could result in the loss of soil fertility, loss of seedbank present in the topsoil, and introduction of rock into the topsoil. Construction activities in areas of stony/rocky soils may result in a concentration of large clasts near the surface. Erosion may result in loss of valuable topsoil from its original location through wind and/or water erosion. Reestablishing soil-protective vegetation cover would be performed to minimize and avoid soil erosion.

Impacts to soil resources from construction activities are associated with clearing, grading, excavation, and other activities necessary for construction of the converter station, access roads and the transmission line structures and lines. Impacts during construction could expose erosion-prone soils to conditions of increased erosion potential; soils with high compaction potential would be susceptible to compaction from construction vehicles and equipment.

Construction disturbance to areas of steep slopes could cause increased erosion hazards in these areas and reclamation of these areas might be more difficult and less successful.

Blasting

Blasting of bedrock might be required in the some areas of the Project. Blasting activities have the potential to cause soil mixing and the introduction of rock into the topsoil. Erosion may result in loss of valuable topsoil from its original location through wind and/or water erosion and could lead to poor revegetation following construction.

Access Road Construction and Use

Construction and use of access roads during Project construction could result in direct impacts to soil from rutting and compaction. Construction and use of access roads would range from overland travel in areas with low vegetation, to grading in steep areas. Driving construction equipment through soils can crush vegetation and compact soils, particularly where soils are prone to compaction. The degree of compaction depends on the moisture content and texture of the soil at the time of construction.

Fuel and Lubricant Handling

Inadvertent spills of fluids used during construction, such as fuel, lubricants, antifreeze, detergents, paints, solvents, and herbicides could directly affect soils through contamination.

Previously Contaminated Soils

Excavation activities during construction might uncover previously unknown areas of contaminated soils. Contaminated soils might cause hazardous conditions for workers and cause construction delays and, if disturbed, might allow contaminants to migrate to surrounding soil and water resources.

Herbicide Use

The Applicant may selectively apply herbicides during clearing and grading for construction to minimize regrowth of certain trees and woody species. Herbicides may be toxic to soil organisms and could have a temporary direct impact on the revegetation potential of the area depending on the type used and the concentration.

Dewatering

Open excavations and trenches may occasionally accumulate water as groundwater seeps in or from precipitation. When that occurs, the excavations and trenches may require periodic dewatering to allow for proper and safe construction, which may lead to soil erosion if the water is discharged directly to the ground and soil is washed away.

Conversion of Designated Farmland

The DOE has consulted with the Oklahoma, Arkansas, and Tennessee NRCS offices concerning impacts to farmland protected under the FPPA and has received a determination from the agencies that the transmission lines do not irreversibly convert farmland (Sagona 2014 and Adams 2014). This determination has been further confirmed with the NRCS National Leader for FPPA. It should be noted, however, that this determination does not apply to the converter stations, which would potentially convert farmland and would require a Form AD-1006 to be submitted for evaluation. The locations of access roads needed for the Project has not yet been determined; however, the Applicant would avoid placement of permanent access roads through farmland. Once the exact locations of Project components have been determined, a farmland conversion assessment would be completed by the NRCS and DOE for any remaining components for which NRCS has not yet issued a determination.

Operations and Maintenance

Operations and maintenance impacts to soils generally depend on the area of ground affected by operations and maintenance activities within ROWs, along access roads, and at facility sites such as converter stations. Soil resources may be temporarily affected by periodic vegetation maintenance during the operations and maintenance phase of the Project. Impacts from the construction and use of access roads might expose soils to erosion and compaction. Impacts to soils include permanent removal of soils from other potential uses and ongoing minimal impacts from maintenance activities along Project ROWs. Maintenance activities such as the use of trucks and heavy equipment to maintain low vegetation could result in damage to drainage and ground vegetation along ROWs that might expose soils to erosion and compaction hazards. The application of EPMs would help minimize or avoid impacts to soils during operations and maintenance.

Decommissioning

Decommissioning of the Project could result in impacts to soil resources, similar to those for construction (e.g., increased sedimentation, erosion, soil compaction, limited direct removal of vegetation, and accidental spills of chemicals). Decommissioning would result in an overall decrease in impacts to soil resources because the acreage associated with the structures and ROWs would be available for long-term reclamation.

3.6.2.6.1.2 Environmental Protection Measures

Clean Line would develop and implement the following plans as part of the Project:

- Blasting Plan: This plan will describe measure designed to minimize adverse effects due to blasting.
- Restoration Plan: This plan will describe post-construction activities to reclaim disturbed areas.
- Spill Prevention, Control and Countermeasures (SPCC) Plan: This plan will describe the measures designed to prevent, control, and cleanup spills of hazardous materials.
- Storm Water Pollution Prevention Plan (SWPPP): This plan, consistent with federal and state regulations, would describe the practices, measures, and monitoring programs to control sedimentation, erosion, and runoff from disturbed areas.
- Decommissioning Plan: This plan would describe all measures necessary to ensure the prevention of erosion, compaction, and other adverse impacts to soils during decommissioning. The plan would also include post-decommissioning activities to reclaim disturbed areas.

A complete list of EPMs for the Project is provided in Appendix F; those EPMs that would reduce impacts to soils or minimize the potential for release or mismanagement of hazardous constituents that could eventually result in an impact on soils are listed below:

- GE-1: Clean Line will train personnel on health, safety, and environmental matters. Training will include practices, techniques, and protocols required by federal and state regulations and applicable permits.
- GE-3: Clean Line will minimize clearing vegetation within the ROW, consistent with a Transmission Vegetation Management Plan filed with NERC, and applicable federal, state, and local regulations. The TVMP may require additional analysis under NEPA depending on whether and under what conditions DOE decides to participate in the Project.
- GE-4: Vegetation removed during clearing will be disposed of according to federal, state, and local regulations.
- GE-5: Any herbicides used during construction and operations and maintenance will be applied according to label instructions and any federal, state, and local regulations.
- GE-6: Clean Line will restrict vehicular travel to the ROW and other established areas within the construction, access, or maintenance easement (s).
- GE-7: Roads not otherwise needed for maintenance and operations will be restored to preconstruction conditions to the extent practicable. Roads needed for maintenance and operations will be retained.
- GE-8: Access controls (e.g., cattle guards, fences, gates) will be installed, maintained, repaired, replaced, or restored as required by regulation, road authority, or as agreed to by landowner.
- GE-9: Clean Line will avoid damage to drainage features and other improvements such as ditches, culverts, levees, tiles, and terraces to the extent practicable. If these features or improvements are inadvertently damage, they will be repaired and or restored to the extent practicable.
- GE-11: Clean Line will conduct construction, operation, and maintenance activities to minimize the creation of dust. This may include measures such as limitations on equipment, speed, and/or travel routes utilized. Water, dust palliative, gravel, combinations of these, or similar control measures may be used. Clean Line will implement measures to minimize the transfer of mud onto public roads.
- GE-12: Clean Line will avoid remedial structures (e.g., capped areas, monitoring equipment, or treatment wells) on contaminated sites, Superfund sites, CERCLA remediation sites, and other similar sites. Workers will use appropriate protective equipment and appropriate safe working techniques when working at or near contaminated sites.
- GE-13: Emergency and spill response equipment will be kept on hand during construction.
- GE-14: Clean Line will restrict the refueling and maintenance of vehicles and the storage of fuels and hazardous chemicals within at least 100 feet from wetlands, surface waterbodies, and groundwater wells, or as otherwise required by federal, state, or local regulations.
- GE-15: Waste generated during construction or maintenance, including solid waste, petroleum waste, and any potentially hazardous materials will be removed and taken to an authorized disposal facility.
- GE-22: Clean Line will impose speed limits during construction for access roads (e.g., to reduce dust emissions, for safety reasons, and for protection of wildlife).
- LU-1: Clean Line will work with landowners and operators to ensure that access is maintained as needed to existing operations (e.g., to oil/gas wells, private lands, agricultural areas, pastures, hunting leases).
- GE-27: Clean Line will minimize compaction of soils and rutting through appropriate use of construction equipment (e.g., low ground pressure equipment and temporary equipment mats).

- GE-28: Hazardous materials and chemicals will be transported, stored, and disposed of according to federal, state, or local regulations or permit requirements.
- GE-29: Clean Line will work with landowners and operators of active oil and gas wells, utilities, and other infrastructure to identify and verify the location of facilities and to minimize adverse impacts. Identification may include use of the One Call system and surveying of existing facilities.
- GE-30: Clean Line will minimize the amount of time that any excavations remain open.
- AG-1: Clean Line will avoid or minimize adverse effects to surface and subsurface irrigation and drainage systems (e.g., tiles). Clean Line will work with landowners to minimize the placement of structures in locations that would interfere with the operation of irrigation systems.
- AG-2:–Agricultural soils directly impacted by construction, operation, or maintenance activities will be restored to pre-activity conditions to the extent practicable. Appropriate soil remediation efforts may include decompaction, liming, tillage, fertilization, or use of other soil amendments.
- AG-3: Clean Line will consult with landowners and/or tenants to identify the location and boundaries of agriculture or conservation reserve lands and to understand the criteria for maintaining the integrity of these committed lands.
- AG-4: Clean Line will work with landowners and/or tenants to identify specialty agricultural crops or lands (e.g., certified organic crops or products that require special practices, techniques, or standards) that may require protection during construction, operation, or maintenance. Clean Line will avoid and/or minimize impacts that could jeopardize standards or certifications that support specialty croplands or farms.
- GEO-1: As appropriate, Clean Line will stabilize exposed slopes to minimize erosion.
- W-5: Clean Line will construct access roads to minimize disruption of natural drainage patterns including perennial, intermittent, and ephemeral streams.
- W-8: Dewatering will be conducted in a manner designed to prevent soil erosion (e.g., through discharge of water to vegetated areas and/or the use of flow control devices).

3.6.2.6.2 Impacts Associated with the Applicant Proposed Project

3.6.2.6.2.1 Converter Stations and AC Interconnection Siting Areas

3.6.2.6.2.1.1 Oklahoma and Tennessee Converter Station and AC Interconnection Tie

3.6.2.6.2.1.1.1 Construction Impacts

No areas of designated farmland are present in the Oklahoma Converter Station Siting Area and 8 percent (73 acres) of the Oklahoma AC Interconnection Siting Area contains designated farmland. The Tennessee Converter Station Siting Area and AC Interconnection Tie consists of 68 percent (149 acres) designated farmland. Depending on the specific siting of the converter stations and the Oklahoma Interconnection line, impacts from construction activities could include exposing prime farmland to conditions of increased erosion potential, and soils with high compaction potential would be susceptible to compaction from construction vehicles and equipment. Either impact could result in a decrease in the productivity of such soils and a loss of fertile topsoil. Depending on the specific siting of the converter stations, areas susceptible to erosion and hydric soils could be avoided or impacted during construction activities.

Two facilities (one NPDES site and one TRI site) that are required to report activity to a state or federal system were identified in the Tennessee Converter Station Siting Area. The NPDES site, located within the northeastern portion of the siting area, indicates a stone and gravel operation where a permit was granted in 2008 for the discharge of stormwater. The TRI site is the existing Shelby 500kV substation. These sites indicate a records inventory and do not raise a concern at this time in regards to areas of soil contamination.

3.6.2.6.2.1.1.2 Operations and Maintenance Impacts

Impacts from operations and maintenance are described in Section 3.6.2.6.1.

3.6.2.6.2.1.1.3 Decommissioning Impacts

Impacts from decommissioning are described in Section 3.6.2.6.1.

3.6.2.6.2.2 AC Collection System

3.6.2.6.2.2.1 Construction Impacts

The amounts of designated farmland for the AC collection system routes are summarized in Table 3.6.2-19. The AC collection system routes representative ROWs only traverse areas of prime farmland and do not traverse other categories of designated farmland and therefore the other categories are not presented in the table.

Table 3.6.2-19:
Designated Farmland—AC Collection System Routes 200-Foot-Wide Representative ROW (Percentage and Acreage)

AC Collection System Route	Total Representative ROW (acres)	Total Designated Farmland Impacted[1] (acres and percentage of representative ROW)
E-1	708	142 (20%)
E-2	974	502 (51%)
E-3	977	432 (44%)
NE-1	730	367(50%)
NE-2	637	209 (33%)
NW-1	1,265	646 (51%)
NW-2	1,365	670 (49%)
SE-1	979	517 (53%)
SE-2	325	167 (49%)
SE-3	1,194	671 (56%)
SW-1	326	9 (3%)
SW-2	901	108 (12%)
W-1	508	193 (38%)

GIS Data Source: NRCS 2013: In Route E-1 designated farmland is present in 42% of the larger ROI; and in Route E-2 designated farmland is present in 19% of the larger ROI.

1 Includes all designated farmland categories (prime farmland is the only category present in the AC collection system impact areas).

Impacts to soil limitation parameters for the 200-foot-wide representative ROW of the AC collection system routes are summarized in Table 3.6.2-20.

One facility, the Lasley Cattle Feedlot (latitude/longitude: 36.2994/-101.82411), is a NPDES stormwater discharge permit site identified within the AC Collection System Route SW-2. Discharge from the feedlot is indicated to be permitted and does not pose a soil contamination concern at this time. Ten other facilities/sites that are required to report activity to a state or federal system were identified in the surrounding AC collection system ROI. Based on available information, these sites do not pose a soil contamination concern.

Table 3.6.2-20:
Soil Limitations—AC Collection System Routes 200-Foot-Wide Representative ROW (Percentage and Acreage)

Project Component Area	High Compaction Potential[1]	Moderate to High Wind Erosion Potential[2]	High Water Erosion Potential[3]	Corrosion Potential[4]	Stony Soils[5]	Hydric Soils[6]	Restrictive Layer[7]	15 to 30% Slopes	>30% Slopes	Summary of Impact Comparison to All AC Collection System Routes (unless otherwise specified)
E-1	97% 688	79% 560	0% 0	9% 62	0% 0	0% 0	20% 138	0% 0	0% 0	Among the highest impacts to soils with high wind erosion potential.
E-2	99% 963	45% 435	0% 0	30% 291	0% 0	0% 0	8% 81	0% 0	0% 0	Among the highest impacts to soils with moderate to high wind erosion potential.
E-3	98% 955	51% 500	0% 0	10% 99	0% 0	0% 0	12% 117	0% 0	0% 0	Among the highest impacts to soils with high wind erosion potential.
NE-1	97% 707	50% 363	0% 0	4% 28	0% 0	<1% 2	9% 63	0% 0	0% 0	In the medium range of impact to soils susceptible to moderate to high wind erosion.
NE-2	95% 609	67% 429	0% 0	3% 17	0% 0	2% 10	19% 119	0% 0	0% 0	More impact to soils with moderate to high wind erosion potential than NE-1 and is among the greatest of impacts to soils with high wind erosion potential.
NW-1	96% 1,209	49% 620	0% 0	27% 340	0% 0	0% 0	5% 64	0% 0	0% 0	Less impact to soils with moderate to high wind erosion potential than NW-2 and is one of the highest impacts to soils with moderate to high wind erosion potential.
NW-2	9% 127	51% 695	0% 0	26% 351	0% 0	0% 0	5% 71	0% 0	0% 0	More impact to soils with moderate to high wind erosion potential than NW-1 and is among the highest impact to soils with moderate to high wind erosion potential.
SE-1	21% 203	45% 436	0% 0	51% 500	0% 0	0% 0	7% 69	0% 0	0% 0	More impact to soils with moderate to high wind erosion potential than SE-2 and SE-3 and is among the highest impact to soils with moderate to high wind erosion potential.
SE-2	100% 325	35% 112	0% 0	52% 170	0% 0	0% 0	20% 66	14% 46	0% 0	Less impact to soils with moderate to high wind erosion potential than SE-1 and more impact than SE-3 and is among the least impact to soils with moderate to high wind erosion potential.

Table 3.6.2-20:
Soil Limitations—AC Collection System Routes 200-Foot-Wide Representative ROW (Percentage and Acreage)

Project Component Area	High Compaction Potential[1]	Moderate to High Wind Erosion Potential[2]	High Water Erosion Potential[3]	Corrosion Potential[4]	Stony Soils[5]	Hydric Soils[6]	Restrictive Layer[7]	15 to 30% Slopes	>30% Slopes	Summary of Impact Comparison to All AC Collection System Routes (unless otherwise specified)
SE-3	99% 1,182	41% 76	0% 0	45% 531	0% 0	0% 0	7% 81	0% 0	0% 0	Less impact to soils with moderate to high wind erosion potential than SE-1 and SE-2 and has the least impact to soils with moderate to high wind erosion potential.
SW-1	83% 269	76% 246	0% 0	0% 0	0% 0	0% 0	20% 66	12% 40	0% 0	Less impact to soils with moderate to high wind erosion potential than SW-2 and is among the medium impact to soils with moderate to high wind erosion potential.
SW-2	92% 831	86% 779	0% 0	20% 180	0% 0	0% 0	10% 86	5% 43	0% 0	More impact to soils with moderate to high wind erosion potential than Has the highest impact to soils with high wind erosion potential.
W-1	94% 478	62% 315	0% 0	4% 19	0% 0	0% 0	9% 43	0% 0	0% 0	Among the medium range of impact to soils susceptible to high wind erosion.

GIS Data Source: NRCS (2013). In AC Collection System Route E-2, moderate to high wind erosion potential is present in 49% of the larger ROI. In AC Collection System Route NW-2, high compaction potential is present in 88% of the larger ROI. In AC Collection System Route SE-1, high compaction potential is present in 89% of the larger ROI.

1 SSURGO severe rutting hazard.
2 SSURGO WEG wind erosion groups: 1-4L.
3 SSURGO Kf >0.4.
4 SSURGO high steel or concrete potential.
5 SSURGO soils characterized as stony, cobbly, channery, flaggy, bouldery, or bedrock.
6 SSURGO Hydric Condition (includes only entirely hydric soils and not partially hydric soils).
7 Bedrock < 60 inches from ground surface.

3.6.2.6.2.2.2 Operations and Maintenance Impacts

Impacts from operations and maintenance are described in Section 3.6.2.6.1.

3.6.2.6.2.2.3 Decommissioning Impacts

Impacts from decommissioning are described in Section 3.6.2.6.1.

3.6.2.6.2.3 HVDC Applicant Proposed Route

3.6.2.6.2.3.1 Construction Impacts

Designated Farmland

Acreages and percentages of designated farmland for the Applicant Proposed Route 200-foot-wide representative ROW are provided in Table 3.6.2-21 by Project region. The total impact to designated farmland from the Applicant Proposed Route encompasses 48 percent (or 8,321 acres). The greatest impacts to designated farmland are in Regions 1 and 3. The greatest impact to the "farmland–if–drained" category is in Region 6; the greatest impact to "farmland if drained and either protected from flooding or not frequently flooded during the growing season" is in Region 7. The greatest impact to farmland of statewide and local importance is in Region 6. Temporary impacts in the tensioning areas would impact 1,682 acres within the Applicant Proposed Route.

Table 3.6.2-21:
Designated Farmland in Applicant Proposed Route 200-Foot-Wide Representative ROW—All Regions (Percentage and Acreage)

Applicant Proposed Route by Region[1]	Total Acres of Representative ROW	Total Designated Farmland (acres and percentage of Impact Area)[2]
Region 1	2,825	1,405 (50%)
Region 2	2,588	593 (23%)
Region 3	3,949	1,961 (50%)
Region 4	3,088	1,382 (42%)
Region 5	2,760	1,052 (38%)
Region 6	1,332	1,097 (78%)
Region 7	1,048	836 (81%)
Total APR (all Regions)	17,590	8,321 (48%)

1 The values in the table (Regions 2–7) do not reflect the minor changes that would result from application of the minor route variations and adjustments.
2 Includes total for all designated farmland categories.
GIS Data Source: NRCS (2013)

Soil Limitations

Impacts to soil limitation parameters for the Applicant Proposed Route impact areas are summarized in Table 3.6.2-22 by Project region. Impacts to soils with high compaction potential are greater than 1,000 acres in Regions 1, 2, 3, and 4. Total impacts to soils with high compaction potential could occur for 56 percent (9,996 acres) of the Applicant Proposed Route. Wind erosion potential is greatest in Regions 1, 2, and 5, with total impact to 6,648 acres potentially occurring in all Regions for this parameter. Water erosion potential is greatest in Regions 3, 4, and 6. Steep slopes are most prevalent in Regions 3, 4, and 5. Impacts associated with soil limitations are further discussed by Region below. Temporary impacts in the tensioning areas would impact 949 acres of soils with high compaction potential with the Applicant Proposed Route.

This page intentionally left blank.

Table 3.6.2-22:
Soil Limitations in Applicant Proposed Route 200-Foot-Wide Representative ROW—All Regions (Percentage and Acreage)

Project Component Area[1a]	High Compaction Potential[2]		Moderate to High Wind Erosion Potential[3]		High Water Erosion Potential[4]		Corrosion Potential[5]		Stony Soils[6]		Hydric Soils[7]		Restrictive Layer[8]		15 to 30% Slopes		>30% Slopes	
Region 1	91%	2,582	52%	1,461	<1%	9	26%	744	0%	0	0%	0	12%	328	2%	63	0%	0
Region 2	41%	1,050	73%	1,889	9%	229	17%	428	0%	0	0%	0	18%	475	4%	112	0%	0
Region 3	80%	3,153	23%	923	35%	1,367	55%	2,181	9%	361	0%	0	54%	2,118	10%	390	<1%	6
Region 4	42%	1,309	29%	892	22%	677	64%	1,969	33%	1,031	4%	137	59%	1,836	25%	779	2%	64
Region 5	23%	626	45%	1,246	13%	351	57%	1,567	31%	852	4%	98	87%	2,399	16%	447	1%	32
Region 6	92%	324	10%	136	58%	766	71%	948	0%	0	31%	407	47%	622	2%	29	0%	0
Region 7	91%	952	10%	101	39%	405	44%	462	0%	0	32%	339	5%	54	7%	77	2%	19
Total	56%	9,996	38%	6,648	22%	3,804	47%	8,299	13%	2,244	6%	981	45%	7,832	11%	1,897	1%	121

1a The values in the table (Regions 2–7) do not reflect the minor changes that would result from application of the minor route variations and adjustments.

GIS Data Source: NRCS (2013)

1 SSURGO severe rutting potential.
2 SSURGO WEG wind erosion groups: 1-4L.
3 SSURGO Kf >0.4.
4 SSURGO high concrete or steel corrosion potential.
5 SSURGO soils characterized as cobbly, stony, flaggy, channery, bouldery, and bedrock.
6 SSURGO Hydric Condition (includes only entirely hydric soils and not partially hydric soils).
7 SSURGO restrictive layer < 60 inches from ground surface.

This page intentionally left blank.

Soil Contamination

No areas of potential soil contamination were identified within the Applicant Proposed Route Regions 1, 2, 3, 4, and 6 representative ROWs or larger ROI. The representative ROW in Region 5 includes the DeSoto Gathering/Phillips Mountain gas facility, located along Applicant Proposed Link 3. The representative ROW in Region 7 includes a PDS site, Mitchell Station. The PDS site could be indicative of any number of potential reported issues. Additional information would be obtained for the site during final design to ascertain if avoidance of the area is necessary. In comments on the Draft EIS, the Tennessee Division of Solid Waste Management identified a potential concern in relation to the Chickasaw Bluffs (crossed by Applicant Proposed Route 7 Link 3), where large gullies might have been used for illicit disposal of waste. The Applicant would implement EPMs to address previously undiscovered waste disposal sites and any necessary handling of waste materials in Project construction areas.

Route Variations

No route variations were proposed in Region 1. Two route variations were developed for the Applicant Proposed Route in Region 2 in response to public comments on the Draft EIS. Link 1, Variation 1, would affect 4 more acres of designated farmland, a greater acreage (5 acres) of soils with high wind erosion potential, and less acreage (3 acres) of soils with high compaction potential. The variation was developed to reduce impacts to cultivated fields and structures. Link 2, Variation 2, was developed to reduce impacts to agricultural operations on several parcels, but would affect a slightly greater acreage (3 acres) of designated farmland. Effects to soil limitations parameters would vary slightly higher and lower (within 8 acres).

Five route variations were developed for the Applicant Proposed in Region 3 in response to public comments on the Draft EIS. Link 1, Variation 2, would reduce impacts to cultivated cropland, but would have approximately 8 acres of greater impacts to designated farmland. Effects to soils with high water erosion potential and shallow bedrock would be less, but effects to soils with high wind erosion potential would be greater. Effects to soil limitation parameters would generally be less (<8 acres) except for soils susceptible to high compaction (2 acres more). Link 4, Variation 1, would have less impact to designated farmland (1 acre) and erosive soils (2 acres), and slightly more impacts (<1 acre) to soils susceptible to compaction. Link 4, Variation 2, would impact slightly less (<1 acre) designated farmland and would have less acreage impacts to soils with limitations (<5 acres); however, the variation would impact approximately 4 acres more of soils with high wind erosion potential. Link 5, Variation 2, would have about the same acreage (within 0.5 acre) impact to designated farmland and slightly greater impact to soils with high water erosion potential (3 acres), but would have less impacts to all other soils with soil limitations (<5 acres).

Seven route variations were developed for the Applicant Proposed in Region 4 in response to public comments on the Draft EIS. Link 3, Variation 1, would have 6 acres greater impact to designated farmland; and greater impact to soils with high water erosion potential (7 acres) and less impact to soils with high susceptibility for compaction (2 acres). Link 3, Variation 2, would have 6 acres more of impacts to designated farmland, 2 acres less of impacts to soils with high water erosion potential, and 50 acres less of impacts to soils with a high susceptibility to compaction. Link 3, Variation 3, would have 1 acre more impact to designated farmland, 9 more acres impact to soils with high wind potential, 38 acres less impact to stony soils, and 12 acres greater impact to soils with high susceptibility to compaction. Link 6, Variation 1, would impact about the same amount of designated farmland, and have 4 acres greater impact to both soils with high water erosion potential and soils with high wind erosion potential. Link 6, Variation 2, would have 3 acres less impact to designated farmland and avoid a WRP easement, but it otherwise generally has the same land use. Link 6, Variation 3, would have slightly less impact to designated farmland (<1 acre), 3 acres less impact to slopes of greater than 20 percent, about 3 acres greater impact to soils with high water erosion potential, 1 acre less impact to soils with high wind erosion potential, and about 6 acres greater impact to soils with high susceptibility to compaction. Link 9, Variation 1, would have 3 acres less impact to designated farmland, 2 acres less impact to soils with high water erosion potential, and 2 acres greater impact to soils with high wind erosion potential.

Five route variations were developed for the Applicant Proposed Route in Region 5 in response to public comments on the Draft EIS. Link 1, Variation 2, would have 30 acres less impact to designated farmland, 2 acres greater impact to soils with high water erosion potential, 3 acres less impact to soils with high wind erosion potential, and 3 acres greater impact to soils with high susceptibility to compaction. Link 2, Variation 2, would reduce impacts to designated farmland by 1 acre, have 1 greater acre of impact to soils with high wind erosion potential, and 13 acres more impact to stony soils. Links 2 and 3, Variation 1, would have 7 acres more impact to designated farmland, 2 acres more impact to soils with high wind erosion potential, and 3 acres more impact to soils with high susceptibility to compaction. It should be noted that a route adjustment was made for HVDC Alternative Route 5-B to maintain continuity with the proposed variation. Links 3 and 4, Variation 2, would have almost 3 acres more impact to designated farmland, 24 acres more impact to soils with high wind erosion potential, and 8 acres less impact to soils with high susceptibility to compaction. It should be noted that a route adjustment was made for HVDC Alternative Route 5-E to maintain continuity with the proposed variation. Link 7, Variation 1, would have almost 4 acres more of impacts to designated farmland and soils with high wind erosion potential.

One route variation was developed for the Applicant Proposed Route in Region 6 in response to public comments on the Draft EIS. Link 2, Variation 1, would have 0.7 acre less impact to designated farmland, 17 acres more impact to soils with high water erosion potential, 1 acre less impact to soils with high wind erosion potential, and 17 acres more impact to soils with high susceptibility to compaction. It should be noted that a route adjustment was made for HVDC Alternative Route 6-A to maintain continuity with the proposed variation. The variation is illustrated in Exhibit 1 of Appendix M.

Three route variations were developed for the Applicant Proposed Route in Region 7 in response to public comments on the Draft EIS. Link 1, Variation 1, would have almost 5 acres more impact to hydric soils and to soils with high susceptibility to compaction. Link 1, Variation 2, would have 11 acres less impact to soils with high water erosion potential, 3 acres less impact to soils with high wind erosion potential, and almost 13 more acres impact to soils with high susceptibility to compaction. Link 5, Variation 1, would have almost the same impacts to designated farmland and to soils with evaluated limitations.

3.6.2.6.2.3.2 Operations and Maintenance Impacts

Impacts from operations and maintenance are described in Section 3.6.2.6.1.

3.6.2.6.2.3.3 Decommissioning Impacts

Impacts from decommissioning are described in Section 3.6.2.6.1.

3.6.2.6.3 Impacts Associated with the DOE Alternatives

3.6.2.6.3.1 Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area

3.6.2.6.3.1.1 Construction Impacts

The Arkansas Converter Station Alternative Siting Area is located within 192 acres of designated farmland. The converter station would require 20 to 35 acres of land. The AC interconnection representative ROW includes 662 acres (or 100 percent) within designated farmland. Depending on the specific siting of the converter station and AC interconnect line within these areas, impacts from construction activities could include exposing designated farmland to conditions of increased erosion potential, and soils with high compaction potential would be susceptible to compaction from construction vehicles and equipment. Either impact could result in a decrease in the productivity of such soils and a loss of fertile topsoil.

Five sites were identified in the Arkansas converter station ROI. All are private farmstead or ranch locations. Implementation of EPMs would minimize potential contamination of soils.

A new substation would be required at the point where the 500kV AC interconnection line taps the existing Arkansas Nuclear One-Pleasant Hill 500kV line. The footprint of this substation is estimated to be between 25 and 35 acres, with an additional 5 acres for temporary materials staging and equipment storage. Impacts to designated farmland could increase by up to 35 acres. Impacts to soils with soil limitations are expected to potentially increase to a lesser degree based on the presence or lack thereof of these specific limitation parameters listed for the ROI in Region 5. Soils within the substation site would be permanently impacted.

3.6.2.6.3.1.2 Operations and Maintenance Impacts

Impacts from operations and maintenance are described in Section 3.6.2.6.1.

3.6.2.6.3.1.3 Decommissioning Impacts

Impacts from decommissioning are described in Section 3.6.2.6.1.

3.6.2.6.3.2 HVDC Alternative Routes

3.6.2.6.3.2.1 Construction Impacts

Construction impacts to soil resources would be similar to those of the Application Proposed, but acres of designated farmland and soil limitations would vary by route alternatives. The amounts of designated farmland and soil limitations for HVDC alternative routes representative ROWs and the Applicant Proposed Route are compared for each region in Tables 3.6.2-23 and 3.6.2-24, respectively. Impacts for the individual alternatives are summarized and compared with the Applicant Proposed Route in the far right column of the tables.

This page intentionally left blank.

Table 3.6.2-23:
Designated Farmland in HVDC Alternative Routes by Region (Percentage and Acreage in 200-Foot-Wide Representative Corridor)

Project Component Area[1]	Associated APR Link Numbers	Total Acres in Representative ROW	Total Designated Farmland (Acres and percentage of impact area)[2]	Impact Comparison with Applicant Proposed Route Corresponding Links
Region 1				
AR 1-A	2, 3, 4, 5	3,003	805 (27%)	Less impact to designated farmland.
AR 1-B	2, 3	1,268	564 (44%)	Less impacts to designated farmland.
AR 1-C	2, 3	1,272	679 (53%)	Less impact to designated farmland. Greater impacts to designated farmland than 1-B.
AR 1-D	3, 4	819	330 (40%)	Somewhat greater impacts to designated farmland.
APR Link 1	NA	48	0 (0%)	NA
APR Link 2	NA	1,301	873 (67%)	NA
APR Link 3	NA	15	13 (87%)	NA
APR Link 4	NA	808	305 (38%)	NA
APR Link 5	NA	654	215 (33%)	NA
Region 2				
AR 2-A	2	1,396	335 (24%)	Greater impacts to designated farmland.
AR 2-B	3	728	365 (50%)	Greater impacts to designated farmland.
APR Link 1	NA	494	31 (6%)	NA
APR Link 2	NA	1,331	260 (20%)	NA
APR Link 3	NA	764	302 (40%)	NA
Region 3				
AR 3-A	1	919	339 (37%)	Fewer impacts to designated farmland.
AR 3-B	1, 2, 3	1,167	457 (39%)	Somewhat less effects to designated farmland.
AR 3-C	3, 4, 5, 6	2,968	1,577 (53%)	Somewhat more impact to designated farmland.
AR 3-D	5, 6	959	676 (71%)	Greater impact to designated farmland.
AR 3-E	6	208	110 (53%)	Similar impacts to designated farmland.
APR Link 1	NA	977	375 (38%)	NA
APR Link 2	NA	77	27 (36%)	NA
APR Link 3	NA	167	95 (57%)	NA
APR Link 4	NA	1,872	827 (56%)	NA

Table 3.6.2-23:
Designated Farmland in HVDC Alternative Routes by Region (Percentage and Acreage in 200-Foot-Wide Representative Corridor)

Project Component Area[1]	Associated APR Link Numbers	Total Acres in Representative ROW	Total Designated Farmland (Acres and percentage of impact area)[2]	Impact Comparison with Applicant Proposed Route Corresponding Links
APR Link 5	NA	667	529 (79%)	NA
APR Link 6	NA	190	107 (57%)	NA
APR Link 5	NA	67	60 (90%)	NA
APR Link 6	NA	25	13 (54%)	NA
Region 4				
AR 4-A	3, 4, 5, 6	1,426	316 (22%)	Less impacts to designated farmland.
AR 4-B	2, 3, 4, 5, 6, 7, 8	1,920	352 (18%)	Less impacts to designated farmland.
AR 4-C	5	83	19 (23%)	Slightly greater effect to designated farmland.
AR 4-D	4, 5, 6	618	200 (32%)	Less impacts to designated farmland than the corresponding APR links.
AR 4-E	8, 9	897	503 (56%)	Slightly greater impacts to designated farmland.
APR Link 1	NA	203	37 (18%)	NA
APR Link 2	NA	103	12 (12%)	NA
APR Link 3	NA	856	190 (22%)	NA
APR Link 4	NA	26	1 (2%)	NA
APR Link 5	NA	53	9 (16%)	NA
APR Link 6	NA	540	465 (86%)	NA
APR Link 7	NA	360	177 (49%)	NA
APR Link 8	NA	50	21 (41%)	NA
APR Link 9	NA	897	471 (52%)	NA
Region 5				
AR 5-A	1	308	137 (44%)	Greater impacts to designated farmland.
AR 5-B	3, 4, 5, 6	1,732	878 (51%)	Much greater impacts to designated farmland.
AR 5-C	6	225	166 (74%)	Greater impacts to designated farmland.
AR 5-D	9	530	248 (47%)	Less impacts to designated farmland.
AR 5-E	4, 5, 6	885	498 (56%)	Much greater impacts to designated farmland.
AR 5-F	5, 6	544	341 (63%)	Greater impacts to designated farmland.

Table 3.6.2-23:
Designated Farmland in HVDC Alternative Routes by Region (Percentage and Acreage in 200-Foot-Wide Representative Corridor)

Project Component Area[1]	Associated APR Link Numbers	Total Acres in Representative ROW	Total Designated Farmland (Acres and percentage of impact area)[2]	Impact Comparison with Applicant Proposed Route Corresponding Links
APR Link 1	NA	300	121 (40%)	NA
APR Link 2	NA	158	34 (22%)	NA
APR Link 3	NA	830	206 (25%)	NA
APR Link 4	NA	352	128 (36%)	NA
APR Link 5	NA	350	122 (35%)	NA
APR Link 6	NA	109	80 (74%)	NA
APR Link 7	NA	120	77 (64%)	NA
APR Link 8	NA	40	13 (33%)	NA
APR Link 9	NA	500	275 (54%)	NA
Region 6				
AR 6-A	2, 3, 4	396	140 (65%)	Less impact to designated farmland.
AR 6-B	3	344	200 (58%)	More impact to designated farmland.
AR 6-C	6, 7	566	487 (86%)	Less impact to designated farmland.
AR 6-D	7	224	214 (95%) (a)	Slightly more impact to designated farmland.
APR Link 1	NA	150	139 (92%)	NA
APR Link 2	NA	42	25 (59%)	NA
APR Link 3	NA	236	130 (55%)	NA
APR Link 4	NA	155	134 (87%)	NA
APR Link 5	NA	46	43 (93%)	NA
APR Link 6	NA	397	323 (81%)	NA
APR Link 7	NA	209	208 (99%)	NA
APR Link 8	NA	96	94 (98%)	NA
Region 7				
AR 7-A	1	1,052	1,000 (95%)	Greater impact to designated farmland.
AR 7-B	3, 4	210	97 (46%)	Less impact to designated farmland.
AR 7-C	3, 4, 5	579	381 (66%)	Greater impact to designated farmland.
AR 7-D	4, 5	160	91 (57%)	Less impact to designated farmland.

Table 3.6.2-23:
Designated Farmland in HVDC Alternative Routes by Region (Percentage and Acreage in 200-Foot-Wide Representative Corridor)

Project Component Area[1]	Associated APR Link Numbers	Total Acres in Representative ROW	Total Designated Farmland (Acres and percentage of impact area)[2]	Impact Comparison with Applicant Proposed Route Corresponding Links
APR Link 1	NA	698	644 (92%)	NA
APR Link 2	NA	27	27 (100%)	NA
APR Link 3	NA	166	68 (41%)	NA
APR Link 4	NA	39	36 (92%)	NA
APR Link 5	NA	118	61 (52%)	NA

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.

2 Includes all farmland categories that apply in each region.

NA—Not applicable.

NE—Not evaluated for tensioning areas.

Table 3.6.2-24:
Soil Limitations in HVDC Alternative Routes by Region (Percentage and Acreage in 200-Foot-Wide Representative Corridor)

Project Component Area[1a]	Associated APR Link Numbers	High Compaction Potential[1]		Moderate to High Wind Erosion Potential[2]		High Water Erosion Potential[3]		Corrosion Potential[4]		Stony Soils[5]		Hydric Soils[6]		Restrictive Layer[7]		15 to 30% Slopes		>30% Slopes		Alternative Route Compared to Applicant Proposed Route Corresponding Links
Region 1																				
AR 1-A	2, 3, 4, 5	90%	2,707	69%	2,065	1%	16	8%	236	0%	0	0%	0	19%	582	5%	150	0%	0	Greater impacts to high compaction soils, soils with wind erosion potential, and areas of steep slopes.
AR 1-B	2, 3	99%	1,250	52%	660	0%	0	12%	151	0%	0	0%	0	8%	100	0%	0	0%	0	Less impact to high compaction soils and greater impact to soils with wind erosion potential and areas of steep slopes.
AR 1-C	2, 3	99%	1,254	46%	583	0%	0	12%	156	0%	0	0%	0	5%	63	0%	0	0%	0	Less impact to high compaction soils and greater impact to soils with wind erosion potential and areas of steep slopes than.
AR 1-D	3, 4	94%	767	73%	594	<1%	1	27%	218	0%	0	0%	0	6%	46	0%	0	0%	0	Somewhat more impact to high compaction soils and areas of steep slopes and less impact to soils with wind erosion potential.
APR Link 1	NA	100%	48	100%	48	0%	0	0%	0	0%	0	0%	0	62%	29	0%	0	0%	0	NA
APR Link 2	NA	99%	1,289	30%	391	0%	0	41%	537	0%	0	0%	0	3%	40	0%	0	0%	0	NA
APR Link 3	NA	100%	15	13%	2	0%	0	65%	10	0%	0	0%	0	0%	0	0%	0	0%	0	NA
APR Link 4	NA	92%	740	77%	622	0%	0	22%	179	0%	0	0%	0	3%	25	0%	0	0%	0	NA
APR Link 5	NA	75%	491	61%	399	<1%	9	3%	19	0%	0	0%	0	36%	234	10%	63	0%	0	NA
Region 2																				
AR 2-A	2	63%	879	78%	1,082	14%	202	26%	362	0%	0	0%	0	39%	550	10%	139	0%	0	Greater impact to high compaction soils, soils with wind erosion potential, and areas of steep slopes. Greater overall soils impacts.
AR 2-B	3	80%	585	38%	278	13%	93	29%	210	0%	0	0%	0	41%	299	0%	0	0%	0	Greater impact to high compaction soils and areas of steep slopes and less impact to soils with wind erosion potential. Greater overall soils impacts.
APR Link 1	NA	9%	43	96%	474	0%	0	4%	22	0%	0	0%	0	0%	0	0%	0	0%	0	NA

Table 3.6.2-24:
Soil Limitations in HVDC Alternative Routes by Region (Percentage and Acreage in 200-Foot-Wide Representative Corridor)

Project Component Area[1a]	Associated APR Link Numbers	High Compaction Potential[1]		Moderate to High Wind Erosion Potential[2]		High Water Erosion Potential[3]		Corrosion Potential[4]		Stony Soils[5]		Hydric Soils[6]		Restrictive Layer[7]		15 to 30% Slopes		>30% Slopes		Alternative Route Compared to Applicant Proposed Route Corresponding Links
APR Link 2	NA	41%	550	75%	1,004	5%	72	12%	157	0%	0	0%	0	22%	296	6%	76	0%	0	NA
APR Link 3	NA	60%	457	54%	411	20%	156	33%	248	0%	0	0%	0	24%	180	5%	35	0%	0	NA
Region 3																				
AR 3-A	1	86%	790	29%	265	23%	215	43%	398	0%	0	<1%	1	69%	631	6%	51	0%	0	Less impact to high compaction soils and to soils with wind erosion potential.
AR 3-B	1, 2, 3	87%	1,016	27%	320	25%	292	47%	546	0%	0	<1%	1	66%	774	5%	61	0%	0	Slightly less impact to high compaction soils. Somewhat less overall soils impacts.
AR 3-C	3, 4, 5, 6	76%	2,245	25%	729	33%	969	47%	1,398	12%	364	<1%	6	50%	1,480	13%	389	0%	0	Less impact to high compaction soils; greater impact to soils with wind erosion potential and to areas of steep slopes. Somewhat greater overall soils impacts.
AR 3-D	5, 6	100%	954	11%	105	55%	524	69%	660	<1%	1	0%	0	33%	320	8%	73	0%	0	Greater impact to high compaction soils, soils with wind erosion potential, and areas of steep slopes. The alternative route would have somewhat greater overall soils impacts.
AR 3-E	6	99%	206	13%	26	34%	70	77%	161	0%	0	0%	0	54%	112	30%	63	0%	0	Greater impact to high compaction soils and areas of steep slopes.
APR Link 1	NA	84%	825	33%	320	20%	197	34%	332	0%	0	0%	0	65%	638	6%	60	1%	6	NA
APR Link 2	NA	82%	63	28%	22	45%	34	79%	60	0%	0	0%	0	39%	30	13%	10	0%	0	NA
APR Link 3	NA	83%	138	35%	58	29%	49	51%	84	0%	0	0%	0	46%	76	4%	7	0%	0	NA
APR Link 4	NA	68%	1,276	23%	434	29%	550	57%	1,065	19%	361	0%	0	59%	1,107	14%	264	0%	0	NA
APR Link 5	NA	100%	665	8%	56	69%	459	72%	482	0%	0	0%	0	25%	170	0%	0	0%	0	NA
APR Link 6	NA	98%	187	17%	32	41%	78	83%	157	0%	0	0%	0	52%	98	26%	49	0%	0	NA

Table 3.6.2-24:
Soil Limitations in HVDC Alternative Routes by Region (Percentage and Acreage in 200-Foot-Wide Representative Corridor)

Project Component Area[1a]	Associated APR Link Numbers	High Compaction Potential[1]		Moderate to High Wind Erosion Potential[2]		High Water Erosion Potential[3]		Corrosion Potential[4]		Stony Soils[5]		Hydric Soils[6]		Restrictive Layer[7]		15 to 30% Slopes		>30% Slopes		Alternative Route Compared to Applicant Proposed Route Corresponding Links
Region 4																				
AR 4-A	3, 4, 5, 6	24%	345	21%	303	7%	97	75%	1,073	54%	768	<1%	3	85%	1,212	52%	741	<1%	4	Less impact to high compaction soils, soils with high water erosion potential and greater impact to areas of steep slopes. Somewhat less overall soils impacts.
AR 4-B	2, 3, 4, 5, 6, 7, 8	21%	402	22%	413	5%	103	65%	1,246	53%	1,018	0%	0	80%	1,528	53%	1,020	1%	20	Less impact to high compaction soils, soils with wind erosion potential, and soils with high water erosion potential and greater impact to areas of steep slopes.
AR 4-C	5	31%	26	19%	15	18%	15	64%	53	50%	42	0%	0	100%	83	50%	42	0%	0	Similar impacts to soil limitation parameters.
AR 4-D	4, 5, 6	19%	118	43%	263	6%	37	58%	357	31%	194	1%	3	88%	545	29%	177	1%	4	Less impact to high compaction soils, soils with wind erosion potential, and soils with high water erosion potential and would have greater impact to areas of steep slopes.
AR 4-E	8, 9	21%	186	48%	435	16%	146	31%	279	25%	222	0%	0	57%	513	12%	105	1%	8	Less impact to high compaction soils and soils with high water erosion potential and would have greater impact to areas of steep slopes and soils with wind erosion potential.
APR Link 1	NA	51%	104	3%	5	17%	34	69%	140	51%	103	0%	0	59%	120	63%	127	0%	0	NA
APR Link 2	NA	34%	35	0%	0	9%	9	97%	99	66%	68	0%	0	77%	79	66%	68	0%	0	NA
APR Link 3	NA	57%	491	1%	8	25%	215	95%	811	47%	406	0%	0	62%	532	42%	361	0%	0	NA
APR Link 4	NA	23%	6	12%	3	2%	<1	86%	22	40%	10	0%	0	100%	26	40%	10	0%	0	NA
APR Link 5	NA	20%	11	38%	20	6%	3	56%	30	42%	22	0%	0	100%	53	42%	22	0%	0	NA
APR Link 6	NA	59%	316	53%	284	34%	182	71%	385	9%	51	25%	136	38%	207	9%	51	0%	0	NA
APR Link 7	NA	31%	112	51%	182	17%	61	25%	91	28%	101	<1	1	75%	268	18%	64	0%	0	NA
APR Link 8	NA	25%	13	44%	22	24%	12	16%	8	29%	15	0%	0	64%	32	9%	5	0%	0	NA
APR Link 9	NA	25%	222	41%	267	18%	160	42%	380	28%	255	0%	0	58%	518	8%	70	7%	64	NA

Table 3.6.2-24:
Soil Limitations in HVDC Alternative Routes by Region (Percentage and Acreage in 200-Foot-Wide Representative Corridor)

Project Component Area[1a]	Associated APR Link Numbers	High Compaction Potential[1]		Moderate to High Wind Erosion Potential[2]		High Water Erosion Potential[3]		Corrosion Potential[4]		Stony Soils[5]		Hydric Soils[6]		Restrictive Layer[7]		15 to 30% Slopes		>30% Slopes		Alternative Route Compared to Applicant Proposed Route Corresponding Links
Region 5																				
AR 5-A	1	13%	41	44%	136	8%	26	41%	125	34%	104	0%	0	83%	256	33%	101	0%	0	Less impact to high compaction soils and soils with wind erosion potential and would have greater impact to areas of steep slopes than APR Link 1.
AR 5-B	3, 4, 5, 6	20%	352	59%	1,019	14%	247	33%	564	17%	288	0%	0	92%	1,591	17%	287	0%	0	More impact to high compaction soils, soils with wind erosion potential, and areas of steep slopes and less impact to stony soils.
AR 5-C	6	32%	73	46%	104	24%	53	25%	57	21%	47	0%	0	91%	205	11%	24	0%	0	Greater impact to high compaction soils, soils with wind erosion potential, soils with high water erosion potential, areas of steep slopes, and stony soils. Overall greater impact to soils susceptible to soil limitations.
AR 5-D	9	45%	240	20%	108	31%	162	58%	310	35%	183	7%	36	79%	416	11%	58	0%	0	Less impact to high compaction soils, soils with high water erosion potential, and areas of steep slopes and more impact to soils with wind erosion potential and stony soils.
AR 5-E	4, 5, 6	26%	228	58%	512	19%	169	38%	332	16%	145	0%	0	95%	837	12%	103	0%	0	Greater impact to high compaction soils, soils with wind erosion potential, soils with high water erosion potential, and areas of steep slopes and less impact to stony soils.
AR 5-F	5, 6	36%	196	52%	283	25%	138	50%	271	12%	65	0%	0	92%	501	10%	56	0%	0	Greater impact to high compaction soils, soils with wind erosion potential, soils with high water erosion potential, and areas of steep slopes and less impact to stony soils.
APR Link 1	NA	17%	51	49%	146	8%	23	51%	153	36%	108	0%	0	89%	267	31%	94	0%	0	NA
APR Link 2	NA	12%	18	30%	47	11%	18	46%	73	44%	69	0%	0	83%	131	51%	81	0%	0	NA
APR Link 3	NA	14%	116	50%	414	4%	35	62%	511	32%	268	0%	0	91%	753	25%	208	1%	8	NA
APR Link 4	NA	10%	35	69%	242	6%	20	69%	242	23%	82	0%	0	99%	350	3%	11	0%	0	NA
APR Link 5	NA	8%	29	48%	168	4%	13	58%	202	43%	152	0%	0	95%	333	12%	42	7%	24	NA

Table 3.6.2-24:
Soil Limitations in HVDC Alternative Routes by Region (Percentage and Acreage in 200-Foot-Wide Representative Corridor)

Project Component Area[1a]	Associated APR Link Numbers	High Compaction Potential[1]	Moderate to High Wind Erosion Potential[2]	High Water Erosion Potential[3]	Corrosion Potential[4]	Stony Soils[5]	Hydric Soils[6]	Restrictive Layer[7]	15 to 30% Slopes	>30% Slopes	Alternative Route Compared to Applicant Proposed Route Corresponding Links
APR Link 6	NA	42% 47	32% 35	20% 21	31% 34	14% 15	0% 0	76% 83	0% 0	0% 0	NA
APR Link 7	NA	5% 6	70% 85	4% 4	35% 42	24% 29	0% 0	91% 109	20% 24	0% 0	NA
APR Link 8	NA	0% 0	33% 13	0% 0	67% 27	67% 27	0% 0	100% 40	53% 21	0% 0	NA
APR Link 9	NA	65% 324	19% 97	43% 217	57% 283	21% 103	20% 98	66% 332	9% 46	0% 0	NA
Region 6											
AR 6-A	2, 3, 4	95% 375	25% 98	75% 297	94% 371	0% 0	37% 148	60% 238	0% 0	0% 0	Less impact to high compaction soils and soils with high water erosion potential and greater impact to hydric soils.
AR 6-B	3	94% 324	15% 52	84% 288	94% 322	0% 0	19% 64	61% 209	0% 0	0% 0	More impact to high compaction soils, soils with wind erosion potential, and soils with high water erosion potential. Overall greater impacts to soils with soils limitations.
AR 6-C	6, 7	98% 555	0% 0	86% 486	72% 408	0% 0	25% 139	46% 262	7% 42	0% 0	Less impact to high compaction soils and hydric soils and greater impact to soils with high water erosion potential and to areas of steep slopes.
AR 6-D	7	95% 213	0% 0	40% 88	68% 152	0% 0	71% 158	2% 4	0% 0	0% 0	Less impact to high compaction soils and hydric soils and would have greater impact to soils with high water erosion potential.
APR Link 1	NA	73% 109	26% 39	46% 69	69% 103	0% 0	10% 15	7% 10	0% 0	0% 0	NA
APR Link 2	NA	72% 30	28% 12	72% 30	72% 30	0% 0	0% 0	41% 17	0% 0	0% 0	NA
APR Link 3	NA	94% 222	14% 34	85% 201	93% 219	0% 0	27% 64	74% 173	0% 0	0% 0	NA
APR Link 4	NA	99% 154	30% 47	69% 107	98% 152	0% 0	30% 47	56% 88	0% 0	0% 0	NA
APR Link 5	NA	99% 46	0% 0	99% 46	94% 43	0% 0	0% 0	93% 43	0% 0	0% 0	NA
APR Link 6	NA	93% 369	1% 5	79% 315	73% 192	0% 0	8% 31	73% 291	7% 29	0% 0	NA
APR Link 7	NA	99% 208	0% 0	0% 0	28% 58	0% 0	99% 208	0% 0	0% 0	0% 0	NA
APR Link 8	NA	98% 94	0% 0	0% 0	54% 52	0% 0	44% 43	0% 0	0% 0	0% 0	NA

Table 3.6.2-24:
Soil Limitations in HVDC Alternative Routes by Region (Percentage and Acreage in 200-Foot-Wide Representative Corridor)

Project Component Area[1a]	Associated APR Link Numbers	High Compaction Potential[1]		Moderate to High Wind Erosion Potential[2]		High Water Erosion Potential[3]		Corrosion Potential[4]		Stony Soils[5]		Hydric Soils[6]		Restrictive Layer[7]		15 to 30% Slopes		>30% Slopes		Alternative Route Compared to Applicant Proposed Route Corresponding Links
Region 7																				
AR 7-A	1	91%	958	19%	202	17%	174	64%	676	0%	0	33%	352	0%	0	0%	0	0%	0	More impact to high compaction soils, soils with high water erosion potential, soils with high wind erosion potential, and hydric soils. Overall greater impacts to soils with soil limitations.
AR 7-B	3, 4	97%	203	0%	0	86%	180	18%	38	0%	0	18%	37	6%	13	23%	49	4%	9	More impact to hydric soils. Otherwise, impacts to soils with soil limitations are similar.
AR 7-C	3, 4, 5	98%	570	0%	0	94%	546	54%	310	0%	0	18%	106	23%	134	8%	49	2%	9	More impact to high compaction soils, soils with high water erosion potential, and hydric soils. Greater overall impacts to soils with soil limitations.
AR 7-D	4, 5	100%	160	0%	0	100%	159	8%	13	0%	0	3%	4	9%	14	15%	24	0%	0	Less impact to areas of steep slopes. Otherwise, impacts are similar in terms of soil limitation parameters.
APR Link 1	NA	87%	607	10%	101	16%	109	56%	390	0%	0	40%	280	0%	0	0%	0	0%	0	NA
APR Link 2	NA	100%	27	0%	0	0%	0	100%	27	0%	0	100%	27	0%	0	0%	0	0%	0	NA
APR Link 3	NA	97%	161	0%	0	84%	139	12%	20	0%	0	13%	22	11%	19	31%	52	8%	13	NA
APR Link 4	NA	100%	39	0%	0	100%	39	1%	1	0%	0	0%	0	36%	14	0%	0	0%	0	NA
APR Link 5	NA	99%	118	0%	0	99%	118	21%	25	0%	0	9%	11	18%	21	21%	25	5%	6	NA

1a The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
GIS Data Source: NRCS (2013)
1 SSURGO severe rutting potential.
2 SSURGO WEG wind erosion groups: 1-4L.
3 SSURGO Kf >0.4.
4 SSURGO high concrete or steel corrosion potential.
5 SSURGO soils characterized as cobbly, stony, flaggy, channery, bouldery, and bedrock.
6 SSURGO Hydric Condition (includes only entirely hydric soils and not partially hydric soils).
7 SSURGO restrictive layer < 60 inches from ground surface.

No areas of potential soil contamination were identified within the HVDC alternative routes representative ROW or ROI for Regions 1, 2, 3, or 6. An eGRID site and an EIA-860 site occur in the 200-foot-wide representative ROW for HVDC Alternative Route 4-B. These are electric power generation facilities and are not indicative of a potential contamination concern at this time. Another two facilities/sites were identified in the Region 4 HVDC alternatives ROI, but also do not raise a concern at this time in regards to areas of soil contamination. No sites/facilities were identified in the representative ROW for the HVDC alternative routes in Regions 5 or 7. Thirteen facilities/sites were identified in the Region 5 ROI and two in the Region 7 ROI, but they do not raise concerns at this time in regards to areas of soil contamination. In a public comment on the Draft EIS, the Tennessee Division of Solid Waste Management identified a potential concern in relation to the Chickasaw Bluffs (crossed by HVDC Alternate Route 7-C), where large gullies might have been used for illicit disposal of waste. The Applicant would implement EPMs to address previously undiscovered waste disposal sites and any necessary handling of waste materials in Project construction areas.

A route adjustment was developed for HVDC Alternative Route 3-A to maintain continuity with Applicant Proposed Route Link 1, Variation 1, and Links 1 and 2, Variation 1, which were developed in response to public comments on the Draft EIS. The route adjustment would have 1 acre less impact to designated farmland, over 3 acres less impact to soils with high water erosion potential, and almost 4 acres less impact to soils with high susceptibility to compaction.

A route adjustment was developed for HVDC Alternative Route 5-B to maintain continuity with Applicant Proposed Route Links 2 and 3, Variation 1, which was developed in response to public comments on the Draft EIS. The adjustment would have over 8 acres more impact to stony soils, but is otherwise similar in terms of soil resources impacts. A route variation was developed for HVDC Alternative Route 5-E in response to public comments on the Draft EIS to maintain continuity with Applicant Proposed Route Links 3 and 4, Variation 2. The variation would cross 0.3 acre more designated farmland and 0.8 acre more soil with high wind erosion potential.

A route adjustment was developed for HVDC Alternative Route 6-A to maintain continuity with Applicant Proposed Route Link 1, Variation 1, and Link 2, Variation 1, which were developed in response to public comments on the Draft EIS. The route adjustment would impact about 10 acres less designated farmland, 4 acres less soil with high water erosion potential, 10 acres less soil with high wind erosion potential, and 4 acres less soil with high susceptibility to compaction.

3.6.2.6.3.2.2 Operations and Maintenance Impacts

Impacts from operations and maintenance are described in Section 3.6.2.6.1.

3.6.2.6.3.2.3 Decommissioning Impacts

Impacts from decommissioning are described in Section 3.6.2.6.1.

3.6.2.6.4 Best Management Practices

One BMP has been identified that could avoid and minimize impacts to soils:

- If signs of contaminated soils are uncovered during construction activities, work would be stopped in the area of potentially contaminated soils until appropriate Project representatives could be consulted.

3.6.2.6.5 Unavoidable Adverse Impacts

The Project would result in unavoidable impacts to soil resources during construction and operations and maintenance phases. Removal of vegetation during construction grading and excavation activities associated with the Project could result in the exposure of soils to erosion and compaction of soils susceptible to compaction. Transmission line structures and converter station sites would permanently impact agricultural soils and remove them from productivity during construction and operations and maintenance. Access roads used during construction would temporarily remove agricultural soils from productivity, and the use of unpaved access roads during all Project phases could result in the exposure of soils to erosion and compaction. All Project phases could result in the loss of fertile topsoil from activities that would either remove topsoil or expose topsoil to erosion. Adverse impacts therefore include the potential depletion of soil productivity, including erosion and loss of fertile topsoil and potential erosion of exposed areas and compaction of areas traversed by equipment and vehicles. Reclamation activities and Applicant EPMs would be implemented to avoid and minimize adverse impacts to soil resources. However, the loss of soil resources used for agricultural activities within the Project footprint during construction and operations and maintenance of the Project is unavoidable.

3.6.2.6.6 Irreversible and Irretrievable Commitment of Resources

There would be no irreversible and irretrievable commitments of soil resources provided that all transmission line concrete foundations, converter station facilities, and access roads were removed and successful reclamation was achieved as part of decommissioning the Project.

3.6.2.6.7 Relationship between Local Short-term Uses and Long-Term Productivity

Overall site productivity is primarily a matter of revegetation/reclamation success and availability for agricultural or other uses. Impacts to short-term uses of soil resources would result from construction and operations and maintenance of the Project, while impacts to long-term productivity would depend on the success of the reclamation activities. Short-term impacts are associated with land areas directly affected by construction and operations and maintenance of the Project. Short-term impacts include the construction and use of access roads during the construction phase of the Project and the use of access roads for operations and maintenance. Other short-term impacts to soil resources could occur at the footprint areas of construction work areas, converter station sites, transmission line structures, fiber optic sites, and construction tensioning and pulling areas. These areas could all be returned to other productive uses following decommissioning. A decrease in the long-term productivity of soils would result if soils were not reclaimed to their existing quality condition including such characteristics as aeration, permeability, texture, salinity and alkalinity, microbial populations, fertility, and other physical and chemical characteristics that are accepted as beneficial to overall plant growth and establishment.

3.6.2.6.8 Impacts from Connected Actions

3.6.2.6.8.1 Wind Energy Generation

3.6.2.6.8.1.1 Construction Impacts

The potential impacts to soils common to all Project components (Section 3.6.2.6.1.1) apply to similar activities during wind energy generation. Specific locations of wind generation facilities are not known at this time and therefore specific impacts to designated farmland, soil limitation parameters, or contaminated soil cannot be determined. Based on the general characteristics of the WDZs, some affected soils may be susceptible to compaction or have moderate to high wind erosion potential. The remaining soil limitation characteristics are not prominent in the WDZs.

Most of the EPA FRS sites located in WDZs are indicative of a records inventory of such regulated sites and do not raise a concern at this time in regards to areas of soil contamination. If wind development is considered in feedlot discharge areas, areas of potential leaking storage tanks, or other potential contaminant release areas, the developers may collect additional information to avoid potential soil contamination.

3.6.2.6.8.1.2 Operations and Maintenance

Permanent wind farm facilities that would impact soils include turbine footprint areas, collector lines, substations, meteorological towers, operation and maintenance buildings, and access roads for the maintenance and operation of these facilities. A conservative estimate is that this infrastructure would impact 1 percent of each WDZ-where wind energy generation occurs. Permanent facilities would typically be maintained for proper drainage and vegetation specifications and would not contribute to soil erosion hazards. Placement of these facilities in areas of steep slopes would typically be avoided or minimized to prevent erosion or other hazards.

Permanent impacts to designated farmland during operations and maintenance would include conversion of the operations and maintenance facility, wind turbine, substation, and access roads to these facilities. Temporary construction areas would be reclaimed for potential farmland use. Designated farmland could continue to be used in areas above underground lines and surrounding these facilities and structures. Agricultural activities such as cultivating crops and livestock grazing are generally permitted up to the wind turbine pads, so only a very minimal area of existing agricultural land would be removed from production for the life of the Project, although long-term access roads and the configuration of wind turbines may change the configuration of fields for crops and grazing.

Operation and maintenance activities have the potential to result in the release of fuels, oil, hydraulic fluid, and other potential contaminants to area soils. Such releases would be most likely to occur at wind turbines, substations, and the operations and maintenance facilities. Operations practices generally include measures to avoid releases of contaminant materials. However, in the event of such releases, immediate actions would be generally implemented to contain and clean up such materials. Adsorbent and containment materials would be generally stored in appropriate areas and workers would likely be trained for such events.

3.6.2.6.8.1.3 Decommissioning Impacts

Wind farm decommissioning could occur at the end of the useful life of the facilities and if the facilities were no longer required. Decommissioning of the WDZs could result in temporary impacts to soil resources, similar to those for construction (e.g., increased sedimentation, erosion, soil compaction, limited direct removal of vegetation, and accidental spills of chemicals). Impacts related to soil disturbance during decommissioning are anticipated to be similar to construction but would be temporary. Impacts to soils would be associated with the removal of wind farm infrastructure, temporary storage of waste and demolition debris, temporary access roads for such removal, and any related clearing and grading that might be necessary. Similar EPMs and BMPs that would be implemented during decommissioning activities for the Project would typically be implemented for the wind generation facilities to avoid and minimize impacts to soil resources.

3.6.2.6.8.2 Optima Substation

Potential impacts to designated farmland may occur, including potential conversion to utility uses. Construction activities may result in soil compaction and erosion given the susceptibility of existing soils. Implementation of a SWPPP would reduce the likelihood for soil erosion.

3.6.2.6.8.3 TVA Upgrades

General impacts from the construction of the new 500kV transmission line would be similar to those described for the Project. Depending on the locations of the required TVA upgrades, ground-disturbing activities could result in decreased productivity and quality of designated farmland and in places of permanent structures some farmland could be taken out of production. Site-specific soil characteristics would determine the potential for erosion impacts to erosion-prone or steep soils or potential compaction impacts from construction vehicles and equipment to soils with high compaction potential. The upgrades to existing transmission lines and the new transmission line, like the Project, are linear (long, narrow) projects with relatively small amounts of ground disturbance considering the amount of area crossed.

3.6.2.6.9 Impacts Associated with the No Action Alternative

Under the No Action Alternative, DOE assumes for analytical purposes that the Project would not be constructed and soils would not be impacted. The land would continue to be used for existing agricultural and other uses.

Contents

Tables

Figures Presented in Appendix A

3.7 Groundwater

3.7.1 Regulatory Background

Laws and regulations associated with the management and protection of groundwater could affect the Project or the manner in which it would be implemented. Key elements of select federal and state laws and regulations associated with groundwater management are summarized in Table 3.7-1.

Table 3.7-1:
Federal and State Laws and Regulations Associated with Groundwater Management

Statute/Regulation	Key Elements
Safe Drinking Water Act (42 USC § 300f *et seq.*)	Establishes measures to protect the quality of public water supplies and sources of drinking water Requires states to develop Wellhead Protection Programs to protect public water supply wells
Oklahoma	
Oklahoma Administrative Code 785:30, "Taking and Use of Groundwater"	Requires a permit for use of groundwater for any purpose other than domestic use
Oklahoma Administrative Code 785:45, "Oklahoma's Water Quality Standards"	Establishes groundwater protection measures through groundwater classification, beneficial use designations, and vulnerability level designations Specifies that no groundwater degradation will be allowed that will interfere with attainment or maintenance of an existing or designated beneficial use
Oklahoma Administrative Code 785:46, "Implementation of Oklahoma's Water Quality Standards"	Ensures compliance with the anti-degradation standard by limiting permitted groundwater withdrawals to the maximum annual yield and avoiding withdrawals that would cause contaminated groundwater or surface water to move into groundwater not already contaminated
Arkansas	
Arkansas Act 1051 of 1985	Requires non-domestic users of groundwater or a natural spring involving potential flow rates of more than 50,000 gallons per day to report withdrawals to the Arkansas Natural Resources Commission (ANRC) (pre-use notification is not required)
Arkansas Act 154 of 1991	Requires the ARNC to define critical groundwater areas, sustainable yield, and groundwater level trends and gives ANRC authority to regulate groundwater use in designated critical groundwater areas (such regulations have not yet been proposed)
Arkansas Act 472 of 1949	Establishes authority for development and implementation of groundwater quality standards, which are currently being drafted by the ANRC
Tennessee	
Chapter 0400-40-03, General Water Quality Criteria	Establishes groundwater classifications and quality criteria Describes TDEC authority to require remediation when a release or other event causes groundwater to not meet applicable quality criteria Requires landowner or prospective purchaser of property to notify TDEC if groundwater testing shows contamination in excess of applicable groundwater quality criteria
Chapter 0400-45-08, Water Registration Requirements	Requires users withdrawing water from either a surface or groundwater source at an average rate of 10,000 gallons or more per day to be pre-registered with the TDEC (agricultural, emergency and certain non-recurring withdrawals are exempt) Purchase of water from a utility is not considered withdrawal
Texas	
Texas Administrative Code 30-293.19 and 30-294.41–294.44	Sets procedures for the designation of Priority Groundwater Management Areas and issues related to creation of Groundwater Conservation Districts in designated management areas

3.7.2 Data Sources

Data were obtained from multiple publicly available sources. Because of the length of the area being evaluated as part of the Project, the analysis relies strongly on GIS datasets (GIS Data Sources: EPA 2011; ODEQ 2012; OWRB 2014, 2011a; AWWCC 2014; TWDB 2013; Clean Line 2013b, 2013c; USGS 2014a, 2004a) to develop a picture of resources within the ROI. GIS datasets were obtained primarily from federal and state programs. For example, the USGS National Hydrography Dataset was used as part of the effort to characterize the affected environment. Databases kept by state agencies were also used to search for specific groundwater-related information such as locations of leaking underground storage tanks. Representatives of state agencies were contacted in some cases and information was obtained via conversations or electronic correspondence. Much of the information presented in this section was obtained from state webpages.

Water use information presented in this section is from the USGS and is for the year of 2010. The USGS compiles water use data every 5 years and since the Draft EIS, the USGS data for 2010 were published and are presented in this Final EIS.

3.7.3 Region of Influence

3.7.3.1 Region of Influence for the Project

The ROI considered in the groundwater affected environment and subsequent evaluation of potential impacts varied by Project component and by specific environmental evaluations. The baseline ROIs for the Project are as presented in Section 3.1.1. When considering wells and well systems for the groundwater evaluation, the 1,000-foot-wide corridor ROI for transmission lines was increased by 150 feet on both sides to account for possible adverse effects of blasting, should it be required, within the main portions of the ROI. The ROI for the AC collection system, already at 2 miles wide, was not expanded for evaluating wells and well systems. The ROIs for groundwater evaluations other than wells and well systems are as described in Section 3.1.1.

3.7.3.2 Region of Influence for Connected Actions

The ROI for the wind energy generation, the future Optima Substation, and TVA upgrades is described in Section 3.1.1 for those actions.

3.7.4 Affected Environment

The affected environment for groundwater, as described separately for each region below, addresses the following elements:

- Principal Aquifers and Their Characteristics: The principal, or important, aquifers over which Project elements would be located are described for each region of the proposed HVDC transmission line route. The discussion of aquifer characteristics includes information, where available, on depths to the water table, groundwater quality, as well as areal extent. No EPA-designated sole-source aquifers occur within the Project ROI (GIS Data Source: EPA 2011).
- Groundwater of Special Interest: The ROI intersects areas where the applicable state has designated the underlying groundwater to be of particular value or concern. The discussion of each region below identifies the specific groundwater designations and the amount of area in which the various Project components overlie designated groundwater.

- Wells and Wellhead Protection Areas: The discussion of each region below identifies the number of public, domestic, agricultural, and industrial water supply wells located within the ROI for the various Project components. Similarly, the discussion identifies the crossing areas for designated wellhead protection areas and the locations of springs (only applicable to Region 4).
- Groundwater Use: The discussion presents water use by county based on 2010 data published by the USGS. As noted in Section 3.7.2, this represents updated information compared to the Draft EIS, which presented USGS data for 2005. The USGS data are presented by use category and note whether the source is groundwater or surface water. To present a complete picture, a county's entire water use is presented together in a single table.

Several route variations for the Applicant Proposed Route in Regions 2 to 7 were developed in response to public comments on the Draft EIS and are described in Appendix M and summarized in Section 2.4.2.1 to 2.4.2.7. Brief descriptions of the groundwater elements that could be affected by the route variations by Project region, including accompanying adjustments to HVDC alternative routes, are provided below. The variations are presented graphically in Exhibit 1 of Appendix M.

3.7.5 Regional Description

Because this EIS considers a linear project that covers a long distance, the area analyzed crosses many groundwater features. Rather than identifying individual features along the more than 700-mile route, the following sections present Regions 1–7 in terms of the compiled area or number of elements (Section 3.7.4) within the ROI. Only the more important or significant groundwater features or feature locations within each region are identified individually. The individual regional discussions identify the important aquifers that underlie that portion of the route. Figure 3.7-1 (located in Appendix A) depicts the locations of the aquifers beneath all seven of the regions.

The regional descriptions in this section also identify groundwater features and elements found within a representative ROW consisting of a 200-foot-wide corridor within the 1,000-foot-wide ROI of the HVDC transmission line routes. This information is used in evaluating potential impacts of the Project in Section 3.7.6. The ROW features and elements are included here in the affected environment in order to provide the reader an easy comparison between features in the ROI and what would be expected in a smaller ROW. Consistent with the ROI discussion of Section 3.7.3, well data for the ROW are based on a 500-foot-wide corridor (i.e., 150 feet added to each side of the 200-foot-wide ROW) to incorporate wells or well systems that potentially could be impacted if blasting were done in the ROW.

3.7.5.1 Region 1

No route variations were proposed in Region 1.

3.7.5.1.1 Region 1 Principal Aquifers and Their Characteristics

Much of Region 1 overlies the High Plains aquifer, one of five principal aquifers or aquifer systems along the ROI. The High Plains aquifer underlies a large area that includes parts of Texas, Colorado, Kansas, Nebraska, New Mexico, South Dakota, and Wyoming as well as western Oklahoma (GIS Data Sources: OWRB 2011a; USGS 2003). The aquifer, often referred to as the Ogallala Aquifer, consists of poorly consolidated layers of sand, silt, clay, and gravel with intermittent well-cemented zones of the Ogallala Formation (OWRB 2012). As shown in Figure 3.7-1 in Appendix A, the High Plains aquifer underlies the AC collection system routes as well as the Oklahoma Converter Station Siting Area. The eastern end of Region 1 is outside the general bounds of the High Plains aquifer. At its eastern end, Region 1 overlies an alluvial aquifer associated with the Beaver or North Canadian River. This aquifer is considered a major alluvial aquifer by the state (GIS Data Source: OWRB 2011a). As indicated by its name, the North Canadian River alluvial aquifer follows the path of the North Canadian River, which in this area is roughly from the northwest to the southeast.

In Oklahoma, the depth below ground surface (BGS) to the water table of the High Plains aquifer ranges from less than 10 feet to greater than 300 feet and the thickness of the saturated zone can range from nearly zero to almost 430 feet. Wells tapping into the High Plains aquifer commonly yield 500 to 1,000 gallons per minute and, in thick highly permeable areas, can yield up to 2,000 gallons per minute. Pumping rates throughout the aquifer, however, have typically exceeded recharge rates and declining groundwater levels have been common (OWRB 2012).

3.7.5.1.1.1 Aquifer Annual Yield

The maximum annual yield of an aquifer is the maximum amount of water that can be removed from a groundwater basin on an annual basis without degrading the groundwater resource. In Oklahoma, the concept of maximum annual yield carries the stipulation that the amount of groundwater removed must allow a minimum 20-year life for the basin. The state estimates the maximum annual yield of the portion of the High Plains aquifer that underlies the Oklahoma Panhandle at about 2.29 million acre-feet (OWRB 2014), which equates to an average daily removal rate of just over 2,000 million gallons per day. When a maximum annual yield value is established and approved by the Oklahoma Water Resources Board, the state then distributes that yield across the groundwater basin to determine an equal proportionate share on a per-acre basis for overlying landowners. Within the Oklahoma Panhandle, the equal proportionate share for the High Plains aquifer is set at 2 acre-feet of water per year per acre of land (OWRB 2014) or an average daily removal rate of about 1,790 gallons per acre.

With regard to the North Canadian River alluvial aquifer, the state has determined a maximum annual yield of 426,000 acre-feet for the section of the aquifer that extends roughly from the western border of Harper County, through Woodward County, and to the southern border of Major County (OWRB 2014). The eastern end of Region 1 overlies a small portion of the alluvial aquifer in Harper County. This annual yield equates to a removal rate of about 380 million gallons per day. The equal proportionate share for this section of the alluvial aquifer is set at 1 acre-foot of water per year per acre of land (OWRB 2014) or an average daily removal rate of about 890 gallons per acre.

3.7.5.1.1.2 Depths to Water Table

The USGS National Water Information System contains groundwater level information for most of the nation, including each of the four Oklahoma counties that are included within Region 1. To ensure the data were reflective of current groundwater levels, DOE first queried the USGS data system for information collected since the start of 2012. If no recent county data were available, as was the case for some counties along the transmission line routes, the query criteria were modified to include entries back through 2005. Based on water level measurements taken since the start of 2012, the water table in Texas County is typically about 94 to 370 feet BGS, and in Beaver County it ranges from 15 to 240 feet BGS. The water table in Harper and Woodward counties can be shallower, ranging from 3 to 170 feet BGS (USGS 2014a).

According to recent (since 2012) data in the USGS data system, the five counties in which the AC collection system routes could be located (i.e., Beaver and Texas counties in Oklahoma and Sherman, Hansford, and Ochiltree counties in Texas) have depths to groundwater that range from 15 to 479 feet, with only Beaver County including a few wells with water table depths less than 30 feet (USGS 2014a). But even in Beaver County, the average depth to groundwater for the reporting locations is greater than 100 feet and the averages in the other four counties are all greater than 200 feet.

3.7.5.1.1.3 Groundwater Quality

Groundwater quality of the High Plains aquifer in Oklahoma is considered generally good, although localized areas contain high nitrate levels (OWRB 2012). In general, water in the aquifer south of the Canadian River (roughly 40 to 50 miles south of the Region 1 area of the Oklahoma Panhandle) begins having diminishing water quality in terms of increasing concentrations of total dissolved solids. North of the river, total dissolved solids concentrations are typically less than 400 milligrams per liter; the National Secondary Drinking Water Regulations (40 CFR Part 143, for aesthetic qualities) standard is 500 milligrams per liter. South of the river, large areas have concentrations more than twice the standard (George et al. 2011).

3.7.5.1.2 Region 1 Groundwater of Special Interest

Within Oklahoma, groundwater of special interest that could be crossed by the HVDC transmission line routes or underlie other Project components includes groundwater areas designated by the state as a Class I Special Source Groundwater or a Nutrient Vulnerable Groundwater. Class I groundwaters are areas with exceptional water quality, an irreplaceable source of water, a need to maintain an outstanding resource, or ecologically important groundwater. Class I groundwaters are also considered to be very vulnerable to contamination. Oklahoma further divides Class I into Subclass A for groundwater underneath watersheds of “Scenic Rivers,” Subclass B for groundwater underneath lands designated by regulation (specifically, Appendix B of Oklahoma Administrative Code (OAC) 785-45), and Subclass C for groundwater underneath state approved wellhead or source water protection areas (OAC 785-45-7-3). This section’s discussion is limited to Subclass A and B groundwater; wellhead protection areas are discussed in Section 3.7.5.1.3. Oklahoma also classifies groundwater areas with Class II, III, or IV designations, which are not considered to be of special interest for the current discussion because Class II is for general use groundwater, and Classes III and IV are for groundwater that is naturally of poor quality.

“Nutrient-vulnerable groundwater” is a designation Oklahoma gives to certain hydrogeologic basins considered to have a high or very high vulnerability to contamination from surface sources of pollution. The groundwater basins for the North Canadian, Cimarron, and Arkansas rivers in the ROI in Oklahoma have been designated Nutrient Vulnerable.

No Class I groundwater occurs in Region 1, although several thousand acres of land overlying nutrient-vulnerable groundwater do occur as shown Table 3.7-2. Also shown in parentheses in Table 3.7-2 are reduced areas of land in the 200-foot-wide corridor of the representative ROW that overlie groundwater of special interest.

Table 3.7-2:
Land Area in the 1,000-Foot-Wide Corridor (and the 200-Foot-Wide Representative ROW) of the HVDC Transmission Line Routes Overlying Groundwater of Special Interest—Region 1

Route—Proposed and Alternatives[1, 2]	Link 1	Link 2	Link 3	Link 4	Link 5	Total
Land Area Over Oklahoma Class 1 Special Source Groundwater—No groundwater of Class 1, Subclass A or B is within Region 1.						
Land Area Over Oklahoma Nutrient Vulnerable Groundwater						
APR (acres)	0	475 (96)	0	6 (0)	2,367 (474)	2,848 (570)
With AR 1-A (acres)	0	4,426 (884)				4,426 (884)
With AR 1-B (acres)	0	498 (101)		6 (0)	2,367 (474)	2,871 (575)

Table 3.7-2:
Land Area in the 1,000-Foot-Wide Corridor (and the 200-Foot-Wide Representative ROW) of the HVDC Transmission Line Routes Overlying Groundwater of Special Interest—Region 1

Route—Proposed and Alternatives[1, 2]	Link 1	Link 2	Link 3	Link 4	Link 5	Total
With AR 1-C (acres)	0	730 (147)		6 (0)	2,367 (474)	3,103 (621)
With AR 1-D (acres)	0	475 (96)	6 (0)		2,367 (474)	2,848 (570)

1 Each region of the Applicant Proposed Route (APR) is divided into links that lie between points, or nodes, where the APR is intersected by alternative routes (ARs). ARs bypass specific links of the APR as shown in the table.
2 For the ARs, the unshaded portion of the rows provides the data for the length of the AR. The shaded portion of the rows provides the data for the balance of the APR, thereby providing perspective across the region.
GIS Data Sources: OWRB (2011b, 2011c)

Using the same groundwater categories as those described for Table 3.7-2, the acreage of lands within the total 2-mile-wide ROI corridors (and 200-foot-wide representative ROWs) of the AC collection system routes that overlie groundwater of special interest is as follows (routes not shown overlie no groundwater of special interest) (GIS Data Sources: OWRB 2011b, 2011c):

- Land area over Class 1 Special Source Groundwater: 1,003 acres (0 acres) total
  - Route E-1 in Texas and Beaver counties, Oklahoma: 967 acres (0 acres)
  - Route E-2 in Texas and Beaver counties, Oklahoma: 18 acres (0 acres)
  - Route NE-1 in Texas County, Oklahoma: 18 acres (0 acres)
- Land area over Nutrient-Vulnerable Groundwater: 27,093 acres (482 acres) total
  - Route E-1 in Texas and Beaver counties, Oklahoma: 9,893 acres (174 acres)
  - Route E-2 in Texas and Beaver counties, Oklahoma: 5,184 acres (97 acres)
  - Route E-3 in Texas and Beaver counties, Oklahoma: 5,369 acres (100 acres)
  - Route SE-1, the portion in Texas County, Oklahoma: 1,463 acres (14 acres)
  - Route SE-3, the portion in Texas and Beaver counties, Oklahoma: 5,184 acres (97 acres)

The above numbers for nutrient-vulnerable groundwater within the ROIs are large in comparison to the values shown in Table 3.7-2 for the HVDC transmission line route, primarily because of the wider ROI (2 miles) associated with the AC collection system routes. No groundwater areas of special interest underlie the AC collection system routes in Texas (TCEQ 2013), which include all or parts of AC Collection System Route SW-2 in Sherman and Hansford counties, AC Collection System Route SW-1 in Hansford County, AC Collection System Route SE-2 in Hansford County, AC Collection System Route SE-1 in Hansford and Ochiltree counties, and AC Collection System Route SE-3 in Ochiltree County.

No groundwaters of special interest are underneath the Oklahoma Converter Station Siting Area or the associated AC interconnection (GIS Data Sources: OWRB 2011b, 2011c).

3.7.5.1.3 Region 1 Wells and Wellhead Protection Areas

Because water supply wells or well systems could potentially be impacted by the Project, the affected environment for each region includes consideration of private or public water supply wells and agricultural and industrial water wells located in the ROI. The description of the affected environment also addresses areas that have been designated by the applicable state as wellhead protection areas. Oklahoma identifies three somewhat concentric zones within wellhead protection areas: a 300-foot fixed radius, a 2-year groundwater travel time boundary, and a 10-year groundwater travel time boundary. To be reasonably conservative, data analyzed for the EIS represent the total area within the boundary of the outermost zones.

Table 3.7-3 summarizes the number of private, public, agricultural, and industrial water supply wells in the Region 1 expanded ROIs (and 200-foot-wide representative ROWs plus 150-foot buffers). The table also provides the wellhead protection areas in the baseline ROIs (and 200-foot-wide representative ROWs). There are private, domestic water supply wells along the HVDC transmission line routes, but there are no public water supply wells within Region 1. The ROI for HVDC Alternative Routes 1-B and 1-C cross wellhead protection areas.

Table 3.7-3:
Water Supply Wells and Wellhead Protection Areas within the HVDC Transmission Line Routes—Region 1

Route—Proposed and Alternatives[1, 2]	Link 1	Link 2	Link 3	Link 4	Link 5	Total
Private (Domestic) Water Supply Wells within a 1,300-Foot-Wide Corridor (and 500-Foot-Wide Corridor)						
APR	0	4 (2)	0	1 (0)	2 (0)	7 (2)
With AR 1-A	0	13 (3)				13 (3)
With AR 1-B	0	4 (2)		1 (0)	2 (0)	7 (2)
With AR 1-C	0	4 (1)		1 (0)	2 (0)	7 (1)
With AR 1-D	0	4 (2)	4 (2)		2 (0)	10 (4)
Public Water Supply Wells within a 1,300-Foot-Wide Corridor—No public water supply wells are within Region 1.						
Agricultural Water Wells within a 1,300-Foot-Wide Corridor (and 500-Foot-Wide Corridor)						
APR	1 (0)	6 (5)	0	3 (1)	2 (2)	12 (8)
With AR 1-A	1 (0)	5 (1)				6 (1)
With AR 1-B	1 (0)	2 (1)		3 (1)	2 (2)	8 (4)
With AR 1-C	1 (0)	3 (1)		3 (1)	2 (2)	9 (4)
With AR 1-D	1 (0)	6 (5)	4 (3)		2 (2)	13 (10)
Industrial Water Wells within a 1,300-Foot-Wide Corridor (and 500-Foot-Wide Corridor)						
APR	1 (1)	8 (2)	0	2 (0)	0	11 (3)
With AR 1-A	1 (1)	13 (4)				14 (5)
With AR 1-B	1 (1)	6 (2)		2 (0)	0	9 (3)
With AR 1-C	1 (1)	4 (1)		2 (0)	0	7 (2)
With AR 1-D	1 (1)	8 (2)	7 (4)		0	16 (7)
Wellhead Protection Areas within a 1,000-foot-wide Corridor (and 200-foot-wide ROW)						
APR (acres)	0	0	0	0	0	0
With AR 1-A (acres)	0	0				0
With AR 1-B (acres)	0	7.2 (0)		0	0	7.2 (0)
With AR 1-C (acres)	0	7.2 (0)		0	0	7.2 (0)
With AR 1-D (acres)	0	0	0		0	0

1 Each region of the Applicant Proposed Route (APR) is divided into links that lie between points, or nodes, where the APR is intersected by alternative routes (ARs). ARs bypass specific links of the APR as shown in the table.
2 For the ARs, the unshaded portion of the rows provides the data for the length of the AR. The shaded portion of the rows provides the data for the balance of the APR, thereby providing perspective across the region.
GIS Data Sources: Source: ODEQ (2012), OWRB (2014)

The AC collection system routes contain the wells and wellhead protection areas shown in Table 3.7-4.

Table 3.7-4:
Water Wells within 2-Mile-Wide (and 500-Foot-Wide) Corridors and Wellhead Protection Areas within 2-Mile-Wide Corridor (and 200-Foot-Wide Representative ROWs) of the AC Collection System Routes

AC Route Designation	Number of Wells by Use Category				Total Number of Wells	Wellhead Protection Area(Acreage)
	Domestic Water Supply	Public Water Supply	Agricultural	Industrial		
E-1	15 (0)	1 (0)	23 (0)	27 (2)	66 (2)	219 (0)
E-2	21 (2)	0	56 (5)	34 (1)	111 (8)	0
E-3	21 (0)	0	39 (4)	40 (4)	100 (8)	18 (0)
NE-1	25 (0)	0	124 (4)	27 (1)	176 (5)	18 (0)
NE-2	17 (2)	0	56 (2)	14 (2)	87 (6)	0
NW-1	25 (0)	0	35 (1)	28 (2)	88 (3)	0
NW-2	29 (1)	1 (0)	175 (7)	31 (0)	236 (8)	0
SE-1	10 (1)	0	52 (3)	16 (1)	78 (5)	0
SE-2	1 (0)	0	16 (0)	5 (0)	22 (0)	0
SE-3	18 (1)	0	49 (6)	20 (1)	87 (8)	0
SW-1	1 (0)	0	9 (0)	5 (0)	15 (0)	0
SW-2	10 (0)	0	15 (0)	13 (0)	38 (0)	0
W-1	18 (3)	0	38 (4)	19 (0)	75 (7)	0
Totals	211 (10)	2 (0)	687 (36)	279 (14)	1,179 (60)	255 (0)

Source: GIS Data Sources: ODEQ (2012), OWRB (2011a)

Again, the great number of wells and, to a lesser extent, the acreage of wellhead protection area are attributed to the much greater ROI width (2 miles) associated with the AC collection system routes.

No wells or wellhead protection areas are associated with the Oklahoma Converter Station Siting Area and one industrial well is located within the ROW of the AC interconnection.

3.7.5.1.4 Region 1 Groundwater Use

Groundwater and surface water uses in the counties crossed by the Region 1 ROI are summarized in Table 3.7-5. The average use of groundwater in the four-county area of Beaver, Harper, Texas, and Woodward counties in Oklahoma was about 372 million gallons per day in 2010 and the greatest share of that use, at about 62 percent, was attributed to irrigation. Mining, public water supplies, and livestock were the other notable use categories for groundwater in the four-county area. The use of 372 million gallons of groundwater per day is compared to the use of only 5.1 million gallons per day of surface water. Groundwater accounts for about 99 percent of area's total water usage, and all of the area's public water supplies consist of water from groundwater sources. This use is consistent with the characterization of the area being one where intermittent streams are much more frequently encountered than are perennial streams (Section 3.15.5.1).

Table 3.7-5:
Average 2010 Water Use by Water Source and Category in Region 1 Counties (in million gallons per day)

County Source	Public Water Supply	Domestic Self-Supplied	Industrial Self-Supplied	Irrigation	Live-stock	Aqua-culture	Mining	Thermo-electric	Totals
Groundwater Sources									
Beaver, OK	0.49	0.23	0	24.60	2.54	0	14.07	0	41.93
Harper, OK	0.94	0.07	0	2.30	1.29	0	0.33	0	7.93
Texas, OK	7.46	0.19	0.02	198.00	8.74	0	87.13	0	301.54
Woodward, OK	6.63	0.35	0.40	5.50	1.98	0	8.02	1.02	23.90
Subtotals	15.52	0.84	0.42	230.40	14.55	0	109.55[1]	1.02	372.30
Surface Water Sources									
Beaver, OK	0	0	0	0.10	0	0	0	0	0.10
Harper, OK	0	0	0	4.02	0	0	0	0	4.02
Texas, OK	0	0	0	0.40	0	0	0	0	0.40
Woodward, OK	0	0	0	0.54	0	0	0	0	0.54
Subtotals	0	0	0	5.06	0	0	0	0	5.06
Totals	15.52	0.84	0.42	235.46	14.55	0	109.55	1.02	377.36

1 Of the 109.55 million gallons per day, 109.02 million gallons are identified as coming from saline groundwater sources, compared to only 9.27 million gallons per day coming from saline groundwater sources and used for mining in 2005.

Source: USGS (2014b)

Table 3.7-6 summarizes the average 2010 water use in the five-county area of Beaver and Texas counties in Oklahoma, and Hansford, Ochiltree, and Sherman counties in Texas that encompass the AC collection system routes. The predominant use of groundwater in the five-county area is even more apparent than for the four-county area described above. In the five-county area, surface water use at about 2.0 million gallons per day is less than 0.3 percent of the area’s total water use of 736 million gallons per day. Of the 734 million gallons per day of groundwater used in the area, irrigation is by far the predominant use category. Irrigation is followed by the use categories of mining, livestock, and public water supplies.

Table 3.7-6:
Average 2010 Water Use by Water Source and Category in the Counties of the AC Collection System Routes (in million gallons per day)

County Source	Public Water Supply	Domestic Self-Supplied	Industrial Self-Supplied	Irrigation	Live-stock	Aqua-culture	Mining	Thermo-electric	Totals
Groundwater Sources									
Beaver, OK	0.49	0.23	0	24.60	2.54	0	14.07	0	41.93
Texas, OK	7.46	0.19	0.02	198.00	8.74	0	87.13	0	301.54
Hansford, TX	0.87	0.10	0	114.68	2.35	0	0.39	0	118.39
Ochiltree, TX	1.81	0.23	0	54.00	1.16	0	1.13	0	58.33
Sherman, TX	0.48	0.08	0	211.25	1.74	0	0.16	0	213.71
Subtotals	11.11	0.83	0.02	602.53	16.53	0	102.88[1]	0	733.90

Table 3.7-6:
Average 2010 Water Use by Water Source and Category in the Counties of the AC Collection System Routes (in million gallons per day)

County Source	Public Water Supply	Domestic Self-Supplied	Industrial Self-Supplied	Irrigation	Live-stock	Aqua-culture	Mining	Thermo-electric	Totals
Surface Water Sources									
Beaver, OK	0	0	0	0.10	0	0	0	0	0.10
Texas, OK	0	0	0	0.40	0	0	0	0	0.40
Hansford, TX	0	0	0	0.15	1.01	0	0.02	0	1.18
Ochiltree, TX	0	0	0	0	0.13	0	0.03	0	0.16
Sherman, TX	0	0	0	0	0.19	0	0	0	0.19
Subtotals	0	0	0	0.65	1.33	0	0.05	0	2.03
Totals	11.11	0.83	0.02	603.18	17.86	0	102.93	0	735.93

1 Of the 102.88 million gallons per day, 102.23 million gallons is identified as coming from saline groundwater sources, compared to only 8.96 million gallons per day coming from saline groundwater sources and used for mining in 2005.

Source: USGS (2014b)

3.7.5.2 Region 2

Two route variations to the Applicant Proposed Route were developed in Region 2 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.2. The variations (Applicant Proposed Route Link 1, Variation 1, and Applicant Proposed Route Link 2, Variation 2) are illustrated in Exhibit 1 of Appendix M. The discussion of Region 2 groundwater elements that follows includes identification of differences, if any, that would be expected with the route variations as compared to the original Applicant Proposed Route.

3.7.5.2.1 Region 2 Principal Aquifers and Their Characteristics

As shown in Figure 3.7-1 in Appendix A, no principal aquifers are present under Region 2, but the region does include two alluvial aquifers as well as an area of “other rocks,” which designates areas where there are only minor aquifers or no delineated aquifers. The western half of Region 2 overlies the North Canadian River alluvial aquifer that follows the Beaver/North Canadian River as mentioned in Section 3.7.5.1.1. This aquifer is considered a major alluvial aquifer by the state. Further to the east, Region 2 crosses over the Cimarron River alluvial aquifer that follows the Cimarron River, which the state also considers a major alluvial aquifer. The state identifies several minor alluvial and bedrock aquifers in between the two major alluvial aquifers and to the east of the Cimarron River alluvial aquifer that are crossed by the eastern half of Region 2 (GIS Data Source: OWRB 2011a). Neither of the two route variations to the Applicant Proposed Route developed in Region 2 would change the aquifers that would be crossed.

3.7.5.2.1.1 Aquifer Annual Yield

Oklahoma has determined a maximum annual yield of 426,000 acre-feet for the section of the North Canadian alluvial aquifer that extends roughly from the western border of Harper County, through Woodward County, and to the southern border of Major County (OWRB 2014). This annual yield equates to a removal rate of about 380 million gallons per day. Based on this yield, the state developed an equal proportionate share for area landowners of 1 acre-foot of water per year per acre of land or an average daily removal rate of about 890 gallons per acre.

The state has not finalized a maximum annual yield for the Cimarron River alluvial aquifer (OWRB 2014a), but has assigned a temporary equal proportionate share for area landowners of 2 acre-feet of water per year per acre of land (OWRB 2013a) or an average daily removal rate of about 1,790 gallons per acre.

3.7.5.2.1.2 Depths to Water Table

In the Oklahoma counties that contain Region 2, the USGS National Water Information System data collected in 2012 or later show the water table ranges from 3 to 170 feet BGS in Woodward County and ranges from 7 to 78 feet BGS in Major County. The USGS data system contained no recent (2012 or earlier) information for Garfield County, but searching the data back to 2005 shows water table depths in the county ranging from 4 to 41 feet below the surface (USGS 2014a).

3.7.5.2.1.3 Groundwater Quality

Water in Oklahoma's alluvial aquifers is generally of good quality, but in some western areas has high concentrations for chloride and sulfate and these aquifers are vulnerable to contamination from surface activities (OWRB 2012).

3.7.5.2.2 Region 2 Groundwater of Special Interest

Table 3.7-7 summarizes the acreage of land overlying groundwater of special interest in Region 2. No Class I groundwater areas occur within Region 2, but nutrient-vulnerable groundwater areas are present. Also shown in parentheses in Table 3.7-7 are the smaller land areas within the 200-foot-wide corridor of the representative ROW that overlie groundwater of special interest.

Table 3.7-7:
Land Area in the 1,000-Foot-Wide Corridor (and the 200-Foot-Wide Representative ROW) of the HVDC Transmission Line Routes Overlying Groundwater of Special Interest—Region 2

Route—Proposed and Alternatives[1, 2, 3]	Link 1	Link 2	Link 3	Region 2 Total
Land Area Over Oklahoma Class 1 Special Source Groundwater—No groundwater of Class 1, Subclass A or B is within Region 2				
Land Area Over Oklahoma Nutrient Vulnerable Groundwater				
APR (acres)	2,485 (494)	3,962 (780)	1,797 (361)	8,244 (1,635)
With AR 2-A (acres)	2,485 (494)	4,316 (861)	1,797 (361)	8,598 (1,716)
With AR 2-B (acres)	2,485 (494)	3,962 (780)	1,024 (206)	7,471 (1,480)

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
2 Each region of the Applicant Proposed Route (APR) is divided into links that lie between points, or nodes, where the APR is intersected by alternative routes (ARs). ARs bypass specific links of the APR as shown in the table.
3 For the ARs, the unshaded portion of the rows provides the data for the length of the AR. The shaded portion of the rows provides the data for the balance of the APR, thereby providing perspective across the region.
GIS Data Source: OWRB (2011c)

The two variations to the Applicant Proposed Route in Region 2 would involve very minor changes in the amount of nutrient-vulnerable groundwater area that would be crossed by the original Applicant Proposed Route. Link 1, Variation 1, would increase the area crossed by the 200-foot-wide ROW by about 1.5 acres, and Link 2, Variation 2, would decrease the area crossed by less than 1 acre.

3.7.5.2.3 Region 2 Wells and Wellhead Protection Areas

Table 3.7-8 summarizes the number of private (domestic), public, agricultural, and industrial water supply wells in the Region 2 expanded ROIs and expanded representative ROWs (with 150-foot buffers added to each side). The table also provides the wellhead protection areas in the baseline ROIs (and 200-foot-wide ROWs). Public water supply wells are only found in the ROI of HVDC Alternative Route 2-A.

Table 3.7-8:
Water Supply Wells and Wellhead Protection Areas within the HVDC Transmission Line Routes—Region 2

Route—Proposed and Alternatives[1, 2, 3]	Link 1	Link 2	Link 3	Region 2 Total
Private (Domestic) Water Supply Wells within a 1,300-Foot-Wide Corridor (and 500-Foot-Wide Corridor)				
APR	1 (1)	7 (1)	2 (0)	10 (2)
With AR 2-A	1 (1)	8 (2)	2 (0)	11 (3)
With AR 2-B	1 (1)	7 (1)	1 (1)	9 (3)
Public Water Supply Wells within a 1,300-Foot-Wide Corridor (and 500-Foot-Wide Corridor)				
APR	0	0	0	0
With AR 2-A	0	10 (2)	0	10 (2)
With AR 2-B	0	0	0	0
Agricultural Water Wells within a 1,300-Foot-Wide Corridor (and 500-Foot-Wide Corridor)				
APR	0	3 (2)	4 (3)	7 (5)
With AR 2-A	0	3 (0)	4 (3)	7 (3)
With AR 2-B	0	3 (2)	3 (1)	6 (3)
Industrial Water Wells within a 1,300-Foot-Wide Corridor (and 500-Foot-Wide Corridor)				
Applicant Proposed Route	3 (1)	2 (1)	1 (1)	6 (3)
With AR 2-A	3 (1)	2 (1)	1 (1)	6 (3)
With AR 2-B	3 (1)	2 (1)	0	5 (2)
Wellhead Protection Areas within a 1,000-foot-wide Corridor (and 200-foot-wide ROW)				
APR (acres)	0	0	34 (7)	34 (7)
With AR 2-A (acres)	0	116 (21)	34 (7)	150 (28)
With AR 2-B (acres)	0	0	0	0

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
2 Each region of the Applicant Proposed Route (APR) is divided into links that lie between points, or nodes, where the APR is intersected by alternative routes (ARs). ARs bypass specific links of the APR as shown in the table.
3 For the ARs, the unshaded portion of the rows provides the data for the length of the AR. The shaded portion of the rows provides the data for the balance of the APR, thereby providing perspective across the region.
GIS Data Sources: ODEQ (2012) OWRB (2014)

The two variations to the Applicant Proposed Route in Region 2 would involve a minimal change to the number of wells within the 500-foot-wide corridor of the end-to-end route—at most by one well. Neither of the Region 2 route variations involve wellhead protection area.

3.7.5.2.4 Region 2 Groundwater Use

Groundwater and surface water uses in the ROI in Region 2 are summarized in Table 3.7-9. The average use of groundwater in the three-county area of Garfield, Major, and Woodward counties in Oklahoma was about 49 million gallons per day in 2010, and the largest use category was public water supplies. Irrigation, mining, and livestock were the other notable uses of groundwater in the area. The amount of surface water used in the three-county area was much less at only about 2.6 million gallons per day. Groundwater accounts for about 95 percent of area's total water usage, and all of the area's public water supplies are taken from groundwater sources.

Table 3.7-9:
Average 2010 Water Use by Water Source and Category in Region 2 Counties (in million gallons per day)

County Source	Public Water Supply	Domestic Self-Supplied	Industrial Self-Supplied	Irrigation	Live-stock	Aqua-culture	Mining	Thermo-electric	Totals
Groundwater Sources									
Garfield, OK	4.77	0.13	0	1.10	0.12	0	2.44	0	8.56
Major, OK	6.12	0.18	0	7.60	1.78	0.01	0.83	0	16.52
Woodward, OK	6.63	0.35	0.40	5.50	1.98	0	8.02	1.02	23.90
Subtotals	17.52	0.66	0.40	14.20	3.88	0.01	11.29[1]	1.02	48.98
Surface Water Sources									
Garfield, OK	0	0	0	0.12	1.10	0	0.01	0	1.23
Major, OK	0	0	0	0.54	0	0.25	0.01	0	0.80
Woodward, OK	0	0	0	0.54	0	0	0	0	0.54
Subtotals	0	0	0	1.20	1.10	0.25	0.02	0	2.57
Totals	17.52	0.66	0.40	15.40	4.98	0.26	11.31	1.02	51.55

1 Of the 11.29 million gallons per day, 11.18 million gallons are identified as coming from saline groundwater sources.
Source: USGS (2014b)

3.7.5.3 Region 3

Five route variations to the Applicant Proposed Route were developed in Region 3 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.3. The Applicant Proposed Route variations (Link 1, Variation 2; Links 1 and 2, Variation 1; Link 4, Variation 1; Link 4, Variation 2; and Link 5, Variation 2) are illustrated in Exhibit 1 of Appendix M. It should be noted that a route adjustment was made for HVDC Alternative Route 3-A to maintain an end-to-end route with the Links 1 and 2 variations. The discussion of Region 3 groundwater elements that follows includes identification of differences, if any, that would be expected with the route variations as compared to the original Applicant Proposed Route. The element discussions also address any changes attributed to the adjustment to HVDC Alternative Route 3-A.

3.7.5.3.1 Region 3 Principal Aquifers and Their Characteristics

As shown in Figure 3.7-1 in Appendix A, Region 3 crosses over two principal aquifers. HVDC Alternative Route 3-C passes over a small portion of the Central Oklahoma aquifer and the Applicant Proposed Route crosses the Ada-Vamoosa aquifer (or Vamoosa-Ada aquifer in some references). The Central Oklahoma aquifer underlies about 2,900 square miles, entirely in Oklahoma. The aquifer consists primarily of the Garber Sandstone in the Wellington Formation and is generally designated the Gabner-Wellington aquifer by the state. This bedrock aquifer is overlain in some places by the North Canadian River and Canadian River alluvial aquifers.

The Ada-Vamoosa aquifer underlies about 2,300 miles in east-central Oklahoma and extends northward into Kansas. It consists primarily of layers of fine- to coarse-grained sandstone of the Ada and Vamoosa groups. Its maximum thickness is about 900 feet, and the aquifer is confined at its western extent, but unconfined at its eastern extent, where it is near land surface.

Figure 3.7-1 in Appendix A identifies areas of no principal aquifers with an “other rocks” designation to the west of the Central Oklahoma aquifer, to the east of the Ada-Vamoosa aquifer, and in between the two aquifer areas. The state identifies no major or minor aquifers in these areas; on a state map, they are designated as areas with “no delineated aquifer boundary” (GIS Data Source: OWRB 2011a). The very eastern end of Region 3 may be over the Arkansas River alluvial aquifer, which is considered to be a major alluvial aquifer by the state, but for purposes of this discussion, it is assumed this aquifer starts beneath the western end of Region 4 as discussed in Section 3.7.5.4.1.

Neither the route variations to the Applicant Proposed Route developed in Region 3 nor the adjustment to HVDC Alternative Route 3-A would change the aquifers that would be crossed.

3.7.5.3.1.1 Aquifer Annual Yield

The state has not finalized a maximum annual yield for the Central Oklahoma (or Garber-Wellington) aquifer (OWRB 2014), but has assigned a temporary equal proportionate share for area landowners of 2 acre-feet of water per year per acre of land (OWRB 2013a) or an average daily removal rate of about 1,790 gallons per acre.

The state has determined a maximum annual yield of about 2.97 million acre-feet for the Oklahoma portion of the Ada-Vamoosa aquifer (OWRB 2014), which equates to a removal rate of about 2,650 million gallons per day. Based on this yield, the state developed an equal proportionate share for area landowners of 2 acre-feet of water per year per acre of land, which equates to an average daily removal rate of about 1,790 gallons per acre.

3.7.5.3.1.2 Depths to Water Table

Depth to water in the Central Oklahoma aquifer varies from less than 100 feet to 350 feet BGS (OWRB 2012). For the Ada-Vamoosa aquifer, a 1986 study by the USGS and Oklahoma Geological Survey reported depths in Creek, Lincoln, and Payne counties ranging from 3 to 280 feet BGS (D’Lugosz et al. 1986). Of the eight Oklahoma counties that encompass Region 3, the USGS National Water Information System has very limited data as recent as 2012; in one Creek County well the depth to the water table is 37 feet BGS and in two Lincoln County wells the depth is about 100 feet BGS. Considering data in the USGS system back through 2005, depths to groundwater range from 4 to 41 feet below the ground surface in Garfield County, from 1 to 39 feet in Kingfisher County, from 3 to 140 feet in Logan County, from 12 to 36 feet in Payne County, and 130 to 160 feet in Okmulgee County. Even going back to 2005, there were no data available for Muskogee County (USGS 2014a).

3.7.5.3.1.3 Groundwater Quality

Water quality in the Central Oklahoma aquifer is considered good, but nitrate is reported in some shallow portions of the aquifer and high concentrations of arsenic, chromium, and selenium can be found in some deep parts. Water quality in the Ada-Vamoosa aquifer is also considered good, but iron filtration and hardness are issues in some areas (OWRB 2013a).

3.7.5.3.2 Region 3 Groundwater of Special Interest

Table 3.7-10 summarizes the acreage of land overlying groundwater of special interest in Region 3. No Class I groundwater areas occur within Region 3, but nutrient-vulnerable groundwater areas are present. Also shown in parentheses in Table 3.7-10 are the smaller land areas of the 200-foot-wide ROW corridor that overlie groundwater of special interest.

Table 3.7-10:
Land Area in the 1,000-Foot-Wide Corridor (and the 200-Foot-Wide Representative ROW) of the HVDC Transmission Line Routes Overlying Groundwater of Special Interest—Region 3

Route—Proposed and Alternatives[1, 2, 3]	Link 1	Link 2	Link 3	Link 4	Link 5	Link 6	Region 3 Total
Land Area Over Oklahoma Class 1 Special Source Groundwater—No groundwater of Class 1, Subclass A or B is within Region 3							
Land Area Over Oklahoma Nutrient Vulnerable Groundwater							
APR (acres)	303 (63)	55 (12)	245 (49)	698 (137)	0	0	1,301 (261)
With AR 3-A (acres)	23 (5)	55 (12)	245 (49)	698 (137)	0	0	1,039 (203)
With AR 3-B (acres)	112 (21)			698 (137)	0	0	810 (158)
With AR 3-C (acres)	303 (63)	55 (12)	651 (130)				1,009 (205)
With AR 3-D (acres)	303 (63)	55 (12)	245 (49)	698 (137)	0		1,301 (261)
With AR 3-E (acres)	303 (63)	55 (12)	245 (49)	698 (137)	0	0	1,301 (261)

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
2 Each region of the Applicant Proposed Route (APR) is divided into links that lie between points, or nodes, where the APR is intersected by alternative routes (ARs). ARs bypass specific links of the APR as shown in the table.
3 For the ARs, the unshaded portion of the rows provides the data for the length of the AR. The shaded portion of the rows provides the data for the balance of the APR, thereby providing perspective across the region.
GIS Data Sources: OWRB (2011b, 2011c)

Of the five variations to the Applicant Proposed Route in Region 3, only one variation, Links 1 and 2, Variation 1, would cross over nutrient-vulnerable groundwater area. This variation would increase the area crossed by the 200-foot-wide ROW by about 16 acres. The adjustment to HVDC Alternative Route 3-A would also cross over nutrient-vulnerable groundwater area, but its 200-foot-wide ROW would cross 0.4 acre less than the original HVDC alternative.

3.7.5.3.3 Region 3 Wells and Wellhead Protection Areas

Table 3.7-11 summarizes the number of private, public, agricultural, and industrial water supply wells in the Region 3 expanded ROI and the expanded ROW. The table also provides the wellhead protection areas in the baseline ROIs and 200-foot-wide representative ROWs. There are many private water supply wells in the region, but no public water supply wells or industrial wells and few agricultural wells. There are also only limited wellhead protection areas in the region.

Table 3.7-11:
Water Supply Wells and Wellhead Protection Areas of the HVDC Transmission Line Routes—Region 3

Route—Proposed and Alternatives[1, 2, 3]	Link 1	Link 2	Link 3	Link 4	Link 5	Link 6	Region 3 Total
Private (Domestic) Water Supply Wells within a 1,300-Foot-Wide Corridor (and 500-Foot-Wide Corridor)							
APR	5 (0)	3 (0)	24 (7)	10 (5)	0	0	42 (12)
With AR 3-A	6 (1)	3 (0)	24 (7)	10 (5)	0	0	43 (13)
With AR 3-B	22 (7)			10 (5)	0	0	32 (12)
With AR 3-C	5 (0)	3 (0)	23 (7)				31 (7)

Table 3.7-11:
Water Supply Wells and Wellhead Protection Areas of the HVDC Transmission Line Routes—Region 3

Route—Proposed and Alternatives[1, 2, 3]	Link 1	Link 2	Link 3	Link 4	Link 5	Link 6	Region 3 Total
With AR 3-D	5 (0)	3 (0)	24 (7)	10 (5)	1 (0)		43 (12)
With AR 3-E	5 (0)	3 (0)	24 (7)	10 (5)	0	0	42 (12)
Public Water Supply Wells within a 1,300-Foot-Wide Corridor—No public water supply wells are within Region 3.							
Agricultural Water Wells within a 1,300-Foot-Wide Corridor (and 500-Foot-Wide Corridor)							
APR	0	0	0	1 (0)	0	0	1 (0)
With AR 3-A	0	0	0	1 (0)	0	0	1 (0)
With AR 3-B	0			1 (0)	0	0	1 (0)
With AR 3-C	0	0	3 (1)				3 (1)
With AR 3-D	0	0	0	1 (0)	0		1 (0)
With AR 3-E	0	0	0	1 (0)	0	0	1 (0)
Industrial Water Wells within a 1,300-Foot-Wide Corridor—No industrial water wells are within Region 3.							
Wellhead Protection Areas within a 1,000-foot-wide corridor (and 200-foot-wide ROW)							
APR (acres)	0	0	0	0	0	0	0
With AR 3-A (acres)	0	0	0	0	0	0	0
With AR 3-B (acres)	4 (0)			0	0	0	4 (0)
With AR 3-C (acres)	0	0	53 (11)				53 (11)
With AR 3-D (acres)	0	0	0	0	0		0
With AR 3-E (acres)	0	0	0	0	0	0	0

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
2 Each region of the Applicant Proposed Route (APR) is divided into links that lie between points, or nodes, where the APR is intersected by alternative routes (ARs). ARs bypass specific links of the APR as shown in the table.
3 For the ARs, the unshaded portion of the rows provides the data for the length of the AR. The shaded portion of the rows provides the data for the balance of the APR, thereby providing perspective across the region.
GIS Data Sources: ODEQ (2012), OWRB (2014)

Wells are present in three of the five route variations in Region 3 (Links 1 and 2, Variation 1; Link 4, Variation 2; and Link 5, Variation 2), but the number of wells would increase at the most by six wells within the 500-foot-wide corridor of the end-to-end route. No wells are present in the 500-foot-wide corridor of the adjustment to HVDC Alternative Route 3-A. Neither the variations nor the adjustment would involve wellhead protection areas.

3.7.5.3.4 Region 3 Groundwater Use

Groundwater and surface water uses in the ROI in Region 3 are summarized in Table 3.7-12. A shift occurs in the use of surface water in this region as compared to Regions 1 and 2. The average use of groundwater in the eight-county area of Creek, Garfield, Kingfisher, Lincoln, Logan, Muskogee, Okmulgee, and Payne counties in Oklahoma was about 267 million gallons per day in 2010, compared to about 81 million gallons per day of surface water used in the same area. Groundwater accounts for about 77 percent of area’s total water usage. The largest use of groundwater in the eight-county area is for mining activities at 242 million gallons per day. Public water supplies, irrigation, and self-supplied domestic are the other notable uses of groundwater in the area.

Table 3.7-12:
Average 2010 Water Use by Water Source and Category in Region 3 Counties (in million gallons per day)

County Source	Public Water Supply	Domestic Self-Supplied	Industrial Self-Supplied	Irrigation	Live-stock	Aqua-culture	Mining	Thermo-electric	Row Totals
Groundwater Sources									
Creek, OK	1.24	0.62	0	0	0.06	0	209.82	0	211.74
Garfield, OK	4.77	0.13	0	1.10	0.12	0	2.44	0	8.56
Kingfisher, OK	1.77	0.36	0	2.97	0.65	0	1.79	0	8.55
Lincoln, OK	0.52	1.61	0	0	0.10	0	13.84	0	16.07
Logan, OK	1.33	1.23	0.01	0.03	0.06	0	3.17	0	5.83
Muskogee, OK	0.51	0.61	0	2.50	0.10	0	1.35	0	5.07
Okmulgee, OK	0	0	0	0	0.06	0	2.69	0	2.75
Payne, OK	1.71	0.83	0	0.33	0.07	0.23	5.44	0	8.61
Subtotals	11.85	5.39	0.01	6.93	1.22	0.23	241.55[1]	0	267.18
Surface Water Sources									
Creek, OK	4.26	0	0	0.12	0.53	0	0	0	4.91
Garfield, OK	0	0	0	0.12	1.10	0	0.01	0	1.23
Kingfisher, OK	0	0	0.01	0.41	1.27	0	0.02	0	1.71
Lincoln, OK	1.92	0	0	2.31	0.92	0	0.03	0	5.18
Logan, OK	1.95	0	1.06	1.65	0.60	0	0.08	0	5.34
Muskogee, OK	13.20	0	8.49	4.45	0.93	0	0	15.90	42.97
Okmulgee, OK	14.26	0	0	1.24	0.60	0.02	0	0	16.12
Payne, OK	2.52	0	0	0.05	0.68	0.01	0	0	3.26
Subtotals	38.11	0	9.56	10.35	6.63	0.03	0.14	15.90	80.72
Totals	49.96	5.39	9.57	17.28	7.85	0.26	241.69	15.90	347.90

1 Of the 241.55 million gallons per day, 240.54 million gallons are identified as coming from saline groundwater sources, compared to only 32.12 million gallons per day coming from saline groundwater sources and used for mining in 2005.

Source: USGS (2014b)

3.7.5.4 Region 4

Seven route variations to the Applicant Proposed Route were developed in Region 4 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.4. The Applicant Proposed Route variations (Link 3, Variation 1; Link 3, Variation 2; Link 3, Variation 3; Link 6, Variation 1; Link 6, Variation 2; Link 6, Variation 3; and Link 9, Variation 1) are illustrated in Exhibit 1 of Appendix M. The discussion of Region 4 groundwater elements that follows includes identification of differences, if any, that would be expected with the route variations as compared to the original Applicant Proposed Route.

3.7.5.4.1 Region 4 Principal Aquifers and Their Characteristics

As shown in Figure 3.7-1 in Appendix A, no principal aquifers underlie Region 4; rather, the figure identifies an area of “other rocks.” However, the western end of Region 4 overlies the Arkansas River alluvial aquifer that follows the Arkansas River as it traverses from northwest to southeast in this part of its reach. This aquifer is considered a major alluvial aquifer by the state. Past the Arkansas River alluvial aquifer to the east, Region 4 passes over a minor bedrock aquifer that extends to the Oklahoma-Arkansas border (GIS Data Source: OWRB 2011a).

In Arkansas, Region 4 proceeds through the Arkansas Valley. The geology of the valley has a predominance of shale and many subsurface interbeds are of similar low porosity. As a result, few rocks qualify as aquifers. Most wells in the area have poor yield (less than 10 gallons per minute), so communities rely heavily on surface water sources. The alluvium along the Arkansas River is an exception and represents a consistent source of groundwater, which is used primarily for irrigation (AGS 2014). In this area, the Arkansas River flows roughly west to east and lies to the south of the HVDC transmission line routes, also aligned in a west-east direction.

The route variations to the Applicant Proposed Route developed in Region 4 would not change the aquifers crossed.

3.7.5.4.1.1 Aquifer Annual Yield

Oklahoma has not finalized a maximum annual yield for the Arkansas River alluvial aquifer (OWRB 2014a), but has assigned a temporary equal proportionate share for area landowners of 2 acre-feet of water per year per acre of land (OWRB 2013b) or an average daily removal rate of about 1,790 gallons per acre. As noted above, aquifer yield within the Region 4 area of Arkansas is low.

3.7.5.4.1.2 Depths to Water Table

The USGS National Water Information System has no recent (2012 or newer) depth to groundwater information for the Oklahoma and Arkansas counties that encompass Region 4. The query was extended to 2005 or newer and available data indicate that the water table in two of the counties (Sequoyah County, Oklahoma, and Crawford County, Arkansas) ranges from 4 to 28 feet BGS (USGS 2014a). Even with the extended search timeframe, no data were available for the other four counties.

3.7.5.4.1.3 Groundwater Quality

Water in Oklahoma’s alluvial aquifers, such as the Arkansas River alluvial aquifer, is generally of good quality, but it is vulnerable to contamination from surface activities (OWRB 2012). On the Arkansas side of Region 4, few rock formations produce sufficient water to qualify as aquifers (AGS 2014).

3.7.5.4.2 Region 4 Groundwater of Special Interest

Table 3.7-13 summarizes the acreage of land overlying groundwater of special interest in Region 4. Both Class I groundwater areas and nutrient-vulnerable groundwater areas are present within Region 4. The Applicant Proposed Route passes over the Oklahoma-Arkansas state line within Link 3 of Region 4. No groundwater of special interest is crossed in Links 4 through 9. The Oklahoma designations of groundwater of special interest stop at the state line; Arkansas groundwater designations of special interest are not present underneath Region 4.

The Applicant has proposed a route variation in Region 4, the Lee Creek Variation, that is not included in Table 3.7-13. The Lee Creek Variation would move a short segment, slightly more than 3 miles in length, of Link 3 of the Applicant Proposed Route less than 0.5 mile to the north in the area of the Lee Creek Reservoir, which is roughly on the Oklahoma-Arkansas border. The variation then drops back south to join the Applicant Proposed Route. Land area of the Lee Creek Variation that overlies groundwater of special interest is estimated as follows:

- Land area over Oklahoma Class 1 Special Source Groundwater: approximately 170 acres in the 1,000-foot-wide corridor and 30 acres in the 200-foot-wide ROW

- Land area over Oklahoma Nutrient-Vulnerable Groundwater: approximately 250 acres in the 1,000-foot-wide corridor and 50 acres in the 200-foot-wide ROW
- The amount land overlying groundwater of special interest within the avoided segment of the Applicant Proposed Route would be very similar to the above values

Table 3.7-13:
Land Area in the 1,000-Foot-Wide Corridor (and the 200-Foot-Wide Representative ROW) of the HVDC Transmission Line Routes Overlying Groundwater of Special Interest—Region 4

Route Proposed and Alternatives[1, 2, 3]	Link 1	Link 2	Link 3[4]	Link 4	Link 5	Link 6	Link 7	Link 8	Link 9	Region 4 Total
Land Area Over Oklahoma Class 1 Special Source Groundwater										
APR (acres)	0	0	786 (159)	0	0	0	0	0	0	786 (159)
With AR 4-A (acres)	0	0	1,327 (267)				0	0	0	1,327 (267)
With AR 4-B (acres)	0	1,239 (249)							0	1,239 (249)
With AR 4-C (acres)	0	0	786 (159)	0	0	0	0	0	0	786 (159)
With AR 4-D (acres)	0	0	786 (159)	0			0	0	0	786 (159)
With AR 4-E (acres)	0	0	786 (159)	0	0	0	0	0		786 (159)
Land Area Over Oklahoma Nutrient Vulnerable Groundwater										
APR (acres)	22 (4)	109 (19)	402 (76)	0[a]	0	0	0	0	0	533 (99)
With AR 4-A (acres)	22 (4)	109 (19)	16 (0)				0	0	0	147 (23)
With AR 4-B (acres)	22 (4)	0							0	22 (4)
With AR 4-C (acres)	22 (4)	109 (19)	402 (76)	0	0	0	0	0	0	533 (99)
With AR 4-D (acres)	22 (4)	109 (19)	402 (76)	0			0	0	0	533 (99)
With AR 4-E (acres)	22 (4)	109 (19)	402 (76)	0	0	0	0	0		533 (99)

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
2 Each region of the Applicant Proposed Route (APR) is divided into links that lie between points, or nodes, where the APR is intersected by alternative routes (ARs). ARs bypass specific links of the APR as shown in the table.
3 For the ARs, the unshaded portion of the rows provides the data for the length of the AR. The shaded portion of the rows provides the data for the balance of the APR, thereby providing perspective across the region.
4 Link 3 of Region 4 spans Oklahoma and Arkansas, so beyond Link 3 there are no Oklahoma groundwater designations. Region 4 does not cross over specially designated groundwater in Arkansas.
GIS Data Sources: OWRB (2011b, 2011c)

Within Arkansas, groundwaters of special interest are those areas designated by the state as “Critical Groundwater Areas.” These are areas where aquifers are experiencing significant declines in water table elevations or water quality degradation (ANRC 2005). The critical designation establishes authority for the state to initiate additional regulation of the groundwater area, but to date, no additional regulations have been proposed for any of the state’s designated groundwater areas (ANRC 2014). In the areas of Arkansas crossed by the HVDC transmission line routes, Region 6 traverses the Cache Critical Groundwater Area, which is described further in the Region 6 discussion (Section 3.7.5.6.2).

None of the seven route variations to the Applicant Proposed Route in Region 4 would cross over groundwater of special interest.

3.7.5.4.3 Region 4 Wells and Wellhead Protection Areas

Table 3.7-14 summarizes the number of private, public, agricultural, and industrial water supply wells in the Region 4 expanded ROI and the expanded ROW. The table also provides the wellhead protection areas in the baseline ROIs and the 200-foot-wide representative ROWs. There are private domestic water wells along the ROI of the HVDC transmission line routes. Only a few agricultural or industrial wells are encountered by any of the route ROIs. The Lee Creek Variation, not shown in the table, would not include any wells.

Table 3.7-14:
Water Supply Wells and Wellhead Protection Areas within the HVDC Transmission Line Routes—Region 4

<table>
<tr><th>Route—Proposed and Alternatives[1, 2, 3]</th><th>Link 1</th><th>Link 2</th><th>Link 3</th><th>Link 4</th><th>Link 5</th><th>Link 6</th><th>Link 7</th><th>Link 8</th><th>Link 9</th><th>Region 4 Total</th></tr>
<tr><td colspan="11">Private (Domestic) Water Supply Wells within a 1,300-Foot-Wide Corridor (and 500-Foot-Wide Corridor)—Number within link</td></tr>
<tr><td>APR</td><td>0</td><td>0</td><td>1 (0)</td><td>0</td><td>1 (0)</td><td>1 (0)</td><td>3 (1)</td><td>0</td><td>2 (0)</td><td>8 (1)</td></tr>
<tr><td>With AR 4-A</td><td>0</td><td>0</td><td colspan="4">10 (5)</td><td>3 (1)</td><td>0</td><td>2 (0)</td><td>15 (6)</td></tr>
<tr><td>With AR 4-B</td><td>0</td><td colspan="7">19 (12)</td><td>2 (0)</td><td>21 (12)</td></tr>
<tr><td>With AR 4-C</td><td>0</td><td>0</td><td>1 (0)</td><td>0</td><td>1 (0)</td><td>1 (0)</td><td>3 (1)</td><td>0</td><td>2 (0)</td><td>8 (1)</td></tr>
<tr><td>With AR 4-D</td><td>0</td><td>0</td><td>1 (0)</td><td colspan="3">6 (1)</td><td>3 (1)</td><td>0</td><td>2 (0)</td><td>12 (2)</td></tr>
<tr><td>With AR 4-E</td><td>0</td><td>0</td><td>1 (0)</td><td>0</td><td>1 (0)</td><td>1 (0)</td><td>3 (1)</td><td colspan="2">1 (0)</td><td>7 (1)</td></tr>
<tr><td colspan="11">Public Water Supply Wells within a 1,300-Foot-Wide Corridor—No public water supply wells are within Region 4.</td></tr>
<tr><td colspan="11">Agricultural Water Wells within a 1,300-Foot-Wide Corridor (and 500-Foot-Wide Corridor)</td></tr>
<tr><td>APR</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>With AR 4-A</td><td>0</td><td>0</td><td colspan="4">2 (1)</td><td>0</td><td>0</td><td>0</td><td>2 (1)</td></tr>
<tr><td>With AR 4-B</td><td>0</td><td colspan="7">2 (1)</td><td>0</td><td>2 (1)</td></tr>
<tr><td>With AR 4-C</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1 (0)</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1 (0)</td></tr>
<tr><td>With AR 4-D</td><td>0</td><td>0</td><td>0</td><td colspan="3">0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>With AR 4-E</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td colspan="2">0</td><td>0</td></tr>
<tr><td colspan="11">Industrial Water Wells within a 1,300-Foot-Wide Corridor (and 500-Foot-Wide Corridor)</td></tr>
<tr><td>APR</td><td>1 (0)</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1 (0)</td></tr>
<tr><td>With AR 4-A</td><td>1 (0)</td><td>0</td><td colspan="4">0</td><td>0</td><td>0</td><td>0</td><td>1 (0)</td></tr>
<tr><td>With AR 4-B</td><td>1 (0)</td><td colspan="7">0</td><td>0</td><td>1 (0)</td></tr>
<tr><td>With AR 4-C</td><td>1 (0)</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1 (0)</td></tr>
<tr><td>With AR 4-D</td><td>1 (0)</td><td>0</td><td>0</td><td colspan="3">0</td><td>0</td><td>0</td><td>0</td><td>1 (0)</td></tr>
<tr><td>With AR 4-E</td><td>1 (0)</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td colspan="2">0</td><td>1 (0)</td></tr>
<tr><td colspan="11">Wellhead Protection Areas within a 1,000-foot-wide corridor—No wellhead protection areas are within Region 4</td></tr>
</table>

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
2 Each region of the Applicant Proposed Route (APR) is divided into links that lie between points, or nodes, where the APR is intersected by alternative routes (ARs). ARs bypass specific links of the APR as shown in the table.
3 For the ARs, the unshaded portion of the rows provides the data for the length of the AR. The shaded portion of the rows provides the data for the balance of the APR, thereby providing perspective across the region.
Source: Clean Line (2013); GIS Data Sources: ODEQ (2012), OWRB (2014), AWWCC (2014),

The seven route variations to the Applicant Proposed Route in Region 4 would have no effect on the number of wells within a 500-foot-wide corridor of the route.

It should be noted that the Arkansas well data included in Table 3.7-14, as well as in the corresponding tables for Regions 5, 6, and 7, came from a source (GIS Data Source: AWWCC 2014) that included a number of wells in the search area with no use designations. Wells with a blank designation were not included in the evaluations presented in this document because it was not known whether they were of possible concern if damaged, such as for the well categories shown in the table, or if they were abandoned or of some other limited value.

The only spring identified within any Project ROI is within Region 4. Dripping Spring is located just inside the 1,000-foot-wide corridor of HVDC Alternative Route 4-D in the area where it departs from the Applicant Proposed Route in Crawford County, Arkansas.

3.7.5.4.4 Region 4 Groundwater Use

Groundwater and surface water uses in the ROI in Region 4 are summarized in Table 3.7-15. Water use in this region has shifted further in favor of surface water than described in Region 3. The average use of groundwater in the six-county area of Muskogee and Sequoyah counties in Oklahoma, and Crawford, Franklin, Johnson, and Pope counties in Arkansas, was about 9.4 million gallons per day in 2010. Conversely, surface water use was almost 1,100 million gallons per day in the same area. Groundwater accounts for only about 0.9 percent of area's total water usage. The largest use of groundwater in the six-county area is for irrigation at an average of about 4.3 million gallons per day and the second largest use category is for mining, but it is followed closely by self-supplied domestic water use.

Table 3.7-15:
Average 2010 Water Use by Water Source and Category in Region 4 Counties (in million gallons per day)

County Source	Public Water Supply	Domestic Self-Supplied	Industrial Self-Supplied	Irrigation	Live-stock	Aqua-culture	Mining	Thermo-electric	Totals
Groundwater Sources									
Muskogee, OK	0.51	0.61	0	2.50	0.10	0	1.35	0	5.07
Sequoyah, OK	0	0.07	0	0.499	0.06	0	0.27	0	0.89
Crawford, AR	0	0	0	0.66	0.21	0	0	0	0.87
Franklin, AR	0	0	0	0.06	0.37	0	0	0.05	0.48
Johnson, AR	0	0.06	0	0	0.29	0	0	0	0.35
Pope, AR	0	0.73	0	0.58	0.39	0	0	0	1.70
Subtotals	0.51	1.47	0	4.29	1.42	0	1.62[1]	0.05	9.36
Surface Water Sources									
Muskogee, OK	13.20	0	8.49	4.45	0.93	0	0	15.90	42.97
Sequoyah, OK	6.70	0	1.33	0.85	0.57	0	0.02	0	9.47
Crawford, AR	32.47	0	0	0.63	0.31	0	0.45	0	33.86
Franklin, AR	3.03	0	0	0	0.56	0	0	7.07	10.66
Johnson, AR	4.80	0	0	0	0.42	0	0	0	5.22

Table 3.7-15:
Average 2010 Water Use by Water Source and Category in Region 4 Counties (in million gallons per day)

County Source	Public Water Supply	Domestic Self-Supplied	Industrial Self-Supplied	Irrigation	Live-stock	Aqua-culture	Mining	Thermo-electric	Totals
Pope, AR	11.17	0	0	0.73	0.59	0	0.03	972.93	985.45
Subtotals	71.37	0	9.82	6.66	3.38	0	0.50	995.90	1087.63
Totals	71.88	1.47	9.82	10.95	4.80	0	2.12	995.95	1096.99

1 Of the 1.62 million gallons per day, 1.61 million gallons are identified as coming from saline groundwater sources.
Source: USGS (2014b)

3.7.5.5 Region 5

Five route variations to the Applicant Proposed Route were developed in Region 5 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.5. The Applicant Proposed Route variations (Link 1, Variation 2; Link 2, Variation 2; Links 2 and 3, Variation 1; Links 3 and 4, Variation 2; and Link 7, Variation 1) are illustrated in Exhibit 1 of Appendix M. It should be noted that route adjustments were made for HVDC Alternative Route 5-B to maintain an end-to-end route with Links 2 and 3, Variation 1, and for HVDC Alternative Route 5-E to maintain an end-to-end route with Links 3 and 4, Variation 2. The discussion of Region 5 groundwater elements that follows includes identification of differences, if any, that would be expected with the route variations as compared to the original Applicant Proposed Route. The element discussions also address any changes attributed to the adjustments to HVDC Alternative Route 5-B and HVDC Alternative Route 5-E.

3.7.5.5.1 Region 5 Principal Aquifers and Their Characteristics

Principal aquifers underlie Region 5 of the Project's ROI, but only at the very eastern end of the region. As shown in Figure 3.7-1 in Appendix A, the eastern end of Applicant Proposed Route in Region 5 overlies the Mississippi River Valley alluvial aquifer; all other portions of the route in this region are identified as an area of "other rocks." The largest portion of Region 5 is within the Arkansas Valley area described in Section 3.7.5.4.1, where there are few subsurface strata that yield sufficient water to qualify as aquifers. The exception is the Arkansas River alluvial aquifer, which follows the Arkansas River, although in Region 5 the river moves further away as the ROI progresses to the east.

The Mississippi River Valley alluvial aquifer at the eastern end of Region 5 is a principal aquifer that underlies about 33,000 square miles in Missouri, Kentucky, Tennessee, northwestern Mississippi, northeastern Louisiana, and eastern Arkansas. The aquifer consists primarily of a coarse sand and gravel layer that is overlain with silt, clay, and fine sand confining unit that hinders movement of water down into the aquifer. The confining unit ranges from less than 20 to more than 60 feet thick and the aquifer ranges from 25 to 150 feet thick (Renken 1998). In Arkansas, depth to the water table of the aquifer ranges from 0 to 115 feet (ANRC 2013). Wells pulling water from the Mississippi River Valley alluvial aquifer can have high yields, 500 gallons per minute is typical, some can yield 1,000 to 5,000 gallons per minute (Renken 1998).

Neither the route variations to the Applicant Proposed Route developed in Region 5 nor the adjustments to HVDC Alternative Route 5-B and HVDC Alternative Route 5-E would change the aquifers that would be crossed.

3.7.5.5.1.1 Aquifer Annual Yield

Aquifer yields in most of Region 5 are low as was described in Section 3.7.5.4.1. The estimated sustainable yield of the Mississippi River Valley alluvial aquifer (within the state) is 2,987 million gallons per day (ARNC 2012), which equates to about 3.3 million acre-feet per year.

3.7.5.5.1.2 Depths to Water Table

The USGS National Water Information System data collected in 2012 or later include well data in three of the seven Arkansas counties that compose Region 5. The depth to the water table in the single well in Faulkner County is 6 feet BGS, the water table ranges from less than 1 to 84 feet BGS in White County and the water table ranges from 11 to 73 feet BGS in Jackson County (USGS 2014a). For the other four counties, the data search was expanded to 2005 or later, but no data were available.

3.7.5.5.1.3 Groundwater Quality

Water from the Mississippi River Valley alluvial aquifer is generally of sufficient quality for most uses. Dissolved-solids concentrations are usually less than 500 milligrams per liter (the limit for esthetic qualities per 40 CFR Part 143), but in some areas, concentrations can range from 1,000 to 3,000 milligrams per liter (Renken 1998). Naturally occurring arsenic is found in some areas of the Mississippi River Valley alluvial aquifer and low concentrations (below drinking water standards) of pesticides are often detected in samples from the aquifer (EPA 2009).

3.7.5.5.2 Region 5 Groundwater of Special Interest

Region 5 of the Applicant Proposed Route crosses no Arkansas-designated critical groundwater areas.

3.7.5.5.3 Region 5 Wells and Wellhead Protection Areas

Table 3.7-16 summarizes the number of private, public, agricultural, and industrial water supply wells in the Region 5 expanded ROIs and the expanded ROWs. The table also provides the wellhead protection areas in the baseline ROIs and 200-foot-wide representative ROWs. Small numbers of private and agricultural wells are present in the region, but no public water supply wells or industrial wells. The amount of wellhead protection area in the region is also very small.

Table 3.7-16:
Water Supply Wells and Wellhead Protection Areas within the HVDC Transmission Line Routes—Region 5

Route Proposed and Alternatives[1, 2, 3]	Link 1	Link 2	Link 3	Link 4	Link 5	Link 6	Link 7	Link 8	Link 9	Region 5 Total
Private (Domestic) Water Supply Wells within a 1,300-Foot-Wide Corridor (and 500-Foot-Wide Corridor)										
APR	1 (0)	0	0	0	1 (0)	0	0	0	1 (1)	3 (1)
With AR 5-A	2 (1)	0	0	0	1 (0)	0	0	0	1 (1)	4 (2)
With AR 5-B	1 (0)	0	5 (2)				0	0	1 (1)	7 (3)
With AR 5-C	1 (0)	0	0	0	1 (0)	0		0	1 (1)	3 (1)
With AR 5-D	1 (0)	0	0	0	1 (0)	0	0	0	3 (2)	5 (2)
With AR 5-E	1 (0)	0	0	2 (1)			0	0	1 (1)	4 (2)
With AR 5-F	1 (0)	0	0	0	0		0	0	1 (1)	2 (1)
Public Water Supply Wells within a 1,300-Foot-Wide Corridor—No public water supply wells are within Region 5.										

Table 3.7-16:
Water Supply Wells and Wellhead Protection Areas within the HVDC Transmission Line Routes—Region 5

Route Proposed and Alternatives[1, 2, 3]	Link 1	Link 2	Link 3	Link 4	Link 5	Link 6	Link 7	Link 8	Link 9	Region 5 Total
Agricultural Water Wells within a 1,300-Foot-Wide Corridor (and 500-Foot-Wide Corridor)										
APR	0	0	0	0	0	0	0	0	3 (3)	3 (3)
With AR 5-A	0	0	0	0	0	0	0	0	3 (3)	3 (3)
With AR 5-B	0	0	3 (0)				0	0	3 (3)	6 (3)
With AR 5-C	0	0	0	0	0	0		0	3 (3)	3 (3)
With AR 5-D	0	0	0	0	0	0	0	0	0	0
With AR 5-E	0	0	0	2 (0)			0	0	3 (3)	5 (3)
With AR 5-F	0	0	0	0	0		0	0	3 (3)	3 (3)
Industrial Water Wells within a 1,300-Foot-Wide Corridor—No industrial water wells are within Region 5.										
Wellhead Protection Areas within a 1,000-foot-wide Corridor (and 200-foot-wide ROW)										
APR (acres)	0	0	0	0	0	0	0	0	0	0
With AR 5-A (acres)	0	0	0	0	0	0	0	0	0	0
With AR 5-B (acres)	0	0	0				0	0	0	0
With AR 5-C (acres)	0	0	0	0	0	0		0	0	0
With AR 5-D (acres)	0	0	0	0	0	0	0	0	2.1[4] (0)	2.1 (0)
With AR 5-E (acres)	0	0	0	0			0	0	0	0
With AR 5-F (acres)	0	0	0	0	0		0	0	0	0

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
2 Each region of the Applicant Proposed Route (APR) is divided into links that lie between points, or nodes, where the APR is intersected by alternative routes (ARs). ARs bypass specific links of the APR as shown in the table.
3 For the ARs, the unshaded portion of the rows provides the data for the length of the AR. The shaded portion of the rows provides the data for the balance of the APR, thereby providing perspective across the region.
4 Arkansas considers the locations of wellhead protection areas to be confidential information and as such are not shown on any figures associated with this document. The entry in this table is presented because it provides only very general location information and is of value to the analysis.
Source: Clean Line (2013); GIS Data Source: AWWCC (2014)

There are no wells or wellhead protection areas in the Arkansas Converter Station Alternative Siting Area or in the associated AC Interconnection Siting Area, including the site of the new substation.

Wells are present in three of the five route variations proposed for the Applicant Proposed Route in Region 3 (Link 1, Variation 1; Links 2 and 3, Variation 1; and Links 3 and 4, Variation 2), but number of wells would increase at most by two wells within the 500-foot-wide corridor of the end-to-end route. No wells are present in the 500-foot-wide corridor of the adjustments to HVDC Alternative Route 5-B or HVDC Alternative Route 5-E. Neither the variations nor the adjustments would involve wellhead protection areas.

3.7.5.5.4 Region 5 Groundwater Use

Groundwater and surface water uses in the ROI in Region 5 are summarized in Table 3.7-17. Water use in this region is more evenly divided between groundwater and surface water than in Region 4, but surface water is the predominant source. The average use of groundwater in the seven-county area of Cleburne, Conway, Faulkner, Jackson, Pope, Van Buren, and White counties in Arkansas was about 460 million gallons per day in 2010. Surface water use was approximately 1,120 million gallons per day in the same area. Groundwater accounts for about 29 percent of area's total water usage. The largest use of groundwater in the six-county area is for irrigation at an average of about 450 million gallons per day. Public water supplies, aquaculture, livestock, and self-supplied domestic water are the other groundwater use categories of note. It should be noted that if the amount of surface water used for thermoelectric power plant cooling (Table 3.7-17) was dropped from the equation, groundwater would be the predominant source for water use in the area.

Table 3.7-17:
Average 2010 Water Use by Water Source and Category in Region 5 Counties (in million gallons per day)

County by Water Source	Public Water Supply	Domestic Self-Supplied	Industrial Self-Supplied	Irrigation	Live-stock	Aqua-culture	Mining	Thermo-electric	Row Totals
Groundwater Sources									
Cleburne, AR	0	0	0	0.13	0.24	0	0	0	0.37
Conway, AR	0	0.18	0	1.02	0.46	0	0	0	1.66
Faulkner, AR	2.74	0.40	0	1.15	0.24	0	0	0	4.53
Jackson, AR	1.59	0.18	0.18	415.30	0.05	2.20	0	0	419.50
Pope, AR	0	0.73	0	0.58	0.39	0	0	0	1.70
Van Buren, AR	0	0.11	0	0	0.14	0	0	0	0.25
White, AR	0.04	0	0	31.91	0.40	0.21	0	0	32.56
Subtotals	4.37	1.60	0.18	450.09	1.92	2.41	0	0	460.57
Surface Water Sources									
Cleburne, AR	9.28	0	0	0	0.36	0	15.94	0	25.58
Conway, AR	13.09	0	7.03	4.87	0.69	0	1.82	0	27.50
Faulkner, AR	3.20	0	0	0.48	0.37	0	0.20	0	4.25
Jackson, AR	0	0	0	22.37	0.11	0	0	0	22.48
Pope, AR	11.17	0	0	0.73	0.59	0	0.03	972.93	985.45
Van Buren, AR	2.01	0	0	0	0.21	0	1.88	0	4.10
White, AR	9.09	0	0.06	25.33	0.60	0.60	19.79	0	55.47
Subtotals	47.84	0	7.09	53.78	2.93	0.604	39.66	972.93	1124.83
Totals	52.21	1.60	7.27	503.87	4.85	3.01	39.66	972.93	1585.40

Source: USGS (2014b)

3.7.5.6 Region 6

One route variation to the Applicant Proposed Route was developed in Region 6 in response to comments on the Draft EIS to parallel more parcel boundaries to minimize impacts to agricultural operations and is illustrated in Exhibit 1 of Appendix M. It should be noted that a route adjustment was made for HVDC Alternative Route 6-A to maintain an end-to-end route with Link 2, Variation 1. The discussion of Region 6 groundwater elements that follows includes identification of differences, if any, that would be expected with the route variation as compared to the original Applicant Proposed Route. The element discussions also address any changes attributed to the adjustment to HVDC Alternative Route 6-A.

3.7.5.6.1 Region 6 Principal Aquifers and Their Characteristics

As shown in Figure 3.7-1 in Appendix A, principal aquifers underlie all of Region 6. Most of the region is over the Mississippi River Valley alluvial aquifer, but in the central part of the region, the ROI crosses a narrow band of the Mississippi embayment aquifer system. In most areas, the Mississippi River Valley alluvial aquifer overlies the Mississippi embayment system. The Mississippi River Valley alluvial aquifer was described in Section 3.7.5.5.1. The description below focuses on the Mississippi embayment aquifer system.

The Mississippi embayment aquifer system is a system of regional aquifers, consisting primarily of semi-consolidated sand that underlies parts of Louisiana, Arkansas, Missouri, Illinois, Kentucky, Tennessee, Mississippi, Alabama, and Florida. The system comprises nine hydrogeologic units made up of six regional aquifers and three confining units, and can be up to 6,000 feet thick (Renken 1998). Within Arkansas, the state refers to the Sparta and Memphis Sands of the Mississippi embayment aquifer system as the Sparta/Memphis aquifer. Throughout the Mississippi embayment aquifer system, depth to water ranges from 37 to about 320 feet BGS (ANRC 2013). Yield from this aquifer system varies greatly depending on location and which regional aquifer is being pumped, but well production on the order of 300 to 1,000 gallons per minute are common and yields occasionally exceed 2,000 gallons per minute (Renken 1998).

Neither the route variation to the Applicant Proposed Route developed in Region 6 nor the adjustment to HVDC Alternative Route 6-A would change the aquifers that would be crossed.

3.7.5.6.1.1 Aquifer Annual Yield

As indicated in Section 3.7.5.5.1, the sustainable yield of the Mississippi River Valley alluvial aquifer (within the state) is estimated to be 2,987 million gallons per day (ANRC 2012), which equates to about 3.3 million acre-feet per year. The state estimates the sustainable yield for the Sparta/Memphis aquifer at 87 million gallons per day (ANRC 2012), which equates to about 97,500 acre-feet per year.

3.7.5.6.1.2 Depths to Water Table

The USGS National Water Information System includes 2012 or later data for all three of the Arkansas counties that compose Region 6. The depth to the water table in Jackson County ranges from 11 to 73 feet BGS, the water table ranges from 7 to 150 feet BGS in Poinsett County, and the water table ranges from 17 to 210 feet BGS in Cross County (USGS 2014a).

3.7.5.6.1.3 Groundwater Quality

Water quality in the Region 6 area of the Mississippi embayment aquifer system is generally good; dissolved-solids concentrations are less than 500 milligrams per liter (Renken 1998). Groundwater quality in the Mississippi River alluvial aquifer was described in Section 3.7.5.5.1.

3.7.5.6.2 Region 6 Groundwater of Special Interest

Table 3.7-18 summarizes the acreage of land overlying Arkansas critical groundwater areas in Region 6. The feature of interest in Region 6 is the Cache Critical Groundwater Area, which is crossed by the HVDC transmission line routes in Poinsett and Cross counties. The Cache Critical Groundwater Area, however, is much larger in extent than the counties, encompassing the Mississippi River Valley alluvial aquifer and the Memphis Sand aquifer and extending into seven Arkansas counties. The critical groundwater designation is attributed to significant groundwater depletion and the associated decrease in saturated thickness has the potential to cause salt water intrusion (ANRC 2009).

Table 3.7-18:
Land Area in the 1,000-Foot-Wide Corridor (and the 200-Foot-Wide Representative ROW) of the HVDC Transmission Line Routes Overlying Groundwater of Special Interest—Region 6

Route—Proposed and Alternatives[1, 2, 3]	Link 1	Link 2	Link 3	Link 4	Link 5	Link 6	Link 7	Link 8	Region 6 Total
Land Area Over Arkansas Critical Groundwater									
APR (acres)	0	0	64 (14)	798 (155)	236 (46)	1,519 (301)	0	0	2,617 (516)
With AR 6-A (acres)	0	711 (145)			236 (46)	1,519 (301)	0	0	2,466 (492)
With AR 6-B (acres)	0	0	70 (16)	798 (155)	236 (46)	1,519 (301)	0	0	2,623 (518)
With AR 6-C (acres)	0	0	64 (14)	798 (155)	236 (46)	1,511 (301)		0	2,609 (516)
With AR 6-D (acres)	0	0	64 (14)	798 (155)	236 (46)	1,519 (301)	0	0	2,617 (516)

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
2 Each region of the Applicant Proposed Route (APR) is divided into links that lie between points, or nodes, where the APR is intersected by alternative routes (ARs). ARs bypass specific links of the APR as shown in the table.
3 For the ARs, the unshaded portion of the rows provides the data for the length of the AR. The shaded portion of the rows provides the data for the balance of the APR, thereby providing perspective across the region.
GIS Data Source: ANRC (2014)

Neither the route variation to the Applicant Proposed Route developed in Region 6 nor the adjustment to HVDC Alternative Route 6-A overlie groundwater of special interest.

3.7.5.6.3 Region 6 Wells and Wellhead Protection Areas

Table 3.7-19 summarizes the number of private, public, agricultural, and industrial water supply wells in the Region 6 expanded ROIs and the expanded ROW. The table also provides the wellhead protection areas in the baseline ROIs and 200-foot-wide representative ROWs. None of the HVDC transmission line routes in Region 6 contain private or public water supply wells or industrial water supply wells. The 1,000-foot-wide corridors for all of the routes do, however, contain roughly the same number of agricultural wells, ranging from 28 to 31 wells. Only the ROI of HVDC Alternative Route 6-B would cross any wellhead protection areas.

Table 3.7-19:
Water Supply Wells and Wellhead Protection Areas within the HVDC Transmission Line Routes—Region 6

Route—Proposed and Alternatives[1, 2, 3]	Link 1	Link 2	Link 3	Link 4	Link 5	Link 6	Link 7	Link 8	Region 6 Total
Private (Domestic) Water Supply Wells within a 1,300-Foot-Wide Corridor—No domestic water supply wells are within Region 6									
Public Water Supply Wells within a 1,300-Foot-Wide Corridor—No public water supply wells are within Region 6									
Agricultural Water Wells within a 1,300-Foot-Wide Corridor (and 500-Foot-Wide Corridor)									
APR	5 (2)	2 (0)	4 (1)	3 (0)	1 (0)	7 (2)	6 (3)	2 (1)	30 (9)
With AR 6-A	5 (2)	8 (2)			1 (0)	7 (2)	6 (3)	2 (1)	29 (10)

Table 3.7-19:
Water Supply Wells and Wellhead Protection Areas within the HVDC Transmission Line Routes—Region 6

Route—Proposed and Alternatives[1, 2, 3]	Link 1	Link 2	Link 3	Link 4	Link 5	Link 6	Link 7	Link 8	Region 6 Total
With AR 6-B	5 (2)	2 (0)	5 (2)	3 (0)	1 (0)	7 (2)	6 (3)	2 (1)	31 (10)
With AR 6-C	5 (2)	2 (0)	4 (1)	3 (0)	1 (0)	12 (6)		2 (1)	29 (10)
With AR 6-D	5 (2)	2 (0)	4 (1)	3 (0)	1 (0)	7 (2)	4 (1)	2 (1)	28 (7)
Industrial Water Wells within a 1,300-Foot-Wide Corridor—No industrial water supply wells are within Region 6.									
Wellhead Protection Areas within a 1,000-foot-wide Corridor (and 200-foot-wide ROW)									
APR (acres)	0	0	0	0	0	0	0	0	0
With AR 6-A (acres)	0	0			0	0	0	0	0
With AR 6-B (acres)	0	0	152[4] (0)	0	0	0	0	0	152 (0)
With AR 6-C (acres)	0	0	0	0	0	0		0	0
With AR 6-D (acres)	0	0	0	0	0	0	0	0	0

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
2 Each region of the Applicant Proposed Route (APR) is divided into links that lie between points, or nodes, where the APR is intersected by alternative routes (ARs). ARs bypass specific links of the APR as shown in the table.
3 For the ARs, the unshaded portion of the rows provides the data for the length of the AR. The shaded portion of the rows provides the data for the balance of the APR, thereby providing perspective across the region.
4 Arkansas considers the locations of wellhead protection areas to be confidential information and as such are not shown on any figures associated with this document. The entry in this table is presented because it provides only very general location information and is of value to the analysis.
Source: Clean Line (2013); GIS Data Source: AWWCC (2014)

3.7.5.6.4 Region 6 Groundwater Use

Groundwater and surface water uses in the ROI in Region 6 are summarized in Table 3.7-20. The distribution of water use in this region has shifted back to groundwater as being the predominant source. The average use of groundwater in the three-county area of Cross, Jackson, and Poinsett counties in Arkansas was approximately 1,790 million gallons per day in 2010. About 152 million gallons per day of surface water were used in the same area. Groundwater accounts for about 92 percent of area's total water usage. Groundwater use was attributed primarily to irrigation; public water supplies and aquaculture were the other notable uses.

Table 3.7-20:
Average 2010 Water Use by Water Source and Category in Region 6 Counties (in million gallons per day)

County Source	Public Water Supply	Domestic Self-Supplied	Industrial Self-Supplied	Irrigation	Live-stock	Aqua-culture	Mining	Thermo-electric	Row Totals
Groundwater Sources									
Cross, AR	2.63	0	0.41	520.67	0.01	0.02	0	0	523.74
Jackson, AR	1.59	0.18	0.18	415.30	0.05	2.20	0	0	419.50
Poinsett, AR	2.86	0.16	0	839.97	0.01	2.78	0.04	0	845.82
Subtotals	7.08	0.34	0.59	1775.94	0.07	5.00	0.04	0	1789.06
Surface Water Sources									
Cross, AR	0	0	0	37.94	0.02	0.01	0	0	37.97

Table 3.7-20:
Average 2010 Water Use by Water Source and Category in Region 6 Counties (in million gallons per day)

County Source	Public Water Supply	Domestic Self-Supplied	Industrial Self-Supplied	Irrigation	Live-stock	Aqua-culture	Mining	Thermo-electric	Row Totals
Jackson, AR	0	0	0	22.37	0.11	0	0	0	22.48
Poinsett, AR	0	0	0	91.42	0.02	0	0	0	91.44
Subtotals	0	0	0	151.73	0.15	0.01	0	0	151.89
Totals	7.08	0.34	0.59	1927.67	0.22	5.01	0.04	0	1940.95

Source: USGS (2014b)

3.7.5.7 Region 7

Three route variations to the Applicant Proposed Route were developed in Region 7 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.7. The Applicant Proposed Route variations (Link 1, Variation 1; Link 1, Variation 2; and Link 5, Variation 1) are illustrated in Exhibit 1 of Appendix M. The discussion of Region 7 groundwater elements that follows includes identification of differences, if any, that would be expected with the route variations as compared to the original Applicant Proposed Route.

3.7.5.7.1 Region 7 Principal Aquifers and Their Characteristics

As with Region 6, Region 7 passes over the Mississippi River Valley alluvial aquifer and the Mississippi embayment aquifer system (Figure 3.7-1 in Appendix A); the alluvial aquifer in the western and central portions of the region and the aquifer system in the eastern portion. Since both of these principal aquifers were described in the preceding discussions of Region 5 and 6 (Sections 3.7.5.5.1 and 3.7.5.6.1, respectively), the information will not be repeated here. The route variations to the Applicant Proposed Route developed in Region 7 would not change the aquifers crossed.

The eastern end of Region 7 is in Tennessee, so the information below is specific to the portion of Region 7 that is in Tennessee. Similar information for Arkansas was presented in the Region 5 and 6 discussions.

3.7.5.7.1.1 Aquifer Annual Yield

Tennessee has not yet developed estimates of sustainable yield for the aquifer underlying the eastern end of Region 7.

3.7.5.7.1.2 Depths to Water Table

The USGS National Water Information System includes 2012 or later data for both of the Arkansas counties and both of the Tennessee counties that compose Region 7. The depth to water table in Poinsett County, Arkansas, ranges from 7 to 150 feet BGS and from 7 to 54 feet BGS in Mississippi County, Arkansas. The single well in Tipton County, Tennessee, has a water table 34 feet BGS and, in Shelby County, Tennessee, the depth ranges from 11 to 170 feet BGS (USGS 2014a).

3.7.5.7.1.3 Groundwater Quality

The general quality of water in the Mississippi River Valley alluvial aquifer and the Mississippi embayment aquifer system was described in Sections 3.7.5.5.1 and 3.7.5.6.1.

3.7.5.7.2 Region 7 Groundwater of Special Interest

The Applicant Proposed Route passes over the Arkansas-Tennessee state line within Link 1 of Region 7. The Arkansas portion of Region 7 of the Applicant Proposed Route crosses over no critical groundwater areas. Similarly, the Tennessee portion of Region 7 crosses over no groundwater areas designated by the state as a Special Source Water (a groundwater with exceptional quality or quantity that may serve as a valuable source for water supply or which is ecologically significant) or a Site-Specific Impaired Groundwater (one that has been contaminated by human activity and for which remediation is not reasonable or technically feasible). As indicated above, groundwater of either designation was not found within Region 7. Tennessee also uses classifications of General Use Groundwater and Unusable Groundwater, which were not considered to be of special interest for the current discussion.

3.7.5.7.3 Region 7 Wells and Wellhead Protection Areas

Table 3.7-21 summarizes the number of private, public, agricultural, and industrial water supply wells in the Region 7 expanded ROIs and the expanded ROWs. There are no wellhead protection areas in the Region 7 ROI. The ROI corridor for HVDC Alternative Route 7-D is the only one containing private domestic water supply wells and is the only one that contains no agricultural wells.

Table 3.7-21:
Water Supply Wells and Wellhead Protection Areas within the HVDC Transmission Line Routes—Region 7

Route—Proposed and Alternatives[1, 2, 3]	Link 1	Link 2	Link 3	Link 4	Link 5	Region 7 Total
Private (Domestic) Water Supply Wells within a 1,300-Foot-Wide Corridor (and 500-Foot-Wide Corridor)						
APR	0	0	0	0	0	0
With AR 7-A	0	0	0	0	0	0
With AR 7-B	0	0	0		0	0
With AR 7-C	0	0	0			0
With AR 7-D	0	0	0	2 (0)		2
Public Water Supply Wells within a 1,300-Foot-Wide Corridor—No public water supply wells are within Region 7.						
Agricultural Water Wells within a 1,300-Foot-Wide Corridor (and 500-Foot-Wide Corridor)						
APR	11 (5)	0	0	0	0	11 (5)
With AR 7-A	18 (10)	0	0	0	0	18 (10)
With AR 7-B	11 (5)	0	1 (0)		0	12 (5)
With AR 7-C	11 (5)	0	1 (0)			12 (5)
With AR 7-D	11 (5)	0	0	0		11 (5)
Industrial Water Wells within a 1,300-Foot-Wide Corridor—No industrial water wells are within Region 7.						
Wellhead Protection Areas within a 1,000-foot-wide corridor—No wellhead protection areas are within Region 7.						

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
2 Each region of the Applicant Proposed Route (APR) is divided into links that lie between points, or nodes, where the APR is intersected by alternative routes (ARs). ARs bypass specific links of the APR as shown in the table.
3 For the ARs, the unshaded portion of the rows provides the data for the length of the AR. The shaded portion of the rows provides the data for the balance of the APR, thereby providing perspective across the region.
GIS Data Sources: AWWCC (2014), Clean Line (2013a, 2013b)

As can be seen in the table, there are no public or industrial water wells in Region 7. The table also shows no wellhead protection areas within Region 7, but in this case it is the result of insufficient information to determine any acreage values. The Millington Water Department and Naval Support Activity Mid-South in Shelby County, along with the Poplar Grove Utility District in Tipton County, are named community water systems in the Region 7 vicinity that utilize wells as water sources (TDEC 2003). Wells supplying community water systems would be associated with wellhead protection areas, but there was not sufficient location information to develop any estimates of crossing acreage. No wells or wellhead protection areas are located within the Tennessee Converter Station Siting Area and AC Interconnection Tie.

Two of the variations (Link 1, Variation 1, and Link 1, Variation 2) to the Applicant Proposed Route in Region 7 could increase the number of wells within the route corridor at most by two wells.

3.7.5.7.4 Region 7 Groundwater Use

Groundwater and surface water uses in the ROI in Region 7 are summarized in Table 3.7-22. The distribution of water use in this region again shows groundwater as the predominant source. The average use of groundwater in the four-county area of Mississippi and Poinsett counties in Arkansas, and Shelby and Tipton counties in Tennessee, was 1,440 million gallons per day in 2010. About 540 million gallons per day of surface water are used in the same area. Groundwater accounts for about 73 percent of area's total water usage. The largest use of groundwater in the four-county area is for irrigation at an average of approximately 1,210 million gallons per day and the second largest use category is for public water supplies at 190 million gallons per day. Public water supplies in the area were identified as coming entirely from groundwater sources.

Table 3.7-22:
Average 2010 Water Use by Water Source and Category in Region 7 Counties (in million gallons per day)

County Source	Public Water Supply	Domestic Self-Supplied	Industrial Self-Supplied	Irrigation	Live-stock	Aqua-culture	Mining	Thermo-electric	Row Totals
Groundwater Sources									
Mississippi, AR	7.19	0.11	1.67	363.12	0	0.84	0	0.60	373.55
Poinsett, AR	2.86	0.16	0	839.97	0.01	2.78	0.04	0	845.82
Shelby, TN	173.07	0.20	34.29	2.78	0.07	0	0.08	0	210.49
Tipton, TN	6.50	0.14	0	0.92	0.10	0.08	0.16	0	7.90
Subtotals	189.62	0.61	35.96	1206.79	0.18	3.70	0.28	0.60	1437.74
Surface Water Sources									
Mississippi, AR	0	0	0.23	2.69	0.03	0	0	4.70	7.65
Poinsett, AR	0	0	0	91.42	0.02	0	0	0	91.44
Shelby, TN	0	0	0	0.50	0.02	0.01	0.23	435.00	435.76
Tipton, TN	0	0	0	0.92	0	0.23	0	0	1.15
Subtotals	0	0	0.23	95.53	0.07	0.24	0.23	439.70	536.00
Totals	189.62	0.61	36.19	1302.32	0.25	3.94	0.51	440.30	1973.74

Source: USGS (2014b)

3.7.5.8 Connected Actions

3.7.5.8.1 Wind Energy Generation

3.7.5.8.1.1 Principal Aquifers and Their Characteristics

Wind energy generation would likely occur within WDZs. The WDZs are located within the Oklahoma and Texas Panhandles that overlie the High Plains aquifer, also known as the Ogallala aquifer, as shown in Figure 3.7-1 (located in Appendix A). Portions of Zones D and J are exceptions as they fall over the area of "Other Rocks" shown in Figure 3.7-1 in Appendix A that extends across Beaver County and into Texas County along the general course of the Beaver (or North Canadian) River. Alluvial materials along the general course of the Beaver River in Beaver and Texas counties may contain usable quantities of groundwater as in the North Canadian River alluvial aquifer just to the east, but the state of Oklahoma does not consider the Beaver and Texas county portions to be a major, or even a minor alluvial aquifer (OWRB 2012). The extent and characteristics of the High Plains aquifer were described in Section 3.7.5.1.1.

As described in Section 3.7.5.1.1, the maximum annual yield of the portion of the High Plains aquifer that underlies the Oklahoma Panhandle is estimated at about 2.29 million acre-feet per year. In Texas, the WDZs are located within the North Plains Groundwater Conservation District, which has set the allowable annual production for groundwater, beginning January 1, 2012, at 1.5 acre-feet per acre of land (North Plains Groundwater Conservation District 2013). Also as described in Section 3.7.5.1.1, groundwater in the portions of the High Plains aquifer north of the Canadian River, which includes all of the WDZs, is generally considered to be of good quality.

With regard to depths to the water table, the USGS National Water Information System contains groundwater level information for each of the three Oklahoma and three Texas counties that encompass the WDZs. Table 3.7-23 provides a summary of the depth to groundwater data for measurements taken since the beginning of 2012. As indicated in the table, the more shallow water tables occur in the eastern-most counties (that is, Beaver County in Oklahoma and Ochiltree County in Texas), but even in these counties, some areas have quite deep water tables.

Table 3.7-23:
Depths to Groundwater in the Oklahoma and Texas Counties with Wind Development Zones

County	Wind Development Zones within County	Groundwater Level Measurements Since 1-1-2012 in USGS Database		
		Number of Monitored Sites/Wells	Minimum Depth BGS (feet)	Maximum Depth BGS (feet)
Beaver, OK	J, K	26	16	238
Cimarron, OK	G	30	77	353
Texas, OK	D, E, F, G, H, I, J	68	94	367
Hansford, TX	A, B, C, F, L	58	39	453
Ochiltree, TX	A, K, L	42	30	479
Sherman, TX	C, F	45	229	369

Source: USGS (2014a)

3.7.5.8.1.2 Groundwater of Special Interest

Groundwater areas of special interest within Oklahoma are Class I Special Source Groundwater and Nutrient Vulnerable Groundwater as described in Section 3.7.5.1.2. In Texas, groundwater areas of special interest are those designated as Priority Groundwater Management Areas. Texas uses this designation for groundwater areas experiencing, or expected to experience, critical groundwater problems. However, the three Texas counties containing WDZs have no Priority Groundwater Management Areas (TCEQ 2013). Table 3.7-24 summarizes the acreage of land overlying groundwater of special interest within the WDZs. For comparison, the table also shows the total acreage of each WDZ.

Table 3.7-24:
Wind Development Zone Acreage over Groundwater of Special Interest

Wind Development Zone	Total Acreage of Zone	Special Interest Categories	
		Acreage Over Oklahoma Class I Special Source Groundwater	Acreage Over Oklahoma Nutrient Vulnerable Groundwater
A	109,747	NA[1]	NA[1]
B	125,479	NA[1]	NA[1]
C	161,048	NA[1]	NA[1]
D	69,189	319	1,743
E	47,092	0	0
F	112,461	0	0
G	187,315	0	0
H	116,226	0	0
I	105,203	0	2,496
J	92,567	0	20,081
K	92,894	0	0
L	165,848	NA[1]	NA[1]

1 NA = Not Applicable. WDZs A, B, C, and L are located in Texas, so would not be applicable to Oklahoma groundwater designations. The three Texas counties in which WDZs A, B, C, and L are located do not contain groundwater areas with special interest designations.
GIS Data Sources: OWRB (2011b, 2011c)

As can be seen in Table 3.7-24, with the exception of Zone J, there are either no groundwater areas of special interest underlying the WDZs or they are very small in comparison to the zone's total area. With regard to Zone J, almost 22 percent of the zone's total area is over Nutrient Vulnerable Groundwater. The single area of Oklahoma Class 1 Special Source Groundwater in Zone D has a Subclass B designation for groundwater underneath lands designated by regulation (specifically, Appendix B of OAC 785.45). In this case, the designation is because of the overlying Optima Wildlife Management Area.

3.7.5.8.1.3 Wells and Wellhead Protection Areas

Table 3.7-25 summarizes the number of private (domestic), public, agricultural, and industrial water supply wells and wellhead protection areas in each of the WDZs. In the first column, the table also includes the total area of each WDZ for comparison to the wellhead protection area. As can be seen in the table, all of the zones contain relatively large numbers of wells; four of the zones (WDZs E, F, I, and K) in excess of 250 water wells each. Possibly of more significance, three of the zones (WDZs A, F, and I) each contain 8 or 9 public water supply wells. Most of the WDZs contain wellhead protection areas, but in all cases the protected areas are small in comparison to the total zone acreage.

Table 3.7-25:
Water Wells and Wellhead Protection Areas within Each of the Wind Development Zones

Wind Development Zone Number—Acreage	Number of Wells by Use Category				Total Number of Wells	Wellhead Protection Area - Acreage
	Domestic Water Supply	Public Water Supply	Agricultural	Industrial		
A—109,747	2	9	31	0	42	252
B—125-479	3	0	78	1	82	0
C—161,048	3	0	68	0	71	8
D—69,189	20	1	101	41	163	208
E—47,092	21	0	215	29	265	0
F—112,461	81	8	197	56	342	147
G—187,315	30	1	91	51	173	124
H—116,226	30	0	57	40	127	0
I—105,203	37	8	150	60	255	550
J—92,567	37	1	28	57	123	36
K—92,894	32	0	55	169	256	141
L—165,848	2	2	83	0	87	53
Totals	298	30	1,154	504	1,986	1,519

GIS Data Sources: ODEQ (2012), OWRB (2014)

3.7.5.8.1.4 Groundwater Use

Groundwater and surface water uses in the three Oklahoma counties and three Texas counties that contain WDZs are summarized in Table 3.7-26. Also shown in the table are WDZs within each of the counties, many extending across more than one county and in some cases by very small amounts (for example, the portions of Zones F and K that extend into Texas counties). The average use of water in the six-county area was about 791 million gallons per day in 2010 and the vast majority (99.7 percent) came from groundwater sources. All of the area's public and private drinking water supplies were taken from groundwater. The predominant use for groundwater in the six-county area was irrigation with mining a distant second.

Table 3.7-26:
Average 2010 Water Use by Water Source and Category in Oklahoma and Texas Counties Containing Wind Development Zones (in million gallons per day)

County Source	Wind Development Zone within County	Water Use Categories[1]						Totals
		Public Water Supply	Domestic Self-Supplied	Industrial Self-Supplied	Irrigation	Livestock	Mining	
Groundwater Sources								
Beaver, OK	J, K	0.49	0.23	0	24.60	2.54	14.07	41.93
Cimarron, OK	G	0.51	0.08	0	52.00	1.79	0.66	55.04
Texas, OK	D, E, F, G, H, I, J	7.46	0.19	0.02	198.00	8.74	87.13	301.54
Hansford, TX	A, B, C, F, L	0.87	0.10	0	114.68	2.35	0.39	118.39
Ochiltree, TX	A, K, L	1.81	0.23	0	54.00	1.16	1.13	58.33
Sherman, TX	C, F	0.48	0.08	0	211.25	1.74	0.16	213.71
Subtotals		11.62	0.91	0.02	654.53	18.32	103.54[2]	788.94

Table 3.7-26:
Average 2010 Water Use by Water Source and Category in Oklahoma and Texas Counties Containing Wind Development Zones (in million gallons per day)

County Source	Wind Development Zone within County	Water Use Categories[1]						Totals
		Public Water Supply	Domestic Self-Supplied	Industrial Self-Supplied	Irrigation	Livestock	Mining	
Surface Water Sources								
Beaver, OK	J, K	0	0	0	0.10	0	0	0.10
Cimarron, OK	G	0	0	0	0.38	0	0	0.38
Texas, OK	D, E, F, G, H, I, J	0	0	0	0.40	0	0	0.40
Hansford, TX	A, B, C, F, L	0	0	0	0.15	1.01	0.02	1.18
Ochiltree, TX	A, K, L	0	0	0	0	0.13	0.03	0.16
Sherman, TX	C, F	0	0	0	0	0.19	0	0.19
Subtotals		0	0	0	1.03	1.33	0.05	2.41
Totals		11.62	0.91	0.02	655.56	19.65	103.59	791.35

1 The data source includes water use categories for aquaculture and thermoelectric power production, but there was no water use in those categories for the counties in the table.
2 Of the 103.54 million gallons per day, 102.89 million gallons are identified as coming from saline groundwater sources.
Source: USGS (2014b)

3.7.5.8.2 Optima Substation

The future Optima Substation would be on a 160-acre site located just east of the Oklahoma Converter Station and AC Interconnection Siting Areas. Groundwater features in the ROI for the Optima Substation would be as described in the Region 1 discussion above (Section 3.7.5.1) for the Oklahoma converter station and AC interconnection. The Optima Substation would overlie the High Plains Aquifer. The depth to groundwater in the vicinity (Texas County) is typically 94 to 370 feet BGS. No groundwater of special interest is present and no wells or wellhead protection areas are expected to be present.

3.7.5.8.3 TVA Upgrades

The ROI for the direct assignment facilities (which are included in the Applicant Proposed Project) would occur within the Tennessee Converter Station Siting Area and more specifically within the Shelby Substation. The ROI for the network upgrades, and in particular TVA's future 500kV transmission line, cannot be fully determined at this time. The new 500kV transmission line would be constructed in western Tennessee. The upgrades to existing facilities would mostly be in western and central Tennessee. Principal aquifers in this area include the unconfined Mississippi River Valley alluvial aquifer (described in Section 3.7.5.5.1) in the floodplains of major rivers and confined Tertiary and Cretaceous sand aquifers. Groundwater yields can be high and groundwater is the major source for public water supplies (Bohac and Bowen 2012; Webbers 2003).

Upgrades to existing infrastructure would include upgrading terminal equipment at three existing 500kV substations and six existing 161kV substations; making appropriate upgrades to increase heights on 16 existing 161kV transmission lines to increase line ratings, and replacing the conductors on eight existing 161kV transmission lines. Where possible, general impacts associated with the required TVA upgrades are discussed in the impact sections that follow.

3.7.6 Impacts to Groundwater

3.7.6.1 Methodology

This section addresses potential impacts to groundwater that would be expected from typical construction actions for Project components. Potential impacts to groundwater during operations and maintenance, which would be minor in comparison to those during construction, are addressed in the individual Project component discussions in Sections 3.7.6.2 and 3.7.6.3. Decommissioning impacts are also discussed by individual Project component, but are described in terms of their similarity to construction impacts. Typical construction impacts from construction activities include potential impacts related to release of contaminants directly to groundwater or that could infiltrate the ground and reach groundwater, changes to infiltration and recharge rates, effects on water availability, and physical damage to well systems as described below.

3.7.6.1.1 Potential for Groundwater Contamination

Project-related contaminants, primarily in the form of fuels and lubricants, would be present in equipment or storage containers at locations where construction activities would occur and at construction staging or storage yards. Additional potential contaminants would be associated with concrete operations, including at temporary concrete batch plants that would be needed for construction areas that are too far from commercial batch plants. In any of these locations there would be the potential for contaminants to leak, spill, or otherwise accidently release to the environment. If the released quantity were large enough and not cleaned up quickly, or if infiltrating precipitation or runoff carried the release downward, contamination could reach groundwater. If a release occurred, groundwater quality could be threatened and local agricultural or drinking water wells could become contaminated. Project-related chemicals and minerals would also come into direct contact with groundwater in instances where excavation and drilling used in foundation construction went below the water table. However, as explained further below, because of the plans and permitting requirements that the Applicant would follow when conducting construction activities and because of the non-toxic nature of relevant additives, it is unlikely that construction activities would result in contaminated groundwater.

Potential water contaminants, as well as the construction actions in which they would be used, would be managed in accordance with plans and procedures that the Applicant would be required to develop and implement. The construction would require a stormwater discharge permit under the EPA’s NPDES program (Appendix C). Each of the states in which construction actions would occur has been given the authority by EPA to implement a state program. Arkansas and Tennessee implement their own state programs pursuant to this authority; Oklahoma and Texas implement their own programs except in Indian country and for specific discharges (not applicable to the Project) where EPA implements the permitting program for stormwater discharges during construction (EPA 2013). Each of these states implements its National Pollutant Discharge Elimination System (NPDES) stormwater discharge permit program through a general permit, referred to here simply as the construction general permit. Common to all of the construction general permits is the requirement for the Applicant to prepare a SWPPP, which would describe and ensure implementation of practices to reduce pollutants in stormwater discharges associated with the construction activities.

The same permit requirements that address measures to prevent stormwater contamination would act to prevent groundwater contamination because they include measures to prevent releases. These measures may include items such as using secondary containment for onsite fueling tanks or containers; providing cover, containment, and protection for chemicals, liquid products, petroleum products, and other potentially hazardous materials; using spill prevention and control measures when conducting maintenance, fueling, and repair of equipment and vehicles; and providing immediate response to any spill incident. Similarly, Clean Line would develop and follow its own SPCCP (Section 2.1.7) to minimize the potential for accidental discharge of hazardous or controlled substances. Should such a discharge occur, the elements of the SPCCP would also minimize the potential for contaminants to leave the site or reach groundwater.

Concrete operations are mentioned separately because they are common to construction actions and involve equipment carrying materials of concern in addition to fuels and lubricants. Clean Line would perform washout of concrete trucks and equipment, either at the construction site or at a temporary batch plant, at storage tanks, plastic-lined berms, or some similar containment structure. Captured liquids would not be discharged; rather, they would be allowed to evaporate or removed for disposal at an approved offsite location. Dried concrete would similarly be hauled off for proper disposal or recycling, or be broken up and used as clean fill. Clean Line may also bury hardened concrete in onsite embankments in accordance with applicable permit requirements (see Appendix F).

The deepest foundations would be those for the transmission line structures. In most instances, foundation depths for lattice structures would be about 15 feet, and for pole structures, the depths would be about 30 feet. Within the Mississippi floodplain, foundation depths generally would be greater: from 17 to 158 feet deep for lattice structures (with most foundation depths not exceeding 40 feet) and from 26 to 115 feet deep for pole structures (with most not exceeding 56 feet). Structure foundations would have to be deeper in the floodplain areas given the expected soil conditions. In the floodplain, pole structures are identified as having a more shallow range of foundations than lattice structures because, due to engineering constraints, the Applicant would need to limit the height of poles in floodplains to 130 feet to minimize the foundation depth (Thomas 2014). Lattice structures would be used exclusively in floodplain locations requiring greater heights than 130 feet. Other than possibly in the Texas and Oklahoma Panhandles, these foundation depths could reach the water table in some areas of each region of the Project. The Applicant has identified (Appendix F) two types of Project-related materials expected to come into contact with groundwater in areas where foundation construction would include work below the water table: Super Mud™ and high yield bentonite gel, both products of PDSCo. Inc. (Polymer Drilling Systems) of El Dorado, Arkansas.

Super Mud™ is described as a synthetic polymer used to create high viscosity slurries for stabilizing excavations (see Appendix F). The safety data sheet for the product provides the chemical name as anionic polyacrylamide in a water-in-oil emulsion. The only Occupational Safety & Health Administration-regulated component identified on the safety data sheet, which makes up 24 percent of the product, is "hydrotreated light petroleum distillate" (CAS No. 64742-47-8). EPA identifies this distillate as an inert material cleared for food, nonfood, and fragrance use (EPA 2014). High Yield Bentonite Gel is described as a polymer extended sodium bentonite, which is a naturally occurring clay material. It is designed for use in drilling applications and acts to stabilize the borehole walls as it circulates back to the surface, cooling the drill bit and transporting drill cuttings. The safety data sheet for this product identifies the crystalline quartz contaminants along with the nuisance dust as respirable hazards, but lists no other specific concerns. The slurries with either product would be pumped or otherwise removed from the hole prior to foundation construction, but residues would remain behind and contact with groundwater would occur during excavation or drilling. Because the materials used in these slurries do not contain contaminants of concern, impacts to groundwater would not be expected to occur.

Considering the requirements of the construction general permits, the measures that the Applicant would implement per its internal plans and procedures (Section 3.7.6.1.5), and the non-toxic nature of additives used in excavating or drilling below the water table, it is unlikely that construction activities would result in contaminated groundwater.

3.7.6.1.2 Changes to Infiltration Rates

During construction, soils at the sites of the transmission line structures and converter stations would be broken up and loosened for some period of time, either in areas of disturbed soils or in soil stockpiles, and would be expected to have lower runoff rates, and correspondingly higher infiltration rates, than before the disturbance. Higher infiltration rates would mean more water soaking into the ground that could potentially reach groundwater as recharge. At the same time, the soil in unpaved areas where heavy equipment traveled to, from, or around construction sites and in the temporary staging or storage areas could become more compacted than natural conditions and result in increased runoff and correspondingly lower infiltration rates. Conditions of loosened soil, however, would be relatively short-term and, for the most part, the disturbed areas would be restored to a pre-disturbance condition once the foundations and structures were in place. With regard to soils that may become compacted as a byproduct of equipment traffic, the Applicant would take measures to prevent serious issues such as the use of low ground pressure equipment and, as appropriate, use of temporary equipment mats. If necessary, the Applicant would also work with the landowners or tenants to determine the need for soil remediation and, as appropriate, undertake actions including decompaction, particularly in agricultural areas, to return soils to pre-disturbance conditions (Section 3.7.6.1.5). There is no evidence to suggest that the relatively small and short-term changes in infiltration rates associated with the proposed construction actions would cause noticeable changes in the area's natural groundwater recharge rates.

3.7.6.1.3 Effects on Water Availability

Adverse effects on water availability could result if the Project hindered the use of a local water well or reduced the amount of water available for other existing users. The former situation could result from the Project causing physical damage to a well or its equipment so that it was no longer operable, by taking actions such as blasting that altered local aquifer properties, or by causing contamination in a local well. As discussed further in Section 3.7.6.1.4 below, the Applicant would work with property owners or tenants to identify well locations, which would minimize the potential to inadvertently cause damage to well components, would monitor wells within 150 feet of any blasting location for changes in quality or yield, and control the use of hazardous materials. These actions would minimize the potential to release or cause contamination that could reach area wells.

Water would be needed to support construction activities, but the activities would not involve major demands for water. Water would be needed to facilitate soil compaction on access roads and at construction sites and then periodically for controlling dust on those surfaces. Slurries used in drilling and, as necessary, in stabilizing excavations would require water for their formulation. Whether mixed at commercial batch plants or at temporary portable batch plants in remote areas, water would be needed to make the concrete that would be used in foundations and for washing out concrete trucks and mixing equipment. Site restoration actions involving re-seeding or landscaping would include a water demand and some water may be required for fire prevention activities. The Applicant has considered the various construction actions that would require water and estimates the Project would require approximately 110 million gallons of water over a construction period of about 36 months (Appendix F). The Applicant would seek to obtain the water from municipal water providers along the transmission-line route where such water supplies are within a reasonable haul distance. Any other water required would be obtained through permitted sources or through supply agreements with landowners. The Applicant does not anticipate the need to drill wells to obtain water to support construction actions, but if new wells became necessary to support operational facilities, the Applicant would obtain the necessary approvals and limit withdrawal volumes so as to not adversely affect supplies for other uses (see Appendix F).

Although 110 million gallons is a substantial amount of water, when averaged over the entire construction period, it equates to about 100,000 gallons or 0.1 million gallons per day. In addition, this water demand would be spread out over a large geographic area, so the average demand of 0.1 million gallons per day would be experienced in different areas along the 700-mile route as construction progressed. Construction of the proposed converter stations, however, would be expected to cause their portions of the overall HVDC transmission line route to be associated with a higher percentage of the water demand than those sections with only transmission lines being constructed. As summarized in the average water use tables in Section 3.7.5, regional groundwater use varies from about 9 to 1,790 million gallons per day within the seven regions along the HVDC transmission line route. Because water for the Project is expected to come from municipal providers, its source could be groundwater or surface water depending on which part of the route is being worked. In any case, a water demand of 0.1 million gallons per day over the relatively short duration of construction is minor compared to quantities of groundwater already being used. Perennial or sustainable yields of aquifers along the route, where values are available, range from 87 to 2,987 million gallons per day, so in comparison to these numbers, the water demand of the Project represents an even smaller portion. Water demand associated with the Project is therefore not expected to have noticeable effects on groundwater resources beyond those resulting from existing water usage in Regions 1 through 7.

3.7.6.1.4 Physical Damage to Well Systems

If water wells or their associated piping systems were damaged due to construction activities, it could result in water availability issues for the local water user and breaks or other openings in the system could even provide an avenue for contamination to travel down the well and reach groundwater. Well system damage could occur as a result of direct impacts from equipment traffic or during excavations, and could also occur at locations more remote from construction if blasting was used at excavation sites. Blasting would only be used if determined to be the best way to deal with hard rock in an excavation site. The shock wave or ejected materials from blasting actions could cause damage to well systems at some distance from the excavation site.

To minimize potential impacts to wells, from either physical damage or from potential contaminants, the Applicant would work with landowners and tenants prior to construction to identify and mark locations of existing and planned wells and irrigation systems. If blasting were required within 150 feet of a spring or groundwater well, the Applicant would work with the landowner to perform preconstruction monitoring of yield and water quality and, if there was damage, would arrange for a temporary water supply until a permanent solution was identified (see EPMs in Section 3.7.6.1.5).

3.7.6.1.5 Environmental Protection Measures for Groundwater

The Applicant has developed and would adopt a comprehensive list of EPMs to avoid or minimize impacts to groundwater. Implementation of these EPMs is assumed throughout the impact analysis that follows for the Project. A complete list of EPMs for the Project is provided in Appendix F. The EPMs associated with groundwater are presented below in three general potential impact categories: (1) contamination, (2) runoff and infiltration rates, and

(3) water availability, including from well system damage. Each EPM is identified by its Applicant-designated reference number.

Practices would be implemented to minimize the potential for release or mismanagement of hazardous materials that could eventually result in groundwater contamination. These EPMs include the following:

- GE-1: Clean Line will train personnel on health, safety, and environmental matters. Training will include practices, techniques, and protocols required by federal and state regulations and applicable permits.
- GE-5: Any herbicides used during construction and operations and maintenance will be applied according to label instructions and any federal, state, and local regulations.
- GE-13: Emergency and spill response equipment will be kept on hand during construction.
- GE-14: Clean Line will restrict the refueling and maintenance of vehicles and the storage of fuels and hazardous chemicals within at least 100 feet from wetlands, surface waterbodies, and groundwater wells, or as otherwise required by federal, state, or local regulations.
- GE-28: Hazardous materials and chemicals will be transported, stored, and disposed of according to federal, state, or local regulations or permit requirements.
- GE-31: Clean Line will provide sanitary toilets convenient to construction; these will be located greater than 100 feet from any stream or tributary or to any wetland. These facilities will be regularly serviced and maintained; waste disposal will be properly manifested. Employees will be notified of sanitation regulations and will be required to use sanitary facilities.
- W-14: Clean Line will ensure that there is no off-site discharge of wastewater from temporary batch plant sites.

Practices would be implemented to minimize changes to stormwater runoff and infiltration rates that could potentially change quantities and locations of groundwater recharge. Such EPMs would include the following:

- GE-3: Clean Line will minimize clearing vegetation within the ROW, consistent with a Transmission Vegetation Management Plan filed with NERC, and applicable federal, state, and local regulations. The TVMP may require additional analysis under NEPA depending on whether and under what conditions DOE decides to participate in the Project.
- GE-6: Clean Line will restrict vehicular travel to the ROW and other established areas within the construction, access, or maintenance easements(s).
- GE-7: Roads not otherwise needed for maintenance and operations will be restored to preconstruction conditions. Restoration practices may include decompacting, recontouring, and re-seeding. Roads needed for maintenance and operations will be retained.
- GE-9: Clean Line will avoid and/or minimize damage to drainage features and other improvements such as ditches, culverts, levees, tiles, and terraces; however, if these features or improvements are inadvertently damaged, they will be repaired and/or restored.
- GE-27: Clean Line will minimize compaction of soils and rutting through appropriate use of construction equipment (e.g., low ground pressure equipment and temporary equipment mats).
- GE-30: Clean Line will minimize the amount of time than any excavations remain open.
- AG-2: Agricultural soils temporarily impacted by construction, operation, or maintenance activities will be restored to pre-activity conditions. For example, soil remediation efforts may include decompaction, recontouring, liming, tillage, fertilization, or use of other soil amendments.
- GEO-1: Clean Line will stabilize slopes exposed by its activities to minimize erosion.

Practices would be implemented to minimize changes to existing groundwater availability, including avoiding damage to water wells and utilities. Such EPMs would include the following:

- GE-29: Clean Line will work with landowners and operators of active oil and gas wells, utilities, and other infrastructure to identify and verify the location of facilities and to minimize adverse impacts. Identification may include use of the One Call system and surveying of existing facilities.
- W-5: Clean Line will construct access roads to minimize disruption of natural drainage patterns including perennial, intermittent, and ephemeral streams.
- W-11: Clean Line will locate and minimize impacts to groundwater wells and springs within the construction ROW.
- W-12: If blasting is required within 150 feet of a spring or groundwater well, Clean Line will conduct preconstruction monitoring of yield and water quality in cooperation with the landowner. In the event of damage, Clean Line will arrange for a temporary water supply through a local supplier until a permanent solution is identified.
- W-13: If any groundwater wells are needed to support operational facilities, withdrawal volumes will be limited so as not to adversely affect supplies for other uses.
- W-15: Clean Line will seek to procure water from municipal water systems where such water supplies are within a reasonable haul distance; any other water required will be obtained through permitted sources or through supply agreements with landowners.

3.7.6.2 Impacts Associated with the Applicant Proposed Project

3.7.6.2.1 Converter Stations and AC Interconnection Siting Areas

3.7.6.2.1.1 Construction Impacts

3.7.6.2.1.1.1 Oklahoma Converter Station Siting Area and AC Interconnection Siting Area

The Oklahoma converter station and the AC interconnection siting areas would be located over the High Plains aquifer, but not in an area with designations of special interest. No wells or wellhead protection area are located within the station siting area and a single industrial well is within the ROW of the AC interconnection. It is expected the well would be avoided by the transmission line, but in any case, potential impacts to wells would be minimized as described in Section 3.7.6.1. Potential impacts associated with construction of the station and AC interconnection line would be the same as those common impacts described in Section 3.7.6.1. In Texas County, where the depth to groundwater is great enough (about 94 to 370 feet BGS) that construction would not include work below the water table, work materials would not come into contact with groundwater during construction. Water needed to support construction of the converter station and AC interconnection—although expected to be obtained from a municipal provider—would likely come from groundwater, since groundwater is the predominant source of water in Texas County (Table 3.7-5). The amount of water required for construction of the converter station and AC interconnection would be spread over a couple of years and would not be expected to have an impact on the availability of groundwater for other uses.

3.7.6.2.1.1.2 Tennessee Converter Station Siting Area and AC Interconnection Tie

The Tennessee converter station and the AC interconnection tie would be located over the Mississippi embayment aquifer system, but not in an area with designations of special interest. No wellhead protection area or wells occur within the siting areas. Potential impacts associated with construction of the station and AC interconnection tie would be the same as those common impacts described in Section 3.7.6.1. As shown in Table 3.7-22, surface water is used heavily in Shelby County, most for thermo-electric power plant cooling, but public water supplies in Shelby County come entirely from groundwater, so water to support construction of the converter station would be expected to come from groundwater. The depth to water in Shelby County is as shallow as about 11 feet. At this depth, construction of the converter station might not encounter groundwater. If foundation construction extended below the water table, materials described in Section 3.7.6.1.1 could come into contact with groundwater. As described in that section, however, groundwater contamination would not be expected to occur.

3.7.6.2.1.2 Operations and Maintenance Impacts

Operation and maintenance of the converter stations and the AC interconnections in Oklahoma and Tennessee would not be expected to have any impacts on groundwater. No water would be needed other than the minor amount of drinking water required to support fewer than 15 full-time workers at each station; the Applicant's plans are for the stations to be connected to the municipal water system. However, the Applicant's plans also note that if a new well is required, quantities of water withdrawn would be limited so as not to adversely affect existing groundwater uses.

3.7.6.2.1.3 Decommissioning Impacts

Decommissioning of converter stations and AC interconnection lines or ties would be expected to have impacts similar to those described in Section 3.7.6.1 for common construction activities, i.e., measures would be required to manage the fuel and lubricants that would be present in equipment and actions to protect stormwater runoff at the site would ensure that contaminants did not reach groundwater. Water demand during decommissioning would be limited to that needed for actions such as dust suppression, soil compaction, and possibly re-seeding or landscaping to put the ground back into suitable condition. Water demand would be less than for construction and would not adversely impact groundwater resources.

3.7.6.2.2 AC Collection System

3.7.6.2.2.1 Construction Impacts

Evaluation of the potential impacts of the AC collection system routes is based on a representative 200-foot-wide ROW for each route. Groundwater features and elements within the ROWs were presented in Section 3.7.5.1 along with the information for the 2-mile-wide ROI.

As described in Section 3.7.6.1.1, the deepest foundations for transmission line structures would be in the range of 30 to 44 feet BGS. Based on the typical depths to groundwater (Section 3.7.5.1.1.2) in the five counties in which the AC collection system routes would be located (i.e., Beaver and Texas counties in Oklahoma and Sherman, Hansford, and Ochiltree counties in Texas), it is expected that construction of foundations for transmission line structures would not reach groundwater. Accordingly, potential impacts associated with excavating or drilling to groundwater would not be applicable.

3.7.6.2.2.1.1 Route E-1

AC Collection System Route E-1 would be located over the High Plains aquifer and includes areas over groundwater of special interest. As described in Section 3.7.5.1.2, this route would be the only AC collection system route for which the ROI would cross over any notable amount of special source groundwater area (967 acres); however, the 200-foot-wide ROW would avoid the area. The E-1 ROW would be one of the five routes that cross over groundwater with the nutrient-vulnerable designation. Of the five, AC Collection System Route E-1 would encompass the largest area (174 acres), almost twice that of the next highest route. The E-1 ROW would miss the wellhead protection area that would be in the wider ROI. As shown in Table 3.7-4, the 200-foot-wide E-1 ROW would contain only two wells, both used for industrial water supplies. Potential impacts associated with construction of the AC Collection System Route E-1 would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.2.2.1.2 Route E-2

AC Collection System Route E-2 would be located over the High Plains aquifer and include area with designations of special interest. As described in Section 3.7.5.1.2, the 200-foot-wide ROW of E-2 would avoid the special source groundwater area in the ROI and would be one of five system routes that cross over groundwater with the nutrient-vulnerable designation (at 97 acres), but would go over no wellhead protection area. As shown in Table 3.7-4, the E-2 ROW would contain eight wells, including two domestic water supply wells, but no public supply wells. Potential impacts associated with construction of AC Collection System Route E-2 would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.2.2.1.3 Route E-3

AC Collection System Route E-3 would be located over the High Plains aquifer and include area with designations of special interest. As described in Section 3.7.5.1.2, the 200-foot-wide ROW of E-3 would be one of five routes that cross over groundwater with the nutrient-vulnerable designation (at 100 acres), but would miss the small amount of wellhead protection area in the wider ROI. As shown in Table 3.7-4, the E-3 ROW would contain eight wells, including four agricultural wells and four industrial wells. Potential impacts associated with construction of AC Collection System Route E-3 would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.2.2.1.4 Route NE-1

AC Collection System Route NE-1 would be located over the High Plains aquifer and its 200-foot-wide ROW would be avoid the small amounts of special source groundwater and wellhead protection area that are in the wider ROI. As summarized in Table 3.7-4, the NE-1 ROW would contain no public water supply wells, but would contain five wells, including four agricultural wells and one industrial well. Potential impacts associated with construction of AC Collection System Route NE-1 would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.2.2.1.5 Route NE-2

AC Collection System Route NE-2 would be located over the High Plains aquifer, but not in an area with designations of special interest. As summarized in Table 3.7-4, the 200-foot-wide ROW of NE-2 would contain six wells, including two domestic water supply wells, two agricultural wells, and two industrial wells. Potential impacts associated with construction of AC Collection System Route NE-2 would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.2.2.1.6 Route NW-1

AC Collection System Route NW-1 would be located over the High Plains aquifer, but not in an area with designations of special interest. As summarized in Table 3.7-4, the 200-foot-wide ROW of NW-1 would contain almost three wells, including one agricultural well and two industrial wells. Potential impacts associated with construction of AC Collection System Route NW-1 would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.2.2.1.7 Route NW-2

AC Collection System Route NW-2 would be located over the High Plains aquifer, but not in an area with designations of special interest. As summarized in Table 3.7-4, the 200-foot-wide ROW of NW-2 would contain eight wells, including one domestic water supply well and seven agricultural wells. Potential impacts associated with construction of AC Collection System Route NW-2 would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.2.2.1.8 Route SE-1

AC Collection System Route SE-1 would be located over the High Plains aquifer and includes area with designations of special interest. As summarized in Section 3.7.5.1.2, the 200-foot-wide ROW of SE-1 is one of five routes that would cross over groundwater with the nutrient-vulnerable designation (at 14 acres), but would not pass through wellhead protection area. As shown in Table 3.7-4, the SE-1 ROW would contain five wells, including one domestic water supply well, three agricultural wells, and one industrial well. Potential impacts associated with construction of the AC Collection System Route SE-1 would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.2.2.1.9 Route SE-2

The AC Collection System Route SE-2 would be located over the High Plains aquifer, but not in an area with designations of special interest. As summarized in Table 3.7-4, the 200-foot-wide ROW of SE-2 would contain no wells. Potential impacts associated with construction of AC Collection System Route SE-2 would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.2.2.1.10 Route SE-3

The AC Collection System Route SE-3 would be located over the High Plains aquifer and includes area with designations of special interest. As summarized in Section 3.7.5.1.2, the 200-foot-wide ROW of SE-3 would be one of five routes that cross over groundwater with the nutrient-vulnerable designation (at 97 acres), but would not pass through wellhead protection area. As shown in Table 3.7-4, the SE-3 ROW would contain eight wells, including one domestic water supply well, six agricultural wells, and one industrial well. Potential impacts associated with construction of AC Collection System Route SE-3 would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.2.2.1.11 Route SW-1

AC Collection System Route SW-1 would be located over the High Plains aquifer, but not in an area with designations of special interest. As summarized in Table 3.7-4, the 200-foot-wide ROW of SW-1 would contain no wells. Potential impacts associated with construction of AC Collection System Route SW-1 would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.2.2.1.12 Route SW-2

AC Collection System Route SW-2 would be located over the High Plains aquifer, but not in an area with designations of special interest. As summarized in Table 3.7-4, the 200-foot-wide ROW of SW-2 would contain no wells. Potential impacts associated with construction of AC Collection System Route SW-2 would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.2.2.1.13 Route W-1

AC Collection System Route W-1 would be located over the High Plains aquifer, but not in an area with designations of special interest. As summarized in Table 3.7-4, the 200-foot-wide ROW of W-1 would contain seven wells, including three domestic water supply wells, the largest number of any of the route ROWs, and four agricultural wells. Potential impacts associated with construction of AC Collection System Route W-1 would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.2.2.2 Operations and Maintenance Impacts

Operation and maintenance of AC collection system routes would not impact groundwater. During operations and maintenance, no notable sources of contaminants would be in use other than the typical fuels and lubricants found in vehicles and equipment, no soil disturbance would occur, and water needs would be limited to personal needs of the few workers that would be associated with maintenance of facilities and equipment.

3.7.6.2.2.3 Decommissioning Impacts

Decommissioning of AC collection system routes would be expected to have impacts similar to those described in Section 3.7.6.1 for common construction activities, i.e., the same types of measures would be required to manage the fuel and lubricants that would be present in equipment and actions to protect stormwater runoff at the site would ensure that contaminants did not reach groundwater. Water demand during decommissioning would be limited to that needed for actions such as dust suppression, soil compaction, and possibly re-seeding or landscaping to put the ground back into suitable condition. Water demand would be less than for construction and would not adversely impact groundwater resources.

3.7.6.2.3 HVDC Applicant Proposed Route

3.7.6.2.3.1 Construction Impacts

This section addresses potential impacts from construction of the HVDC transmission line within each of the seven regions. The groundwater features considered in the evaluation for each region are those located within a representative 200-foot-wide ROW for the Applicant Proposed Route. Groundwater features and elements within the ROWs were presented in the regional discussions of Section 3.7.5 along with the information for the 1,000-foot-wide ROIs. Additionally, the ROWs were expanded by 150 feet on either side, forming 500-foot-wide corridors for use in identifying wells to account for possible physical damage from blasting (Section 3.7.6.1.4) within the ROW. Changes to impacts due to route variations and adjustments developed in response to public comments on the Draft EIS are described at the end of the applicable sections.

Considering the descriptions of the depth to groundwater in Sections 3.7.5.1 through 3.7.5.7, groundwater could be encountered during construction of the foundations for transmission line structures all along the Applicant Proposed Route, with the possible exception of the western and central portions of Region 1. Accordingly, the common impacts described in Section 3.7.6.1.1 that are associated with encountering groundwater during construction excavations or drilling could be applicable for each of the regions.

3.7.6.2.3.1.1 Region 1

Much of the Applicant Proposed Route in Region 1 would be located over the High Plains aquifer; the eastern end of the Applicant Proposed Route would pass over the North Canadian River alluvial aquifer. Groundwater designations of special interest along the Applicant Proposed Route are special source groundwater and nutrient-vulnerable groundwater. As summarized in Table 3.7-2, the 200-foot-wide ROW of the Applicant Proposed Route would encompass no special source groundwater, but would overlie 570 acres of nutrient-vulnerable groundwater. As shown in Table 3.7-3, an expanded 500-foot-wide corridor for the Applicant Proposed Route would contain 11 wells, including 2 domestic water supply wells, 8 agricultural wells, and 3 industrial wells. The Applicant Proposed Route also would not pass through wellhead protection area. Potential impacts associated with construction of the Applicant Proposed Route would be the same as those common impacts described in Section 3.7.6.1.

No route variations were proposed in Region 1.

3.7.6.2.3.1.2 Region 2

The most significant aquifers along the Applicant Proposed Route in Region 2 are the North Canadian River and Cimarron River alluvial aquifers. Groundwater designations of special interest along the Applicant Proposed Route are special source groundwater and nutrient-vulnerable groundwater. As summarized in Table 3.7-7, the 200-foot-wide ROW of the Applicant Proposed Route would encompass no special source groundwater, but would overlie 1,635 acres of nutrient-vulnerable groundwater. The Region 2 ROW would encompass only 7 acres of wellhead protection area. As shown in Table 3.7-8, the expanded ROW for the Applicant Proposed Route would contain 10 wells, including 2 domestic water supply wells, 5 agricultural wells, 3 three industrial wells. Potential impacts associated with construction of the Applicant Proposed Route would be the same as those common impacts described in Section 3.7.6.1.

The variations involve very minor changes in the amount of nutrient-vulnerable groundwater that would be crossed and, at most, one additional well within the 500-foot-wide corridor of the end-to-end route would be present. These minor changes in the groundwater elements would not affect the potential impacts associated with construction.

3.7.6.2.3.1.3 Region 3

The Applicant Proposed Route in Region 3 would pass over only one principal aquifer, the Ada-Vamoosa aquifer. Groundwater designations of special interest along the Applicant Proposed Route are special source groundwater and nutrient-vulnerable groundwater. As summarized in Table 3.7-10, the 200-foot-wide ROW of the Applicant Proposed Route would encompass no special source groundwater, but would overlie 261 acres of nutrient-vulnerable groundwater. No wellhead protection area would be located along the Applicant Proposed Route. As shown in Table 3.7-11, the expanded ROW for the Applicant Proposed Route would contain twelve wells, all domestic water supply wells. Potential impacts associated with construction of the Applicant Proposed Route would be the same as those common impacts described in Section 3.7.6.1.

The variations involve a small 16-acre increase (all attributed to Applicant Proposed Route Links 1 and 2, Variation 1) in the amount of nutrient-vulnerable groundwater that would be crossed and, at most, six additional wells within the 500-foot-wide corridor of the end-to-end route would be present. As indicated in Section 3.7.6.1.5, the Applicant would work with landowners and tenants to minimize impacts to wells as necessary. These minor changes in the groundwater elements would not affect the potential impacts associated with construction.

3.7.6.2.3.1.4 Region 4

The western end of the Applicant Proposed Route in Region 4 would pass over the Arkansas River alluvial aquifer, but that is the only principal or major aquifer in the region. Groundwater designations of special interest along the Applicant Proposed Route are special source groundwater and nutrient-vulnerable groundwater in Oklahoma and critical groundwater area in Arkansas. As summarized in Table 3.7-13, the 200-foot-wide ROW for the Applicant Proposed Route would encompass 159 acres of special source groundwater, 99 acres of nutrient-vulnerable groundwater, and no critical groundwater area. No wellhead protection areas would be located along the Applicant Proposed Route. As shown in Table 3.7-14, the expanded ROW for the Applicant Proposed Route would contain only one well, a domestic water supply well. If the Applicant were to use the Lee Creek Variation, the route ROW would cross very similar areas of special source groundwater and nutrient-vulnerable groundwater; there would be no difference in the number of wells encountered. Potential impacts associated with construction of the Applicant Proposed Route would be the same as those common impacts described in Section 3.7.6.1.

The route variations would cross no areas overlying groundwater of special interest and there would be no changes in the number of wells within the 500-foot-wide corridor of the end-to-end route. These minor changes in the groundwater elements would not affect the potential impacts associated with construction.

3.7.6.2.3.1.5 Region 5

The eastern end of the Applicant Proposed Route in Region 5 would pass over the Mississippi River Valley alluvial aquifer, and it is the only principal or major aquifer in the region. The groundwater designation of special interest along the Applicant Proposed Route is critical groundwater area, but there are no groundwater designations of special interest or wellhead protection area along the 200-foot-wide ROW of the Applicant Proposed Route. As shown in Table 3.7-16, the expanded ROW for the Applicant Proposed Route would contain four wells, including one domestic water supply well and three wells used for agricultural purposes. Potential impacts associated with construction of the Applicant Proposed Route would be the same as those common impacts described in Section 3.7.6.1.

The variations would cross no areas overlying groundwater of special interest and at most two additional wells would be encountered within the 500-foot-wide corridor of the end-to-end route. These minor changes in the groundwater elements would not affect the potential impacts associated with construction.

3.7.6.2.3.1.6 Region 6

The Applicant Proposed Route in Region 6 would traverse two principal aquifers in its path from west to east. From the west, it would cross the Mississippi River Valley alluvial aquifer, the Mississippi embayment aquifer system (crossing Crowley's Ridge in eastern Arkansas), and the Mississippi River Valley alluvial aquifer again in the east. The groundwater designation of special interest along the Applicant Proposed Route is critical groundwater area. As summarized in Table 3.7-18, the 200-foot-wide ROW of the Applicant Proposed Route would cross over 516 acres of critical groundwater area and per Table 3.7-19, would not cross wellhead protection area. Also as shown in Table 3.7-19, the expanded ROW for the Applicant Proposed Route would contain nine wells, all agricultural wells. Potential impacts associated with construction of the Applicant Proposed Route would be the same as those common impacts described in Section 3.7.6.1.

The variation would cross no areas overlying groundwater of special interest and at most encounter an additional three wells within the 500-foot-wide corridor of the end-to-end route. These minor changes in the groundwater elements would not affect the potential impacts associated with construction.

3.7.6.2.3.1.7 Region 7

The Applicant Proposed Route in Region 7 would traverse two principal aquifers in its path from west to east, the Mississippi River Valley alluvial aquifer in the west and the Mississippi embayment aquifer system to the east. Groundwater designations of special interest along the Applicant Proposed Route are critical groundwater areas in Arkansas and special source water and site-specific impaired groundwater in Tennessee. No groundwater designations of special interest or wellhead protection area were identified along the Applicant Proposed Route. As shown in Table 3.7-21, the expanded ROW (i.e., a 500-foot-wide corridor) for the Applicant Proposed Route would contain 15 wells, all identified as being used for agricultural purposes. Potential impacts associated with construction of the Applicant Proposed Route would be the same as those common impacts described in Section 3.7.6.1.

The variations would cross no areas overlying groundwater of special interest and at most would encounter an additional two wells within the 500-foot-wide corridor of the end-to-end route. These minor changes in the groundwater elements would not affect the potential impacts associated with construction.

3.7.6.2.3.2 Operations and Maintenance Impacts

Operations and maintenance of the HVDC transmission line in Regions 1 through 7, using the Applicant Proposed Route, would not impact groundwater. During operations and maintenance, no notable sources of contaminants would be in use other than the typical fuels and lubricants found in vehicles and equipment, no soil disturbance would occur, and water needs would be limited to personal needs of the few workers that would be associated with maintenance of facilities and equipment.

3.7.6.2.3.3 Decommissioning Impacts

Decommissioning of HVDC transmission lines would be expected to have impacts similar to those described in Section 3.7.6.1 for common construction activities, i.e., the same types of measures would be required to manage the fuel and lubricants that would be present in equipment and actions to protect stormwater runoff at the site would ensure that contaminants did not reach groundwater. Water demand during decommissioning would be limited to that needed for actions such as dust suppression, soil compaction, and possibly re-seeding or landscaping to put the ground back into suitable condition. Water demand primarily would be for dust suppression, soil compaction, and possibly re-seeding or landscaping to put the ground back into suitable condition. Water demand would be expected to be less than for construction and would not adversely impact groundwater resources.

3.7.6.3 Impacts Associated with the DOE Alternatives

3.7.6.3.1 Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area

3.7.6.3.1.1 Construction Impacts

The Arkansas Converter Station Alternative Siting Area and Alternative AC Interconnection Siting Area, including the site of the new substation at the southern end of the AC Interconnection Siting Area, would be located over an area that has no principal aquifer. This area has few subsurface strata that yield sufficient water to qualify as aquifers. No wellhead protection area or wells are present in the siting areas. Potential impacts associated with construction of the converter station, AC interconnection line, and substation would be the same as those common impacts described in Section 3.7.6.1. Surface water is the predominant source of water in Pope County (Table 3.7-17), where the siting areas are located, so water to support construction of the converter station, AC interconnection line, and substation would likely not come from groundwater even though it is expected to be obtained from a municipal provider. Although water depth measurements were not available for Pope County, water tables in other portions of Region 5 of the HVDC transmission line route are often shallow, so construction actions could encounter groundwater even though the water-bearing strata may not qualify as an aquifer.

3.7.6.3.1.2 Operations and Maintenance Impacts

Operation and maintenance of the Arkansas converter station, AC interconnection line, and substation would not be expected to have any impacts on groundwater. There would be no water demand other than the minor amount of drinking water required to support fewer than 15 full-time workers and the station would be connected to the municipal water system.

3.7.6.3.1.3 Decommissioning Impacts

Decommissioning of Arkansas converter station, AC interconnection line, and substation would be expected to have impacts similar to those described in Section 3.7.6.1 for common construction activities, i.e., the same types of measures would be required to manage the fuel and lubricants that would be present in equipment and actions to protect stormwater runoff at the site would ensure that contaminants did not reach groundwater. Water demand during decommissioning would be limited to that needed for actions such as dust suppression, soil compaction, and possibly re-seeding or landscaping to put the ground back into suitable condition. Water demand would be less than for construction and would not adversely impact groundwater resources.

3.7.6.3.2 HVDC Alternative Routes

3.7.6.3.2.1 Construction Impacts

This section addresses potential impacts from construction of the HVDC transmission line within the HVDC alternative routes identified for each of the same seven regions considered for the Applicant Proposed Route. The groundwater features considered in the evaluation of the HVDC alternative routes are those located within a representative 200-foot-wide ROW corridor (i.e., 100 feet on either side of the centerline of the alternative route). Groundwater features and elements within the ROWs were presented in the regional discussions of Section 3.7.5 along with the information for the 1,000 foot-wide ROIs. Additionally, the ROWs were expanded by 150 feet on either side, forming 500-foot-wide corridors for use in identifying wells to account for possible physical damage from blasting (Section 3.7.6.1.4) within the ROW.

As identified for the Applicant Proposed Route, depths to groundwater in each of the regions (Sections 3.7.5.1 through 3.7.5.7) indicate that groundwater could be encountered during construction of the foundations for transmission line structures all along the various HVDC alternative routes, with the possible exception of those in the western and central portions of Region 1. Accordingly, the common impacts described in Section 3.7.6.1.1 that are associated with encountering groundwater during construction excavations or drilling could be applicable for each of the regions.

3.7.6.3.2.1.1 Region 1

HVDC Alternative Routes 1-A through 1-D would be located largely over the High Plains aquifer and the eastern ends pass over the North Canadian River alluvial aquifer. The ROIs of HVDC alternative routes in Region 1 would encompass areas with groundwater designations of special interest and wellhead protection areas. As shown in Table 3.7-2, the 200-foot-wide ROWs of HVDC Alternative Routes 1-A, 1-B, and 1-C would cross 314, 5, and 51 more acres, respectively, of nutrient-vulnerable groundwater area than the corresponding links of the Region 1 Applicant Proposed Route, and HVDC Alternative Route 1-D would cross the same amount of area. Like the Applicant Proposed Route, none of the Region 1 HVDC alternative routes would cross wellhead protection areas. As shown in Table 3.7-3, the combined number of wells (domestic, agricultural, and industrial) encompassed by the expanded (500-foot-wide) ROWs of HVDC Alternative Routes 1-A, 1-B, and 1-C would be fewer by four, four, and six wells, respectively, than encompassed by the corresponding links of the Region 1 Applicant Proposed Route, while the combined number of wells within the expanded ROW of HVDC Alternative Route 1-D would be eight greater than the Applicant Proposed Route. Potential impacts associated with construction of an HVDC alternative route in Region 1 would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.3.2.1.2 Region 2

The most significant aquifers along the Region 2 HVDC alternative routes are the North Canadian River and Cimarron River alluvial aquifers. As summarized in Tables 3.7-7 and 3.7-8, the HVDC alternative routes in Region 2 would encompass areas with two groundwater designations of special interest: nutrient-vulnerable groundwater and wellhead protection area. The 200-foot-wide ROW of HVDC Alternative Route 2-A would cross 81 more acres of nutrient-vulnerable groundwater than the corresponding links of the Region 2 Applicant Proposed Route, while 2-B would cross 155 fewer acres. With respect to well head protection area, the ROW of HVDC Alternative Route 2-A would cross 21 more acres than the corresponding links of the Applicant Proposed Route and 2-B would cross none compared to 7 acres by the Applicant Proposed Route. As shown in Table 3.7-8, the combined number of wells (domestic, agricultural, and industrial) encompassed by the expanded (500-foot-wide) ROW of HVDC Alternative Route 2-A would be one more than encompassed by the corresponding links of the Region 2 Applicant Proposed Route, while the total number of wells within the expanded ROW of HVDC Alternative Route 2-B would be two less. Of note in these numbers, HVDC Alternative Route 2-A would encompass two public water supplies wells compared to none in the corresponding links of the Applicant Proposed Route. Potential impacts associated with construction of any of the HVDC alternative routes in Region 2 would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.3.2.1.3 Region 3

The HVDC alternative routes in Region 3 would pass over the principal aquifer, the Ada-Vamoosa aquifer, and HVDC Alternative Route 3-C also would pass over the edge of a second principal aquifer, the Central Oklahoma aquifer. As summarized in Tables 3.7-10 and 3.7-11, the HVDC alternative routes in Region 3 would encompass areas with two groundwater designations of special interest: nutrient-vulnerable groundwater and wellhead protection area. As shown in Table 3.7-10, the 200-foot-wide ROWs of HVDC Alternative Routes 3-A, 3-B, and 3-C would cross 58, 103, and 56 fewer acres, respectively, of nutrient-vulnerable groundwater area than the corresponding links of the Region 3 Applicant Proposed Route, and HVDC Alternative Routes 3-D and 3-E would cross the same amount of area. With respect to wellhead protection area, the ROW of HVDC Alternative Route 3-C would cross 11 acres while the ROWs of the other HVDC alternative routes as well as the Applicant Proposed Route would encompass none. As shown in Table 3.7-11, the combined number of wells (domestic, agricultural, and industrial) encompassed by the expanded (500-foot-wide) ROW of HVDC Alternative Route 3-A would be one more than encompassed by the corresponding links of the Region 3 Applicant Proposed Route, while the total number of wells within the expanded ROW of HVDC Alternative Route 3-C would be four less; the expanded ROWs of HVDC Alternative Routes 3-B, 3-D, and 3-E would be the same as the corresponding links of the Applicant Proposed Route. Potential impacts associated with construction of an HVDC alternative routes in Region 3 would be the same as those common impacts described in Section 3.7.6.1.

As described in Appendix M and summarized in Section 2.4.2.3, a route adjustment was developed for HVDC Alternative Route 3-A to maintain an end-to-end route with the Applicant Proposed Route Links 1 and 2, Variation 1. The adjustment to HVDC Alternative Route 3-A would involve a very small decrease (0.4 acre) in the amount of nutrient-vulnerable groundwater crossed by the alternative and would involve no change in the number of wells within the 500-foot-wide corridor. These minor changes in the groundwater elements would not affect the potential impacts associated with construction.

3.7.6.3.2.1.4 Region 4

The only principal or major aquifer passed over by the HVDC alternative routes in Region 4 would be the Arkansas River alluvial aquifer. As summarized in Table 3.7-13, groundwater designations of special interest along the Region 4 HVDC alternative routes are special source groundwater and nutrient-vulnerable groundwater. The 200-foot-wide ROWs of HVDC Alternative Routes 4-A and 4-B would cross 108 and 90 more acres, respectively, of special source groundwater than the corresponding links of the Region 4 Applicant Proposed Route. With respect to nutrient-vulnerable groundwater, the ROWs of HVDC Alternative Routes 4-A and 4-B would cross no designated areas, but the corresponding links of the Applicant Proposed Route would cross 76 and 95 acres, respectively. The ROWs of HVDC Alternative Routes 4-C, 4-D, and 4-E, being in Arkansas, would cross no area of special source groundwater or nutrient-vulnerable groundwater just as the corresponding links of the Applicant Proposed Route would cross none. As shown in Table 3.7-14, the combined number of wells (domestic, agricultural, and industrial) encompassed by the expanded (500-foot-wide) ROWs of HVDC Alternative Routes 4-A, 4-B, and 4-D would be more by 6, 12, and 1, respectively, than encompassed by the corresponding links of the Region 4 Applicant Proposed Route. No wells would be within the expanded ROW of HVDC Alternative Routes 4-C and 4-E, just as there would be no wells in corresponding links of the Applicant Proposed Route. Potential impacts associated with construction of an HVDC alternative route in Region 4 would be the same as those common impacts described in Section 3.7.6.1.

HVDC Alternative Route 4-B passes through national forest land. The greater amount of special source groundwater and number of wells that would be encompassed by this alternative route, as compared to the corresponding links of the Applicant Proposed Route, might be considered to represent more potential for environment impact. However, the potential would still remain low.

3.7.6.3.2.1.5 Region 5

The eastern end of the HVDC alternative routes in Region 5 would pass over the Mississippi River Valley alluvial aquifer, the only principal or major aquifer in the region. No groundwater designations of special interest are present along HVDC alternative routes in Region 5 and the 200-foot-wide ROWs of all alternative routes avoid wellhead protection area. As shown in Table 3.7-16, the combined number of wells (domestic, agricultural, and industrial) encompassed by the expanded (500-foot-wide) ROWs of HVDC Alternative Routes 5-A, 5-B, and 5-E would be more by one, two, and one, respectively, than the number of wells in the corresponding links of the Region 5 Applicant Proposed Route. The ROWs of HVDC Alternative Routes 5-C and 5-F would contain the same number of wells as the corresponding links of the Applicant Proposed Route, and the ROW of HVDC Alternative Route 5-D would contain two fewer wells than the corresponding links of the Applicant Proposed Route. Potential impacts associated with construction of an HVDC alternative route in Region 5 would be the same as those common impacts described in Section 3.7.6.1.

As described in Appendix M and summarized in Section 2.4.2.5, a route adjustment was developed for HVDC Alternative Route 5-B to maintain an end-to-end route with the Applicant Proposed Route Links 2 and 3, Variation 1. Another route adjustment was developed for HVDC Alternative Route 5-E to maintain an end-to-end route with the Applicant Proposed Route Links 3 and 4, Variation 2. The adjustments to HVDC Alternative Routes 5-B and 5-E would not overlie groundwater of special interest and they would result in no change in the number of wells within the 500-foot-wide corridor of either alternative. The minor changes in HVDC Alternative Routes 5-B and 5-E would not affect the potential impacts associated with construction.

3.7.6.3.2.1.6 Region 6

The HVDC alternative routes in Region 6 would traverse two principal aquifers in their paths from west to east. From the west, they would cross the Mississippi River Valley alluvial aquifer, the Mississippi embayment aquifer system (crossing Crowley's Ridge in eastern Arkansas), and the Mississippi River Valley alluvial aquifer again in the east. The only groundwater designation of special interest along the HVDC alternative routes in Region 6 is critical groundwater area. As shown in Table 3.7-18, the 200-foot-wide ROW of HVDC Alternative Route 6-A would cross 24 fewer acres of critical groundwater area than the corresponding links of the Region 6 Applicant Proposed Route, and HVDC Alternative Route 6-B would cross 2 more acres than the corresponding links of the Applicant Proposed Route. The ROWs of HVDC Alternative Routes 6-C and 6-D would cross the same amount of designated area as the corresponding links of the Applicant Proposed Route. The 200-foot-wide ROWs of all alternative routes avoid wellhead protection area. As shown in Table 3.7-19, the combined number of wells (domestic, agricultural, and industrial) encompassed by the expanded (500-foot-wide) ROWs of HVDC Alternative Routes 6-A, 6-B, and 6-C would each be one more well than encompassed by the corresponding links of the Region 6 Applicant Proposed Route, while the total number of wells within the expanded ROW of HVDC Alternative Route 6-D would be two less. Potential impacts associated with construction of an HVDC alternative route in Region 6 would be the same as those common impacts described in Section 3.7.6.1.

As described in Appendix M and summarized in Section 2.4.2.6, a route adjustment was developed for HVDC Alternative Route 6-A to maintain an end-to-end route with the Applicant Proposed Route Links 2, Variation 1. The adjustment to HVDC Alternative Route 6-A underlies no groundwater of special interest and would involve no change in the number of wells within the 500-foot-wide corridor of the alternative. The minor adjustment in HVDC Alternative Route 3-A would not affect the potential impacts associated with construction.

3.7.6.3.2.1.7 Region 7

The HVDC alternative routes in Region 7 would traverse two principal aquifers in their path from west to east, the Mississippi River Valley alluvial aquifer in the west and the Mississippi embayment aquifer system to the east. Like the Applicant Proposed Route, no groundwater designations of special interest—or wellhead protection area—are identified along the Region 7 HVDC alternative routes. As shown in Table 3.7-21, the combined number of wells (domestic, agricultural, and industrial) encompassed by the expanded (500-foot-wide) ROW of HVDC Alternative Route 7-A would be five more than encompassed by the corresponding links of the Region 7 Applicant Proposed Route and they are all agricultural wells. There are no wells in the expanded ROWs of HVDC Alternative Routes 7-B, 7-C, and 7-D, the same as for the corresponding links of the Applicant Proposed Route. Potential impacts associated with construction of an HVDC alternative route in Region 7 would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.3.2.2 Operations and Maintenance Impacts

Operation and maintenance of an HVDC transmission line in Regions 1 through 7, using any of the HVDC alternative routes, would not impact groundwater. During operations and maintenance, no notable sources of contaminants would be in use other than the typical fuels and lubricants found in vehicles and equipment, no soil disturbance would occur, and water needs would be limited to personal needs of the few workers that would be associated with maintenance of facilities and equipment.

3.7.6.3.2.3 Decommissioning Impacts

Decommissioning of HVDC transmission lines, with the Applicant Proposed Route or any of the HVDC alternative routes, would be expected to have impacts similar to those described in Section 3.7.6.1 for common construction activities, i.e., the same types of measures would be required to manage the fuel and lubricants that would be present in equipment and actions to protect stormwater runoff at the site would ensure that contaminants did not reach groundwater. Water demand during decommissioning would be limited to that needed for actions such as dust suppression, soil compaction, and possibly re-seeding or landscaping to put the ground back into suitable condition. Water demand would be expected to be less than for construction and would not adversely impact groundwater resources.

3.7.6.4 Best Management Practices

The Applicant has developed a comprehensive list of EPMs that would avoid and minimize impacts to groundwater. A complete list of EPMs for the Project is provided in Appendix F; those EPMs that would minimize the potential for release or mismanagement of hazardous materials, changes to stormwater runoff and infiltration rates, and changes to existing groundwater availability are identified in Section 3.7.6.1.5. The EPMs are sufficiently comprehensive to minimize or avoid potential adverse impacts to groundwater. DOE has therefore not identified any additional groundwater-related best management practices.

3.7.6.5 Unavoidable Adverse Impacts

Standard construction practices along with the EPMs to which the Applicant has committed (Section 3.7.6.1.5) should avoid adverse impacts to groundwater with the exception that water resources would be required to support the construction. Although the water needed for the Project is expected to come from municipal water systems, some of that municipal water would undoubtedly come from groundwater sources. To the extent that groundwater resources are replenished by cyclic, seasonal recharge, adverse impacts would be small and relatively short-term, but there would be a minor reduction in groundwater available for other uses or natural features while the construction took place.

As described in Section 3.7.6.1.1, common materials present during construction would be considered groundwater contaminants were those materials to be spilled, leaked, or otherwise released and eventually reach groundwater. The potential for groundwater quality problems is minor because measures required by permits as well as the additional measures that would be implemented by the Applicant (i.e., the EPMs of Section 3.7.1.6.5) would ensure proper management of such materials and appropriate responses to any releases should they occur, but the potential would not be eliminated.

Water (some likely from groundwater sources) would also be needed to support operations and maintenance of the transmission lines and converter stations, but the quantities would be minor in comparison to quantities currently used in the region.

3.7.6.6 Irreversible and Irretrievable Commitment of Resources

The Project would involve a commitment of groundwater resources, but at least to some extent, those resources would be replenished by cyclic seasonal recharge. The commitment of groundwater resources would be irreversible in that it would limit, in the short term, other options for use of that resource. Over time, however, the amounts of groundwater used to support construction would be expected to have a negligible effect on groundwater resources. In sum, the groundwater resource would be renewable or recoverable, so the commitment would not be considered irretrievable.

3.7.6.7 Relationship between Local Short-term Uses and Long-term Productivity

Groundwater required to support the Project would represent a new, short-term use of the resource, but would have negligible effect on its long-term productivity.

3.7.6.8 Impacts from Connected Actions

3.7.6.8.1 Wind Energy Generation

3.7.6.8.1.1 Construction Impacts

Construction of wind farms in the Oklahoma and Texas Panhandle regions would be expected to involve potential impacts to groundwater similar to those described in Section 3.7.6.1 for common construction activities under the Project. Sources of contamination, primarily in the form of fuels and lubricants, would be present at construction sites and at associated construction staging and storage yards. Soils in construction areas, access routes, and support areas would be disturbed and, for at least some period of time, would be expected to experience changes in stormwater infiltration and runoff rates as compared to undisturbed conditions. Water needs to support construction activities could affect the availability of groundwater resources for other users in the region. The construction actions could also affect local groundwater availability by causing damage to existing wells or piping systems.

The groundwater features that could be affected by construction or that could alter construction approaches due to added requirements are presented in Section 3.7.5.8.1 by WDZ. Although there are differences in groundwater features between the WDZs, DOE has no way of predicting precisely where wind farms might be constructed within the WDZs and therefore cannot address whether those features would be of concern to a specific wind farm proposal. Further, it is estimated that future wind farm developments utilizing the Applicant’s transmission line would include only 20 to 30 percent of any WDZ (Clean Line 2014) and the nature of wind farm developments is that large areas are required, but only relatively small areas are physically impacted. As a result, wind farm design would be expected to have flexibility on where roads and facilities were placed and what locations, specifically those with environmental concerns, could be avoided. Because of these factors, DOE has not identified potential groundwater impacts for individual WDZs; rather the discussion that follows provides more detail on the typical impacts that would be expected from the construction of wind farms within any of the WDZs.

3.7.6.8.1.1.1 Potential for Groundwater Contamination

Construction of even one large wind turbine would involve land disturbance of more than 1 acre (BLM 2005), which is the trigger in both Oklahoma and Texas for requiring a construction general permit for stormwater discharges under the EPA NPDES program as implemented by each state. Accordingly, construction of a wind farm in either state would be subject to the requirements of a construction general permit and the standard permit provisions described in Section 3.7.6.1.1. The future wind farm developer would be required to prepare and implement a SWPPP, which would in turn act to prevent groundwater contamination by requiring actions to prevent contaminant releases. If wind farm construction required setup of a temporary concrete batch plant, its operation would also be subject to permit requirements. Since wind farm developments require relatively small amounts of permanently disturbed or dedicated land (or restated, large areas of land remain unused between individual wind turbines) (Denholm et al. 2009), it is typical for them to be located on private land under lease agreements with landowners. Since some type of formal agreement with landowners would be expected, it is unlikely that wind farm construction would take place without knowing the exact locations of existing features such as wells that are important to the landowner. It is reasonable to assume that any actions that might damage or contaminate any wells (and groundwater) would be avoided.

Wind farm construction activities could involve foundation depths up to 40 feet if pier foundations are used, but the often-used mat foundations, while requiring more land area, generally do not require excavations of more than 10 feet in depth (DOE 2013). As shown by the water table depths in Table 3.7-23, construction of pier foundations in WDZs in Beaver County, Oklahoma, or in Ochiltree County, Texas (i.e., WDZ-A, -J, -K, and -L), could encounter groundwater, but in the other counties, construction would be unlikely to reach groundwater. Construction of mat foundations would be unlikely to encounter groundwater in any of the WDZs. As described in Section 3.7.6.1.1 for the Project, if foundations for wind turbines or other facilities involve excavations or drillings that reach groundwater, materials such as drilling muds or bentonite could be used to help stabilize excavation or borehole walls. Although they would come into contact with groundwater, these materials are formulated to be relatively immobile in groundwater (they adhere to and stabilize soil surfaces), are non-toxic, and would be used for their intended purposes.

With the wind farm development elements described above, it is expected that construction of the connected action would involve the same minor potential for groundwater contamination impacts as described in Section 3.7.6.1.1 for general construction under the Project.

3.7.6.8.1.1.2 Changes to Infiltration Rates

As described in Section 3.7.6.1.2 for the Project, soils at connected action construction sites would be broken up, loosened, and stockpiled for some period of time during which such soils would have higher infiltration rates, possibly with higher groundwater recharge, than undisturbed soils. Similarly, soil in some areas could be compacted intentionally to improve its stability or indirectly through equipment traffic and have lower infiltration rates as a result. However, such conditions would be expected to be relatively short-term, with most soils being restored to a pre-disturbance condition once foundations and structures were in place. Also, areas of permanent or long-term disturbance would be relatively small compared to surrounding areas not disturbed by the connected action; it is estimated that the footprint of all wind farm facilities and structures, including maintained access roads, would be approximately 1 percent of the total wind farm area (Denholm et al. 2009). The relatively small and short-term changes in infiltration rates would not be expected to result in any noticeable changes in the area's natural groundwater recharge rates.

3.7.6.8.1.1.3 Effects on Water Availability

Water would be needed to support construction of the connected action wind farms. As shown in Table 3.7-26, the majority of water used in the six-county area of the WDZs comes from groundwater. Accordingly, it is assumed that whatever water is needed to support construction of the connected action wind farms would be from groundwater sources. Primary water needs would include use for soil compaction during road, substation, and wind turbine foundation construction; as a component of concrete; and for dust suppression.

The BLM (2010) estimated that 9.8 million gallons of water would be required over an 8-month construction period for a typical wind farm of 34 to 52 wind turbines, each with a capacity of 3MW. For the current evaluation, it is conservatively assumed that this would be the water demand for 34 such wind turbines, which equates to a construction water demand of 96,000 gallons/MW of wind farm generating capacity. The Applicant assumes that the total capacity of the wind farms in the WDZs would have to be 4,000 to 4,550MW to achieve the Project's full utilization of 3,500 to 4,000MW. The Applicant also assumes that 90 percent of this total capacity can be constructed in a 2-year time frame leading up to the operation date of the Project, with the remaining 10 percent constructed in the following year (Clean Line 2014). At 90 percent of 4,550MW and an estimated construction water demand of 96,000 gallons/MW, it is estimated that 363 million gallons of water would be needed during 2 years of peak wind farm construction, or an average water demand of 0.54 million gallons per day during the 2-year period.

The Applicant estimates the maximum wind development for the individual WDZs ranges from a minimum of 300MW (for WDZ-D and WDZ-E) to a maximum of 1,300MW (for WDZ-G). To construct wind farms with a combined capacity of 4,095MW (i.e., 90 percent of 4,550MW) in two years, it is clear that the estimated water demand of 0.54 million gallons per day would be spread out over multiple WDZs. At any given time, the water demand could be focused in a small number of the zones, but over time the average demand in any single zone would be expected to be only a fraction of the 0.54 million gallons per day. Although a notable amount of water, 0.54 million gallons per day is only 0.07 percent of the 791 million gallons per day (Table 3.7-26) used in the six-county area in which the WDZs are located. On a county-by-county basis, however, 0.54 million gallons per day represents as much as 1.3 percent of a county's water use (in the case of Beaver County, Oklahoma). As noted above, however, over the two-year construction period, the total water demand would have to be spread out over multiple WDZs and multiple counties.

Since groundwater is the predominant source of water used in the six-county region of the WDZs (Table 3.7-26), it is assumed that water to support construction of the connected action wind farms would be obtained from new wells or, more likely, from existing wells and existing water rights holders. Irrigation is the predominant water use in all six counties (Table 3.7-26) and there are large numbers of agricultural wells in each of the WDZs (Table 3.7-25). It seems less likely that any significant portion of the water demand would be obtained from public water systems because the public water systems in all six counties produce less than 12 million gallons per day, with three of the counties producing about 0.5 million gallons per day each. It is important to note that the water needed to support the primary construction demands would not have to be of drinking water quality.

3.7.6.8.1.2 Operations and Maintenance Impacts

Operations and maintenance of wind farm facilities in any of the WDZs would not impact groundwater. During operations and maintenance, no notable sources of contaminants would be in use other than the typical fuels and lubricants found in vehicles and equipment, no soil disturbance would occur, and water needs would be limited to personal needs of the few workers that would be associated with maintenance of facilities and equipment.

3.7.6.8.1.3 Decommissioning Impacts

Decommissioning of wind farms would be expected to have impacts similar to those described in Section 3.7.6.8.1 and in more detail in Section 3.7.6.1 for common construction activities. Measures would be required to manage the fuel and lubricants that would be present in equipment and actions would be taken to protect stormwater runoff at the site to ensure that contaminants did not reach groundwater. Water demand during decommissioning would be limited to the amounts needed for actions such as dust suppression, soil compaction, and possibly re-seeding or landscaping to put the ground back into suitable condition. Water demand would be expected to be less than for construction and would not adversely impact groundwater resources.

3.7.6.8.2 Optima Substation

Groundwater impacts from construction of the Optima Substation would be the same as described in Section 3.7.6.2.1 for the Oklahoma converter station and AC interconnection and the common construction impacts described in Section 3.7.6.1. Depths to groundwater are great enough that it is unlikely that groundwater would be reached during excavation for the substation’s foundation. Impacts during operations and maintenance would be expected to be similar to those described for the Oklahoma converter station and AC interconnection in Section 3.7.6.2.1.

3.7.6.8.3 TVA Upgrades

Groundwater impacts of concern for the required TVA upgrades, like the Project, are associated with the potential for groundwater contamination, changes to infiltration rates, effects on water availability, and physical damage to well systems. These concerns would be limited primarily to construction activities associated with the new transmission line. The TVA upgrades would not be expected to use large quantities of water during long-term operations.

The new transmission line would be expected to involve the presence of the same type of potential contaminants (primarily fuels and lubricants in equipment) during construction and to implement the same type of measures to ensure those contaminants were not released. The construction would be expected to involve relatively minor changes to infiltration rates and, to minimize potential liability, TVA would take precautions to ensure that equipment movement and excavations did not unknowingly damage well systems. Water needs for dust suppression, soil compaction, equipment cleaning, and concrete formulation would be relatively minor and short term. There would be little potential for impacts to groundwater during upgrades involving modifications to existing facilities. A possible exception would be if replacement of structures was required as part of the upgrades to existing transmission lines. These type activities could involve new ground disturbances and potential for impacts to groundwater similar to those described for typical construction.

3.7.6.9 Impacts Associated with the No Action Alternative

Under the No Action Alternative, DOE assumes for analytical purposes that the Project would not move forward. Groundwater conditions would remain as described in the affected environment descriptions of Section 3.7.5.

This page intentionally left blank.

Contents

Tables

This page intentionally left blank.

3.8 Health, Safety, and Intentional Destructive Acts

This section presents the results of DOE's analysis of potential health and safety impacts associated with the Project. Some additional health and safety concerns regarding members of the public are addressed in individual resource area discussions elsewhere in this EIS including electrical environment (Section 3.4), surface and subsurface instability (Section 3.6), noise (Section 3.11), surface water resources (Section 3.15), and transportation (Section 3.16).

3.8.1 Regulatory Background

3.8.1.1 Federal Requirements

Transmission line projects must be designed to meet or exceed applicable safety and reliability criteria and requirements outlined by organizations and standards such as NERC, the National Electrical Safety Code (NESC), the Southwest Power Pool, TVA, the American Society of Chemical Engineers, and other applicable federal, state, or local requirements. Appendix B of the NESC contains detailed requirements to ensure the safe design, construction, and operations and maintenance of transmission line projects. The NESC is published by the IEEE (IEEE 2011). Worker safety during construction and operations is regulated by workplace safety rules established by the Occupational Safety and Health Administration (OSHA) and/or equivalent workplace safety rules established by each state (Clean Line 2013a). The OSHA standards and NESC rules work together to create a comprehensive set of standards and practices designed to protect the health and safety of workers engaged in the construction, operations, and maintenance of a project. Industrial construction and routine workplace operations are governed by the Occupational Safety and Health Act of 1970, specifically 29 CFR Part 1910 (general industry standards) and 29 CFR Part 1926 (construction industry standards).

EO 13045, Protection of Children from Environmental Health Risks and Safety Risks (62 FR 19885, April 23, 1997), dictates that each federal agency ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health or safety risks; children are defined as populations under the age of 18. This EO is relevant if it is determined that there may be disproportionate health and safety impacts to children from construction or operations and maintenance of the Project.

Management of hazardous waste is governed by RCRA, which establishes a program administered by the EPA that regulates the generation, transportation, treatment, storage, and disposal of hazardous waste. Section 3.8.4.1 identifies the hazardous materials that could be used and the potential hazardous waste that could be generated on the Project. Title III of the Superfund Amendments and Reauthorization Act also known as the Emergency Planning and Community Right-to-Know Act requires states to promote outreach for developing local emergency preparedness programs to respond to chemical releases, receive reports from the regulated community, and to analyze and disseminate the resulting information on hazardous chemicals to local governments and the public.

Security of the components of the Project facilities can involve a variety of different regulatory and reporting structures, authorities, and agencies. Intentional destructive acts, sabotage, vandalism, theft, or other mischief, whether from terrorist activities or other criminal behavior, would be addressed through law enforcement and Project design protocols.

Presidential Policy Directive 21, "Critical Infrastructure Security and Resilience," identifies 16 critical infrastructure sectors, including energy, and identifies the national goal to advance a national policy to strengthen and maintain secure, functioning, and resilient critical infrastructure. This Project would fall under the energy sector's definition of critical infrastructure. This directive includes measures that address public-private partnerships to reduce vulnerability and guidelines to address vulnerability, and the directive establishes federal government roles and responsibilities for protecting critical infrastructure.

The NERC is a not-for-profit entity whose mission is to ensure the reliability of the bulk-power system in North America. The NERC develops and enforces reliability standards; assesses seasonal and long-term reliability; monitors the bulk-power system through system awareness; and educates, trains, and certifies industry personnel. The NERC's reliability standards include requirements for physical and cyber security of bulk-power system facilities, including major transmission lines (NERC 2014). In November 2013, the Federal Energy Regulatory Commission issued Order Number 791 (FERC 2013), approving Version 5 Critical Infrastructure Protection Reliability Standards submitted for approval by the NERC. There are 10 reliability standards that require certain users, owners, and operators of the bulk-power system to comply with specific requirements to safeguard critical cyber assets. In the area of security, the NERC reliability standards have focused on cyber security for operational systems; however, related requirements apply to security risk assessment and physical security and protection of critical facilities.

The U.S. Department of Homeland Security Homeland Infrastructure Threat and Risk Analysis Center, which conducts integrated threat analysis for all critical infrastructure and key resources, works in partnership with owners and operators and other federal, state, and local government agencies to ensure that suitable threat information is made available (DHS 2010).

3.8.1.2 State Requirements

State health and safety requirements are designed to be generally consistent with the federal requirements to ensure comparable standards for the workplace. Workplace health and safety requirements for Oklahoma, Arkansas, Tennessee, and Texas are summarized in Table 3.8-1. Although Oklahoma, Arkansas, and Tennessee have adopted the federal OSHA requirements, some exceptions may apply in cases where further information or more stringent requirements were deemed necessary by the state; exceptions are identified within each state's OSHA program.

Table 3.8-1:
State Occupational Health and Safety Information

State	Workplace Health and Safety Authority	Responsible State Agency	Additional Information
Oklahoma	Oklahoma Occupational Health and Safety Standards Act, codified in the Oklahoma Statutes, Title 40, Sec. 401, et seq.	Oklahoma Department of Labor; OSHA, Consultation Division	The state has adopted the U.S. Department of Labor OSHA health and safety standards
Arkansas	Arkansas Department of Labor Safety Code 11 on Electrical Safety	Arkansas Department of Labor, Occupational Safety and Health Division	The state has adopted the U.S. Department of Labor OSHA health and safety standards
Tennessee	Tennessee Occupational Safety and Health Act of 1972 as codified in Tennessee Code Annotated Sec. 50-3-101 through 50-3-919	Tennessee Occupational Health and Safety Administration	The state has adopted the U.S. Department of Labor OSHA health and safety standards
Texas	No comprehensive workplace health and safety legislation	Texas Department of Insurance, Division of Workers Compensation	Texas does not have its own occupational health and safety regulatory program, but all private-sector workplaces must comply with federal OSHA regulations

Source: Clean Line (2013a)

The ODEQ manages hazardous waste in Oklahoma under the Oklahoma Hazardous Waste Management Act (27A Oklahoma Statutes Sec. 2-7-101 et seq.), which applies to construction and operations and maintenance activities. The Oklahoma Emergency Response Act (27A Oklahoma Statutes Sec. 4-2-102) governs emergency response to hazardous material incidents that may present a threat to public health and safety throughout the state. This act applies in the event of a release of a hazardous material caused by construction, operations, or decommissioning activities in Oklahoma. Oklahoma's Emergency Planning and Community Right-to-Know regulation (Oklahoma Administrative Code 252-020) requires reporting for the use or generation of hazardous chemicals. Projects that include handling of hazardous chemicals during construction or operations and maintenance and that meet regulatory thresholds would require reporting under this regulation.

Under the Arkansas Hazardous Waste Management Act (Arkansas Code, Sec. 8-7 202 et seq.), the Arkansas State Hazardous Waste Division manages hazardous waste in Arkansas through the state's RCRA Subtitle C waste management program. This program provides specific requirements for the management and disposal of hazardous wastes, used oils, and universal wastes (ADEQ 2013).

The TDEC manages hazardous materials in accordance with the Tennessee Hazardous Waste Program. The TDEC's administrative rules for hazardous waste management (Chapter 0400-12-01) provide specific requirements for the management and disposal of hazardous waste (TDEC 2012). Projects that include transport, handling, storage, or disposal activities of hazardous chemicals identified during construction or operations and maintenance activities would trigger the need to meet state reporting and waste management requirements under these rules.

The Texas Hazard Communication Act (Texas Health and Safety Code 502.001 et seq.), as amended in 1993, sets the minimum requirements employers must meet for providing information about hazardous chemicals in the workplace to employees and other interested parties and is enforced by the Texas Department of Health. The rules require project developers to compile workplace chemical lists for work sites, train all exposed employees regarding the hazards associated with the chemicals they use, maintain a file of safety data sheets (formerly known as material safety data sheets), and supply the appropriate emergency response personnel with information.

3.8.2 Data Sources

Much of the information presented herein for the health, safety, and intentional destructive acts resource areas relies on the Safety, Security, and Hazards Technical Report for the Project and associated, independently verified references (Clean Line 2013a). The connected actions discussion addressing potential wind energy generation facility development and related substation or transmission upgrades utilizes information and references from the Wind Generation Technical Report for the Project (Clean Line 2014a). The health, safety, and intentional destructive acts analysis herein relies on relevant publicly available information and reports to provide information on the existing affected environment. Sources of information include federal, state, and municipal governments, as well as non-governmental organizations. Security risk- and hazard-related data were obtained through official agency websites or directly from government agencies. In addition, health and safety, security, and hazard information was received from regulatory agencies and other stakeholders during the DOE scoping process.

Noise, traffic, electrical environment, land use, geology, and water resources information was reviewed from other sections of this EIS for applicability to the health and safety resource area. The U.S. Bureau of Labor Statistics' (BLS) website was consulted for worker fatality and injury data. The BLS, like OSHA, is part of the U.S. Department of Labor.

3.8.3 Region of Influence

The ROI for the health, safety, and intentional destructive acts resource area for the Project and connected actions is described in Section 3.1.1 and does not differ for purposes of impact analyses for this resource area.

3.8.4 Affected Environment

This section includes a description of the existing environment for health, safety, and intentional destructive acts such that impacts may be effectively evaluated. The affected environment includes descriptions of worker health and safety, hazardous materials and waste, aircraft and rail operations, fire hazards, natural events and disasters, and intentional destructive acts.

3.8.4.1 Worker Health and Safety

Worker safety in construction and industrial settings is regulated by OSHA. The Project would be subject to OSHA standards during construction and operations and maintenance (e.g., OSHA General Industry Standards [29 CFR Part 1910] and the OSHA Construction Industry Standards [29 CFR Part 1926]). OSHA standards are designed to protect workers from potential construction and industrial accidents, as well as to minimize exposure to workplace hazards (e.g., noise, chemicals).

Industrial health and safety is concerned with occupational and worker hazards during routine operations. The BLS maintains statistics on the incidence of workplace injuries, illnesses, and fatalities. The health and safety incident categories are defined as follows:

- Total recordable cases: The total number of work-related deaths, illnesses, or injuries that result in the loss of consciousness, days away from work, restricted work activity or job transfer, or required medical treatment beyond first aid.
- Days away from work, or days of restricted work activity or job transfer: Cases that involve days away from work, or days of restricted activity or job transfer, or both.
- Worker fatality: Cases that involve the death of a worker.

The incidence rates (cases per 100 full-time workers for non-fatality statistics and cases per 100,000 full-time workers for fatality statistics) maintained by the BLS are calculated separately for different industries based on the reported health and safety cases for that particular industry.

To minimize the effect of industrial health and safety hazards, industries must comply with all applicable regulations that relate to industrial health and safety. Table 3.8-2 summarizes 2012 national safety statistics from the BLS for industry categories that are relevant to the Project.

Table 3.8-2:
2012 National Statistics for Workplace Hazards

Industry	Nonfatal Recordable Incidents (Per 100 FTE Workers)[1]	Lost Workdays (Per 100 FTE Workers)	Fatalities (Per 100,000 FTE Workers)
Construction (all)	3.7	2.0	9.9
Utilities (electric power generation, transmission, control, and distribution)	2.8	1.4	2.5

FTE = Full-time equivalent
1 Nonfatal occupational injury and illness cases requiring days away from work to recuperate.
Source: BLS (2012a, 2012b)

Of the 4,175 worker fatalities that occurred nationally in private industry in calendar year 2012, 806 (19.3 percent) were in construction. The leading causes of worker deaths on construction sites were falls, followed by struck by object, electrocution, and caught-in/between. These "fatal four" were responsible for more than half (54.2 percent) the construction worker deaths in 2012. Eliminating the fatal four would save 437 workers' lives in America every year (OSHA 2013a). Details for these fatal four include the following:

- Falls: 279 out of 806 total deaths in construction in 2012 (34.6 percent)
- Struck by object: 79 (9.8 percent)
- Electrocutions: 66 (8.1 percent)
- Caught-in/between: 13 (1.6 percent)

By comparison, there were 14 fatalities nationally in the private utility industry (electric power transmission, control, and distribution) in calendar year 2012. Causes of worker death in this industry include transportation incidents, exposure to harmful substances or environments, and contact with objects and equipment (OSHA 2013b).

Construction, operations and maintenance, and decommissioning of a transmission line and associated facilities may result in a variety of conditions that present a risk to worker health and safety. A recent article on safety risk management for electrical transmission and distribution line construction found that: “construction contractors account for the highest rate of electrocutions. Within the construction trade, electricians accounted for about 17% of the electrocution fatalities; construction laborers accounted for 9%...and maintenance workers incurred a total of 7%... ” (Albert and Hallowell 2012).

Exposure to certain chemicals can adversely affect human health through toxic reactions, carcinogenic effects, or both. Chemical exposure can occur from chemicals present in water or in soil from past industrial activities. EPA hazardous materials data sources were used to determine known contaminated sites within the ROI. The Applicant conducted site and route selection activities to avoid known contamination sites, so no Superfund sites or brownfield sites are located in the ROI. However, contamination may be encountered where not previously known to occur and is more likely in areas where land uses may have involved the use and/or storage of hazardous materials, including at oil and gas wells, abandoned or active mine sites, oil/gas pipelines, railroads, aerial pesticide application airstrips, and agricultural/commercial/industrial structure sites (Clean Line 2013a).

During construction and operations and maintenance activities, hazardous materials including vehicle fuels, oils, and other vehicle maintenance fluids would be stored and used in construction staging areas and necessary operational work areas. During these activities, mismanagement or accidental releases of these materials could contaminate soil and/or water resources and have adverse effects on human health and the environment. Examples of hazardous wastes include spent hazardous materials and by-products from their use.

A number of hazardous substances are used in the construction, operation, and maintenance of electrical transmission lines and associated facilities. Table 3.8-3 lists common types of materials that could be used, but is not a comprehensive list. Generation of hazardous waste is not anticipated; however, the Applicant would implement applicable EPMs and follow regulatory processes if construction and industrial processes resulted in the generation of hazardous waste.

Table 3.8-3:
Hazardous Materials Typically Used for Transmission Line Construction

Hazardous Material			
2-cycle oil (contains distillates and hydro-treated heavy paraffinic)	ABC fire extinguisher	Acetylene gas	Air tool oil Insulating oil (inhibited, non-polychlorinated biphenyl)
Ammonium hydroxide	Antifreeze (ethylene glycol)	Automatic transmission fluid	Battery acid (in vehicles and in the meter house of the substations)
Bottled oxygen	Brake fluid	Canned spray paint	Chain lubricant (contains methylene chloride)
Connector grease (penotox)	Contact Cleaner 2000 (1,1,1-trichloroethene)	Diesel deicer	Diesel fuel
Diesel fuel additive	Gasoline	Gasoline treatment	Hot stick cleaner (cloth treated with polydimethylsiloxane)
Hydraulic fluid	Lubricating grease	Mastic coating	Methyl alcohol
Motor oils	Paint thinner	Pesticide	Propane
Puncture seal tire inflator	Safety fuses, implosive connectors, conductor splices, deadend assemblies	Starter fluid	Sulfur hexafluoride (within the circuit breakers in the substations)
Potassium hydroxide—nickel-cadmium batteries	WD-40 (penetrating oil)	Edisol XT—insulating oil used in capacitor banks	Transformer oil—insulates and cools transformers

Source: Clean Line (2014b)

3.8.4.2 Aircraft and Rail Operations

Fifty-two known aircraft facilities (airports, airstrips, and heliports) are located within the ROI for transportation impact analyses, which includes a 4-mile-wide corridor from the HVDC transmission line and AC collection system transmission line centerlines (see Section 3.16.3.1). It is possible, however, that unknown private or unofficial airstrips may be located within the ROI or nearby. In addition, the Project is located within agricultural areas where aerial application of pesticides, and fertilizers is a common practice for certain crops (commonly known as crop dusting). Section 3.16.4.4 and Section 3.16.5 (by region) present detailed airport and aircraft operation information applicable to health and safety impact analyses discussed later.

Numerous rail lines are located within the transportation resource area ROI (6-mile area around Project components) as shown on Figures 3.16-1a through 3.16-1f in Appendix A. Railroads are more specifically discussed in Section 3.16.5 by region. Railroads were identified based on the potential encroachment within the ROI, which refers to areas where railroads and railroad ROWs might be affected because the Project would cross the railroad ROW or be located in close proximity to the railroad.

3.8.4.3 Fire Hazards

A wildfire is an uncontrolled fire spreading through vegetative fuels and could occur at any point within the ROI. Oklahoma has a significant wildfire hazard given its climate and the types of vegetative fuels present. Fire season in Oklahoma has been identified as lasting from July through April (ODEM 2011). Wildfires have occurred in every county in Arkansas, but they are most common in the south-central and southwestern parts of the state within the heavily forested Gulf Coastal Plain and southern Ouachita Province (ADEM 2013). The Project would be located in the northern portion of Arkansas, which is primarily categorized as having a low to medium occurrence of wildfire events over the period 1997 to 2012 (ADEM 2013).

3.8.4.4 Natural Events and Disasters

Natural events and disasters consisting of extreme weather, ground surface and subsurface instabilities (e.g., earthquakes), and flooding have the potential to cause damage to Project facilities with resultant impacts to worker and public health and safety.

Severe weather such as thunderstorms, lightning, high winds, ice storms, and tornadoes may occur during all phases of the Project since activities would be conducted year-round. Tornadoes and thunderstorms are most likely to occur during spring, summer, and fall; ice storms could occur during late fall, winter, and early spring; and high winds may occur at any time of year. Weather forecasts are generally accurate at predicting potential periods when severe weather may occur and forecasts would be monitored during construction. Tornadoes are a particular concern in the ROI and have occurred in each Oklahoma County approximately two to three times per year on average based on data from 1950 to 2013; the majority of the tornadoes recorded were in lower strength categories measuring less than F-3 on the Fujita scale[1] (THP 2014). In Arkansas and western Tennessee, tornadoes occur in the vicinity of the ROI approximately once or twice per year on average during the same reporting period identified above, and the majority also were in lower strength categories (THP 2014).

Surface and subsurface ground instabilities such as earthquakes, faulting, liquefaction, landslides, and subsidence could have an effect on the health and safety of workers and the public. Section 3.6 describes the affected environment and impact analyses for geology, paleontology, minerals, and soils including locations of active faults and seismic risk scenarios for the various components, facilities, and routing locations of the Project.

Flooding is another natural event that could have an effect on Project components with resultant impacts to the health and safety primarily of workers. Section 3.15 describes the affected environment and impact analyses for surface water resources including watersheds, surface water features, water quality, and water use. Section 3.19 describes the affected environment and impact analyses for wetlands, floodplains, and riparian areas including definitions and locations of floodplains applicable to the Project.

3.8.4.5 Intentional Destructive Acts

There are not any specific sources of information regarding acts of terrorism specific to the ROI; however, three incidents of intentional destructive acts, alleged to be sabotage, occurred in September and October 2013 to a high-voltage transmission line in Arkansas and are under investigation by the Federal Bureau of Investigation (Blinder 2013).

Equipment theft is also a growing concern that is very costly to construction projects. According to the National Insurance Crime Bureau, between $300 million to $1 billion a year is lost nationwide to the theft of construction equipment (NICB 2012). A 2008 industry research study commissioned by LoJack Corporation and the National Insurance Crime Bureau showed that 71 percent of equipment owners have experienced the theft of equipment in the previous year (LoJack 2012). According to LoJack, the types of equipment most frequently stolen are light utility work trucks and trailers, loaders, skid steers, and generators/air compressors/welders.

---

[1] The Fujita scale, more popularly known as the F scale is used to measure the intensity of a tornado based on the amount of damage done by a passing tornado over an area. The F scale rates a tornado from F-0 to F-5 with a F-5 tornado having the fastest wind speeds and causing the most damage

Energy transmission has become increasingly reliant on computer-based control systems that operate and monitor energy infrastructure. The following points were extracted from a DOE-sponsored report through the Energy Sector Control Systems Working Group (ESCSWG 2012) addressing cyber security threats to energy delivery systems:

- “Because the private sector owns and operates most of the energy sector’s critical assets and infrastructure, and governments are responsible for national security, securing energy delivery systems against cyber threats is a shared responsibility of both the public and private sectors.”
- “Smart technologies (e.g., smart meters, phasor measurement units), new infrastructure components, the increased use of mobile devices, and new applications are changing the way that energy information is communicated and controlled while introducing new vulnerabilities and creating new needs for the protection of consumer and energy market information.”
- “Adversaries have pursued progressively innovative techniques to exploit flaws in system components, telecommunication methods, and common operating systems found in modern energy delivery systems with the intent to infiltrate and sabotage them.”

3.8.4.6 Protection of Children

Electrical and magnetic fields are known to occur around transmission lines, distribution lines and electric appliances. Extensive scientific research has been conducted in the United States and around the world to determine whether exposure to power-frequency AC electric and magnetic fields has any potential to produce human health effects among adults and children. Section 3.4.11.2.1.2.2.7 presents an overview of the scientific literature on potential health effects of AC electric and magnetic fields, including epidemiology studies on potential health effects on children. Sections 3.4.11.2.2.2.1 and 3.4.11.2.2.2.2 present AC electric and magnetic field calculations for the various structure and transmission line configurations for the Project.

3.8.4.7 Connected Actions

3.8.4.7.1 Wind Energy Generation

Worker activities occurring during construction and operation of wind energy generation facilities typically involve major actions such as establishing site access, excavating and installing structure foundations, working at heights (e.g., erecting turbines, nacelle and blade placement, and turbine maintenance), constructing support buildings and electrical substations, assembling and erecting meteorological towers, constructing access roads, and routine maintenance of ancillary facilities and components. Decommissioning presents many of the same hazards to the workforce as construction. Construction and operations workers at any facility are subject to risks of injuries and fatalities from physical hazards. While such occupational hazards can be minimized when workers adhere to safety standards and use appropriate protective equipment, fatalities and injuries from accidents can still occur with rates consistent with the data presented in Table 3.8-2. Many of the occupational hazards associated with wind energy generation projects are similar to those of the heavy construction and electric power industries.

A potential physical effect of operating wind turbines is shadow flicker and blade glint and glare. These terms refer to the phenomenon that occurs when the moving blades of wind turbines cast moving shadows (shadow flicker) or reflections (blade glint or glare) that cause a flickering effect. When the sun is in such a position in relation to the blades, and the shadow or reflection falls across occupied buildings, the light passing through windows can disturb the occupants. This can be viewed by observers as either brief changes in brightness in an indoor environment or by moving shadows on the ground in an outdoor environment. The type of turbine, landscape features, latitude, weather, and wind energy generation facility layout are all factors that would impact shadow flicker and blade glint and glare (Bos et al. 2013).

Construction, routine operations and maintenance, and decommissioning of wind turbines would include the use of some hazardous materials such as fuels, greases, lubricants, coolants, paints, and/or coatings for corrosion control. Hazardous materials, such as insulating fluids in electrical transformers, may also be present at substations. Information and data regarding potential existing soil contamination within WDZs are based on available information from regulatory databases including EPA's Facility Registry Services database, which lists facilities that are required to report hazardous waste management activities but does not necessarily identify sites where soil contamination has occurred. Table 3.6.2-18 lists Facility Registry Services sites within WDZs; one site in WDZ-A and one in WDZ-D are indicated as having soil contamination and are in some stage of clean up (see Section 3.6.2.5.1). It is possible; however, that other unknown hazardous waste sites may be encountered during potential wind energy generation facility development especially during foundation and cable trench excavations.

Wind turbines, generation tie lines, substations, and associated facilities could be targets of intentional destructive acts, such as sabotage, terrorism, vandalism, and theft. Such acts include cyber-attack; gunfire at turbines, generation tie lines, transmission structures, or substation and support building equipment; vandalism; and theft of equipment, supplies, tools, or materials. Theft is the most likely threat during wind energy generation facility construction, operations and maintenance, and decommissioning. There are no sources of information regarding acts of terrorism specific to specific wind energy generation facility development areas. However, there is anecdotal evidence that this should be a concern to wind energy generation facility developers. An investigation into a recent turbine collapse in the United Kingdom revealed that bolts were missing from the base (Collins 2013). Though the turbine collapsed during a high wind event, it is being speculated that it could be the result of an intentional act (Collins 2013).

3.8.4.7.2 Optima Substation

The future Optima Substation would be constructed on approximately 160 acres partially within the area identified on Figure 2.1-3 in Appendix A as the AC Interconnection Siting Area. The descriptions of the affected environment in Sections 3.8.4.1 through 3.8.4.6 are applicable to the future Optima Substation. The same worker health and safety accident statistics for the construction and operational electric utility industry would apply to the construction and operations and maintenance of the future Optima Substation.

3.8.4.7.3 TVA Upgrades

The ROI for the direct assignment facilities (which are included in the Applicant Proposed Project) would occur within the Tennessee Converter Station Siting Area, and more specifically within the Shelby Substation in Shelby County. The ROI for the network upgrades, and in particular TVA's future 500kV transmission line, cannot be fully determined at this time. The new 500kV transmission line would be constructed in western Tennessee. The upgrades to existing facilities would mostly be in western and central Tennessee. Upgrades to existing infrastructure would include upgrading terminal equipment at three existing 500kV substations and six existing 161kV substations, making appropriate upgrades to increase heights on 16 existing 161kV transmission lines to increase line ratings, and replacing the conductors on eight existing 161kV transmission lines. Where possible, general impacts associated with the required TVA upgrades are discussed in the impact sections that follow.

3.8.4.8 Regional Description

The description of the affected environment provided in Section 3.8.4 is applicable to all seven regions across Oklahoma, Arkansas, Texas, and Tennessee and to areas associated with connected actions in these states.

3.8.5 Impacts to Health and Safety

Electric transmission projects may affect worker and public health and safety during construction, operations and maintenance, and decommissioning. Additionally, project components could become the target of intentional destructive acts or sabotage (e.g., terrorist attack or mischievous actions). Potential health and safety concerns related to power transmission during construction include worker injuries; exposure to hazardous materials, contaminated sites, or excessive noise; and other risks to workers and the surrounding community from technological and natural hazards that could result in accidents within the ROI (Section 3.8.3). Health and safety concerns associated with operations and maintenance include electrical shock, electric and magnetic fields, corona, stray and induced voltage, collision hazards, fire risk, and public access to transmission structures and substation equipment.

Specific Project-related activities that could cause impacts include:

- Operating equipment near energized lines
- Energized lines/equipment put in service
- Excavation/trenching and installing foundations
- Climbing poles/operating aerial lifts
- Grounding/removing grounding
- Framing of temporary and permanent structures
- Inspecting/troubleshooting power lines/equipment
- Splicing, repairing, and installing conductors and wiring
- Clearing/trimming trees and bushes
- Moving energized conductors
- Assembling/repairing equipment and hardware
- Traffic control
- Hanging and installing transformers and vaults
- Installing and connecting busses, switches, circuit breakers, and regulators
- Installing conduit or cable trough
- Installing insulators
- Assembling and erecting substations
- Removing/replacing existing line
- Installing lightning arrestors
- Sagging to provide clearance between wires
- Attaching/replacing insulators
- Replacing shield wire
- Installing/removing dampers
- Installing/removing spacers
- Metering, testing, and measuring

3.8.5.1 Methodology

The methodology for evaluating impacts on health and safety and from intentional destructive acts involves identifying and assessing Project design, construction, operational and maintenance standards, and decommissioning guidelines for electric transmission lines and associated components. The Applicant has conducted research and evaluations addressing potential health and safety impacts associated with the Project (Clean Line 2013a). DOE has reviewed and verified these evaluations for applicability and where appropriate, has summarized them and other applicable information in the impact analyses in the following sections.

The Applicant has developed, and would implement, the EPMs listed in Appendix F to avoid or minimize potential impacts from construction and operations and maintenance of the Project. Activities described in Appendix F would incorporate and be subject to the EPMs as well as measures/requirements imposed as part of federal or state permits and authorizations. The measures that would specifically minimize the potential for impacts on health and safety are listed below:

- GE-1: Clean Line will train personnel on health, safety, and environmental matters. Training will include practices, techniques, and protocols required by federal and state regulations and applicable permits.
- GE-3: Clean Line will minimize clearing vegetation within the ROW, consistent with a Transmission Vegetation Management Plan filed with NERC, and applicable federal, state, and local regulations. The TVMP may require additional analysis under NEPA depending on whether and under what conditions DOE decides to participate in the Project.
- GE-5: Any herbicides used during construction and operations and maintenance will be applied according to label instructions and any federal, state, and local regulations.
- GE-6: Clean Line will restrict vehicular travel to the ROW and other established areas within the construction, access, or maintenance easement(s).
- GE-8: Access controls (e.g., cattle guards, fences, gates) will be installed, maintained, repaired, replaced, or restored as required by regulation, road authority, or as agreed to by landowner.
- GE-12: Clean Line will avoid remedial structures (e.g., capped areas, monitoring equipment, or treatment wells) on contaminated sites, Superfund sites, CERCLA remediation areas, and other similar areas. Workers will use appropriate protective equipment and appropriate safe working techniques when working at or near contaminated sites.
- GE-13: Emergency and spill response equipment will be kept on hand during construction.
- GE-15: Waste generated during construction or maintenance, including solid waste, petroleum waste, and any potentially hazardous materials will be removed and taken to an authorized disposal facility.
- GE-16: Where required by FAA, or in certain areas to protect aviator safety, Clean Line will mark structures and/or conductors and/or shield wires with high-visibility markers (i.e., marker balls or other FAA-approved devices).
- GE-19: Clean Line will properly ground permanent structures (e.g., fences, gates) to reduce the potential for induced voltage and currents onto conductive objects in the ROW.
- GE-21: Clean Line will maintain construction equipment in good working order. Equipment and vehicles that show excessive emissions of exhaust gasses and particulates due to poor engine adjustments or other inefficient operating conditions will be repaired or adjusted.
- GE-22: Clean Line will impose speed limits during construction for access roads (e.g., to reduce dust emissions, for safety reasons, and for protection of wildlife).

- GE-25: Clean Line will turn off idling equipment when not in use.
- GE-28: Hazardous materials and chemicals will be transported, stored, and disposed of according to federal, state, or local regulations or permit requirements.
- GE-29: Clean Line will work with landowners and operators of active oil and gas wells, utilities, and other infrastructure to identify and verify the location of facilities and to minimize adverse impacts. Identification may include use of the One Call system and surveying of existing facilities.
- AG-5: Clean Line will work with landowners and/or tenants to consider potential impacts to current aerial spraying or application (i.e., crop dusting) of herbicides, fungicides, pesticides, and fertilizers within or near the transmission ROW. Clean Line will avoid or minimize impacts to aerial spraying practices when routing and siting the transmission line and related infrastructure.

Clean Line will also develop the following plans or procedures to implement the EPMs:

- Blasting Plan. This plan will describe measures designed to minimize adverse effects due to blasting.
- Spill Prevention, Control and Countermeasures (SPCC) Plan. This plan will describe the measures designed to prevent, control, and clean up spills of hazardous materials.
- Transmission Vegetation Management Plan (TVMP). This plan would be developed and implemented pursuant to the North American Electric Reliability Corporation (NERC) Reliability Standard FAC-003 and will describe how Clean Line will conduct work on its right-of-way to prevent outages due to vegetation. The TVMP may require additional analysis under NEPA depending on whether and under what conditions DOE decides to participate in the Project.
- Construction Security Plan. This plan will describe measures designed to avoid and/or minimize adverse effects associated with breaches in Project security during construction including terrorism, sabotage, vandalism, and theft. The plan will include provisions describing how the Project construction team will coordinate with state and local law enforcement agencies during construction to improve Project security and facilitate security incident response, if required.
- Transportation and Traffic Management Plan. This plan would include railroad crossing protocols and construction and post-construction practices to avoid vehicle, railroad, and transmission line conflicts. Typically, stoppage of railroad traffic is not required during construction or conductor stringing and tensioning activities. Crossing activities are similar to those for road crossings and typically involve the use of guard structures. Stringing and tensioning activities would be performed in coordination with the appropriate railroad authorities as required.

3.8.5.2 Impacts Associated with the Project

The impacts discussed below are common to all components of the Project within Oklahoma, Arkansas, Tennessee, and Texas, including converter stations and AC interconnections, the HVDC transmission line, AC collection system transmission lines, access roads, multi-use construction yards and other temporary construction areas, and communications sites. There are no appreciable differences in health and safety impacts between the Applicant Proposed Project and DOE Alternatives unless otherwise stated in specific sections below because Project components, construction and operation processes, and facility footprints would be the same or similar.

Several route variations to the Applicant Proposed Route in Regions 2–7 were developed in response to public comments on the Draft EIS and are described in Appendix M and summarized in Sections 2.4.2.1–2.4.2.7. Assessments of the health and safety impacts related to the route variations, including accompanying HVDC alternative route adjustments, do not differ across the regions, routes, or variations. The variations are presented graphically in Exhibit 1 of Appendix M.

3.8.5.2.1 Construction Impacts

Construction activities could pose hazards that affect worker and public health and safety. In addition, natural disasters, accidents, or intentional destructive acts or mischief could impact the health and safety of construction workers and the public. The following sections include a qualitative summary of each hazard and its relative frequency, severity, potential impacts, and avoidance and minimization measures for the construction phase.

3.8.5.2.1.1 Worker and Public Health and Safety

Accidents during construction that could present a worker and public health and safety risk include heavy equipment and commuting vehicle accidents, electrocution, personal accidents (e.g., slips, trips, and falls), hazardous materials spills, construction-induced fires, and aircraft accidents.

Construction activities pose various health and safety risks to workers that are considered typical for large construction projects involving electrical components, working at height, and operating heavy machinery. The following potential risks could be associated with the Project:

- Falls from working at height
- Crush injuries in excavation work
- Slips and trips
- Cuts and scrapes from sharp tools or construction materials or debris
- Receiving injuries from hand tools and/or rotating machinery
- Electrocution
- Being struck by falling objects
- Manually lifting heavy loads
- Bad working positions, possibly in confined spaces
- Being struck or crushed by a workplace vehicle
- Inhalation of dust
- Handling of rough materials
- Exposure to dangerous substances (chemical and biological)
- Working near, in, or over water
- Hearing damage from loud noises
- Sustaining injuries as a result of an on-road or off-road accident involving a motor vehicle or construction equipment

Based on BLS data reported nationally within the construction industry (BLS 2012a), there were 3.7 non-fatal recordable incidents per 100 full-time equivalent workers. A full-time equivalent worker equates to 2,080 labor hours annually. Using the BLS data, based on an average full-time equivalent construction workforce of approximately 1,260 workers (Appendix F) working for an assumed 36 months on all components of the Applicant Proposed Project, it is estimated there would be approximately 140 non-fatal recordable incidents associated with the construction phase. Also, BLS data reported nationally within the construction industry identify 9.9 fatal incidents per

100,000 full-time equivalent workers (BLS 2012b). Using the average construction workforce of 1,260 workers, it is estimated that there would be approximately 0.4 fatalities during the assumed 36-month construction phase.

3.8.5.2.1.2 Aircraft and Rail Operations

Airports and associated air traffic in the vicinity of the components of the Project have the potential to result in impacts to workers, aircraft occupants, and Project components if an aircraft collides with a structure. The use of helicopters during Project surveying, structure installation, and line and conductor stringing could result in accidents that cause health and safety impacts to workers. Low-altitude aircraft that apply pesticides, herbicides, and fertilizers on nearby agricultural operations could result in an increased risk of collision with Project components, especially lines and conductors, which aircraft operators have more difficulty seeing. An aircraft collision is possible and would be expected to result in major injury or death—more likely to the aircraft occupants but possibly people on the ground. Additionally, an aircraft collision with Project facilities or components could cause significant damage to Project assets during construction. Environmental Protection Measure GE-16 would ensure Project structures and components are appropriately marked with devices to help aviators identify potential dangers to aircraft operations.

As identified in Section 3.16, railroads cross at several points or are in close proximity to the Applicant Proposed Route and the various DOE alternative routes. No increase in railroad traffic is expected to occur as a result of the construction of the Project, and therefore no additional health and safety risk would result. Structure heights and placement, span lengths, and vertical clearance would be determined in accordance with the NESC, the Applicant's design criteria, and applicable standards and laws. The NESC provides for minimum distances between the conductors and the ground, crossing points of other lines and the transmission support structure, and other conductors, and minimum working clearances for vehicles and personnel.

3.8.5.2.1.3 Fire Hazards

Wildfires in the vicinity of the ROI as a result of lightning strikes or accidental events can cause risks to Project components and personnel during construction. Although not necessarily caused by construction activities of the Project, once ignited, a wildfire could spread causing injuries to workers or the public and damage to Project facilities, construction equipment, and construction materials. A wildfire during the construction phase of the Project is considered possible, but it would not be expected to result in permanent or significant damage to Project components or health and safety of workers or members of the public since emergency reporting and response actions coupled with identified EPMs would minimize impacts.

The potential for construction activities to start a fire represents a potential safety hazard for workers or nearby residents. Fire hazards could result from workers welding, operating motorized construction equipment, smoking, refueling, electrical mishaps while energizing components, and operating or parking vehicles in areas with dry vegetation. With implementation of adequate preparedness and response measures, the potential for a fire to cause major damage to Project components or to result in injuries or death to workers or members of the public is considered unlikely.

3.8.5.2.1.4 Natural Events and Disasters

Project facilities and components may be susceptible to natural events and disasters and could be damaged by extreme weather, ground surface and subsurface instabilities (e.g., earthquakes), and flooding. Failure of partially constructed transmission line components from natural events can result in structures and lines falling to the ground;

impacts would generally be limited to the Project ROW. Damage to Project infrastructure may result in temporary adverse impacts to worker and public health and safety and nearby property. Natural events and disasters may occur on a relatively frequent basis; however, severe events would be less likely to result in structural damage or downed lines and conductors since the Project would be designed and built according to federal, state, and industry building codes and standards, which are intended to avoid or minimize safety risks posed by natural events and disasters.

Sudden severe weather during construction could result in hazardous conditions for workers including difficulty in controlling equipment and structural components, difficulty working at heights, reduced visibility, poor road conditions, impaired footing, and increased possibility of electrocution.

Surface and subsurface instabilities and displacement from earthquakes, faulting, liquefaction, landslides, and subsidence is a possibility during construction activities. Collapse of structures or falling objects pose potential risks to workers or nearby members of the public. Ground instability or failure associated with events described above occurs with little or no notice and preparation by onsite personnel would be minimal. Based on USGS earthquake-risk scenarios, seismic hazards are low for the entire Project area except for the eastern portion of the ROI in Region 5 and all of Regions 6 and 7 as the Project routes approach a relatively active seismic zone (see Sections 3.6.1.5.3 through 3.6.1.5.7). While the area's seismic hazard increases south of the ROI in Regions 2 and 3, the hazard for the ROI in these regions is low. Some areas within the regions have a range of susceptibility and incidence rates for ground instability events (see Table 3.6.1-11 through 3.6.1-19). Compliance with federal and state earthquake preparedness and response procedures would help ensure risks to workers and the public during seismic events would be minimized.

The occurrence of flooding during construction could put workers at risk of drowning. Flooding may also cause erosion that may damage construction sites and access routes or create spills of hazardous materials with resulting human exposure to environmental contamination or injury. However, flood events can often be forecast, which allows time to prepare, so the most severe impacts of flooding can more likely be avoided. Although construction and placement of structures in 100-year floodplains would be avoided as much as possible, all seven regions contain several 100-year floodplains that would potentially be crossed by the Applicant Proposed Route or the DOE alternative routes (see applicable discussions in Section 3.19). Placement of some structures within 100-year floodplains would be unavoidable in some areas (e.g., approaches to the Mississippi River).

3.8.5.2.1.5 Intentional Destructive Acts

Although it is not possible to predict whether acts of terrorism or sabotage events would occur, or the nature of such events if they did occur, DOE has considered the potential for events involving terrorism, sabotage, or criminal mischief that could result in health and safety impacts to workers and members of the public. Also, sabotage of onsite equipment or placement of explosive devices that could disrupt the Project is a remote possibility. Impacts to health and safety from intentional destructive acts would be unlikely to be greater than events involving extreme weather. A more likely scenario would involve mischievous or criminal acts of theft or vandalism, which would generally pose lower safety risks. Theft of tools, equipment, and construction materials is a relatively common occurrence at large sites, especially when spread across large geographic areas where security is more difficult to maintain. Impacts could result in schedule and cost delays to the construction effort. Although the possibility of some theft or vandalism is considered likely, related health and safety impacts to workers or the public are negligible.

As identified earlier, the Applicant would prepare a comprehensive Construction Security Plan that would describe measures designed to avoid and/or minimize adverse effects associated with breaches in Project security during construction, including terrorism, sabotage, vandalism, and theft. This plan would include provisions describing how the Project construction team and operations and maintenance personnel would coordinate with state and local law enforcement agencies to improve Project security and facilitate security incident response if required.

3.8.5.2.1.6 Protection of Children

While the potential for effects on members of the public from construction activities cannot be dismissed, the Project is not expected to cause any disproportionate effects on people less than 18 years of age. (Children are factored into construction impact analyses as members of the general public.)

3.8.5.2.2 Operations and Maintenance Impacts

Operations and maintenance activities could pose hazards that affect worker and public health and safety. In addition, natural disasters, accidents, or intentional destructive acts or mischief could impact the health and safety of operational workers and the public. The following sections include a qualitative summary of each hazard and its relative frequency, severity, potential impacts, and avoidance and minimization measures for the operations and maintenance phase.

3.8.5.2.2.1 Worker and Public Health and Safety

During the operations and maintenance phase of the Project, potential health and safety impacts to workers would be similar to those described during the construction phase. Electrocution remains a safety concern during operations and maintenance activities that occur in close proximity to or under transmission lines or at converter stations. The Project components would be designed and built to NESC guidelines, minimizing the risk of electrocution (IEEE 2011). Potential injuries or fatalities to workers could also occur from falls from heights, equipment and vehicle accidents, and other operational and maintenance activities. Because day-to-day activities with regard to operating equipment and vehicles and hazardous materials management would be less during operational activities than during construction, the frequency of accidents that could affect members of the public would also be less. Electrical and magnetic field impacts and potential health effects are discussed in Section 3.4.6.

Based on BLS data reported nationally within the electric utility industry (BLS 2012a), there were 2.8 non-fatal recordable incidents per 100 full-time equivalent workers annually. Using the BLS data, based on an average full-time equivalent operations workforce of approximately 72 individuals (See Section 2.1.5) working over the assumed 80-year operational phase of the Applicant Proposed Project, it is estimated there would be approximately 2.0 non-fatal recordable incidents annually. Also, BLS data reported nationally within the utility industry identify 2.5 fatal incidents per 100,000 full-time equivalent workers (BLS 2012b). Using the average operations workforce of 72 workers, it is estimated that there would be approximately 0.002 fatalities annually during the operational phase.

3.8.5.2.2.2 Aircraft and Rail Operations

A fully constructed and operating transmission system could pose long-term hazards to low-flying aircraft in the vicinity of the Project. Structure heights are not expected to exceed 180 feet along the majority of the Project, but could reach heights of approximately 380 feet at the Mississippi River crossing to maintain necessary clearance over the navigable channels. Potential health and safety impacts to workers, members of the public, and aircraft operators and passengers could occur from low-flying aircraft that use nearby airports and landing strips or that conduct aerial application of herbicides, pesticides, and/or fertilizers on nearby croplands. Low-flying aircraft would present a potential hazard to worker and public health and safety, Project assets, and the power supply for the life of the Project up until the facilities are decommissioned and removed. EPM GE-16 would ensure Project structures and components are appropriately marked with devices to help aviators identify potential dangers to aircraft operations.

As explained in Section 3.8.5.2.1.2, no increase in railroad operations is expected to occur as a result of any phase of the Project, so no increased health and safety risk would result.

3.8.5.2.2.3 Fire Hazards

Potential fire hazards would remain during the operations and maintenance phase of the Project. Events that may cause fires include ignition from airborne debris that comes in contact with electrical system components, natural debris buildup on insulators, vegetation contact with transmission lines, and incidents involving firearms. Wildlife interactions with Project components (e.g., perching birds) are not expected to cause bridging between two electrical conductors given the large separation between components which, depending on the type of structure used, would provide a minimum conductor separation distance of approximately 21 feet (see Figures 3.4-21 and 3.4-22 for typical 345kV configuration, Figures 3.4-29 and 3.4-30 for typical ±600kV configuration). Higher-voltage transmission lines (like the Project), where conductors are separated by relatively large distances, makes electrical arcing between components and resultant ignition of fires much less likely.

3.8.5.2.2.4 Natural Events and Disasters

Given the relatively long timeframe of the operations and maintenance phase (assumed to be 80 years), natural events and disasters consisting of severe weather (e.g., ice and windstorms and tornadoes) and ground instability events (e.g., earthquakes) are possible. Project components could fail in a manner that would result in collapse of structures with resultant health and safety concerns and disruption of electrical service. Impacts would typically remain within the ROW but may extend beyond in extreme cases (e.g., a tornado with sufficient strength to transport dislodged structural material from the Project beyond the ROW). The Applicant has designed robust structures that incorporate the appropriate NESC requirements. The Project's design criteria contemplate a wind-loading scenario on a structure without wires of wind speeds equivalent to an F-2/EF3 tornado[2]. While these loading scenarios would not eliminate the potential for damage to the line, they would decrease the likelihood of structure damage or a major outage. The transmission system would be designed according to applicable engineering standards to withstand, to the maximum extent practicable, natural disasters that could result in system failures. In general, the potential for tornadoes to occur can be forecast; however, the actual severity of tornadoes cannot be accurately predicted. The Applicant plans to utilize weather monitoring systems currently in place in the regions of the Project to track tornadic activity and to communicate elevated risk levels to interconnecting utilities to ensure operational readiness. Forecasting potential severe weather would generally allow adequate time to alert, prepare, and mobilize response teams to be ready to respond if needed (see Appendix F).

As with the construction phase, natural events and disasters may occur relatively frequently, but an event severe enough to result in structural damage or downed lines with resultant health and safety hazards or significant

[2] The Enhanced Fujita scale (EF-Scale) was implemented in place of the F-Scale in the United States in 2007 and has the same basic design as the F-Scale. It was revised to reflect better examinations of tornado damage surveys to align wind speeds more closely with associated wind damage.

disruption of electrical service is less likely since the Project would be designed, built, and operated according to federal, state, and industry building codes and standards, which are intended to avoid or minimize safety risks posed by natural events and disasters. The Applicant would take all prudent measures to site transmission towers at safe distances from residences and other structures to provide safety buffers.

3.8.5.2.2.5 Intentional Destructive Acts

Although it is not possible to predict if acts of terrorism or sabotage events would occur, or the nature of such events if they did occur, DOE has considered the potential for events involving terrorism, sabotage, or criminal mischief that could result in health and safety impacts to workers and members of the public. Impacts would be similar to those described for construction. The impacts of terrorism or sabotage of structures or other equipment could range from no noticeable effect to loss of electrical service to some service areas for a period of time. A terrorist cyber-attack could potentially impact operating and communications systems leading to a disruption in service. Although such an attack is possible, the consequences would not be considered major regarding health and safety concerns, although they would be considered critical due to potential impact to the local energy system and grid.

Theft, vandalism, or other mischievous acts could cause safety risks to perpetrators as well as workers and members of the public. Destructive acts such as firearm use near the Project components, including shooting at Project equipment, components, and structures, may cause fires, electrical hazards, personal injury, or death to people in the area. Theft of equipment, supplies, tools, or materials is also a possibility, although less likely than during construction when more equipment would be accessible.

3.8.5.2.2.6 Protection of Children

Electric and magnetic fields are known to occur around transmission lines, distribution lines, and electric appliances. As discussed in detail in Section 3.4.11.2.1.2.2.7, research has been conducted in the United States and around the world to determine whether exposure to power-frequency AC electric and magnetic fields has human health effects.

The general consensus among researchers and the medical and scientific communities is that there is insufficient evidence at this time to conclude whether magnetic fields are a cause of adverse health issues. A review of available literature on the health risk posed by AC electric and magnetic fields was conducted by the World Health Organization (WHO) Task Group (other studies and reviews are discussed in detail in the section cited above). The WHO report, *Environmental Health Criteria 238* (WHO 2007), concluded that:

> Scientific evidence suggesting that every day, chronic low-intensity (above 3–4 mG) power-frequency magnetic field exposure poses a health risk is based on epidemiological studies demonstrating a consistent pattern of increased risk for childhood leukemia. Uncertainties in the hazard assessment include the role that control selection bias and exposure misclassification might have on the observed relationship between magnetic fields and childhood leukemia. In addition, virtually all of the laboratory evidence and the mechanistic evidence fail to support a relationship between low-level power-frequency magnetic fields and changes in biological function or disease status. Thus, on balance, the evidence is not strong enough to be considered causal, but sufficiently strong to remain a concern.

In addition, The National Institute of Environmental Health Sciences (NIEHS) report to the United States Congress, at the conclusion of its multi-year Electric and Magnetic Fields (EMF) Rapid Program, summarized its research and concluded that “The scientific evidence suggesting that extremely low frequency EMF exposures pose any health risk is weak” (NIEHS and NIH 2002).

3.8.5.2.3 Decommissioning Impacts

Potential impacts related to worker and public health and safety and hazards during the decommissioning phase of the Project are expected to be similar to those that could occur during the construction phase. As indicated in Section 2.1.6, a comprehensive decommissioning plan would be prepared prior to decommissioning the Project. This plan would include procedures to minimize safety risks to workers and the public.

3.8.5.3 Impacts Associated with the DOE Alternatives

Potential impacts associated with the Project with the DOE Alternatives within Oklahoma, Arkansas, and Tennessee, including the Arkansas converter station and AC interconnection, the HVDC transmission line alternative routes, access roads, multi-use construction yards and other temporary construction areas, and communications sites, would be similar to those discussed above for the Applicant Proposed Project (Section 3.8.5.2) except for potential injury and fatality statistics, which are discussed below.

The construction impacts to worker health and safety from the Project with the DOE Alternatives would depend on the number of workers, which is related to the length of the routes, ruggedness of terrain, and other factors. The ruggedness of the terrain would also increase the potential health and safety risk associated with construction of the HVDC transmission line. Approximately half of the alternative routes are equal to or shorter than the Applicant Proposed Route; the other half are somewhat longer. The total length of the alternative routes is roughly equivalent to that of the corresponding links of the Applicant Proposed Route. Therefore, the number of workers required for construction of the alternative routes would not be substantially different than the estimate calculated for the Applicant Proposed Project discussed above. This would result in no appreciable change in health and safety impacts to workers from construction of the HVDC transmission line.

The addition of the Arkansas converter station and interconnection would increase the required construction workforce by approximately 10 percent based on the contribution of a typical converter station to the total workforce required for the Applicant Proposed Project (see Appendix F). Because the addition of the Arkansas converter station and interconnection would not replace any elements of the Applicant Proposed Project, the estimated health and safety impacts associated with construction of the Arkansas converter station and interconnection would increase the number of workers and thus the number of non-fatal recordable incidents and potential fatalities by roughly 10 percent over that estimated for the Applicant Proposed Project.

The addition of the Arkansas converter station and interconnection would increase the number of operational workers by 15 over that of the Applicant Proposed Project of 72 operational workers. Based on BLS data reported nationally within the electric utility industry (BLS 2012a), there were 2.8 non-fatal recordable incidents per 100 full-time equivalent workers. Using the BLS data, based on an average full-time equivalent operations workforce of approximately 87 individuals (Clean Line 2013b; Thomas 2014) working over the assumed 80-year operational phase of the Project, it is estimated there would be approximately 2.4 non-fatal recordable incidents annually. Also, BLS data reported nationally within the utility industry identify 2.5 fatal incidents per 100,000 full-time equivalent workers (BLS 2012b). Using the average operations workforce of 87 workers, it is estimated that there would be approximately 0.002 fatalities annually during the operational phase.

3.8.5.4 Best Management Practices

Each of the phases of the Project would be planned, coordinated, and conducted in a manner that protects worker and public health and safety and mitigates or minimizes impacts as described above. Specific EPMs and Project plans and procedures (see Section 3.8.5.1) would be implemented to help ensure protection of workers and the public from identified hazards and intentional destructive acts. Additional practices identified by DOE would minimize the safety risks and consequences posed during construction and operations and maintenance of the Project. However, despite preparedness planning, worker training, and application of safety procedures, accidents may still occur. Although there may be some overlap or inclusion within Applicant-identified EPMs and Project plans, the following BMPs identify additional measures to further ensure impacts are minimized:

- Develop and implement a Health and Safety Plan that describes regulatory requirements, procedures, and practices for conducting activities to help ensure a safe working environment, which for purposes of health and safety measures should include:
  - Fire prevention, suppression, and emergency responder contact procedures
  - Natural disaster and severe weather reporting and contact procedures
  - Law enforcement contact procedures
  - Procedures for addressing hazardous materials spills and other mishaps
  - Helicopter flight safety measures
- Develop and implement a Communications Plan. Section 3.1.2 describes the elements of this plan, which for purposes of health and safety should include:
  - Liaison and public outreach activities with local airports, aviation communities, aviation regulatory bodies, aerial agricultural spraying operations, and railroad operators.
  - Local media and public outreach procedures for applicable hazard communication notices

3.8.5.5 Unavoidable Adverse Impacts

Based on national nonfatal and fatal workplace injury statistics tracked by the BLS (see Table 3.8-2), accidents resulting in worker injuries and possibly death could occur during the construction and/or operations and maintenance phases of the Project. The hazardous nature of the work, the complexity of the electrical system, and the size and areal extent of the Project all would contribute to a potential for worker injuries or death and would be considered unavoidable adverse impacts. These unavoidable adverse impacts could be as a result of common personnel-involved injuries (e.g., slips, trips, or falls), hazardous materials or waste accidents, aircraft incidents, fire hazards, natural events or disasters, or intentional destructive acts.

3.8.5.6 Irreversible and Irretrievable Commitment of Resources

The health of workers and the public are important resources that must be protected. Through the implementation of safety plans, procedures, and required design elements, irreversible commitment of these resources would be kept to a minimum.

3.8.5.7 Relationship between Local Short-term Uses and Long-term Productivity

While there would be a short-term temporary increase in potential health and safety impacts associated with construction, long-term impacts in the region would not increase and would not affect the productivity of the region.

3.8.5.8 Impacts from Connected Actions

3.8.5.8.1 Wind Energy Generation

During construction and operations and maintenance of wind energy generation facilities, potential health and safety impacts to workers and the public would be similar to those described for the Project. Wind energy generation facility developers would be expected to adopt and implement common industry practices and to comply with applicable regulations to protect worker and public health and safety. Installation and operation of wind turbines and associated components present many of the same types of health and safety impacts from working at heights and in an electrically charged environment that are associated with transmission system installations with some exceptions, which are discussed below.

Depending on the alternative selected, the electrical power delivery capacity of the Project would range between 3,500 and 4,000MW. To achieve full utilization of the 3,500 to 4,000MW delivery capacity of the Project, actual wind capacity build-out would be expected to range between 4,200 to 4,550MW, which takes into account line losses, equipment outages, variation in wind turbine power generation, and other operational conditions (Clean Line 2014a, 2014c). Construction of typical, commercial-scale wind energy generation facilities in the Oklahoma or Texas panhandle regions[3] would employ approximately 57 to 515 full-time equivalent workers (Clean Line 2014a) over a 2-year construction period. The minimum full-time equivalent workforce is based on a small-scale wind generation facility with a combined turbine nameplate rating of approximately 53MW (fifteen 3.5MW turbines) and the maximum value is based on a large-scale wind energy generation facility with a combined turbine nameplate rating of 975MW (six hundred fifty1.5MW turbines). Operation of typical commercial-scale wind energy generation facilities in the Oklahoma or Texas panhandle regions would employ approximately 4 to 44 workers annually (Clean Line 2014a).

For purposes of analyses, the following construction and operational calculations are based on the maximum wind capacity build-out of 4,550MW to supply the Project, which could consist of 12 small-scale and 4 large-scale wind energy generation facilities. Worker injury and fatality rates would be expected to be lower if the wind capacity build-out were less than 4,550MW.

Based on BLS data reported nationally within the construction industry (BLS 2012a), there were 3.7 non-fatal recordable incidents per 100 full-time equivalent workers annually. Using the BLS data, based on a full-time equivalent construction workforce (16 wind energy generation facilities) of approximately 2,744 workers working for 2 years, it is estimated there would be approximately 203 non-fatal recordable incidents associated with the construction of the wind energy generation facilities. Also, BLS data reported nationally within the construction industry (BLS 2012b) identify 9.9 fatal incidents per 100,000 full-time equivalent workers. Using the representative construction workforce of 2,744 workers, it is estimated that there would be approximately 0.5 fatalities during a 2-year construction phase.

Operational accident statistics for the 16 wind energy generation facilities is based on BLS data reported nationally within the electric utility industry (BLS 2012a), which identifies 2.8 non-fatal recordable incidents per 100 full-time

---

[3] Although wind generation facility development could occur in Oklahoma or Texas, Oklahoma employment estimates from Clean Line 2014a are used in this EIS for Texas. (The employment estimate for Texas identified in Clean Line 2014a is 56 to 494 full-time equivalent workers over a 2-year construction period and is similar to the Oklahoma estimate. Using the Oklahoma estimate for Texas in this EIS is reasonably conservative.)

equivalent workers. Using the BLS data, based on a full-time equivalent operations workforce of approximately 224 people working over the long-term operational phases of the 16 wind energy generation facilities associated with the maximum 4,550MW build-out capacity, it is estimated there would be approximately 6.3 non-fatal recordable incidents annually. Also, BLS data reported nationally within the utility industry (BLS 2012b) identify 2.5 fatal incidents per 100,000 full-time equivalent workers. Using the operations workforce of 224 workers, it is estimated that there would be approximately 0.006 fatalities annually during the combined operations and maintenance phases of the 16 wind energy generation facilities.

Because of the expected establishment of adequate access controls that prevent entry to hazardous areas by unauthorized individuals, the majority of adverse impacts during construction, operations and maintenance, and decommissioning of wind energy generation facilities have the potential to impact only the respective workforces of those phases (WAPA and USFWS 2013). A primary physical safety hazard of wind turbines occurs if a rotor blade fails and pieces are ejected. Ejection could occur as a result of rotor overspeed, although such occurrences have been extremely rare and have happened mostly with older and smaller turbines (Hau 2000). A related issue, ice throw, can occur if ice builds up on the turbine blades. Although weather conditions relatively near the ground, where the blades would be working, rarely result in ice buildup on the blades, such buildup can and has occurred (WAPA and USFWS 2013). The portion of the ROI in Oklahoma and the Texas Panhandle experience extreme temperature changes, especially in the winter months, from cold fronts moving west to east after crossing the Rocky Mountains. In most instances, ice pieces simply fall from the blade as the air temperature warms and land on the ground near the base of the structure. However, ice pieces as large as 2.2 pounds have been found several hundreds of feet from the structure base (WAPA and USFWS 2013). The extent of impacts from these physical hazards and component failures would typically remain within the wind generation facility site or transmission line ROW, but could extend beyond in extreme cases.

Wind energy generation facility development has the potential to result in health and safety impacts through the handling and use of hazardous materials and the potential to disturb existing known or unknown contaminated sites during construction in the vicinity of WDZs. The types of impacts that may occur are the same as those described for the Project and are considered temporary and minor.

Potential wind energy generation facility development may be located in areas where airports and airstrips are located in the vicinity, which could cause added hazards to workers and the public, aircraft occupants, and wind energy generation facility components from air operations and possible collisions with structures. Wind energy generation facility use of helicopters during construction and operation could cause added risk to occupants, personnel on the ground, and facility structures if a collision were to occur. Table 3.16-7 in Section 3.16 identifies airports or airstrips within or in close proximity to the WDZs. Additionally, potential wind energy generation areas are located within agricultural areas where aerial application of pesticides, herbicides, or fertilizers is a common practice for some crops. Downwind turbulence from rotor airstreams may also cause potential hazards to lighter aircraft (e.g., small private aircraft, aerial spraying aircraft, or helicopters) operating at low altitudes in the area of wind energy generation facilities (Airspace & Safety Initiative 2013).

Fire hazards and natural events and disasters such as severe weather (e.g., tornadoes, ice storms, and flooding), and ground instabilities (e.g., earthquakes) in the vicinity of potential wind energy generation facility developments pose the same types of risks and hazards to workers and members of the public as those described for the transmission Project. Severe weather is known to occur in the WDZs.

Shadow flicker and blade glint and glare are not concerns during construction of wind farm facilities, although operating the wind turbines could cause impacts from such phenomena. Shadow flicker and blade glint and glare would not be an issue during cloudy periods or when turbines are not operating. While there have been studies that have found that shadow flicker may result in the potential for epileptic seizures for those suffering from photosensitive epilepsy (Bos et al. 2013), the AWEA has refuted that finding, noting that "shadow flicker from wind turbines occurs much more slowly than the 'light strobing' associated with seizures" (AWEA 2009). One study (Harding et al. 2008) reported that flickers with a frequency greater than 3 hertz could pose a potential for inducing photosensitive seizures, i.e., a light flashing at a rate of more than 3 times per second. The American Epilepsy Foundation reports that lights flashing in the range of 5 to 30 hertz are most likely to trigger seizures (Epilepsy Foundation 2013). A wind turbine with three blades would have to make a full revolution every second (or 60 revolutions per minute) to reach a frequency of 1 hertz; however, large turbines (like the ones likely for the connected action) operate at 18–45 revolutions per minute or 0.3–0.75 hertz (Bos et al. 2013).

Intentional destructive acts most likely to impact the construction of the wind energy generation facilities are theft and vandalism, which generally pose lower safety risks to individuals but could cause temporary disruptions to electrical service. Wind energy generation facilities are generally designed and constructed to minimize the potential for their destruction or displacement. For example, countermeasures such as regular inspections, security patrols, fencing, signs, and video cameras are commonly used to deter or prevent theft, vandalism, and unauthorized access. Although intentional destructive acts could still occur, implementation of these preventative measures would discourage perpetrators and minimize the potential for such events (Clean Line 2014a).

3.8.5.8.2 Optima Substation

The health and safety impacts associated with the future Optima Substation would be similar to the impacts described for other Project components, including other converter stations and associated transmission lines and components; however, the addition of this substation is anticipated to have a smaller potential for effects due to the relatively smaller scale of the future Optima Substation compared to other substations associated with the Project. There would also be fewer construction and operations workers and therefore lower probabilities for injuries and fatalities.

3.8.5.8.3 TVA Upgrades

Interconnection of the Project with TVA's transmission grid would require construction of approximately 37 miles of new 500kV transmission line in western Tennessee and upgrades to approximately 350 miles of existing transmission lines, mostly in central and western Tennessee (as described in Section 2.5.2). Modifications to several substations also would be required. TVA has identified the types and general sizes (e.g., lengths of transmission lines) of upgrades that would be affected by the Project, but has not yet identified the specific locations of the upgrade activities.

The required TVA upgrades are anticipated to have a similar but smaller potential for health and safety effects than the Project because the upgrades would involve similar activities and workforces and cover a smaller total area, which would likely require less time to construct, potentially resulting in less risk exposure time for workers. TVA would implement measures similar to those listed in Section 3.8.5.1 to minimize or avoid these effects.

3.8.5.9 Impacts Associated with the No Action Alternative

Under the No Action Alternative, DOE assumes for analytical purposes that the Project would not proceed. No impacts to worker and public health and safety or from intentional destructive acts would occur.

Contents

Tables

Figures Presented in Appendix A

This page intentionally left blank.

3.9 Historic and Cultural Resources

3.9.1 Regulatory Background

The federal and state requirements that address identifying, evaluating and considering mitigation measures for cultural and historic resources are identified in Table 3.9-1 and are discussed below.

Table 3.9-1:
Key Statutes and Regulations Related to Historic and Cultural Resources

Jurisdiction	Statute	Legal Code Citation	Key Historic/Cultural Provisions
Federal actions and undertakings	National Environmental Policy Act of 1969, as amended (NEPA)	42 USC §§ 4321–4370 (implementing regulations: 40 CFR Parts 1500–1508) DOE NEPA implementing regulations (10 CFR Part 1021)	Federal law requires evaluation of the potential impacts of major federal actions on historic and cultural resources as a component of the human environment.
	National Historic Preservation Act of 1966, as amended (NHPA)	54 USC § 300101 et seq. (implementing regulations: 36 CFR Part 60 and 36 CFR Part 800)	Federal law requires federal agencies to consider the effects of a federal undertaking on NRHP-listed and NRHP-eligible properties.
Federal and tribal lands	Archaeological Resources Protection Act of 1979, as amended (ARPA)	16 USC §§ 470aa–470mm (implementing regulations: 36 CFR Part 296)	Federal law that prohibits unauthorized collection, excavation of or damage to archaeological resources on federal and tribal lands.
	Native American Graves Protection and Repatriation Act of 1990, as amended (NAGPRA)	25 USC §§ 3001–3013 (implementing regulations: 43 CFR Part 10)	Federal law that protects Native American human remains, funerary objects, and items of cultural patrimony found on federal and tribal lands.
	American Indian Religious Freedom Act	42 USC § 1996	Federal law that protects and preserves for American Indians their inherent right of freedom to believe, express, and exercise traditional religions, including access to sites, use and possession of sacred objects, and freedom to worship through ceremonials and traditional rites.
	Cultural and Heritage Cooperation Authority1	25 USC §§ 3051–3057	Authorizes Secretary of Agriculture to ensure access to National Forest land by Indians and Indian Tribes and Nations for traditional and cultural purposes; authorizes reburial of human remains and cultural items on National Forest land; and prohibits unauthorized disclosure of information regarding reburial sites and locations of sites.
Arkansas public lands	Arkansas Antiquities Act of 1967, as amended	ACA Chap. 13-6-301–13-6-308	Prohibits unauthorized excavation on public lands in Arkansas; specifies excavation and reporting standards; provides penalties for violations; discourages excavations on private lands except in accordance with the provisions and spirit of the act.
Arkansas public and private lands and waters	Arkansas Grave Protection Act of 1991, as amended	ACA Chap. 13-6-401–13-6-409	Protects all human burials and human skeletal burial remains from desecration, without reference to ethnicity, cultural or religious affiliation, or date of burial; establishes a permit system for legitimate excavation; provides penalties for violations; specifies provisions apply to state and federal agencies as well as private individuals and firms.

Table 3.9-1:
Key Statutes and Regulations Related to Historic and Cultural Resources

Jurisdiction	Statute	Legal Code Citation	Key Historic/Cultural Provisions
Historic preservation reviews in Arkansas	Arkansas Historic Preservation Program (AHPP) Act of 1977, as amended	ACA Chap. 13-7-101–13-7-111	Establishes the AHPP; authorizes cooperation with the Arkansas Archaeological Survey (AAS); assigns AHPP and AAS responsibilities for administration of state role in NHPA.
Oklahoma public lands	Oklahoma Antiquities Law of 1985	53 OS 361	Prohibits unauthorized excavation on public lands in Oklahoma; specifies excavation and reporting standards; provides penalties for violations.
Oklahoma public and private lands and waters	Oklahoma Burial Desecration Law of 1987, as amended	21 OS 1168.0–1168.6	Protects all human burials, skeletal remains, and burial furniture from desecration; establishes a permit system for legitimate excavation; provides penalties for violations; specifies provisions apply to state and federal agencies as well as private individuals and firms.
Historic preservation reviews in Oklahoma	Oklahoma State Register of Historic Places Act of 1983	53 OS 351–355	Designates the Executive Director of the Oklahoma Historical Society (OHS) as the State Historic Preservation Officer and directs OHS to work with the federal government and other states concerning matters of historic preservation; establishes a State Register of Historic Places.
Texas public lands	Antiquities Code of Texas	9 TX NRC 191 (implementing regulations at 13 TX AC 24–26)	Protects archaeological and historic sites on state and local public property and establishes the designation of State Antiquities Landmarks.
Cemeteries in Texas	Texas Cemetery Law	8 TX H&SC Chap. 711 (implementing regulations at 13 TX AC 22)	Cemeteries protected from desecration; a person who discovers an unknown or abandoned cemetery shall file notice of the cemetery with the county clerk of the county in which it is located.
Historic preservation reviews in Texas	Texas Historical Commission Act	4 TX GC Chap. 442 (implementing regulations at 13 TX AC 2)	Established the Texas Historical Commission; defines its purpose, powers, and duties; assigns Commission responsibility for administration of state role in NHPA.
Tennessee public lands and waters	Tennessee Archaeology Code	TCA 11-6-101–11-6-106	Establishes the Tennessee Division of Archaeology; protects archaeological sites on public lands and waters from vandalism and unauthorized excavation.
Graves and cemeteries in Tennessee	Tennessee Archaeology Code	TCA 11-6-107 and 11-6-116–11-6-119	Requires notification to Tennessee Division of Archaeology when human remains are discovered on public or private lands; provides for notification of Indian Tribes and Nations when Native American human remains are excavated and grants Native American observers the privilege of presence during such excavations; provides for repatriation and burial.
Places of burial in Tennessee	Tennessee Criminal Code	TCA 39-17-311–39-17-312	Protects places of burial from desecration and the unauthorized disinterment of human remains and their sale.
Historic preservation reviews in Tennessee	Tennessee State Code: State Historian and Historical Commission	TCA 4-11-111	Provides that state agencies consult with Tennessee Historical Commission prior to altering or demolishing state buildings and further provides that Commission staff shall assist agencies, institutions and entities in determining if property is or may be of historical, architectural, or cultural significance.

1 Only relevant to National Forest land.

ACA—Arkansas Code Annotated; OS—Oklahoma Statutes; TCA—Tennessee Code Annotated; TX AC—Texas Administrative Code; TX GC—Texas Government Code; TX H&SC—Texas Health and Safety Code; TX NRC—Texas Natural Resources Code

3.9.1.1 Federal Requirements

For purposes of this EIS, the major federal requirements addressing, identifying, evaluating, and mitigating impacts to cultural and historic resources are in NEPA and the NHPA. These two federal laws are discussed below.

3.9.1.1.1 National Environmental Policy Act

NEPA is a federal law that requires all federal agencies to consider the potential environmental impacts of their proposed major federal actions (42 USC § 4332(C)(i)). The CEQ implementing regulations for NEPA require that EISs discuss the potential environmental consequences to historic and cultural resources (40 CFR 1508.8). Historic and cultural resources under NEPA cover a wide range, including collections, sacred sites, and non-National Register of Historic Places (NRHP)-eligible sites that may be affected by major federal actions that may include activities entirely or partially financed, assisted, conducted, or approved by federal agencies. NEPA's focus is on the environment of the area(s) to be affected by the alternatives under consideration.

In December 2012, DOE published the NOI to prepare an EIS to analyze the potential environmental impacts of the Project. Several of the scoping comments received in response to this NOI addressed potential effects of the Project on specific cultural resources and/or historic resources, including burial sites and a ceremonial ground important to two Tribes, the Honey Springs Battlefield National Historic Landmark identified in consultation with the Oklahoma SHPO, and the potential for effects to portions of the Trail of Tears identified by the NPS.

3.9.1.1.2 National Historic Preservation Act

Section 106 of the NHPA, (54 USC § 306108) requires federal agencies to take into account the effects on historic properties of their undertakings and to provide the ACHP with a reasonable opportunity to comment on such undertakings. A federal undertaking is defined as a federal action, expenditure of funds or issuance of permit, license, or other approval. Under NHPA, historic properties include any prehistoric or historic district, site, building, structure, or object that is included in or eligible for inclusion in the NRHP. Historic properties of traditional religious and cultural importance to Indian Tribes and Native Hawaiian organizations may also be determined to be eligible for inclusion in the NRHP. The ACHP's NHPA implementing regulations (36 CFR Part 800) describe the process for compliance with Section 106 and provide the steps a federal agency must take to determine the Area of Potential Effects (APE) of a proposed undertaking; identify historic properties within the APE; assess potential effects of the proposed undertaking on historic properties; and conduct consultation regarding measures to avoid, minimize, or mitigate any adverse effects of the undertaking on historic properties. These steps are carried out in consultation with SHPOs, Tribal Historic Preservation Officers (THPOs) and/or representatives from Indian Tribes and Nations on whose tribal lands the undertaking may occur or that may attach religious and cultural significance to historic properties that may be affected by the Project undertaking, and other consulting parties (36 CFR 800.2). SHPOs involved in consultation for this Project comprise those of Arkansas, Oklahoma, Tennessee, and Texas; participating Indian Tribes and Nations are enumerated below. During the public comment period for the Draft EIS, the Applicant requested that DOE clarify that the language of Section 106 specifically enjoins federal agencies to take into account the effects of undertakings on historic properties that are listed on or eligible for the NRHP; in addition, while avoidance of Project impacts is often ideally the most desirable alternative, the NHPA implementing regulations use the phrase "avoid, minimize or mitigate" to describe the means by which adverse effects may be resolved (e.g., 36 CFR 800.6). The DOE has determined that participation in Clean Line's Project is an undertaking under the NHPA. Implementing regulations for both the NEPA and the NHPA encourage agencies to integrate the reviews of potential Project impacts that are required under each law (40 CFR 1500.2(c) and 1502.25, for NEPA; 36 CFR 800.8(a) and

800.8(c), for NHPA). DOE informed the ACHP by letter dated November 20, 2012, that pursuant to the NHPA implementing regulation at 36 CFR 800.8(c), it intended to use substitution, under which DOE is authorized to use the NEPA process and documentation required for the preparation of the EIS for the Plains & Eastern Clean Line Project to comply with Section 106 of the NHPA in lieu of the procedures set forth in 36 CFR 800.3 through 800.6.

In November 2012, DOE invited a number of federal agencies to participate in the Section 106 process and related consultation in this combined NEPA/NHPA evaluation. The following agencies are participating as consulting parties in the Section 106 process: BIA, NPS, USFWS, and TVA. DOE is the lead agency for the Section 106 consultation process as indicated in DOE's Memoranda of Understanding with the above-listed federal agencies.

DOE is developing a Programmatic Agreement (PA) pursuant to 36 CFR 800.14(b) to address its obligations under NHPA Section 106, including government-to-government consultation with Indian Tribes and Nations on whose tribal lands the undertaking may occur or that may attach religious and cultural significance to historic properties that may be affected by the undertaking, and consultation with the Arkansas, Oklahoma, Tennessee, and Texas SHPOs as well as the federal agencies listed above. The draft PA is included in Appendix P. DOE intends to execute the PA prior to issuance of the ROD or otherwise comply with procedures set forth in 36 CFR Part 800.

Clean Line will also be a party to the PA. The PA addresses resource identification and evaluation, assessment of effects, and resolution of effects, including avoidance, minimization, and mitigation. Development of a PA under 36 CFR 800.14(b) is appropriate for the Project because its potential effects on historic properties are multi-state and regional in scope, because of the complex nature of the undertaking, and because effects on historic properties cannot be fully determined prior to approval of the undertaking. In such situations, the regulations allow development of a PA to address the identification of historic properties and resolution of adverse effects in a phased approach (36 CFR 800.14(b)). Federal agencies that do not sign or concur in the PA, but whose involvement with the Project constitutes an undertaking pursuant to 36 CFR 800.16(y), would conduct consultation with SHPOs and/or THPOs and/or other appropriate parties according to the regular process described by 36 CFR 800 Subpart B.

DOE initiated consultation with the SHPOs from Arkansas, Oklahoma, and Tennessee in November 2012, when DOE informed the SHPOs about its intention to integrate NEPA and NHPA Section 106 consultation. In January 2013, DOE notified the SHPOs that it authorized Clean Line to initiate the Section 106 consultation, while reaffirming that DOE would remain responsible for government-to-government consultation with Indian Tribes and Nations. DOE's government-to-government consultation with Indian Tribes and Nations is described in greater detail below. After the NEPA public scoping period ended in March 2013, DOE sent a letter to the Oklahoma, Arkansas and Tennessee SHPOs in April 2013, updating them on the status of DOE's public scoping process and tribal consultation. DOE met with the Oklahoma, Arkansas, and Tennessee SHPOs in June 2013. DOE initiated consultation with the SHPO from Texas in January 2014 in a letter that informed the SHPO about DOE's intention to integrate NEPA and NHPA Section 106 consultation by using the substitution process (36 CFR 800.8(c)). On February 19, 2014, the ACHP notified the DOE that ACHP would participate in consultation to develop a PA for the Project given the Project's potential to impact historic properties and the potential that procedural questions might arise because DOE proposed to use a substitution process (36 CFR 800.8(c)) to address certain obligations under both NEPA and NHPA simultaneously. Throughout development of the draft PA, DOE was in contact with individual consulting parties as circumstances required and also invited the participation of all parties, including the Indian Tribes and Nations, in several in-person meetings (September and November 2014 and January 2015), telephone conference calls (October and December 2014), and invitations to comment on the draft PA (May and August 2015).

The consulting parties also had the opportunity to comment on various aspects of the Section 106 process, including the development and general stipulations of the draft PA, during the public comment period for the Draft EIS. The draft PA is provided in Appendix P. The PA will be signed and executed before DOE issues the ROD.

As part of the Section 106 process, DOE also initiated government-to-government consultation with Indian Tribes and Nations in accordance with 36 CFR 800.2. DOE identified Indian Tribes and Nations that may attach religious and cultural significance to historic properties potentially affected by the undertaking and initiated consultation with them in January 2013. DOE has subsequently invited the participation of additional Indian Tribes and Nations as Section 106 consultation identified other Tribes and Nations that also may attach religious and cultural significance to historic properties potentially affected by the undertaking or on whose tribal lands the undertaking may occur. Table 3.9-2 lists Indian Tribes and Nations that DOE has consulted or sought to consult with as part of the coordinated NEPA-NHPA review. Following the NEPA public scoping period, DOE sent a second letter to each Indian Tribe and Nation in April 2013 to provide updates on the status of the NEPA process and the NHPA Section 106 and government-to-government consultation. In July 2013, DOE sent a third letter to Indian Tribes and Nations, in which DOE requested a meeting to discuss the potential development of the PA. Indian Tribes and Nations that have agreed to be consulting parties in the PA are the Absentee-Shawnee Tribe of Indians of Oklahoma, the Cherokee Nation, the Chickasaw Nation, the Choctaw Nation of Oklahoma, the Iowa Tribe of Oklahoma, the Muscogee (Creek) Nation, the Osage Nation, the Quapaw Tribe of Oklahoma, the Sac and Fox Nation, the Thlopthlocco Tribal Town, the United Keetoowah Band of Cherokee Indians in Oklahoma, and the Wichita and Affiliated Tribes (Appendix P).

Table 3.9-2:
Indian Tribes and Nations Consulted under NHPA Section 106

Tribe	Tribe	Tribe
Absentee-Shawnee Tribe of Indians of Oklahoma	Delaware Nation, Oklahoma	Osage Nation
Alabama Quassarte Tribal Town	Delaware Tribe of Indians	Quapaw Tribe of Indians
Apache Tribe of Oklahoma	Eastern Band of Cherokee Indians	Sac and Fox Nation, Oklahoma
Caddo Nation of Oklahoma	Iowa Tribe of Oklahoma	Santee Sioux Nation, Nebraska
Cherokee Nation	Kaw Nation, Oklahoma	Seneca-Cayuga Nation
Cheyenne and Arapaho Tribes, Oklahoma	Kialegee Tribal Town	Thlopthlocco Tribal Town
Chickasaw Nation	Kiowa Indian Tribe of Oklahoma	Tonkawa Tribe of Indians, Oklahoma
Choctaw Nation of Oklahoma	Modoc Tribe of Oklahoma	United Keetoowah Band of Cherokee Indians in Oklahoma
Comanche Nation, Oklahoma	Muscogee (Creek) Nation	Wichita and Affiliated Tribes (Wichita, Keechi, Waco and Tawakonie), Oklahoma

As of late August 2015, one local government, Woodward County, is included as a consulting party in the PA under 36 CFR 800.3(f). However, the county did not wish to be a concurring party and as a result does not have a signature page in the draft PA. No other local government, non-governmental organizations (NGOs) or individuals have requested to be included in the PA as a consulting party under 36 CFR 800.3(f). DOE has issued several invitations to local governments and NGOs to participate in the Section 106 consultation and PA development process, most recently on August 17, 2015, via an e-mail to approximately 70 recipients. On August 15, 2015, DOE also invited the Trail of Tears Association to participate as a consulting party to the Section 106 process, but to date the Association has not notified DOE that it wishes to consult.

3.9.1.1.3 Other Federal and State Laws

Other federal laws that concern the evaluation and management of historic and cultural resources within the Project ROI include Archaeological Resources Protection Act (ARPA), Native American Graves Protection and Repatriation Act (NAGPRA), American Indian Religious Freedom Act (AIRFA), and Cultural and Heritage Cooperation Authority, which only applies to National Forest lands (Table 3.9-1). Very little of the Applicant Proposed Route and only one alternative route, HVDC Alternative Route 4-B, crosses National Forest land. ARPA (16 USC §§ 470aa–470mm) protects archaeological sites and resources on federal and tribal lands from unauthorized damage or impacts, establishes procedures for obtaining permits for archaeological excavation on federal and tribal lands by qualified individuals, and sets criminal and civil penalties for violations of the law. NAGPRA (25 USC §§ 3001–3013) protects Native American human remains, funerary objects, and other items of cultural patrimony found on federal and tribal lands and requires that such materials are treated respectfully if encountered on federal or tribal lands during Project development, construction, operation, or decommissioning. AIRFA (42 USC § 1996 et seq.) protects and preserves for American Indians their inherent right of freedom to believe, express, and exercise their traditional religions, including but not limited to access to sites, use and possession of sacred objects, and the freedom to worship through ceremonials and traditional rites. No tribal lands, as defined by 25 CFR 169.1(d) or 36 CFR 800.16(x), outside of the Arkansas River, are crossed by the Project. The only location along the Project involving tribal lands is in the vicinity of a crossing of the Arkansas River south of Webbers Falls Lock and Dam 16. Tribal interests here are managed by the Arkansas Riverbed Authority, an entity created jointly by the Chickasaw, Choctaw and Cherokee Nations (Title 25 USC §§ 1779-1779f) to administer tribal interests in this section of the river.

State laws and regulations complement federal law on historic and cultural resources. These laws and regulations vary by state (Table 3.9-1). In general, however, all four states in which the Project would be located have laws protecting marked and unmarked graves and cemeteries, and all four states assert control over archaeological and historic resources on state and local public lands. Administrative rules or other standards issued by the respective SHPOs provide specifications and guidance for archaeological and historic architectural surveys, particularly when such studies are completed as part of Section 106 consultation.

3.9.2 Data Sources

To date, evaluation of cultural resources has relied upon background reviews of existing inventories and related information, primarily from SHPO and other state-maintained files. No Project-specific field surveys have been conducted; instead, this analysis relies on data compiled as part of studies, surveys, and reviews that were completed for unrelated projects independent of this EIS in portions of the ROI.

The Applicant and its contractors, SWCA Environmental Consultants (SWCA) and Panamerican Consultants, assembled data on cultural resources from various state agencies in the ROI for the Project. These data and the reports developed from them (Clean Line 2013, 2014) serve as the principal sources of information for the description of the affected environment and the analysis of potential effects related to the Project. Data have been assembled from the following state agencies, some of which are SHPOs (Clean Line 2013):

- Arkansas Archaeological Survey, University of Arkansas, Fayetteville
- Arkansas Historic Preservation Program, Little Rock
- Oklahoma Archaeological Survey, University of Oklahoma, Norman
- Oklahoma State Historic Preservation Office, Oklahoma City

- Tennessee Division of Archaeology, Nashville
- Tennessee Historical Commission, Nashville
- Texas Archaeological Research Laboratory, University of Texas, Austin
- Texas Historical Commission, Austin

In addition to the aforementioned state agency sources, SWCA also examined NRHP online records from the NPS. DOE also conducted its own review of the NRHP-online records (NPS 2014b) for this EIS.

To develop the background sections of their report on the Project, SWCA also reviewed standard scholarly treatments and selected historic preservation planning documents from pertinent SHPOs. DOE is conducting an ongoing consultation with Indian Tribes and Nations on whose tribal lands the undertaking may occur or that may attach religious and cultural significance to historic properties that may be affected by the Project undertaking to identify tribal cultural resources that could be affected by the Project. Clean Line in 2011 and 2012 conducted outreach to Indian Tribes and Nations in the vicinity of the Project.

During the public comment period for the Draft EIS, DOE received information about the locations of several potential archaeological and cultural resources, including Native American camps and other types of sites, burial localities, and historic graves and cemeteries. DOE provided this information to the Applicant for future consideration during micrositing and cultural resource surveys.

In response to public comments on the Draft EIS, DOE reviewed lists of honorees for the Century Farm programs in Oklahoma, Texas, Arkansas, and Tennessee to assess the potential presence of such properties in the ROI for the Project. The lists identify properties that have been honored by the programs by county, but to protect the privacy of property owners, location maps are not available. Lists of honorees were consulted online via the program webpages (Arkansas Agriculture Department 2015; OKSHPO 2015; Texas Department of Agriculture 2015; Middle Tennessee State University Center for Historic Preservation 2015). Comments also expressed concerns about Centennial Trees, but a query by the Applicant to the Oklahoma Forestry Services determined that no database of trees so honored exists. They are therefore not specifically considered in the Final EIS.

The information reported in this section is the best available at the present time concerning historic and cultural resources. DOE has independently reviewed information provided by the Applicant. Additional information on historic and cultural resources that could be impacted by the Project will be obtained through field surveys to be conducted prior to construction.

3.9.3 Region of Influence

As described in Section 3.1.1, this EIS defines the area potentially affected by the Project as the ROI. DOE defines the APE (see Section 3.9.1.1.2), which is the geographic area within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, in the draft PA (Appendix P). The extent of the APE is influenced by the scale and nature of an undertaking and may be different for different types of effects caused by the undertaking.

For historic and cultural resources, the ROI for the Project is as defined in Section 3.1.

For purposes of this EIS, the ROI for potential visual effects to historic and cultural resources is defined as follows:

- A 1-mile-wide corridor along the Applicant Proposed Route or along the HVDC alternative routes, and the AC collection system routes (i.e., a 0.5-mile zone on either side of the centerline).
- Each converter station siting area and AC interconnection siting area with the area extending outward 0.5 mile.[1]
- A 1,000-foot-wide corridor ROI (500 feet on either side of the centerline of the Applicant Proposed Route and HVDC alternative route) is used to characterize and assess potential effects on archaeological sites, which are largely belowground and therefore less likely to experience visual effects; the larger ROI is used to characterize and assess potential effects on aboveground historic properties and historic routes. It is possible that some archaeological sites could have aboveground expressions, but for the purpose of this analysis, archaeological sites were evaluated in the 1,000-foot-wide corridor ROI.

The ROI for historic and cultural resources for wind energy development, the future Optima Substation, and TVA upgrades are as described in Section 3.1.

3.9.4 Affected Environment

The Project encompasses a geographic transect stretching approximately 720 miles across central North America. This transect extends from the grasslands of the High Plains on the west to the forested eastern flank of the Mississippi Valley on the east. It contains a diverse range of climatic zones, terrain, flora, and fauna whose character has gradually altered with global climatic change and with the effects of human activities on local environments over a period of more than 12 millennia. These environmental factors in turn helped shape the different cultures of people who lived in various places at various times throughout central North America in which the ROI is located.

Human occupation in the region began with the arrival of the early ancestors of modern Native Americans, who are known to archaeologists as Paleoindians. Paleoindians specialized in hunting large now-extinct Pleistocene megafauna, and herd animals such as bison, and are believed to have travelled over wide regions to secure their livelihood. With environmental change at the end of the last glacial epoch, forested lands became more widespread and environmental stresses related to warming and drying climatic conditions appeared. While the Plains dwellers of the western end of the Project region continued to depend on bison and other herd animals, further east, Native American peoples developed new subsistence strategies that aimed to exploit the more solitary animals of forests and woodlands, as well as abundant resources found in and around rivers, ponds, and wetlands. This Archaic period, as it is known, lasted for many thousands of years, and in some places Native Americans still practiced what were essentially Archaic period lifeways up to the disruptions caused by the arrival of Euroamerican explorers, traders, and settlers.

Some two to three thousand years ago, innovations originating among the Native Americans of Mexico and Central America reached the Southeast and Plains regions of the United States. Key innovations included the practice of horticulture involving cultivation of corn, beans, and squash, and the manufacture of earthenware pottery. These new practices mark the emergence of the Woodland period. In the eastern part of the ROI, the rise of horticulture was probably one factor in the development of large villages and towns with increasingly complex social and political

[1] Since completion of the Draft EIS, the Applicant has reduced the footprints of the Arkansas Converter Station and the Tennessee Converter Station Siting Areas, has added a substation at the Arkansas AC interconnection, and has eliminated a 1-mile ROW for the Tennessee interconnection. The net effect of these changes is to reduce the total study area footprint. All changes, however, are located within areas studied in the Draft EIS.

organizations, which characterize the final period of prehistory in the eastern Arkansas-western Tennessee region, known as the Mississippian period. To the west, a cultural tradition known to archaeologists as Plains Villager appeared. This tradition was characterized by small semi-permanent settlements and a mixed hunting, gathering, and horticultural way of life; social complexity was less intensely developed than in the Mississippian cultures to the east.

Beginning in the mid-sixteenth century, European explorers started traversing the region. Traders and settlers followed, generally moving west up major valleys from the Mississippi River, causing vast disruption to the traditional cultures and ways of life of the Native American peoples of the region. In the nineteenth century, policies of the federal government relocated many Tribes from the eastern United States into Oklahoma, parts of which then comprised Indian Territory. As the United States grew in population and economic and industrial power, the Project region was drawn into the modern nation-state. Dates of statehood indicate the historical trajectory of this process: Tennessee became a state in 1796, followed by Arkansas in 1834, and Oklahoma in 1907.

Historic and cultural resources preserve traces of this long history for archaeological study and illustrate it for modern Americans. In general, traces of the Native American past prior to the arrival of Euroamericans (conventionally referred to as the prehistoric period of human history in North America) are largely preserved belowground as archaeological sites. Extant, mostly aboveground, buildings and structures, in contrast, serve as important witnesses to colonial and post-colonial American history, mostly of the nineteenth and twentieth centuries, and these standing structures are complemented by archaeological sites of the period.

The discussion below uses only counts of archaeological resources in the Project ROI to maintain the confidentiality of the geographic locations of the sites provided by the SHPOs or state archaeological surveys. Site location confidentiality helps to protect sites from vandalism.

The ROI contains more than 100 inventoried archaeological sites and a roughly similar number of architectural resources. Most cultural resources have been identified only, and their integrity, significance, and potential eligibility for listing in the NRHP remain unevaluated. However, the ROI also contain 13 identified historic properties that are listed on the NRHP. Figure 3.9-1 in Appendix A shows the NRHP sites that are located within Regions 1 through 7. Unlike the majority of inventoried cultural resources in the ROI whose integrity, significance, and eligibility remain unevaluated, these 19 properties have a clearly established level of cultural or historical significance and are identified individually in Tables 3.9-3 and 3.9-12 and in the text below.

Table 3.9-3:
NRHP-Listed Properties in the 1-mile ROI for the Project—All Regions

Region	Project Segment(s)	Property Name	NRIS No.	Location	Distance from Centerline (miles)
1	AC Collection Line NW 2	Tracey [or Tracy] Wood-Frame Grain Elevator[1]	83002137	Muncy, Texas County, Oklahoma	0.03
3	AR 3-C and AR 3-D	Oktaha School	78002242	Oktaha, Muskogee County, Oklahoma	0.29
3	AR 3-C and AR 3-D	Honey Springs Battlefield NHL	70000848	Oktaha vicinity, Muskogee and Macintosh Counties, Oklahoma	0.10
4	APR Link 6	Mulberry River Bridge	06001272	Pleasant Hill vicinity, Crawford County, Arkansas	0.28

Table 3.9-3:
NRHP-Listed Properties in the 1-mile ROI for the Project—All Regions

Region	Project Segment(s)	Property Name	NRIS No.	Location	Distance from Centerline (miles)
4	AR 4-B	Butterfield Overland Mail Route—Lucian Wood Road Segment	09000771	Cedarville vicinity, Crawford County, Arkansas	0.08
4	AR 4-E	Lutherville School	99000228	Lamar vicinity, Johnson County, Arkansas	0.09
4	AR 4-E	Munger House	96001174	Lutherville vicinity, Johnson County, Arkansas	0.05
5	APR Link 9	William Henry Watson Homestead	91001308	Denmark Township, White County, Arkansas	0.34
5	AR 5-B	Charlie Hall House	05000492	Twin Groves vicinity, Faulkner County, Arkansas	0.05
5	AR 5-B, AR 5-E, and AR 5-F	New Mt. Pisgah School	91001331	Mt. Pisgah vicinity, White County, Arkansas	0.29
5	AR 5-C, APR Link 5, and APR Link 6	Wesley Marsh House	91001328	Letona vicinity, White County, Arkansas	0.34 mi (AR 5-C and APR Link 5); 0.41 mi (APR Link 6)
7	AR 7-A	Highway A-7 Bridges Historic District	09000318	Marked Tree Vicinity, Poinsett County, Arkansas	0.0 mi (crosses)
7	AR 7-A	Nodena Site NHL	66000201	Wilson Vicinity, Mississippi County, Arkansas	>0.10

NRIS—National Register Information System.
NHL—National Historic Landmark
1 Examination of aerial imagery available from Google Earth indicates that the Tracey Wood-Frame Grain Elevator is no longer extant. Field survey would be required to verify its disappearance.
Source: NPS (2014b), OKSHPO (2014b)

In addition to the historical dimension of the resources present in the ROI, there may be additional resources including burial sites, individual homestead allotments, and ceremonial grounds important to present-day Indian Tribal identity or lifeways, or cultural significance. Tribal resources conceptually overlap in part with archaeological and architectural resources, but tribal resources have not yet been formally identified or documented. As part of the process of identifying and evaluating historic and cultural resources in this region, and as noted above, DOE is conducting ongoing consultation with Indian Tribes and Nations. Concerns for specific burial and ceremonial ground areas have been expressed in consultation meetings in relation to the ROI.

State-level Century Farms programs provide recognition to self-nominated agricultural operators who can document at least 100 years of continuous operation of a farm or ranch by a single family. These programs are honorary, voluntary, and do not afford legal protections (Arkansas Agriculture Department 2015; OKSHPO 2015; Texas Department of Agriculture 2015; Middle Tennessee State University Center for Historic Preservation 2015). In most of the 33 counties included in the study area for this Project (Tables 2.1-3, 2.1-5, and 2.4-1), around 1 percent (the median) of active farms and ranches have been honored as Century Farms. Most counties have participation rates in their state's Century Farm program of between 0.1 and 3.0 percent. Two counties, Crawford and Cleburne counties, Arkansas, have no Century Farm honorees, and three, Major, Garfield, and Kingfisher counties, Oklahoma, have over 3 percent (7.2, 11.5, and 12.8 percent Century Farms, respectively).

Assessment of effects (including visual effects) on historic properties is based in part on the evaluation of integrity and is related to the characteristics of each property that make it NRHP-eligible. According to the NRHP guidelines, integrity is defined as the ability of an historic property to convey its own significance; evaluations of integrity must always be grounded in an understanding of a property's physical features and whether they remain sufficiently intact to convey its significance. A historic property's integrity includes seven unique aspects: location, setting, design, materials, feeling, workmanship, and association. Based on these aspects, the types of sites considered visually sensitive include, but are not limited to, National Historic Monuments, Districts, Landmarks, and Trails; sites eligible under criteria A, B, or C and Traditional Cultural Properties (36 CFR 800.5). In the Section 106 consultation process, the lead federal agency typically makes a determination about the NRHP eligibility of each identified historic property within the APE of the undertaking; the pertinent SHPO provides concurrence, as appropriate, with the agency's determinations.

Several route variations to the Applicant Proposed Route in Regions 2–7 were developed in response to public comments on the Draft EIS and are described in Appendix M and summarized in Sections 2.4.2.1–2.4.2.7. Exhibit 2 of Appendix M tabulates available information on previously recorded historic and cultural resources, which was obtained from the sources listed above in Section 3.9.2. Assessments of the impacts related to the route variations by Project region, including accompanying HVDC alternative route adjustments, are provided below. The variations are presented graphically in Exhibit 1 of Appendix M.

3.9.5 Regional Description

Geographic and cultural features relevant to the characteristics and distribution of historic and cultural resources are described by region in the sections below. The region names and the Applicant Proposed Route and HVDC alternative routes by region are listed in Table 2.4-1.

3.9.5.1 Region 1

The western end of Region 1 is the location of the AC collection system centered in Texas County, Oklahoma, and including areas in adjoining counties in Oklahoma and Texas. In addition, Region 1 includes the Applicant Proposed Route, HVDC alternative routes, and the Oklahoma Converter Station.

Region 1 is situated in western Oklahoma, including the eastern and central portions of the Oklahoma Panhandle. It also includes the north-central border region of the adjoining Texas Panhandle. The region is part of the Plains culture area as defined by ethnographers for indigenous Native American peoples of the late prehistoric and historical periods (after roughly 1650 AD) (DeMallie 2001). The Oklahoma Archaeological Survey (OAS) places the region within its Southern Plains Adaptations research region for Native American archaeology (OAS 2011). Region 1 spans portions of two historic preservation planning and management regions defined by the Oklahoma State Historic Preservation Office (OKSHPO): OKSHPO Region 1 (the Oklahoma Panhandle) and OKSPHO Region 2 (Northwestern Oklahoma) (OKSHPO 2014a). In Texas, Region 1 is part of the Texas Historical Commission's Archaeology Region 1 and its Plains Trail heritage tourism region (Texas Historical Commission 2014a, 2014b). Texas archaeologists and historians identify Region 1 as part of the Panhandle region of the state (Perttula 2004, Figure 1.1; Rathjen 2010).

Geographically, Region 1 lies within the High Plains physiographic province (Wedel and Frison 2001, Figure 1). It is characterized by level and irregular, rolling to broken plains that grade into dissected canyons, escarpments, hills, buttes, terraces, and dunes. There are scattered playas on the plains of the region. The natural vegetation is mostly short grass prairie (Griffith et al. 2004; Woods et al. 2005). The region today is primarily agricultural and is dominated by cattle ranching. The archaeological record of the region spans over 12,000 years, extending from the sites of early Native American hunter-gatherers of the Paleoindian period through the small pithouse villages of Native American horticulturalists in late prehistory to the remains of dugouts, ranches, and farmsteads of late nineteenth- and twentieth-century non-Indian settlers, ranchers, and farmers (Clean Line 2013). According to the OAS (2011), prehistoric, protohistoric, and early historic period archaeological sites in the region are "characterized by the remains of special activity sites, camps, and villages of Native Americans whose lives were focused around the bison (buffalo)." Historic property types associated with the occupation of the region by Euroamericans and other non-Indian groups from the late nineteenth century onwards include townsites; commercial buildings and structures; non-commercial and governmental buildings; homesteads, farms, and ranches; churches; schools; and cemeteries (Smith 1986a). Such property types occur both as extant standing structures and as archaeological sites.

No historic or cultural resources have been identified within the Oklahoma Converter Station Siting Area or associated AC Interconnection Siting Area (Clean Line 2013). Information about historic and cultural resources in the AC collection system and HVDC transmission facilities in Region 1 is presented in the following sections.

3.9.5.1.1 Region 1 AC Collection System

The proposed AC collection system in Region 1 primarily occupies vast upland regions of the Oklahoma and Texas Panhandles. Terrain in the region is varied, and climate is semi-arid. Inventoried archaeological sites are few in comparison to the acreages involved. Nonetheless, available information shows that archaeological sites typically occur in the vicinity of principal drainages and major tributaries, as well as in the vicinity of terrain features such as escarpments and buttes. Several historic transportation routes cross the area, but no cultural resources have been documented as associated.

The Applicant's initial analysis of potential impacts to historic and cultural resources for the AC collection system routes considered 2-mile-wide siting corridors (the ROI), which represented a combined area of over 440,000 acres. In all, these corridors contain a total of 71 separate sites, but due to overlaps between adjacent 2-mile siting corridors, some of these sites are counted more than once in Table 3.9-4, which shows the numbers of previously inventoried historic and cultural resources associated with the corridors. Among the 71 sites, 46 are prehistoric archaeological sites, 11 are historic period sites, 5 are multicomponent (prehistoric and historic period) sites, and 9 lack a record as to period. Over 80 percent (59 of 71) of the inventoried archaeological sites have not been evaluated for NRHP eligibility. To date, nine of the sites have been determined ineligible for the NRHP, while three are categorized as NRHP-eligible. No previously recorded archaeological sites in the ROI for the AC collection system routes in Region 1 are listed on the NRHP. Prehistoric archaeological site types that may be anticipated within the ROI include open camps, general artifact scatters, isolated burials, and a bison kill sites. Historic archaeological sites may include farmsteads, general artifact scatters, cemeteries (which could also be categorized as historic architectural features), isolated structures, and railroad-related ruins (Clean Line 2013). Only one aboveground historic structure, an NRHP-listed early twentieth-century grain elevator, has been inventoried in the ROI of the AC collection system routes in Region 1. Four historic transportation routes are known in the region, including two railroad lines, a military road, and a cattle trail, and the ROI intersects these historic transportation routes in multiple locations. The region contains few farms or ranches that have been honored as Century Farms.

No route variations were proposed for the AC Collection System in Region 1.

Table 3.9-4:
Previously Inventoried Historic and Cultural Resources in the ROI for the AC Collection System Routes in Region 1

		AC Collection System Route												
		E-1	E-2	E-3	NE-1	NE-2	SE-1	SE-2	SE-3	NW-1	NW-2	SW-1	SW-2	W-1
Archaeological Sites														
Prehistoric	Unique[1]	6	0	11	0	1	3	1	5	0	0	0	0	1
	Duplicate[2]	2	5	2	6	2	9	8	7	3	5	3	10	9
	Total	8	5	13	6	3	12	9	12	3	5	3	10	10
Historic	Unique[1]	0	0	2	0	0	0	0	1	0	0	0	0	0
	Duplicate[2]	0	4	0	1	0	2	1	3	2	4	2	2	2
	Total	0	4	2	1	0	2	1	4	2	4	2	2	2
Multicomponent	Unique[1]	0	0	2	0	1	0	0	0	0	0	0	0	0
	Duplicate[2]	0	2	0	0	0	0	0	1	0	2	0	0	0
	Total	0	2	2	0	1	0	0	1	0	2	0	0	0
Not Specified	Unique[1]	0	0	1	1	0	2	4	0	0	0	0	0	0
	Duplicate[2]	0	0	0	1	0	0	1	0	0	0	0	0	0
	Total	0	0	1	2	0	2	5	0	0	0	0	0	0
Total Archaeological Sites		8	11	18	9	4	16	15	17	5	11	5	12	12
Aboveground Historic Properties[33]														
Inventoried Buildings and Structures		0	0	0	0	0	0	0	0	0	0	0	0	0
NRHP-Listed Properties		0	0	0	0	0	0	0	0	0	1	0	0	0
Total Aboveground Properties		0	0	0	0	0	0	0	0	0	1	0	0	0
Historic Routes, Trails, and Roads[4]		0	3	2	1	0	2	0	2	1	2	0	0	1
Century Farms (estimated)[5, 6]		0	0	0	0	0	0	0	0	1	1	0	0	0

1 “Unique” sites are counted only once in this table. They are within the 2-mile siting corridor for only a single collection line.
2 “Duplicate” sites are counted two or more times in this table. They are overlapping portions areas of the 2-mile siting corridors for two or more collection lines.
3 Due to the low number of aboveground historic properties, duplicate counts do not arise.
4 Trail intersections per 2-mile corridor; includes a combination of several different trails that may intersect a given corridor once or more than once.
5 Estimated number of Century Farms crossed by centerline of the route, rounded to the nearest whole number, based upon per-county data for total number of farms, average size of farms, and percentage county area in farmland (Table 3.13-9); number of Century Farm honorees (OKSHPO 2015; Texas Department of Agriculture 2015); and lengths of route segments. The estimate assumes an unbiased distribution of Century Farms across each county.
6 Century Farms Programs are honorary, voluntary, and do not afford legal protections (Arkansas Agriculture Department 2015; OKSHPO 2015; Texas Department of Agriculture 2015; Middle Tennessee State University Center for Historic Preservation 2015).
Source: Clean Line (2013, Table 3-42B), supplemented by data referenced in Footnote 5.

3.9.5.1.2 Region 1 HVDC Transmission Facilities

Available information for the proposed transmission line corridors of the Applicant Proposed Route and HVDC Alternative Routes 1-A through 1-D in Region 1 indicates that inventoried prehistoric and historic archaeological sites typically occur along the principal drainages and their major tributaries; these increase in prominence toward the eastern end of the region. Historical settlement was dispersed across the region; documented historic standing structures occur in the western end of the ROI in a clustering that results from the low density of historic properties in Region 1 and the limited extent of survey to date (Clean Line 2013). The clustering is not historically meaningful.

Including duplicate counts, 11 prehistoric archaeological sites and five historic archaeological sites are documented for the ROI associated with the HVDC transmission facilities in Region 1 (Table 3.9-5). None of the sites has been determined to be eligible for or is listed on the NRHP. Documented prehistoric archaeological site types in the ROI include general artifact scatters, open camps, and a bison kill site. Documented historic archaeological site types in Region 1 are farmsteads, along with an isolated structure and an unspecified site type. The Applicant Proposed Route and HVDC alternative routes cross several nineteenth-century cattle trails, military roads, and early railroad lines, but no archaeological sites or standing structures have been recorded as specifically associated with these routes in the region. Among the historic trail alignments crossed by the Project route is that of the Western or Great Western Trail, which was recently identified as a potential National Historic Trail NPS 2014d). The intersection of the Project with this historic trail alignment is approximately 2.6 miles west-southwest of May, Harper County, Oklahoma. No historic or cultural resources have been identified as associated with the trail alignment in the vicinity of the intersection. The ROI for potential visual impacts for the Applicant Proposed Route and HVDC alternative routes includes three buildings that are reported to be eligible for the NRHP (Clean Line 2013). The Applicant Proposed Route is estimated to cross approximately one Century Farm, while most HVDC alternative routes are estimated to cross one or two such operations.

No route variations were proposed for the Applicant Proposed Route in Region 1.

Table 3.9-5:
Previously Inventoried Historic and Cultural Resources in the ROI for the Applicant Proposed Route and HVDC Alternative Routes in Region 1

	APR	AR 1-A	AR 1-B	AR 1-C	AR 1-D
Archaeological Sites[1]					
Prehistoric	2[2]	7	1	0	12
Historic	2	2	1	0	0
Multicomponent	0	0	0	0	0
Not Specified	0	0	0	0	0
Total Archaeological Sites	4	9	2	0	1
Aboveground Historic Properties[1]					
Inventoried Buildings and Structures	13	0	1[3,4]	1[3, 4]	0
NRHP-Listed Properties	0	0	0	0	0
Total Aboveground Properties	1	0	1	1	0
Historic Routes, Trails, and Roads[1]	6	6	2	2	0
Century Farms (estimated)[5, 6]	1	2	1	1	0

1 ROI for archaeological sites is a 1,000-foot-wide corridor; ROI for aboveground historic properties and historic routes is a 1-mile corridor.
2 Includes one site that is counted twice because its location is known only to a half quarter-section, and the identified area is intersected by both Applicant Proposed Route Link 4 and HVDC Alternative Route 1-D.
3 Identified by OKSHPO records as NRHP eligible.
4 Duplicate count. Building or structure occurs in conterminous ROI for HVDC Alternative Routes 1-B and 1-C.
5 Estimated number of Century Farms crossed by centerline of the route. See Table 3.9-4 Footnote 5 for basis of estimate.
6 Century Farms Programs are honorary, voluntary, and do not afford legal protections (Arkansas Agriculture Department 2015; OKSHPO 2015; Texas Department of Agriculture 2015; Middle Tennessee State University Center for Historic Preservation 2015).
Source: Clean Line (2013, Table 3-9), supplemented by data from OKSHPO (2015).

3.9.5.2 Region 2

The history of Region 2 includes the Plains culture area as defined by ethnographers for Native American peoples of the late prehistoric and historical periods (after roughly 1650 AD). The OAS (2011) places the region within its Southern Plains Adaptations research region for Native American archaeology (OAS 2011). Region 2 is situated within OKSHPO (2014a) historic preservation planning and management Region 2 (Northwestern Oklahoma).

Geographically, Region 2 lies within the Osage Plains physiographic province (Wedel and Frison 2001, Figure 1). It is characterized by a variety of landforms, including stabilized and active dune fields, gypsum karst terrain, breaks, escarpments, gorges, ledges, canyons, and nearly level prairieland. The natural vegetation of upland areas is predominantly mixed grass prairie. Characteristic soils and hydrological conditions mean that dune and karst areas each support distinct vegetation communities of mixed grasslands, shrubs, and trees. Throughout the region, ravines and stream valleys support woodlands, and woodlands are more extensive to the east, where annual rainfall tends to be greater and less variable (Woods et al. 2005). Cattle ranching dominates the western half of Region 2, and small grain farming is predominant in the eastern half. The archaeological record of Region 2 spans over 12,000 years, extending from the sites of early Native American hunter-gatherers of the Paleoindian period through the small pithouse villages of Native American horticulturalists in late prehistory to the remains of dugouts, ranches, and farmsteads of late nineteenth- and twentieth-century non-Indian settlers, ranchers, and farmers (Clean Line 2013). According to the OAS (2011), prehistoric, protohistoric, and early historic period archaeological sites in the region are “characterized by the remains of special activity sites, camps, and villages of Native Americans whose lives were focused around the bison (buffalo).” Historic property types associated with the occupation of the region by Euroamericans and other non-Indian groups from the late nineteenth century onwards include townsites; commercial buildings and structures; non-commercial and governmental buildings; homesteads, farms, and ranches; churches; schools; and cemeteries (Smith 1986b). Such property types occur both as extant standing structures and as archaeological sites.

Available information indicates that, in general, prehistoric and historic archaeological sites occur most frequently along the region’s principal drainages and their major tributaries, which are more numerous in its central and eastern sections. Historical settlement was dispersed across the region, and the region was crossed by several historical transportation corridors (Clean Line 2013). Among these was the Chisholm Trail, the alignment of which was recently identified by NPS as a potential National Historic Trail (NPS 2014d), and was identified as a potentially significant resource by commenters on the Draft EIS. Approximately 1.6 miles south of Bison, Oklahoma, Link 2 of the Region 2 Applicant Proposed Route passes approximately 200 feet south of a field containing relict wagon ruts from this trail; the property owner is working with the Oklahoma SHPO to develop an NRHP nomination for the property.

Only two archaeological sites have been documented within the ROI in Region 2 (Table 3.9-6), and the available information does not indicate the time period of either. Neither has been determined to be eligible for or is listed on the NRHP. No historic standing structures have been documented in the ROI for potential visual impacts for the Applicant Proposed Route and HVDC alternative routes (Clean Line 2013). The counties of Region 2 have by far both the greatest number and the highest percentage of Century Farms of any region of the Project (OKSHPO 2015). The reasons for the high participation rate are not known, and it is not known whether the high rate reflects notable longevity among family farming enterprises in the region or if it is a result of particular enthusiasm for or strong local promotion of Oklahoma’s Century Farm program. Whatever the reason, it is estimated that the Applicant Proposed Route may cross approximately seven Century Farms, while the shorter HVDC alternative routes may each cross approximately three Century Farms. Consistent with the high estimates for the frequency of Century Farms in this region, three comments on the Draft EIS noted the presence of specific examples along the Applicant Proposed Route in Garfield County or in its vicinity.

Two route variations to the Applicant Proposed Route were developed in Region 2 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.2. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route, and their potential to involve historic and cultural resources appears similar to those segments analyzed for the Draft EIS. Both Link 1, Variation 1, and Link 2, Variation 2, cross similar terrain to the original Applicant Proposed Route considered in the Draft EIS with similar potential to contain archaeological sites and historic resources. There are no recorded historic or cultural resources in the ROIs for either route variation segment (Appendix M).

Table 3.9-6:
Previously Inventoried Historic and Cultural Resources in the ROI for the Applicant Proposed Route and HVDC Alternative Routes in Region 2

Resource[1]	APR	AR 2-A	AR 2-B
Archaeological Sites[2]			
Prehistoric	0	0	0
Historic	0	0	0
Multicomponent	0	0	0
Not Specified	0	2	0
Aboveground Historic Properties[2]			
Inventoried Buildings and Structures	0	1	0
NRHP-Listed Properties	0	0	0
Total Aboveground Properties	0	1	0
Historic Routes, Trails, and Roads[2]	9	4	4
Century Farms (estimated)[3, 4]	7	3	3

1 The values in the table do not reflect the minor changes that would result from application of route variations and adjustments.
2 ROI for archaeological sites is a 1,000-foot-wide corridor; ROI for aboveground historic properties and historic routes is a 1-mile corridor.
3 Estimated number of Century Farms crossed by centerline of the route. See Table 3.9-4 Footnote 5 for basis of estimate.
4 Century Farms Programs are honorary, voluntary, and do not afford legal protections (Arkansas Agriculture Department 2015; OKSHPO 2015; Texas Department of Agriculture 2015; Middle Tennessee State University Center for Historic Preservation 2015).
Source: Clean Line (2013, Table 3-14), supplemented by data from OKSHPO (2015).

3.9.5.3 Region 3

The history of Region 3 includes the Plains culture area as defined by ethnographers for Native American peoples of the late prehistoric and historical periods (after roughly 1650 AD). The OAS (2011) places the region within its Cross Timbers research region for Native American archaeology (OAS 2011). Region 3 is situated within OKSHPO's (2014a) historic preservation planning and management Regions 2 (Northwestern Oklahoma), 3 (Northeastern Oklahoma), and 6 (Central Oklahoma).

Geographically, Region 3 lies within the Osage Plains and Central Lowland physiographic provinces (Wedel and Frison 2001, Figure 1). "Terrain and vegetation are transitional between the less rugged grass-covered ecoregions to the west and the hilly, oak savanna… to the east" (Woods et al. 2005). It is characterized by rough, undulating, and irregular plains, hills, and typically asymmetrical ridges. The natural vegetation varies from west to east. To the west, the characteristic natural vegetation is prairie grasses with scattered trees and light woodlands, while to the east natural vegetation consists of a mosaic of oak savanna, scrubby oak forest, eastern redcedar, and tall grass prairie. Modern land use is varied and includes rangeland, cultivated crops, forests, and commercial and residential development. The archaeological record of Region 3 spans over 12,000 years, extending from the sites of early Native American hunter-gatherers of the Paleoindian period through the small pithouse villages of Native American horticulturalists in late prehistory to the remains of dugouts, ranches, and farmsteads of late nineteenth- and twentieth-century non-Indian settlers, ranchers, and farmers (Clean Line 2013). According to the OAS (2011), the prehistoric archaeology of the Cross Timbers region offers a glimpse into the continual adjustments that Native American peoples made to changing environmental conditions over the 12 millennia during which they occupied the area. A variety of prehistoric Native American site types occur, including special activity sites, camps, and villages. From the 1830s, northeastern Oklahoma (OKSHPO Planning and Management Region 3) was the home of the Creek and Cherokee Nations following the forced removal of Native Americans from the eastern states to Indian Territory. The OKSHPO's historic context for historic Native Americans in northeastern Oklahoma identifies 11 associated classes of properties, described as buildings, structures, objects, sites, and districts related to tribal government; spirit life; education; agriculture, ranching, commerce, and industry; pre-railroad transportation; dwellings and home places; townsites; recreation and encampments; health care; military; and the federal Indian Agency (Baird and Gebhard 1991). Historic property types associated with the occupation of the region by Euroamericans and other non-Indian groups from the late nineteenth century onwards include townsites; commercial buildings and structures; non-commercial and governmental buildings; homesteads, farms, and ranches; churches; schools; and cemeteries (Smith 1984, 1986b, 1986c). Such property types occur both as extant standing structures and as archaeological sites.

Available information indicates that, in general, prehistoric and historic archaeological sites occur most frequently along the region's principal drainages and their major tributaries, which are more numerous than in Regions 1 and 2 to the west. Historical settlement was dispersed across the region, and the region was crossed by several historical transportation corridors, including portions of historic U.S. Route 66 (Clean Line 2013). Congress has recognized the national historical significance of Route 66 and encourages preservation of historic properties along it through the NPS's Route 66 Corridor Preservation Program, which provides leadership for a diverse group of public and private stakeholders (NPS 2014a). Oklahoma has completed historic resource surveys of resources associated with the highway within its borders (Anderson et al. 2002; Cassity 2002).

Including duplicate counts, eight archaeological sites have been documented for the ROI in Region 3, including four prehistoric period sites, three historic period sites, and one site whose age is not specified (Table 3.9-7). None of these has been determined to be eligible for or is listed on the NRHP, and one historic period farmstead is described as not NRHP eligible. General artifact scatters are the only type of prehistoric archaeological site that have been documented in Region 3, while farmsteads are the only type of historic archaeological site type documented for the region. The Applicant Proposed Route and HVDC alternative routes cross several nineteenth-century cattle trails, military roads, and early railroad lines, but no archaeological sites or standing structures have been recorded as specifically associated with these routes in the region.

Table 3.9-7:
Previously Inventoried Historic and Cultural Resources in the ROI for the Applicant Proposed Route and HVDC Alternative Routes in Region 3

Resource[1]	APR	AR 3-A	AR 3-B	AR 3-C	AR 3-D	AR 3-E
Archaeological Sites[2]						
Prehistoric	0	0	0	4	0	0
Historic	2	0	0	1[3]	1[3]	0
Multicomponent	0	0	0	0	0	0
Not Specified	0	0	1	0	0	0
Total Archaeological Sites	2	0	1	5	1	0
Aboveground Historic Properties[2]						
Inventoried Buildings and Structures	2[4]	0	0	0	0	0
NRHP-Listed Properties	0	0	0	2[5]	2[5]	0
Total Aboveground Properties	2	0	0	2	2	0
Historic Routes, Trails, and Roads[2]	20	4	6	19	14	2
Century Farms (estimated)[6, 7]	2	2	2	1	0	0

1 The values in the table do not reflect the minor changes that would result from application of route variations and adjustments.
2 ROI for archaeological sites is a 1,000-foot-wide corridor; ROI for aboveground historic properties and historic routes is a 1-mile corridor.
3 Duplicate count—the same site occurs in conterminous sections of HVDC Alternative Routes 3-C and 3-D.
4 Includes one structure consultant-recommended as NRHP eligible.
5 Duplicate counts—the same two properties occur in conterminous sections of HVDC Alternative Routes 3-C and 3-D.
6 Estimated number of Century Farms crossed by centerline of the route. See Table 3.9-4 Footnote 5 for basis of estimate.
7 Century Farms Programs are honorary, voluntary, and do not afford legal protections (Arkansas Agriculture Department 2015; OKSHPO 2015; Texas Department of Agriculture 2015; Middle Tennessee State University Center for Historic Preservation 2015).

Source: Modified from Clean Line (2013, Table 3-15), supplemented by data from OKSHPO (2015).

The Applicant Proposed Route and HVDC Alternative Route 3-C both intersect the historic U.S. Route 66 corridor in Creek County near the midpoint of Region 3. The Applicant Proposed Route intersects the historic U.S. Route 66 corridor approximately 5 miles northeast of Bristow. HVDC Alternative Route 3-C intersects the historic U.S. Route 66 corridor approximately 5.3 miles west-southwest of Bristow. The Applicant Proposed Route passes within approximately 0.5 mile south of a 1.8 mile segment of the 1926 Portland Concrete-paved alignment of U.S. Route 66, which is the longest privately owned section of unaltered first-generation paving in Oklahoma. This segment is recommended as eligible for the NRHP; information on OKSHPO concurrence (if any) is not available. No historic resources associated with historic U.S. Route 66 have been documented within at least 1.3 miles of HVDC Alternative 3-C (Anderson et al. 2002, Maps 22–23; OKDOT 2012).

The ROI for potential visual impacts for HVDC Alternative Routes 3-C and 3-D contains two NRHP-listed properties (Table 3.9-3), both situated in the vicinity of Oktaha, Muskogee County, Oklahoma, which is located toward the eastern end of the ROI. The listed properties are the Oktaha School and the Honey Springs Battlefield, which is also listed as a National Historic Landmark (NHL) as of 2013. Oktaha School is situated approximately 0.29 mile north of HVDC Alternative Routes 3-C and 3-D conterminous centerlines. The boundaries of Honey Springs Battlefield as defined in the nomination by which the property was listed on the NRHP in 1970 are approximately 0.10 to 3.54 miles south of the same two alternatives. The NHL nomination, which reflects an additional 40 years of historical and archaeological research on the battle as well as a more refined assessment of the current integrity of the battlefield, delineates boundaries approximately 0.41 mile to 3.44 miles south of the alternatives (Fischer and Ruth 1970; NPS 2013, 2014b; Clean Line 2013; Warde et al. 2012). Both properties are also important to the history of Native Americans in Oklahoma.

Aside from the two NRHP-listed properties, no aboveground buildings, structures, districts, sites, or objects properties have been inventoried as historic resources in the 1-mile ROI for Region 3. The estimated number of Century Farms crossed by Applicant Proposed Route is two, which is also the estimate for HVDC Alternative Routes 3-A and 3-B. The western end of this region lies within an area of Oklahoma with a notably high participation rate in Century Farms program (OKSHPO 2015).

Five route variations to the Applicant Proposed Route were developed in Region 3 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.3. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route, and their potential to involve historic and cultural resources appears similar to the original Applicant Proposed Route analyzed for the Draft EIS. Link 1, Variation 2, crosses similar terrain and has similar potential for containing historic and cultural resources as the original Applicant Proposed Route Link 1. Links 1 and 2, Variation 1, crosses similar terrain and has similar potential for containing historic and cultural resources as the original Applicant Proposed Route Link 1. It should be noted that a route adjustment was made for HVDC Alternative Route 3-A to maintain an end-to-end route with the Links 1 and 2 variations. Link 4, Variation 1, and the original Applicant Proposed Route in this location have similar pre-modern terrain and originally had similar potential for containing historic and cultural resources; however, the proposed variation crosses generally undeveloped land, whereas the ROI for the original Applicant Proposed Route crosses a quarry operation, where there would be a lower potential for historic and cultural resources. Link 4, Variation 2, crosses similar terrain and has similar potential for containing historic and cultural resources as the original Applicant Proposed Route. Link 5, Variation 2, crosses similar terrain and has similar potential for containing historic and cultural resources as the original Applicant Proposed Route. There are no recorded historic or cultural resources in the ROIs for any of the five route variation segments, nor for the route adjustment in HVDC Alternative Route 3-A (Appendix M).

3.9.5.4 Region 4

Occupied by the Osage, a Siouan-speaking people, in late prehistory and the historical period, the region is part of the Plains culture area as defined by ethnographers for Native American peoples (after roughly 1650 AD) (Bailey 2001; DeMallie 2001). The western part of Region 4 is part of the OAS's Caddoan Origins research region for Native American archaeology (OAS 2011). Region 4 is situated within OKSHPO's (2014a) historic preservation planning and management Region 3 (Northeastern Oklahoma). In Arkansas, Region 4 is part of the Ozark Plateau/Arkansas Valley geographic region (Clean Line 2013).

Geographically, Region 4 skirts the border between the Ozark Plateau physiographic province to the north and the Ouachita Mountain province to the south (Wedel and Frison 2001, Figure 1). It is characterized by undulating to hilly terrain, with some sections of the alternative alignments crossing the rugged terrain of the southern edge of the Boston Mountains. The natural vegetation is a mosaic of prairie, savanna, woodland, and forest and includes pine–oak savanna, oak–hickory forest, and oak–hickory–pine forest (Woods et al. 2004, 2005). Modern land use is varied and includes haylands, pasture, and forest. The archaeological record of Region 4 spans over 12,000 years, extending from the sites of early Native American hunter-gatherers of the Paleoindian period through the small villages of round or elongate at-grade, earthfast sapling-frame dwellings built by Native American horticulturalists in late prehistory to the remains of homesteads and other structures of nineteenth- and twentieth-century non-Indian settlers (Clean Line 2013). The archaeology of the Region 4 in eastern Oklahoma and western Arkansas reflects the transitional character of the region, with trends characteristic of the Eastern Woodlands and Southeast developing in concert with trends more characteristic of the Plains region (OAS 2011; Clean Line 2013). Prehistoric Native American site types include isolated finds (artifacts), lithic scatters, camps and villages, mounds, rock art localities, and quarries. Historic period property types include residences and farmsteads, commercial properties, small- and large-scale industrial enterprises, military facilities, transportation-related structures, cemeteries, and religious properties (AHPP 2013; Clean Line 2013). Property types associated with the Bell-Drane Cherokee Removal Route of the Trail of Tears (1838–1839) (described below) potentially include roadbed segments; ferry crossings, landings, and fords; campsites; buildings, structures, and building sites; and gravesites (Thomason and Parker 2003, Appendix F). Available information indicates that no historic properties associated with the Trail of Tears have been identified at any of the intersections of the Applicant Proposed Route or the HVDC route alternatives with the Trail of Tears.

Available information indicates that, in general in Region 4, prehistoric and historic archaeological sites occur most frequently “in undulating hills and at stream basins.” Historical settlement was dispersed across the region, and the region was crossed by several historical transportation corridors, including a segment of the Trail of Tears National Historic Trail (Clean Line 2013).

The Trail of Tears in Region 4 is a multi-branched linear resource management corridor, rather than a single continuous historic resource or discontinuous historic district. This network of trails was used during the forced relocation of Native American peoples indigenous to the southeastern United States to Indian Territory (now Oklahoma) in the 1830s. The NPS leads a group of federal, state, local, non-governmental, and private stakeholders in the identification, preservation, interpretation, and promotion of the Trail of Tears National Historic Trail and associated properties. Greatly expanded in 2009, the Trail of Tears National Historic Trail consists of several separate branches that cross, and in one case terminate in, Arkansas. Public comments received on the Draft EIS indicated that the Trail of Tears is of particular historical and cultural interest to the Cherokee Nation and other Indian Tribes and Nations. The ROI for the Project intersects the branch of the Trail of Tears now called the Bell-Drane Route between western Crawford County and south-central Johnson County. Generally following the old Little Rock-to-Fort Gibson Road up the northern side of the Arkansas Valley as far west as Fort Smith, this trail segment is typically described as approximating the present route of U.S. Route 64. From the vicinity of Fort Smith, the Bell-Drane Route turns north and approximates State Route 59 to Evansville, in southwestern Washington County near the Arkansas-Oklahoma line. Between late July 1838 and early January 1839, three groups of Cherokee numbering from around 660 to 1,000 each followed the Bell-Drane Route through the ROI to exile in eastern Indian Territory (Horne 2006; NPS 2007, 2014c; Thomason and Parker 2003, Appendix E).

Including duplicate counts, 62 archaeological sites have been documented for the ROI in Region 4 (Table 3.9-8). This count comprises 24 occurrences of prehistoric period sites, 28 occurrences of historic period sites, and 10 multicomponent (most of which are prehistoric and historic period) sites. Prehistoric archaeological site types include general artifact scatters, open camps, and rockshelters. Historic period archaeological sites include building ruins and foundations (“structures” and “isolated structures”), farmsteads, markers, general artifact scatters, and unspecified. Three individual archaeological sites have been determined to be eligible for the NRHP, including one prehistoric period site and two multicomponent sites. Prehistoric components at the NRHP-eligible sites are described as either general artifact scatters or open camps, while the two historic period components (both at the multicomponent sites) represent farmsteads. Nine sites, three each prehistoric, historic, and multicomponent, have been determined not

NRHP eligible; the remaining sites are unevaluated (Clean Line 2013). While tribal resources have not been delineated across the Project ROI, tribal consultation with DOE in September 2013 indicated the "potential for a burial site location and a ceremonial grounds location" along the Region 4 Applicant Proposed Route (Clean Line 2013). During the public comment period for the Draft EIS, the Applicant explicitly stated that no known burial site locations and no ceremonial grounds are intersected by the Applicant Proposed Route or the HVDC route alternatives in Region 4. In addition, on March 17, 2015, DOE specifically advised the Council of the Cherokee Nation that the Stokes Smith Ceremonial Grounds would not be crossed by the Applicant Proposed Route or HVDC Alternative Route 4-A. The Stokes Smith grounds is an important location of regular cultural activities for the Cherokee Nation. The Applicant Proposed Route is approximately 1.4 miles south of the ceremonial grounds, while the alternative route is approximately 1.6 miles to the northwest (DOE 2015).

Table 3.9-8:
Previously Inventoried Historic and Cultural Resources in the ROI for the Applicant Proposed Route and HVDC Alternative Routes in Region 4

Resource[1]	APR	AR 4-A	AR 4-B	AR 4-C	AR 4-D	AR 4-E
Archaeological Sites[2]						
Prehistoric	10	5[3]	7[3]	0	0	2
Historic	3	3[4]	18[4]	0	1[4]	3
Multicomponent	7	1	0	0	0	2
Not Specified	0	0	0	0	0	0
Total Archaeological Sites	20	9	25	0	1	7
Aboveground Historic Properties[2]						
Inventoried Buildings and Structures	5	2[6,5]	3[5,6]	0	3[6]	1
NRHP-Listed Properties	1	0	1	0	0	2
Total Aboveground Properties	6	2	4	0	3	3
Historic Routes, Trails, and Roads[2,7]	8	7	8	1	1	1
Century Farms (estimated)[8, 9]	0	0	0	0	0	0

1 The values in the table do not reflect the minor changes that would result from application of route variations and adjustments.
2 ROI for archaeological sites is a 1,000-foot-wide corridor; ROI for aboveground historic properties and historic routes is a 1-mile corridor.
3 Includes two duplicate counts—the same two sites occur in conterminous sections of HVDC Alternative Routes 4-A and 4-B.
4 Includes one triplicate count—the same site occurs in conterminous sections of HVDC Alternative Routes 4-A, 4-B, and 4-D.
5 Includes one duplicate count—the same historic property occurs in conterminous sections of HVDC Alternative Routes 4-A and 4-B.
6 Includes one triplicate count—the same historic property occurs in conterminous sections of HVDC Alternative Routes 4-A, 4-B, and 4-D.
7 Most historic routes enumerated in this table are located in Oklahoma. Considerably less readily accessible public information is available for the Arkansas portion of Region 4 than for Oklahoma.
8 Estimated number of Century Farms crossed by centerline of the route. See Table 3.9-4 Footnote 5 for basis of estimate.
9 Century Farms Programs are honorary, voluntary, and do not afford legal protections (Arkansas Agriculture Department 2015; OKSHPO 2015; Texas Department of Agriculture 2015; Middle Tennessee State University Center for Historic Preservation 2015).
Source: Modified from Clean Line (2013, Table 3-19), supplemented by data from Arkansas Agriculture Department (2015) and the Oklahoma SHPO (OKSHPO 2015)

The Applicant Proposed Route and HVDC alternative routes intersect the Bell-Drane Route of the Trail of Tears in the east-central section of Region 4. Intersections occur at roughly 11 locations between the vicinity of State Route 59 north of Fort Smith, Arkansas, on the west, and approximately 6.5 miles west of Clarksville, Arkansas, on the east.

Five intersections occur close to the north-south-aligned State Route 59 at the western end of this area. No historic properties associated with the Trail of Tears have been inventoried in the vicinity of any of these intersections. In addition to the Trail of Tears, the ROI is reported to cross several other historic transportation corridors in different places along the Applicant Proposed Route and HVDC alternative routes, but no historic properties are known to be associated with any of these intersections (Clean Line 2013).

Including duplicate counts, 18 historic buildings and structures have been inventoried at various locations along the Applicant Proposed Route and HVDC alternative routes (Table 3.9-8). The majority of the buildings and structures are unevaluated for NRHP eligibility. One has been determined ineligible, and two have been determined NRHP eligible. Within the 1-mile ROI for aboveground historic properties for the Applicant Proposed Route and HVDC alternative routes, four buildings and structures have been listed on the NRHP (Table 3.9-3). All are located in the Arkansas portion of Region 4 and include the Mulberry River Bridge, 0.28 mile from the Applicant Proposed Route in Crawford County; Lucian Wood Road Segment of the Butterfield Overland Mail Route, 0.08 mile from HVDC Alternative Route 4-B, also in Crawford County; and Lutherville School and the Munger House, 0.09 and 0.05 mile from HVDC Route Alternative 4-E in Johnson County (Clean Line 2013; NPS 2014b).

Based on lists of farms and ranches in Oklahoma and Arkansas that have been honored by their respective states' Century Farms programs, it is estimated that no such agricultural operations would be crossed by the Applicant Proposed Route or any of the HVDC alternative routes. This estimate reflects the small number of Century Farms that have been honored in eastern Oklahoma and western Arkansas, which in the latter area is due in part to the recent establishment of a Century Farms program in Arkansas (Arkansas Agriculture Department 2015; OKSHPO 2015). Two comments on the Draft EIS report that HVDC Alternative Route 4E crosses a Century Farm in western Pope County, Arkansas.

Seven route variations to the Applicant Proposed Route were developed in Region 4 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.4. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route, and their potential to involve historic and cultural resources appears to be generally similar to original Applicant Proposed Route analyzed for the Draft EIS. Link 3, Variation 1, generally has similar terrain and similar potential to contain historic and cultural resources as the original Applicant Proposed Route. Appendix M notes that one cemetery of unknown age and significance falls within the ROI for this route variation segment; this feature is also within the ROI of the original Applicant Proposed Route.

Link 3, Variation 2, crosses somewhat hillier terrain than the original Applicant Proposed Route Link 3, which could indicate minor overall differences in their respective potential to contain historic and cultural resources. This variation passes approximately 0.6 mile south of the Stokes Smith Ceremonial Grounds, which is roughly 1 mile closer than either the original Applicant Proposed Route or HVDC Alternative Route 4-A. There are no recorded historic or cultural resources in the ROI for this route variation segment (Appendix M).

Link 3, Variation 3, crosses less rugged terrain and fewer minor drainages than the Applicant proposed Route, but passes through a small, broad stream valley. These terrain differences could produce minor differences in the presence or absence of historic and cultural resources between the previously analyzed route and the proposed variation. There are no recorded historic or cultural resources in the ROI for this route variation segment (Appendix M).

Link 6, Variations 1, 2, and 3, and Link 9, Variation 1, cross generally similar terrain as the as the links of the original Applicant Proposed Route and appear to have similar potential to contain historic and cultural resources. Although there are no recorded historic or cultural resources in the ROI for the three Link 6 variations, Link 9, Variation 1, is reported to contain one cemetery of unknown age and significance (Appendix M).

3.9.5.5 Region 5

Occupied by the Quapaw, a Siouan-speaking people, in late prehistory and the historical period, the region lies at the eastern edge of the Plains culture area as defined by ethnographers for Native American peoples (after roughly 1650 AD) (DeMallie 2001). Though the Quapaw are regarded as a Plains people on the basis of language and other cultural traits, their settlement and subsistence practices closely resembled those of the Eastern Woodlands peoples to the east more than those of the Plains peoples to the west, due to the predominantly forested environment of their homeland (Young and Hoffman 2001). Region 5 is part of the Ozark Plateau/Arkansas Valley geographic region used for archaeological and historic resources management in Arkansas (Clean Line 2013).

Geographically, Region 5 skirts the border between the Ozark Plateau physiographic province to the north and the Ouachita Mountain province to the south. It is characterized by hilly terrain that flanks the Arkansas Valley to the south. The eastern end of this region lies just inside the Lower Mississippi Alluvial Valley, which comprises most of the eastern end of the ROI (Gremillion 2004, Figure 1; Wedel and Frison 2001, Figure 1). The natural vegetation of Region 5 consists predominantly of oak-hickory and oak-hickory-pine forests (Woods et al. 2004). Modern land use includes forested areas, open lands for pasture or cultivated crops, and rural residential development. The archaeological record of Region 5 spans over 12,000 years, extending from the sites of early Native American hunter-gatherers of the Paleoindian period through the small villages of round or elongate at-grade, earthfast sapling-frame dwellings built by Native American horticulturalists in late prehistory to the remains of homesteads and other structures of nineteenth- and twentieth-century non-Indian settlers (Clean Line 2013). Prehistoric Native American site types include isolated finds, lithic scatters, camps and villages, rock art localities, and quarries. Historic period property types include residences and farmsteads, commercial, small- and large-scale industrial, military, transportation, cemeteries, and religious (AHPP 2013; Clean Line 2013).

Available information indicates that, in general, prehistoric and historic archaeological sites occur most frequently along the region's principal drainages and their major tributaries. Historical settlement was dispersed across the region; initial background research identified no well-defined, named historic transportation corridors (Clean Line 2013).

The Draft EIS reported that 26 previously recorded cultural resources occur within the Arkansas Converter Station Alternative and AC Interconnect Siting Area (Clean Line 2013), which was then defined as a 25,500-acre area in total. The Applicant has since refined these siting areas to substantially smaller footprints within the areas studied by the Draft EIS. The size of the reduced areas for the Arkansas Converter Station Alternative and AC Interconnect Siting Area are discussed in Section 3.1. The cultural resources identified within the Draft EIS study area include 23 previously recorded archaeological sites (17 prehistoric sites, 4 historic sites, and 2 multicomponent sites). The prehistoric site types consist of general artifacts scatters, isolated artifacts, and open camps. The historic site types consist primarily of farmsteads. The multicomponent sites are farmsteads and prehistoric lithic scatters. Of the 23 archaeological sites, 2 are recommended eligible and 21 received no previous recommendation regarding eligibility for inclusion on the NRHP. This area includes no linear resources, no NRHP-eligible properties, and three historic historic-age buildings or structures that have not received a previous recommendation regarding eligibility for inclusion on the NRHP. Information about historic and cultural resources in the HVDC transmission facilities in Region 5 is presented below.

Including duplicate counts, 73 archaeological sites have been documented for the ROI in Region 5, including 41 occurrences of prehistoric period sites, 27 occurrences of historic period sites, and 3 occurrences of a single multicomponent site (Table 3.9-9). Prehistoric archaeological site types include general artifact scatters, open camps, and rockshelters. Historic period archaeological sites include building ruins and foundations ("structures" and "isolated structures"), farmsteads, isolated finds, and general artifact scatters. In addition, five localities are recorded as historic archaeological sites that might equally have been inventoried as historic architectural properties; these include four historic cemeteries and a Cold War-era missile complex. Three separate multicomponent archaeological sites, all of which are general artifact scatters containing both prehistoric and historic materials, are also documented for the Applicant Proposed Route and HVDC alternative routes in Region 5. Of the 50 individual archaeological sites included in the ROI for the Applicant Proposed Alternative and the HVDC alternative routes, two sites, a prehistoric period rockshelter and a historic period structure, have been determined to be eligible for the NRHP, while three prehistoric sites and eight historic sites are not eligible for the NRHP. The remaining 36 individual sites are unevaluated for NHRP eligibility (Clean Line 2013).

Including duplicate counts, a total of 89 buildings and structures are included in the Region 5 ROI. Aside from the four historic cemeteries and the Cold War missile complex that that have been inventoried as archaeological sites (see above), approximately 47 individual historic buildings and structures have been inventoried at various locations along the Applicant Proposed Route and HVDC alternative routes. The majority of the buildings and structures are unevaluated for NRHP eligibility. At least three, however, been determined NRHP ineligible. Four buildings in the 1-mile ROI for the Applicant Proposed Route and HVDC alternative routes are listed on the NRHP (Table 3.9-3). All are located in Arkansas. The listed properties are the William Henry Watson Homestead, White County, 0.34 mile from the Applicant Proposed Route; the Charlie Hall House, Faulkner County, 0.05 mile from HVDC Alternative Route 5-B; the New Mt. Pisgah School, White County, 0.29 mile from overlapping HVDC Alternative Routes 5-B, 5-E, and 5-F; and the Wesley Marsh House, a minimum of 0.34 mile from the Applicant Proposed Route and HVDC Alternative Route 5-C (Clean Line 2013; NPS 2014b). It is estimated that no agricultural operations that have been honored as Century Farms would be crossed by the Applicant Proposed Route and the HVDC alternative routes.

Five route variations to the Applicant Proposed Route were developed in Region 5 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.5. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route, and their potential to involve historic and cultural resources appears similar to the original links of the Applicant Proposed Route that were analyzed for the Draft EIS. Link 1, Variation 2, crosses similar terrain and has similar potential to contain historic and cultural resources as the original Applicant Proposed Route Link 1. Link 2, Variation 2, crosses similar terrain and has similar potential to contain historic and cultural resources as the original Applicant Proposed Route Link 2. Links 2 and 3, Variation 1, crosses similar terrain and has similar potential to contain historic and cultural resources as the original Applicant Proposed Route ; it should be noted that a route adjustment was made for HVDC Alternative Route 5-B to maintain an end-to-end route with Links 2 and 3, Variation 1. Links 3 and 4, Variation 2, crosses similar terrain and has similar potential to contain historic and cultural resources as the original Applicant Proposed Route ; it should be noted that a route adjustment was made for HVDC Alternative Route 5-E to maintain an end-to-end route with this proposed variation. Link 7, Variation 1, crosses similar terrain and has similar potential to contain historic and cultural resources as the original Link 7 of the Applicant

Proposed Route. The ROIs for Link 1, Variation 2 and Links 3 and 4, Variation 2 are both reported to include one cemetery each of unknown age and significance (Appendix M). The cemetery included in the ROI for Links 3 and 4, Variation 2, is outside the ROI of the Applicant Proposed Route analyzed for the Draft EIS. Link 7, Variation 1, contains two previously recorded archaeological sites of unknown age and significance (Appendix M). Precise locations in relationship to the original Applicant Proposed Route analyzed in the Draft EIS are not known. Neither the ROI for the route adjustment for HVDC Alternative Route 5-B, nor that for HVDC Alternative Route 5-E, contains any recorded historic or cultural resources (Appendix M).

Table 3.9-9:
Previously Inventoried Historic and Cultural Resources in the ROI for the Applicant Proposed Route and HVDC Alternative Routes in Region 5

Resource[1]	APR	AR 5-A	AR 5-B	AR 5-C	AR 5-D	AR 5-E	AR 5-F
Archaeological Sites[2]							
Prehistoric	7	0	13[3]	2	3	8[3]	8[3]
Historic	3	0	12[4,5]	1	6	3[4,5]	2[5]
Multicomponent	2	0	1[6]	0	0	1[6]	1[6]
Not Specified	0	0	0	0	0	0	0
Total Archaeological Sites	12	0	26	3	9	12	11
Aboveground Historic Properties[2]							
Inventoried Buildings and Structures	16[7]	0	23[7,8,9]	3	3	20[7,8,9]	17[7,8]
NRHP-Listed Properties	2[10]	0	2[11]	1[10]	0	1[11]	1[11]
Total Aboveground Properties	18	0	25	4	3	21	18
Historic Routes, Trails, and Roads[2,12]	0	0	0	0	0	0	0
Century Farms (estimated)[13, 14]	0	0	0	0	0	0	0

1 The values in the table do not reflect the minor changes that would result from application of route variations and adjustments.
2 ROI for archaeological sites is a 1,000-foot-wide corridor; ROI for aboveground historic properties and historic routes is a 1-mile corridor.
3 Includes eight triplicate counts—the same eight sites occur in conterminous sections of HVDC Alternative Routes 5-B, 5-E, and 5-F.
4 Includes one duplicate count—the same site occurs in conterminous sections of HVDC Alternative Routes 5-B and 5-E.
5 Includes two triplicate counts—the same two sites occur in conterminous sections of HVDC Alternative Routes 5-B, 5-E, and 5-F.
6 Includes one triplicate count—the same site occurs in conterminous sections of HVDC Alternative Routes 5-B, 5-E, and 5-F.
7 Includes two quadruplicate counts—the same two historic properties occur in conterminous sections of HVDC Alternative Routes 5-B, 5-E, and 5-F and in the conterminous 1-mile ROI of Applicant Proposed Route Links 5 and 6.
8 Includes 15 triplicate counts—the same 15 historic properties occur in conterminous sections of HVDC Alternative Routes 5-B, 5-E, and 5-F.
9 Includes three duplicate counts—the same three historic properties occur in conterminous sections of HVDC Alternative Routes 5-B and 5-E.
10 Includes one duplicate count—the same NRHP-listed property occurs in the conterminous ROI of the Applicant Proposed Route and Alternative Route 5-C.
11 Includes one triplicate count—the same NRHP-listed property occurs in the conterminous sections of HVDC Alternative Routes 5-B, 5-E, and 5-F.
12 No readily accessible public information concerning historic routes, trails, and roads is available for Region 5.
13 Estimated number of Century Farms crossed by centerline of the route. See Table 3.9-4 Footnote 5 for basis of estimate.
14 Century Farms Programs are honorary, voluntary, and do not afford legal protections (Arkansas Agriculture Department 2015; OKSHPO 2015; Texas Department of Agriculture 2015; Middle Tennessee State University Center for Historic Preservation 2015).

Source: Clean Line (2013, Table 3-24), supplemented by data from Arkansas Agriculture Department (2015).

3.9.5.6 Region 6

Occupied in late prehistory and the protohistoric period by Tunica and subsequently the Quapaw, the region lies at the southwestern edge of the northeastern Woodlands culture area as defined by ethnographers for Native American peoples living in the region around the time of the arrival of European explorers and colonists (Brain et al. 2004; Callender 1978; Dye 2007; Trigger 1978). Region 6 is part of the Mississippi Alluvial Valley geographic region used for archaeological and historic resources management in Arkansas (Clean Line 2013).

Geographically, Region 6 is situated entirely within the Lower Mississippi Alluvial Valley physiographic province (Gremillion 2004, Figure 1). It is characterized by broad, flat to nearly flat meander belts associated with the modern Mississippi River and several of its important tributaries (the Cache and White rivers) with intervening older alluvial and wind-transported sediments comprising valley train materials deposited during the Pleistocene epoch, the most recent episode of worldwide continental glaciation. Region 6 also crosses Crowley's Ridge in the east-central portion of Region 6, a string of low hills covered by up to several tens of feet of fine wind-blown silt (loess). The natural vegetation of Region 6 is a complex mosaic locally shaped by the alluvial, Pleistocene, and relict landforms present. In better-drained alluvial bottomlands, oak-dominated hardwood forests predominate, while on active natural levees and wooded portions of backswamps and abandoned channels, there is less oak, and trees such as sugarberry, elm, ash, pecan, cottonwood, and sycamore are common. In less frequently flooded areas, such as Crowley's Ridge and portions of the Pleistocene valley trains, forests and woodlands of post oak-blackjack oak, southern red oak-white oak, beech-maple, and post oak-loblolly pine occur. Except for Crowley's Ridge, where substantial tracts of hardwood forest remain, most of the formerly forested lands of Region 6 have been cleared, and modern land use is principally agricultural. Crops such as rice, corn, and soybeans dominate (Woods et al. 2004).

The archaeological record of Region 6 spans over 12,000 years. For the period before European intrusion into the region, the archaeological record encompasses sites of the early Native American, herd-oriented hunters and gatherers of the Paleoindian period, as well as their successors, the efficient hunter-gatherer-fishers of the mast forests and southern rivers of the Archaic period. The archaeological record continues through the camps and villages of the pottery-making horticulturalists of the Woodland period to the farmsteads, hamlets, villages, and earthworks of the late prehistoric Mississippian period. The Mississippi Valley also contains traces of several hundred years of Euroamerican exploration, settlement, warfare, and development, beginning in the mid-seventeenth century. Prehistoric Native American site types include isolated finds, lithic scatters, camps, farmsteads, hamlets, and villages, earth burial and temple mounds, and cemeteries. Historic period property types include residences, farmsteads, and plantations; commercial and small-scale industrial properties; and military, transportation, cemeteries, and religious buildings, structures, and sites (AHPP 2013; Clean Line 2013).

Available information indicates that area "geomorphology and topography greatly influenced settlement patterns in this region. In this relatively flat landscape, minor differences in elevation greatly affect the character of the local floral and faunal communities…. [Sites] at high natural levee ridges between stream meander belts and higher interfluvial 'islands' on Pleistocene terraces" were apparently favored locations for habitation over thousands of years. Historical settlement was dispersed across the region; initial background research identified no well-defined, named historic transportation corridors (Clean Line 2013).

Fourteen archaeological sites (the count involves no duplicates) have been documented for the ROI in Region 6, including 13 prehistoric period sites and one historic period site (Table 3.9-10). Sites are recorded for the Applicant Proposed Route and each alternative except HVDC Alternative Route 6-D, for which no archaeological sites have been identified to date. Prehistoric archaeological site types include general artifact scatters, isolated finds, and villages. The historic period site is described as an “isolated enclosure.” None of the 14 inventoried sites has been evaluated for NRHP eligibility. Very few historic buildings and structures have been recorded in the ROI for potential visual impacts for the Applicant Proposed Route and HVDC alternative routes, and none has been assessed for NRHP eligibility. Of the four historic buildings and structures inventoried for the ROI in Region 6, one is located along the Applicant Proposed Route, one is found along HVDC Alternative Route 6-A, and two occur along HVDC Alternative Route 6-B. No NRHP-listed properties are recorded for Region 6 (Clean Line 2013). It is estimated that approximately one Century Farm would be crossed by the Applicant Proposed Route and that no such operations would be crossed by the HVDC alternative routes.

One route variation to the Applicant Proposed Route was developed for Region 6 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.6. The variations are illustrated in Exhibit 1 of Appendix M. The variation seeks to minimize impacts to agricultural operations and represents a minor adjustment to the Applicant Proposed Route. Link 2, Variation 1, covers similar terrain and has a similar potential for involvement of historic and cultural resources as the original Applicant Proposed Route. There are no recorded historic or cultural resources in the ROI for this route variation segment (Appendix M). It should be noted that a route adjustment was made for HVDC Alternative Route 6-A to maintain an end-to-end route with the Link 2, Variation 1. The ROI for this route adjustment is reported to contain one cemetery of unknown age and significance (Appendix M).

Table 3.9-10:
Previously Inventoried Historic and Cultural Resources in the ROI for the Applicant Proposed Route and HVDC Alternative Routes in Region 6

Resource[1]	APR	AR 6-A	AR 6-B	AR 6-C	AR 6-D
Archaeological Sites[2]					
Prehistoric	4	1	3	5	0
Historic	1	0	0	0	0
Multicomponent	0	0	0	0	0
Not Specified	0	0	0	0	0
Total Archaeological Sites	5	1	3	5	0
Aboveground Historic Properties[2]					
Inventoried Buildings and Structures	1	1	2	0	0
NRHP-Listed Properties	0	0	0	0	0
Total Aboveground Properties	1	1	2	0	0
Historic Routes, Trails, and Roads[2,3]	0	0	0	0	0
Century Farms (estimated)[4, 5]	1	0	0	0	0

1 The values in the table do not reflect the minor changes that would result from application of route variations and adjustments.
2 ROI for archaeological sites is a 1,000-foot-wide corridor; ROI for aboveground historic properties and historic routes is a 1-mile corridor. There are no duplicate, triplicate, or quadruplicate resource counts in Region 6.
3 No readily accessible public information concerning historic routes, trails, and roads is available for Region 6.
4 Estimated number of Century Farms crossed by centerline of the route. See Table 3.9-4 Footnote 5 for basis of estimate.
5 Century Farms Programs are honorary, voluntary, and do not afford legal protections (Arkansas Agriculture Department 2015; OKSHPO 2015; Texas Department of Agriculture 2015; Middle Tennessee State University Center for Historic Preservation 2015).
Source: Clean Line (2013, Table 3-31), supplemented by data from Arkansas Agriculture Department (2015).

3.9.5.7 Region 7

Occupied in late prehistory and the protohistoric period by the Tunica and subsequently the Quapaw, the region lies at the southwestern edge of the northeastern Woodlands culture area for Native American peoples living in the region around the time of the arrival of European explorers and colonists (Brain et al. 2004; Callender 1978; Dye 2007; Trigger 1978). Region 7 is part of the Mississippi Alluvial Valley geographic region used for archaeological and historic resources management in Arkansas (Clean Line 2013). In Tennessee, Region 7 is located in Development District 1 (Memphis Area), one of nine multicounty planning regions mandated by the state legislature, whose functions have grown to encompass historic preservation outreach and planning (Tennessee Historical Commission 2013).

Geographically, Region 7 is mostly situated within the Lower Mississippi Alluvial Valley physiographic province, but the last 9 miles of the Applicant Proposed Route are located in the Southeastern Coastal Plain (locally called the West Tennessee Plateau Slope) province (Gremillion 2004, Figure 1). Overall, Region 7 is characterized by broad, flat to nearly flat meander belts associated with the modern Mississippi River with intervening Pleistocene alluvial and wind-transported sediments comprising valley train deposits. The eastern end of the ROI is characterized by a 150-foot bluff marking the edge of the Mississippi floodplain, east of which are located rolling, irregular plains; a thick blanket of Pleistocene-age wind-blown sediment (loess) caps the landscape at the eastern end of Region 7. In the Mississippi Valley, the natural vegetation of Region 7 is a complex mosaic locally shaped by the alluvial, Pleistocene, and relict landforms present. Broadly speaking, the natural vegetation of the Mississippi meander belts is the Southern floodplain forest (oak, tupelo, bald cypress). Swampy woodlands are often occupied by cypress-gum woodlands, while the uplands of the eastern end of Region 7 are dominated by oak-hickory forests, with abundant beech and sugar maple in some areas. Land use west of the Mississippi River consists chiefly of cultivated crops, while east of the river land use is a mix of agricultural land, hardwood forests, and residential and commercial development (Griffith et al. 1998; Woods et al. 2004).

The archaeological record of Region 7 spans over 12,000 years, extending from the sites of early Native American hunter-gatherers of the Paleoindian period to the farmsteads, hamlets, villages, and earthworks of the late prehistoric Mississippian period. The Mississippi Valley also contains traces of several hundred years of Euroamerican exploration, settlement, warfare, and development, beginning in the mid-seventeenth century. Prehistoric Native American site types include isolated finds, lithic scatters, camps, farmsteads, hamlets, and villages, earth burial and temple mounds, and cemeteries. Historic period property types include residences, farmsteads, and plantations; commercial and small-scale industrial properties, and military, transportation, cemeteries, and religious buildings, structures, and sites (AHPP 2013; Clean Line 2013).

Available information indicates that archaeological sites and historic buildings and structures occur mainly along major streams and focus toward the Mississippi. In the Mississippi meander belts “geomorphology and topography greatly influenced settlement patterns in this region. In this relatively flat landscape, minor differences in elevation greatly affect the character of the local floral and faunal communities…. [Sites] at high natural levee ridges between stream meander belts and higher interfluvial “islands” on Pleistocene terraces” were apparently favored locations for habitation over thousands of years. Historical settlement was dispersed across the region, except in the vicinity of Millington, Tennessee, and a few other small population centers (Clean Line 2013). Although the Mississippi River, which the ROI crosses near Island Number 35, has had vast historical significance for water transport since the mid-eighteenth century, the ROI intersects no well-defined, named historic land routes adjacent to the river. Bell’s Route of Trail of the Tears National Historic Trail crosses east-central Shelby County, Tennessee, several miles south of the ROI. Historians are highly confident that Bell's Detachment of approximately 660 exiled Cherokee travelled through the area on November 22, 1838 via Stage Road (Tennessee State Route 15) (Nance 2001; NPS 2007, Map 5; Thomason and Parker 2003, Appendix E). At its closest, Stage Road passes approximately 6.8 miles south of any portion of the Applicant Proposed Route or HVDC Route Alternatives.

Since completion of the Draft EIS, the Applicant has refined the location of the Tennessee Converter Station Siting Area and reduced its ROI. As currently defined, however, the siting area is still within the previously studied area, and no historic or cultural resources have been identified within it (Clean Line 2013). Information about historic and cultural resources in the HVDC transmission facilities in Region 7 is presented below.

Including duplicate counts, 37 archaeological sites have been documented for the 1,000-foot-wide corridor ROI in Region 7, including an estimated 20 occurrences of prehistoric period sites (17 individual sites), 9 historic period sites (no duplicates), 7 multicomponent sites (no duplicates), and 1 site with no period attributed to it (Table 3.9-11). Thirty individual archaeological sites, including all 17 unique prehistoric sites, 6 each of the historic and multicomponent sites, and the unattributed site have not been evaluated for NRHP eligibility. Four sites, including three historic period sites and one multicomponent site, have been determined not eligible for the NRHP (Clean Line 2013).

In addition to the archaeological sites documented as occurring within the 1,000-foot-wide corridor ROI for the Applicant Proposed Route and HVDC alternative routes, one important prehistoric archaeological site is situated within the 1-mile ROI for historic resources. This is the Nodena Site in Mississippi County, Arkansas. The site is both listed on the NRHP and as a National Historic Landmark (Table 3.9-3). HVDC Alternative Route 7-A crosses more than 0.1 mile to the east of the Nodena Site NHL, which is situated approximately 5 miles east-northeast of Wilson, Arkansas. The exact location of the site is not publicly available, because the property has a restricted address to prevent vandalism. The NRHP/NHL property covers approximately 305 acres and apparently includes several separately designated sites, including the Upper Nodena Site (3MS4) and the Middle Nodena Site (3MS3) (AHPP 2014; Mainfort et al. 2007; NPS 2014b). (Because it is outside the 1,000-foot-wide corridor ROI, the Nodena Site NHL is not included in the archaeological site count of Table 3.9-11.)

Prehistoric period archaeological site types in Region 7 include general artifact scatters, open camps, and village sites. The Mississippian period Nodena Site (ca. 1400 to 1650 AD) is a categorized as a village site. Historic period archaeological site types include farmsteads and general artifact scatters. Multicomponent site types include general artifact scatters and open camps in association with farmsteads (Clean Line 2013).

Including one duplicate count, but excluding the Nodena Site NHL, 82 buildings and structures have been inventoried to date within the 1-mile ROI for the Applicant Proposed Route and HVDC Alternative Routes 7-A and 7-C (Table 3.9-11). Thirty-nine (plus one duplicate) of the inventoried properties occur along the Applicant Proposed Route, and all are situated in the more densely developed Tennessee portion of the alignment. Thirty-eight (plus one duplicate) of the inventoried properties occur along HVDC Alternative Route 7-C, also in Tennessee. None of these properties has been evaluated for eligibility to the NRHP. The remaining two properties occur near HVDC Alternative Route 7-A, probably in Arkansas. One has been recommended as NRHP eligible (Clean Line 2013).

Aside from the Nodena Site NHL, one other NRHP-listed property occurs within the ROI for Region 7. This is the Highway A-7 Bridges Historic District, which is crossed by HVDC Alternative Route 7-A in the vicinity of Marked Tree, Poinsett County, Arkansas (Table 3.9-3).

It is estimated that no agricultural operations that have been honored as Century Farms would be crossed by the Applicant Proposed Route and the HVDC alternative routes.

Three route variations to the Applicant Proposed Route were developed in Region 7 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.7. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route, and their potential to involve historic and cultural resources appears similar to the links of the original Applicant Proposed Route. Link 1, Variation 1; Link 1, Variation 2; Link 5, Variation 1, all cross terrain similar to that considered for the original Applicant Proposed Route and all have similar terrain to the original Applicant Proposed Route considered in the Draft EIS with similar potential to contain archaeological sites and historic properties. There are no recorded historic or cultural resources in the ROIs for any of these route variation segments (Appendix M).

Table 3.9-11:
Previously Inventoried Historic and Cultural Resources in the ROI for the Applicant Proposed Route and HVDC Alternative Routes in Region 7

Resource[1]	APR	AR 7-A	AR 7-B	AR 7-C	AR 7-D
Archaeological Sites[2]					
Prehistoric	8[3]	2	2[3]	6[3]	2
Historic	2	4	0	3	0
Multicomponent	3	1	0	3	0
Not Specified	0	0	0	1	0
Total Archaeological Sites	13	7	2	13	2
Aboveground Historic Properties[2]					
Inventoried Buildings and Structures	40[4]	2	0	39[4]	0
NRHP-Listed Properties	0	2[5]	0	0	0
Total Aboveground Properties	40	4	0	39	0
Historic Routes, Trails, and Roads[2, 6]	0	0	0	0	0
Century Farms (estimated)[7, 8]	0	0	0	0	0

1 The values in the table do not reflect the minor changes that would result from application of route variations and adjustments.
2 ROI for archaeological sites is a 1,000-foot-wide corridor; ROI for aboveground historic properties and historic routes is a 1-mile corridor.
3 Includes one quadruplicate count—the same site is counted twice for the Applicant Proposed Route and also once each in HVDC Alternative Routes 7-B and 7-C, because they are located at a junction for two links of the Applicant Proposed Route and in the adjoining conterminous sections of the alternative routes.
4 Includes one duplicate count—the same historic property occurs in the 1-mile ROI of corresponding link of the Applicant Proposed Route (Link 5) and the overlapping ROI for HVDC Alternative Route 7-C.
5 Includes the Nodena Site NHL, a belowground historic property, which is believed to be located outside the 1,000-foot-wide ROI but within the 1-mile ROI for HVDC Alternative Route 7-A.
6 No readily accessible public information concerning historic routes, trails, and roads is available for Region 7.
7 Estimated number of Century Farms crossed by centerline of the route. See Table 3.9-4 Footnote 5 for basis of estimate.
8 Century Farms Programs are honorary, voluntary, and do not afford legal protections (Arkansas Agriculture Department 2015; OKSHPO 2015; Texas Department of Agriculture 2015; Middle Tennessee State University Center for Historic Preservation 2015).

Source: Modified from Clean Line (2013, Table 3-34), supplemented by data from Arkansas Agriculture Department (2015) and Middle Tennessee State University Center for Historic Preservation (2015).

3.9.5.8 Connected Actions

3.9.5.8.1 Wind Energy Generation

Wind energy generation would likely occur within WDZs. The 12 WDZs contain a total of 155 prehistoric, historic, multicomponent, and indeterminate previously recorded archaeological sites (Table 3.9-12). The WDZs do not overlap, and frequencies of inventoried historic and archaeological resources given in Table 3.9-12 do not contain duplications. There are also 77 inventoried historic buildings and structures and 8 identified intersections of historic routes, trails, and roads (Table 3.9-12). Six historic buildings and structures and one archaeological site listed on the NRHP also occur in the WDZs (Table 3.9-13). Previously recorded sites within the WDZs have not been evaluated for their potential to be eligible to the NRHP. Analysis of the lists of agricultural operations that have been honored by the Oklahoma Centennial Farm and Ranch Program (OKSHPO 2015) and the Texas Family Land Heritage Program (Texas Department of Agriculture 2015) shows that the six counties within which the WDZs are located contain a total of 49 Century Farms. Based upon the number of farms and ranches in the six counties, the surface areas of the WDZs, the mean farm size and proportion of agricultural land per county, the number of active farms and ranches, and the number of Century Farms, it is estimated that each WDZ could potentially contain approximately one Century Farm.

As noted in the discussion of the Region 1 AC collection system routes, at least one of the NRHP-listed properties, the Tracey Wood-Frame Grain Elevator, appears to have suffered severe loss of integrity and may no longer be eligible for the register. It is unknown whether any other NRHP properties have experienced similar losses.

Table 3.9-12:
Previously Inventoried Historic and Cultural Resources by Wind Development Zone

	WDZ											
	A	B	C	D	E	F	G	H	I	J	K	L
Archaeological Sites												
Prehistoric	4	3	0	4	1	4	22	9	9	42	0	10
Historic	2	0	0	6	1	0	2	1	3	7	4	2
Multicomponent	0	0	0	1	0	1	0	0	1	2	1	0
Not Specified	0	0	0	0	0	1	2	5	1	0	0	4
Total Archaeological Sites	6	3	0	11	2	6	26	15	14	51	5	16
Aboveground Historic Properties												
Inventoried Buildings and Structures	25	0	0	0	0	36	0	0	13	0	3	0
NRHP-Listed Properties	1	0	0	0	0	1	0	2	2	0	0	1[1]
Total Aboveground Properties	26	0	0	0	0	37	0	2	15	0	3	1
Historic Routes, Trails, and Roads	1	0	0	0	0	1	1	1	2	1	1	0
Century Farms (estimated)[2]	1	1	1	1	1	1	1	1	1	1	1	1

1 The NRHP-listed historic property in WDZ-L is the Buried City Site (41OC1), a belowground prehistoric archaeological site. It is unknown whether the Buried City Site or any of its separately inventoried components are included in the prehistoric site count for WDZ-L.
2 Estimated number of Century Farms occurring in the WDZ. See Table 3.9-4 Footnote 5 for basis of estimate.
3 Century Farms Programs are honorary, voluntary, and do not afford legal protections (Arkansas Agriculture Department 2015; OKSHPO 2015; Texas Department of Agriculture 2015; Middle Tennessee State University Center for Historic Preservation 2015).
Source: Clean Line (2014, pp 201–204), supplemented by data from OKSHPO (2015) and Texas Department of Agriculture (2015).

Table 3.9-13:
NRHP-Listed Properties in the Wind Development Zones

WDZ	Property Name (Alternate Name)	NRIS No.	Location
A	Plainview Hardware Company Building	90000904	Perryton, Ochiltree County, Texas
F	Penick House (Raymond Choate House)	84003436	Texhoma, Texas County, Oklahoma
H	Eva Wood-Frame Grain Elevator (Wright Grain & Milling Co. Elevator)	83002132	Eva, Texas County, Oklahoma
H	Tracey [or Tracy] Wood-Frame Grain Elevator (Genco Grain Co. Elevator)	83002137	Muncy (Tracey), Texas County, Oklahoma
I	Adams Wood-Frame Grain Elevator (Old Tex-Co Elevator)	83002129	Adams, Texas County, Oklahoma
I	Hooker Wood-Frame Grain Elevator (Wheat Pool Elevator Company)	83002133	Hooker, Texas County, Oklahoma
L	Buried City Site (41OC1)	84001923	Perryton vicinity, Ochiltree County, Texas

NRIS—National Register Information System.
Note: Examination of aerial imagery available from Google Earth indicates that the Eva and Tracey wood-frame grain elevators are no longer extant. Field survey would be required to verify their disappearance.
Source: NPS (2014b)

3.9.5.8.1.1 WDZ-A

WDZ-A contains a total of six previously recorded archaeological sites (Table 3.9-12). These include four prehistoric-period sites representing two site types (artifact scatter and camp site). It also contains two historic period sites including an artifact scatter and a cemetery. These sites have not been evaluated for their potential to be eligible to the NRHP. Also previously recorded within WDZ-A are 25 historic buildings/structures and 1 historic transportation route. Of these, only the Plainview Hardware Company Building, Perryton, Texas, is NRHP-listed (Table 3.9-13), while 25 have not been evaluated for their potential to be eligible to the NRHP. The WDZ is estimated to contain one Century Farm.

3.9.5.8.1.2 WDZ-B

The three archaeological sites recorded within WDZ-B all date to the prehistoric time period (Table 3.9-12). These include a prehistoric artifact scatter and cairn sites. One of these sites was determined not eligible for the NRHP, while the remaining two sites have not been evaluated for their potential to be eligible to the NRHP. No historic period buildings and structures or mapped historic transportation routes have been previously recorded within WDZ-B. The WDZ is estimated to contain one Century Farm.

3.9.5.8.1.3 WDZ-C

There are no previously recorded archaeological sites within WDZ-C (Table 3.9-12). There are also no previously recorded historic period buildings, structures or mapped historic transportation routes recorded within WDZ-C. The WDZ is estimated to contain one Century Farm.

3.9.5.8.1.4 WDZ-D

WDZ-D contains 11 archaeological sites including 4 prehistoric, 6 historic and 1 multicomponent (Table 3.9-12). The range of site types includes prehistoric artifact scatter, camp site, historic artifact scatter, farmstead, cemetery, and abandoned railroad grade. Two of these sites have been determined to be eligible to the NRHP, six have not been evaluated for their potential to be eligible to the NRHP, and three are not eligible to the NRHP. No historic period buildings and structures or mapped historic transportation routes have been recorded within WDZ-D. The WDZ is estimated to contain one Century Farm.

3.9.5.8.1.5 WDZ-E

Two archaeological sites have been recorded within WDZ-E (Table 3.9-12). The one prehistoric artifact scatter and the one historic artifact scatter have not been evaluated for their potential to be eligible to the NRHP. No historic period buildings and structures or mapped historic transportation routes have been recorded within WDZ-E. The WDZ is estimated to contain one Century Farm.

3.9.5.8.1.6 WDZ-F

Previously recorded archaeological sites within WDZ-F include four prehistoric sites, one multicomponent site, and one temporally unspecified site (Table 3.9-12). The range of site types represented includes prehistoric camp, historic farmstead, and unspecified sites. Five of these sites have not been evaluated for their potential to be eligible to the NRHP while one site was determined not eligible for the NRHP. Within WDZ-F, 37 buildings/structures and 1 historic transportation route have been previously recorded. Of these, only the Penick House, Texhoma, Oklahoma, is listed in the NRHP (Table 3.9-13), while 37 have not been evaluated for their potential to be eligible to the NRHP. The WDZ is estimated to contain one Century Farm.

3.9.5.8.1.7 WDZ-G

Records reviewed indicated 26 archaeological sites within WDZ-G (Table 3.9-12). Of these, 22 are prehistoric, 2 historic and 2 are temporally unspecified. Site types represented include prehistoric artifact scatters, camps, historic farmsteads, and unspecified site types. Four of these sites were determined not eligible to the NRHP while 22 sites have not been evaluated for their potential to be eligible to the NRHP. One historic transportation route was previously recorded within WDZ-G, though this site has not been evaluated for its potential to be NRHP-eligible. The WDZ is estimated to contain one Century Farm.

3.9.5.8.1.8 WDZ-H

Within WDZ-H, 15 archaeological sites have been previously recorded, including 9 prehistoric sites, 1 historic site, and 5 temporally unspecified sites (Table 3.9-12). Site types represented include prehistoric artifact scatter, historic farmstead, and unspecified site types. Four of the sites have been evaluated as not eligible to the NRHP while 11 of the sites have not been evaluated for their potential to be NRHP-eligible. WDZ-H contains two NRHP-listed properties in Oklahoma, the Eva Wood-Frame Grain Elevator, Eva, and the Tracey Wood-Frame Grain Elevator, Muncy (Table 3.9-13). One historic transportation route is recorded from documentary sources, but additional property has been recorded but not evaluated for its potential to be eligible to the NRHP. The WDZ is estimated to contain one Century Farm.

3.9.5.8.1.9 WDZ-I

There are 14 previously recorded archaeological sites within WDZ-I (Table 3.9-12), including 9 prehistoric sites, 3 historic sites, 1 multicomponent site, and 1 unspecified site. Site types represented include prehistoric artifact scatter, camp, historic artifact scatter, and cemetery. Three of these sites have been determined to be not eligible for the NRHP while 11 have not been evaluated for their potential to be NRHP-eligible. WDZ-I contains the Adams Wood-Frame Grain Elevator, Adams, Oklahoma, and Hooker Wood-Frame Grain Elevator, Hooker, Oklahoma, both listed in the NRHP (Table 3.9-13). In addition, 13 buildings/structures and 2 historic transportation routes have been previously recorded but not evaluated for their potential to be eligible to the NRHP. The WDZ is estimated to contain one Century Farm.

3.9.5.8.1.10 WDZ-J

Within WDZ-J, 51 archaeological sites have been recorded previously (Table 3.9-13). Of these, 42 sites are prehistoric, 7 are historic, and 2 are multicomponent. Represented site types include prehistoric artifact scatter, camp, historic artifact scatter, farmstead sites, and an isolated prehistoric burial. Thirty-six of these sites have not been evaluated for their potential to be eligible to the NRHP while 14 sites have been determined to be not eligible to the NRHP. One previously recorded historic transportation route has not been evaluated for its potential to be eligible to the NRHP. The WDZ is estimated to contain one Century Farm.

3.9.5.8.1.11 WDZ-K

Five archaeological sites have been previously recorded within WDZ-K (Table 3.9-12). These include four historic period sites and one multicomponent site. Site types represented include prehistoric artifact scatter, camp, historic artifact scatter, and cemetery sites. The potential for these sites to be eligible to the NRHP is unknown. Three buildings/structures and one historic transportation route were previously recorded within WDZ-K. Three of these have been determined to be NRHP-eligible, and one has not been evaluated for its potential to be eligible to the NRHP. The WDZ is estimated to contain one Century Farm.

3.9.5.8.1.12 WDZ-L

Within WDZ-L, 16 archaeological sites have been previously recorded including 10 prehistoric, 2 historic, and 4 unspecified (Table 3.9-12). Site types represented include prehistoric camps, historic farmsteads, and unspecified site types. These sites have not been evaluated for their potential to be eligible to the NRHP. One prehistoric archaeological site is listed on the NRHP, the Buried City Site in Ochiltree County, Texas (Table 3.9-13). It is unknown whether the site is included in the prehistoric counts provided in Clean Line (2014), because site names are not available in the public record provided in that document. WDZ-L does not contain any previously recorded buildings/structures or historic transportation routes. The WDZ is estimated to contain one Century Farm.

3.9.5.8.2 Optima Substation

The future Optima Substation would be on a 160-acre site located just east of the Oklahoma Converter Station Siting Area and partially within the AC Interconnection Siting Area where no historic or cultural resources have been identified.

3.9.5.8.3 TVA Upgrades

The ROI for the direct assignment facilities (which are included in the Applicant Proposed Project) would occur within the Tennessee Converter Station Siting Area and more specifically within the Shelby Substation. The ROI for the network upgrades, and in particular TVA's future 500kV transmission line, cannot be fully determined at this time. The new 500kV transmission line would be constructed in western Tennessee within the Southeast Coastal Plain province. The upgrades to existing facilities would mostly be in western and central Tennessee. Upgrades to existing infrastructure would include upgrading terminal equipment at three existing 500kV substations and six existing 161kV substations, making appropriate upgrades to increase heights on 16 existing 161kV transmission lines to increase line ratings, and replacing the conductors on eight existing 161kV transmission lines. Where possible, general impacts associated with the required TVA upgrades are discussed in the impact sections that follow.

3.9.6 Impacts to Historical and Cultural Resources

3.9.6.1 Methodology

The analysis of potential effects to historic and cultural resources uses the same ROI described in Section 3.9.3 for archaeological sites, aboveground historic properties, and historic routes. Many other resources evaluated in this EIS evaluate 200-foot-wide representative ROWs for direct impacts, but this section uses a broader area because the APE (which DOE defines in the draft PA [Appendix P]) may vary from the typical 200-foot-wide final ROW for the Project transmission lines (Clean Line 2013). Also, for consistency with the HVDC transmission lines, potential effects to historic and cultural resources related to AC collection system routes are evaluated across a 1,000-foot-wide corridor instead of the larger 2-mile ROI.

The assessment of potential impacts to historic and cultural resources entailed a qualitative review of available information on these resources (following from the information described in Sections 3.9.4 and 3.9.5, above) in conjunction with consideration of potential effects of various Project activities (see Appendix F) on different types of historic and cultural resources. The strategy for assessing potential impacts from the Project resulted from the conceptual, preliminary, or non-Project-specific nature of much of the available information. Quantitative information presented below is therefore preliminary and may be refined as Project-specific cultural resources surveys are undertaken prior to construction. In particular, density calculations presented in impact tables are based on available records and may substantially underrepresent the actual resource density. As described in Section 3.9.2, field surveys will be undertaken prior to construction. The results of the surveys will provide specific information as to the presence or absence of cultural resources that may qualify as historic properties.

One proxy indicator of *potential* project interactions, impacts, or effects on historic and cultural resources is provided by considering the land cover of areas within which the Project would be constructed. Land cover is discussed and analyzed in detail in Section 3.10 using data extracted by GIS techniques from the 2006 release of the National Land Cover Database (NLCD) (GIS Data Source: Jin et al. 2013). As a proxy for assessment of *potential* Project effects, the 14 land cover classes observed in a 200-foot-wide representative ROW (consistent with results presented in Section 3.10) were placed into four groups, representing different possible constellations of Project effects (Table 3.9-14). Land cover Group A primarily is composed of terrain that is being actively manipulated, either through crop cultivation or development. Land cover Group B is composed of terrain that is predominantly covered by perennial grasses and herbaceous vegetation and so is relatively open. Land cover Group C comprises woodlands and forests and is relatively closed. Land cover Group W is the residual group of open water, which generally comprises a small percentage of the Project acreage.

Pursuant to the PA, in coordination with consulting parties, more detailed assessments of potential Project impacts to historic and cultural resources will be made prior to construction. Under the PA, the Applicant will also develop and implement plans to manage identification, assessment, and treatment of these resources. These plans would set forth the process that the Applicant would use to identify, evaluate, and treat unanticipated historic properties and cultural resources discovered during construction and operations and maintenance phases of the Project. The evaluation of potential impacts in the following sections assumes implementation of these plans. The draft PA is included in Appendix P.

Table 3.9-14:
Land Cover Groups and Potential Project Effects on Historic and Cultural Resources

Group	Constituent Land Cover Classification	General Characteristics	Potential Project Effects On Historic and Cultural Resources
A	Barren Land Cultivated Crops Developed—Low Intensity Developed—Medium Intensity Developed—Open Space	Typically artificially landscaped or manipulated terrain; generally open and covered in relatively low, often discontinuous vegetation; often contains existing roads or field drives.	<u>Ground Disturbance</u>: Large areas of extant cleared land and availability of roads limit need for extensive new construction to provide access to and work spaces around towers and other permanent facilities. <u>Visual Exposure</u>: Potential for distant views of permanent Project elements because of limited extent of tall vegetative screening.
B	Emergent Herbaceous Wetlands Grassland/Herbaceous Pasture/Hay Shrub/Scrub	Generally open terrain covered by grasslands, shrubs, and discontinuous patches of low trees; existing road access is variable.	<u>Ground Disturbance</u>: Large areas of open land tends to limit need for vegetation clearing and thus amount of ground disturbance outside towers, other permanent facilities, and their associated work spaces. However, limited availability of existing roads in some areas may result in need for construction of temporary or permanent roads. <u>Visual Exposure</u>: Potential for distant views of permanent Project elements because of limited extent of tall vegetative screening.
C	Deciduous Forest Evergreen Forest Mixed Forest Woody Wetlands	Generally closed terrain covered by woodland; access by existing roads tends to be limited.	<u>Ground Disturbance</u>: Probable need for extensive vegetation clearance, possibly resulting in ground disturbances, at towers and other facilities, in new transmission line ROWs between towers and in construction work areas. Access road construction may be necessary. <u>Visual Exposure</u>: Distant views of permanent Project elements tend to be limited in extent because of extensive of tall vegetative screening.
W	Open Water	Water bodies such as rivers, streams, ponds, and lakes.	Minor land cover type; not analyzed.

Source: GIS Data Source: Jin et al. (2013)

3.9.6.1.1 Impacts Common to All Project Components

This section describes potential Project impacts that could affect historic and cultural resources anywhere within the ROI.

The characteristics of specific historic and cultural resources fundamentally affect their susceptibility to different types of potential Project impacts. The discussion that follows focuses primarily on potential direct, physical impacts and on potential visual impacts, because these two types of impact are the most likely to affect the kinds of historic and cultural resources that likely occur in the ROI.

Archaeological sites, consisting of patterns of objects (artifacts) on or in the ground and traces of modifications to the soil and landscape by past peoples, are primarily vulnerable to Project activities that disturb the soil. Such disturbances relocate artifacts, altering archaeologically meaningful spatial relationships among these objects and between these objects and the soil matrix within which they are located; documentation of such spatial relationships is critical to meaningful interpretation of archaeological sites. In addition, some archaeological evidence exists only as contrasting layers of soil and soil boundaries, and ground disturbances can disrupt soil boundaries, mix layers, and obliterate such evidence. Occasionally, an archaeological site's relationship to its surrounding environment is an essential characteristic that contributes fundamentally to the site's significance, and in these instances, the site may also be subject to visual impacts from a project. Typically, however, the analysis of Project impacts on archaeological resources focuses on direct ground disturbance. In the case of archaeological sites that are eligible for listing in the NRHP, efforts would be made to resolve adverse effects by means of avoidance, minimization, or mitigation as per 36 CFR 800.6(a)(1).

Installation of utility systems in rural areas, including generating facilities, transmission lines, converter stations, and other infrastructure related to the construction and/or operation of the project, would typically avoid the demolition or relocation of buildings and other existing elements of the built environment. Factors such as the cost of real estate taking and project setback requirements generally mean that historic buildings, structures, objects, and landscape features (such as identifiable cemeteries) are not directly altered physically, damaged, or demolished by electrical generation and transmission projects in rural areas. Instead, such historic and cultural resources may be impacted by the introduction of non-historical visual or, occasionally, auditory elements into their setting. The identification and analysis of potential visual impacts to historic resources overlaps with that for potential visual and aesthetic impacts (Section 3.18), but the latter is concerned with many types of resources, of which historic and cultural resources are just one category. In the case of historic architectural resources located in the vicinity of the Project that are eligible for listing in the NRHP, visual impacts might constitute an adverse effect under 36 CFR 800.5(a)(2)(v). In this instance, efforts would be made to avoid, minimize, or mitigate effects. Introduction of structures such as the proposed transmission line and associated towers into an otherwise rural or natural setting could diminish the integrity of a property's significant historic features. Assessment of effects (including visual effects) on historic properties is based in part on the evaluation of integrity.

Historic properties of particular interest to Indian Tribes and Nations are varied in their characteristics and could be subject to direct physical disturbances or to disturbances resulting from alteration of the visual surroundings, auditory field, or other characteristics of their setting. As noted in Section 3.9.4, DOE has requested information from Indian Tribes that may attach religious and cultural significance to historic properties that may be affected by the undertaking, but these resources remain to be delineated for the ROI.

The Applicant will develop plans and employ various measures during the construction and operations and maintenance phases of the Project that, if executed effectively and consistently, will help to avoid or minimize impacts to historic and cultural resources. Key Project plans related to these resources include:

- Historic Properties Identification Plan for the early identification of historic and cultural resources within the Project footprint through appropriate surveys
- Historic Properties Treatment Plan for the avoidance, minimization, and mitigation of adverse effects on historic and cultural resources within the Project footprint
- Discovery Plan that outlines the steps to be followed in the event that a historic or cultural resource is discovered during construction

In addition, the Applicant has identified various EPMs that will help avoid or minimize impacts to historic and cultural resources. Applicable measures include:

- GE-1: Clean Line will train personnel on health, safety, and environmental matters. Training will include practices, techniques, and protocols required by federal and state regulations and applicable permits.
- GE-6: Clean Line will restrict vehicular travel to the ROW and other established areas within the construction, access, or maintenance easement(s).

- GE-27: Clean Line will minimize compaction of soils and rutting through appropriate use of construction equipment (e.g., low ground pressure equipment and temporary equipment mats).
- LU-5: Clean Line will make reasonable efforts, consistent with design criteria, to accommodate requests from individual landowners to adjust the siting of the ROW on their properties. These adjustments may include consideration of routes along or parallel to existing divisions of land (e.g., agricultural fields and parcel boundaries) and existing compatible linear infrastructure (e.g., roads, transmission lines, and pipelines), with the intent of reducing the impact of the ROW on private properties.
- GEO-1: Clean Line will stabilize slopes exposed by its activities to minimize erosion.

3.9.6.1.2 Construction Impacts

A wide range of activities associated with the construction of the Project has the potential to result in extensive ground disturbance. From the point of view of archaeological resources, Project-related ground disturbance is the alteration of the structure, composition, and/or texture of the soil and its contents from the air-ground interface to depth in excess of that which would occur in absence of Project activities. Such impacts may occur as a result of earth moving (cutting, filling, grading, foundation preparation, sub-roadbed construction, and similar construction activities) or movements of equipment and vehicles over unprotected ground surfaces. If such ground disturbance results in physical or visual impacts to historic properties that are eligible for listing in the NRHP, such impacts could constitute an NHPA Section 106 adverse effect under 36 CFR 800.5(a)(1), and, therefore, would require consultation with consulting parties to attempt to avoid, minimize, or mitigate adverse effects.

Construction could also cause temporary impacts to historic and cultural resources through the generation of dust, noise, and vibration, but such effects would be transient in nature.

Assuming that demolition of existing buildings, structures, and sites such as marked historic cemeteries would be avoided during construction through appropriate design and application of EPM LU-5 for micrositing, direct effects from constructing the Project would be transient and limited, and could include such temporary alterations of the environment as increased noise, vibration, and dust. Because of their transient nature, such effects would not usually require mitigation in relation to historic and cultural resources.

As indicated in Section 3.9.4, state-level Century Farm programs honor continuity of tenancy of one century or more and family farming. The Project has the potential to impact agricultural land in general during construction (see Section 3.2.6 for details). It is possible that affected agricultural land could include Century Farms.

Wooded terrain requires more ground disturbance because of the need to clear transmission line corridors and build roads, among other activities, but woodlands may also present possibilities for vegetative screening of nearby historic standing structures. Open terrain tends to reduce the need for extensive construction disturbances outside transmission towers and other ground-level facilities. At the same time, open terrain also somewhat increases the potential for adverse visual effects to historic standing structures in close proximity to the Project alignment resulting from the introduction of transmission towers and other facilities. However, with effective implementation of plans and measures such as those described in Section 3.9.6.1.1, adverse effects to historic properties would be resolved through consultation with consulting parties to develop means of avoidance, minimization, or mitigation.

As the types of tribal resources that may be present within the ROI remain to be determined, only a broad, generic description of potential impacts is possible at this time. In general, impacts to tribal resources would be similar to those that might occur to archaeological sites and historic architectural properties as described above.

3.9.6.1.3 Common Operations and Maintenance and Decommissioning Impacts

Adverse impacts to historic and cultural resources are not expected from operations and maintenance or decommissioning of the Project. Operations and maintenance activities and decommissioning would take place within areas that would have been surveyed for historic and cultural resources. DOE intends to address any potentially NRHP-eligible cultural resources that could be recorded in areas affected by the Project through the Section 106 process, as appropriate. DOE intends that compliance with Section 106 would address potential adverse effects to cultural resources that qualify as historic properties during operations and maintenance or decommissioning.

Following decommissioning, removal of Project transmission structures, conductors, and converter stations that may have caused visual alterations to aboveground historic and cultural resources such as buildings and structures would benefit those resources.

3.9.6.2 Impacts Associated with the Applicant Proposed Project

3.9.6.2.1 Converter Stations and AC Interconnection Siting Areas

3.9.6.2.1.1 Construction Impacts

The ROI for the Oklahoma Converter Station Siting Area and AC Interconnection Siting Area and the Tennessee Converter Station Siting Area and AC Interconnection Tie contain no previously recorded archaeological sites or other historic properties. Cultural resources surveys would be performed prior to construction to ascertain whether any unrecorded NRHP-eligible properties are present and to assess the possible impacts of construction on such resources if present. DOE will establish the timing and protocols for cultural resources surveys through the PA. A draft PA is included in Appendix P.

3.9.6.2.1.2 Operations and Maintenance Impacts

No impacts would result from operations and maintenance activities at the Oklahoma converter station and AC interconnection and the Tennessee converter station and AC interconnection tie (see Section 3.9.6.1.3).

3.9.6.2.1.3 Decommissioning Impacts

No impacts would result from decommissioning (see Section 3.9.6.1.3).

3.9.6.2.2 AC Collection System

The AC collection system is located in the high plains of the Oklahoma and Texas panhandles. The frequency of inventoried historic and cultural resources per mile of ROI appears to be low based on available information (Table 3.9-15). Land cover data show that the AC collection system is located in open terrain, which is divided between cultivated crops (in land cover Group A) and rangelands (in land cover Group B) (Table 3.9-16). Overall, available information appears to suggest that the potential for the Project to impact historic and cultural resources is relatively low.

Table 3.9-15:
Frequency Per Linear Mile of AC Collection System Route Centerline for Previously Inventoried Historic and Cultural Resources by Project Alternative in Region 1

	AC Collection System Routes												
	E-1	E-2	E-3	NE-1	NE-2	SE-1	SE-2	SE-3	NW-1	NW-2	SW-1	SW-2	W-1
Length (miles)	28.94	39.82	39.95	30.05	26.28	40.34	13.44	49.09	51.89	56.01	13.39	37.03	20.74
Total Archaeological Sites (n)[1]	1	1	1	0	0	0	0	1	2	2	0	3	2
Total Aboveground Historic Properties (n)[1]	0	0	0	0	0	0	0	0	0	1	0	0	0
Archaeological Sites per Mile[2]	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.02	0.04	0.04	0.00	0.08	0.10
Historic Properties per Mile[2]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00

1 Area analyzed for archaeological sites is a 1,000-foot-wide corridor, and for aboveground historic properties and historic routes is a 1-mile corridor.
2 Density calculations are based on statewide records available in SHPO and state archaeologist offices.
Source: Clean Line (2013)

Table 3.9-16:
Percentages of Land Cover Groups for Assessment of Potential Project Effects on Historic and Cultural Resources for AC Collection Routes in Region 1

	AC Collection Route												
Land Cover Group[1]	E-1	E-2	E-3	NE-1	NE-2	SE-1	SE-2	SE-3	NW-1	NW-2	SW-1	SW-2	W-1
A (Manipulated Terrain)	11.6%	33.4%	28.7%	54.4%	24.3%	50.6%	52.0%	41.3%	46.5%	47.5%	3.1%	17.5%	23.5%
B (Open Vegetation Patterns)	88.3%	66.4%	71.3%	45.6%	75.7%	49.4%	48.0%	58.5%	53.5%	52.4%	96.9%	82.5%	76.5%
C (Closed Vegetation Pattern)	0.1%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%
W (Water)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%
Total Acres	708	974	977	730	637	1,265	1,365	979	325	1,194	326	901	508

1 Land cover percentages and acreages based on a 200-foot-wide representative ROW and including tensioning work sites, which typically extend outside the transmission line ROW. See Section 3.10 for discussion of source data quality and limitations. Percentages may not sum to 100 due to rounding error.
GIS Data Source: Jin et al. (2013)

3.9.6.2.2.1 Construction Impacts

Construction impacts are described in Section 3.9.6.1.1. Cultural resources survey within AC collection system would be performed prior to construction to assess the possible impacts of construction on such resources if present. DOE establishes the timing and protocols for cultural resources surveys in the draft PA (Appendix P). For sites discovered, the possible impacts of construction on such resources would be assessed. If NRHP-eligible historic properties are identified, efforts would be made to avoid, minimize or mitigate effects.

AC Collection System Routes NE-1, NE-2, SE-1, SE-2, and SW-1 contain no previously recorded archaeological sites or other historic properties.

AC Collection System Routes E-1, E-2, E-3, and SE-3 each contain one previously recorded archaeological site that has not been evaluated for NRHP eligibility. None contains previously recorded historic buildings.

AC Collection System Route NW-1 and NW-2 each contain two previously recorded archaeological sites, neither of which has been evaluated for NRHP eligibility. AC Collection System Route NW-1 contains no previously recorded historic buildings. The NRHP-listed Tracey Woodframe Grain Elevator is located in the vicinity of AC Collection System Route NW-2. Listed in 1983, aerial imagery (using Google Earth) from 2013 shows that the elevator has collapsed. Such severe loss of integrity may be sufficient to require delisting from the NRHP. The current condition of this property has not been field-verified, but if the elevator has collapsed, the loss of integrity would mean that any Project elements in the vicinity would not adversely affect the property.

AC Collection System Route SW-2 contains three previously recorded archaeological sites, none of which have been evaluated for NRHP eligibility. The route contains no previously recorded historic properties.

AC Collection System Route W-1 contains two previously recorded archaeological sites, neither of which has been evaluated for NRHP eligibility. The route contains no previously recorded historic properties.

A public comment received on the Draft EIS expressed concern that analysis of AC collection system impacts did not consider the Stamper Site (34TX1, NRIS 66000635), an NHL in the Beaver River valley of Texas County, Oklahoma. However, DOE determined that the site is located outside the conceptual study corridors of all AC collection system routes (specifically AC Collection System Routes NE-1 and NW-2), and therefore had been appropriately excluded from the impacts analysis.

3.9.6.2.2.2 Operations and Maintenance Impacts

No impacts would result from operations and maintenance of any of the AC collection system routes (see Section 3.9.6.1.3).

3.9.6.2.2.3 Decommissioning Impacts

No impacts would result from decommissioning (see Section 3.9.6.1.3).

3.9.6.2.3 HVDC Applicant Proposed Route

Based on available information, the frequency of inventoried historic and cultural resources per mile of centerline along the Applicant Proposed Route varies, with higher frequencies occurring toward the eastern end of the Project, notably in Regions 4, 5, and 7 (Table 3.9-17), as more cultural resources surveys have taken place and more incidental finds have been recorded in these areas. Cultural resources field surveys would be conducted in all regions of the Applicant Proposed Route prior to construction to assess the possible impacts of construction on such resources if present. DOE establishes the timing and protocols for cultural resources surveys in the draft PA (Appendix P).

Land cover data show the increased extent of woodlands from Region 4, in eastern Oklahoma (Table 3.9-18). However, it is also evident that large areas of agricultural land occur in Regions 6 and 7. The implications of the available data are that Regions 4, 5, and 7 appear likely to contain the greatest numbers of historic and cultural resources. For sites discovered, the possible impacts of construction on such resources would be assessed through the measures outlined in the PA. If historic properties are identified, adverse effects would be resolved through consultation with consulting parties to develop means of avoidance, minimization, or mitigation.

As discussed in Sections 3.9.4 and 3.9.5, as a result of public comment on the Draft EIS, the Applicant has proposed several minor variations to the Applicant Proposed Route. Review of these minor variants found that, based on the information currently available to DOE, there is generally similar potential for involvement with historic and cultural resources as compared to the original Applicant Proposed Route, and so the Project effects along these variations are also expected to be similar.

Table 3.9-17:
Frequency Per Linear Mile of the Applicant Proposed Route Centerline for Previously Inventoried Historic and Cultural Resources by Region

Length/Inventory[1]	Applicant Proposed Route (APR)						
	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6	Region 7
Length (miles)	115.46	105.97	161.69	126.28	112.8	54.36	42.83
Total Archaeological Sites (n)[2]	4	0	2	20	13	5	14
Total Aboveground Historic Properties (n)[2]	6	9	20	8	0	0	0
Archaeological Sites per Mile[3]	0.03	0.00	0.01	0.16	0.12	0.09	0.33
Historic Properties per Mile[3]	0.01	0.00	0.01	0.05	0.20	0.02	0.93

1 The values in the table do not reflect the minor changes that would result from application of route variations and adjustments.
2 ROI for archaeological sites is a 1,000-foot-wide corridor; ROI for aboveground historic properties and historic routes is a 1-mile corridor.
3 Density calculations are based on statewide records available in SHPO and state archaeologist offices.
Source: Clean Line (2013)

Table 3.9-18:
Percentage Comparison of Land Cover Groups for Assessment of Potential Project Effects on Historic and Cultural Resources for the HVDC Transmission Line by Region

Land Cover Group[1, 2]	Applicant Proposed Route (APR)						
	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6	Region 7
A (Manipulated Terrain)	32.8%	39.7%	13.2%	5.6%	9.6%	85.8%	73.8%
B (Open Vegetation Patterns)	66.7%	50.5%	58.2%	50.6%	32.7%	0.4%	10.4%
C (Closed Vegetation Pattern)	0.2%	9.6%	28.3%	43.6%	57.3%	13.0%	13.7%
W (Water)	0.4%	0.2%	0.3%	0.2%	0.3%	0.9%	2.2%
Total Acres	2,926	2,687	4,328	3,570	3,051	1,448	1,221

1 The values in the table do not reflect the minor changes that would result from application of route variations and adjustments.
2 Land cover percentages and acreages based on a 200-foot-wide representative ROW and including tensioning work sites, which typically extend outside the transmission line ROW. See Section 3.10 for discussion of source data quality and limitations. Percentages may not sum to 100 due to rounding error.
GIS Data Source: Jin et al. (2013)

3.9.6.2.3.1 Construction Impacts

3.9.6.2.3.1.1 Region 1

Based upon information on archaeological, historical, and tribal resources available from background research as presented in Table 3.9-17, the Applicant Proposed Route appears to have an overall potential for containing a few to some historic and cultural resources in Region 1. Nearly all of the terrain is open (Table 3.9-18), which tends to reduce the need for extensive construction disturbances outside of transmission towers and other ground-level facilities. With effective implementation of plans and measures such as those described in Section 3.9.6.1.1, adverse effects to historic properties would be resolved by consultation with consulting parties to develop means of avoidance, minimization, or mitigation.

The approximate 115-mile Applicant Proposed Route primarily traverses the interfluve between the Beaver River to the north and Wolf Creek to the south, intersecting the headwaters of several widely spaced minor tributaries of the Beaver River. In settings like that of the Applicant Proposed Route on the High Plains, the frequencies of cultural resources tend to be low, except in the vicinity of water sources, such as washes, creeks, rivers, and playas, where cultural resources, particularly prehistoric archaeological sites, may be more common. In contrast, pioneer settlement-era and statehood-period archaeological sites, buildings, and structures tend to be located along road networks, which are generally based on 1-mile section lines; terrain and water sources are thus somewhat less relevant to the distribution of cultural resources of later historic periods than they are to sites of earlier times. The Applicant Proposed Route crosses several historic transportation corridors (trails and railroad lines), but no associated cultural resources have been inventoried in any of these corridors in the vicinity of Project route intersections.

Terrain features related to drainage tend to be infrequent along most sections of the Applicant Proposed Route; the most notable exception to this generalization is the crossing of the Beaver River, where a higher frequency of cultural resources, and consequently a greater potential for Project impacts, may occur. Information on file with state and federal agencies confirms the presence of archaeological sites and historic buildings along the Applicant Proposed Route: inventoried properties include four archaeological sites and six historic buildings and structures. The Applicant Proposed Route crosses several historic transportation corridors (trails and railroad lines), but no associated cultural resources have been inventoried in any of these corridors in the vicinity of their intersections with the Project. The Applicant Proposed Route contains no identified NRHP-listed or -eligible properties.

No route variations were proposed in Region 1.

3.9.6.2.3.1.2 Region 2

Based upon information on archaeological, historical, and tribal resources available from background research as presented in Table 3.9-17, the Applicant Proposed Route appears to have an overall potential to contain a few historic and cultural resources in Region 2. The great majority of terrain is open (Table 3.9-18), which tends to reduce the need for extensive construction disturbances outside of transmission towers and other ground-level facilities. With effective implementation of plans and measures such as those described in Section 3.9.6.1.1, adverse effects to historic properties would be resolved through consultation with consulting parties to develop means of avoidance, minimization, or mitigation.

The approximate 106-mile Applicant Proposed Route parallels the North Canadian River along its approximately 55 westernmost miles, generally staying distant from the river on rolling plains. Much of this distance is located along the drainage divide with the Cimarron River to the north and east. It then enters the Cimarron River drainage via the headwaters of several minor tributaries of the river, crosses the Cimarron River and valley floor, and intersects the middle reaches of two tributary creeks of the river. In settings like that of the Applicant Proposed Route on the High Plains, the frequencies of cultural resources tend to be low, except in the vicinity of water sources, such as washes, creeks, rivers, and playas, where cultural resources, particularly prehistoric archaeological sites, may be more common. In contrast, pioneer settlement-era and statehood-period archaeological sites, buildings, and structures tend to be located along road networks, which are generally based on 1-mile section lines; terrain and water sources are thus somewhat less relevant to the distribution of cultural resources of later historic period than they are to sites of earlier times. An exception to this rule-of-thumb is the location of trails and travel routes from the early historic period, such as the Chisholm Trail, which came into existence before the establishment of the township-and-range surveys and do not necessarily follow section lines.

While much of the Applicant Proposed Route is situated on rolling plains distant from such terrain features, the route does cross several drainages, including headwaters and middle reaches of several creeks and the Cimarron River itself. Such locations have a higher potential to contain cultural resources and a greater potential for Project impacts. Information on file with state and federal agencies, however, suggests the overall low frequency of cultural resources along the Applicant Proposed Route; there are no inventoried archaeological sites or historic buildings and structures (Table 3.9-17). The Applicant Proposed Route crosses several historic transportation corridors (trails and railroad lines), but no associated cultural resources or NRHP-listed or -eligible properties have been inventoried in any of these corridors in the vicinity of their intersections with the Project.

Two minor route variations were proposed in Region 2, as discussed in Section 3.9.5.2. Examination of these variations indicates similar potential for involvement with cultural resources as compared to the original Applicant Proposed Route analyzed in the Draft EIS. Adoption of such variations would not substantively alter the analysis of potential Project effects.

3.9.6.2.3.1.3 Region 3

Based upon information on archaeological, historical, and tribal resources available from background research as presented in Table 3.9-17, the Applicant Proposed Route appears to have an overall potential to contain a moderate number of cultural resources in Region 3. While much of the terrain is open, wooded areas compose around one-quarter of the terrain (Table 3.9-18).

The approximate 162-mile Applicant Proposed Route traverses gently rolling to broken terrain, intersecting numerous small drainages. The route also crosses the Cimarron River near Ripley, Oklahoma, and terminates on the western bank of the Arkansas by Webbers Falls Dam in Muskogee County, Oklahoma. The Applicant Proposed Route crosses several historic transportation corridors (trails and railroad lines), but with one exception associated with the U.S. Highway 66 National Historic Trail near Bristow, Oklahoma, no associated cultural resources have been inventoried in any of these corridors in the vicinity of the Applicant Proposed Route. Region 3 is the longest of the seven regions encompassing the Project—more than 25 percent longer than the second longest region, Region 4—and there are more inventoried historic and cultural resources in the Applicant Proposed Route in Region 3 than in the regions to the west. For any additional sites discovered, the possible impacts of construction on such resources would be assessed.

While there is reason to anticipate that cultural resources would be relatively common in Region 3, information on file with state and federal agencies does not reflect a high resource frequency (Table 3.9-17). Only two archaeological sites have been recorded within a portion of the ROI in this region to date, and no historic buildings have been inventoried. One historic structure, an NRHP-eligible segment of the 1926 original concrete-paved roadway (now abandoned) of U.S. Route 66, occurs as near as 0.5 mile from the Applicant Proposed Route near Bristow, Oklahoma.

Five minor route variations were proposed in Region 3, as discussed in Section 3.9.5.3. Examination of these variations indicates similar potential for involvement with cultural resources as compared to the original Applicant Proposed Route analyzed in the Draft EIS. Adoption of such variations would not substantively alter the analysis of potential Project effects.

3.9.6.2.3.1.4 Region 4

Based upon information on archaeological, historical, and tribal resources available from background research as presented in Table 3.9-17, the Applicant Proposed Route appears to have an overall potential to contain moderate numbers of historic and cultural resources in Region 4. The terrain is a roughly equal mix of open and wooded areas (Table 3.9-18).

The approximate 126-mile Applicant Proposed Route traverses undulating to hilly terrain along the northern edge of the Arkansas River valley. At the western end of Region 4, the Project alignment crosses the river itself at Webbers Falls Dam in Muskogee County, Oklahoma. The Arkansas riverbed would be spanned, and visual impacts would be moderate–low given the distance of the Project from the river and the presence of existing high-voltage transmission lines in close proximity to the Project, as described in Section 3.18.6.3.2.2.4 and Appendix K. Since the Arkansas riverbed would be spanned, there would be no ground disturbing activities and thus impacts would be limited to visual resources. The alignment then roughly parallels the river at a varying distance of approximately 2.25 to 17.5 miles. The route intersects numerous small drainages that flow from the rugged Boston Mountains to the north across the Arkansas Valley to confluences with the Arkansas River. In terrain such as that of Region 4, cultural resources may occur in a variety of settings. However, there is likely a tendency for the number of cultural resources, specifically prehistoric archaeological sites, to be greatest in the vicinity of water-related features, such as ravines, creeks, rivers, wetlands, and ponds. While water-related features might also have affected the locations of certain pioneer settlement-era and statehood-period archaeological sites, buildings, and structures, resources of the historic period tend to be located along road networks. Unlike Oklahoma, where local road networks are generally based on 1-mile section lines, in western Arkansas geographic features such as stream and river courses and the ruggedness of the terrain appear to have played a dominant role influencing the locations of roads and settlements. The Applicant Proposed Route crosses several historic transportation corridors (trails and railroad lines). The most prominent of these is the Trail of Tears National Historic Trail (a multi-branched resource management corridor), specifically the Bell-Drane Route of the trail, over which approximately 2,000 Native Americans traveled into exile in Indian Territory (the future state of Oklahoma) in three separate parties in 1838 and 1839. To date, no NRHP-listed or -eligible properties have been identified at crossings between the identified route of the Trail of Tears and any of the Project proposed or alternative routes. In addition, one property in the Applicant Proposed Route ROI is listed on the NRHP:

- Mulberry River Bridge, Pleasant Hill vicinity, Crawford County, Arkansas

The property is located 0.28 mile off the centerline of the Applicant Proposed Route. The property could be subject to visual impacts from the construction of the proposed HVDC transmission line, if it substantially alters the bridge's historic setting. Analysis of this potential impact would occur prior to construction. Adverse effects, if any, would be resolved by means of avoidance, minimization, or mitigation. Tribal consultation also suggested specific potential for the location of burials and ceremonial grounds along the Applicant Proposed Route.

Taken in combination, these factors suggest that the number of cultural resources is likely higher along the Applicant Proposed Route in Region 4 than in Regions 1 and 2, perhaps somewhat higher than in Region 3, and similar to or somewhat lower than in Regions 5, 6, and 7. For sites discovered, the possible impacts of construction on such resources would be assessed.

The archaeological sensitivity of the Applicant Proposed Route and of Region 4 in general is suggested by the 20 inventoried archaeological sites that have been documented for the Applicant's Proposed Route ROI (Table 3.9-17), all of which are located in the western half of the Applicant Proposed Route, as far east as approximately the Crawford-Franklin county line in Arkansas. These 20 sites span a variety of types and periods and include prehistoric period general artifact scatters (7) and open camps (3), historic period farmsteads (2) and unidentified features (1), and multicomponent (mixed historic and prehistoric period) artifact scatters (5) and prehistoric sites co-occurring with historic period farmsteads (2). There are also several inventoried historic buildings and structures, none of which is NRHP listed or known to be eligible for the Arkansas Register of Historic Places. The Applicant Proposed Route intersects the Bell-Drane Route of the Trail of Tears in approximately six places between western Crawford and eastern Franklin counties. No cultural resources have been previously documented in the vicinity of any of the intersections.

Seven minor route variations were proposed in Region 4, as discussed in Section 3.9.5.4. Examination of these variations indicates similar potential for involvement with cultural resources as compared to the original Applicant Proposed Route analyzed in the Draft EIS. Adoption of such variations would not substantively alter the analysis of potential Project effects.

3.9.6.2.3.1.5 Region 5

Based upon information on archaeological, historical, and tribal resources available from background research as presented in Table 3.9-17, the Applicant Proposed Route appears to have an overall potential to contain moderate numbers of historic and cultural resources in Region 5. A majority of the terrain is wooded, but open areas account for well over one-third of the alignment (Table 3.9-18).

The approximate 113-mile Applicant Proposed Route traverses hilly terrain along the southern fringe of the Ozark Plateau, which flanks northern edge of the Arkansas Valley. The alignment intersects numerous small and large drainages that flow off the Ozark Plateau toward Arkansas River or, at the eastern end of this region, more directly toward the Mississippi. While water-related features might also have affected the locations of certain pioneer settlement-era and statehood-period archaeological sites, buildings, and structures, resources of the historic period tend to be located along road networks. In western and central Arkansas, geographic features such as stream- and river courses and the ruggedness of the terrain appear to have played a dominant role influencing the locations of roads and settlements, rather than public lands section lines, as is characteristic of states to the west and north. Consequently, the intervals at which the Project alignment crosses roads—and thus has a somewhat increased chance of the presence of historic period cultural resources—are apt to be more irregular than in Regions 1, 2, and 3, where section line roads dominate. No historic transportation corridors (trails and railroad lines) have been identified in the ROI for Region 5. Taken in combination, these factors suggest that the number of historic and cultural resources is likely similar to that of Region 4. For sites discovered, the possible impacts of construction on such resources would be assessed. If historic properties are identified, adverse effects would be resolved through consultation with consulting parties to develop means of avoidance, minimization, or mitigation.

The archaeological sensitivity of the Applicant Proposed Route and of Region 5 generally is confirmed by the 12 inventoried archaeological sites that have been documented for the Applicant's Proposed Route ROI. These 12 sites span a variety of types and periods and include prehistoric period general artifact scatters (6), open camps (1), and rockshelters (1); historic period farmsteads (2) and other structures (2); and multicomponent (mixed historic and prehistoric period) artifact scatters (1). There are also 18 inventoried historic buildings and structures. The prehistoric rockshelter site and one of the inventoried historic buildings or structures, both at undisclosed locations, are reported to be NRHP-eligible (Clean Line 2013, Table 3-25). In addition, two properties in the Applicant Proposed Route ROI are listed on the NRHP:

- Wesley Marsh House, Letona vicinity, White County, Arkansas
- William Henry Watson Homestead, Bradford vicinity, White County, Arkansas

Each property is located about 0.34 mile off the centerline of the Applicant Proposed Route and could be subject to visual impacts from the construction of the proposed HVDC transmission line. Analysis of this potential impact would occur prior to construction. Adverse effects, if any, would be resolved through consultation with consulting parties to develop means of avoidance, minimization or mitigation.

Five minor route variations were proposed in Region 5, as discussed in Section 3.9.5.5. Examination of these variations indicates similar potential for involvement with cultural resources as compared to the original Applicant Proposed Route analyzed in the Draft EIS. Adoption of such variations would not substantively alter the analysis of potential Project effects.

3.9.6.2.3.1.6 Region 6

Based upon information on archaeological, historical, and tribal resources available from background research as presented in Table 3.9-17, the Applicant Proposed Route appears to have an overall potential to contain moderate numbers of historic and cultural resources in Region 6. This assessment is based upon information on file with the respective SHPOs and NPS, as no cultural resources surveys of this portion of the Project have been completed to date. This region contains the highest proportion of cultivated crops (Table 3.9-18), which are open and generally present good transportation access.

The approximate 54-mile Applicant Proposed Route traverses the Lower Mississippi Alluvial Valley and crosses Holocene epoch riverine meander belts; Pleistocene epoch valley train deposits; and Crowley's Ridge, a string of low hills. The alignment intersects the Cache and White rivers and numerous small low-order drainages. The pre-agricultural terrain of the region contained numerous wetlands, sloughs, and oxbows. In terrain such as that of Region 6, cultural resources may occur in a variety of settings. However, soil drainage is likely to be a critical factor in the frequently flooded lower Mississippi Valley, with areas of good drainage preferentially occupied over more poorly drained areas, during both prehistoric and historic times. While water-related features doubtless affected the locations of certain pioneer settlement-era and statehood-period archaeological sites, buildings, and structures, resources of the historic period tend to be located along road networks, which, while generally following a grid pattern in Region 6, tend to be irregularly spaced. Consequently, the intervals at which the Project alignment crosses roads are apt to be more irregular than in Regions 1, 2, and 3, where section line roads dominate. No historic transportation corridors (trails and railroad lines) have been identified in the ROI for Region 6. It should also be noted that the natural environment of this region is dynamic, with flooding from the Mississippi River and its major tributaries occurring frequently. Such alluvial activity may tend to remove or obscure archaeological resources, and the combination of the natural dynamism of the area and intensive agriculture may account for the decrease in the number of historic and cultural resources in Region 6 as compared to the regions to the east and west (Table 3.9-17).

For sites discovered, the possible impacts of construction on such resources would be assessed. If historic properties are identified, adverse effects would be resolved through consultation with consulting parties to develop means of avoidance, minimization, or mitigation.

The archaeological sensitivity of the Applicant Proposed Route and of Region 6 is evidenced by the five archaeological sites (four prehistoric archaeological sites and one historic period archaeological site) that have been documented for the route. In addition, one historic building or structure has been inventoried along the Applicant Proposed Route ROI. This alignment contains no NRHP-listed properties.

One minor route variation was proposed in Region 6, as discussed in Section 3.9.5.6. Examination of this variation indicates similar potential for involvement with cultural resources as compared to the original Applicant Proposed Route analyzed in the Draft EIS. Adoption of such variations would not substantively alter the analysis of potential Project effects.

3.9.6.2.3.1.7 Region 7

Based upon information on archaeological, historical, and tribal resources available from background research as presented in Table 3.9-17, the Applicant Proposed Route appears to have an overall potential to contain numerous cultural resources in Region 7. This assessment is based upon information on file with the respective SHPOs and NPS, as no cultural resources surveys of this portion of the Project have been completed to date. A majority of the Project alignment is cultivated crops or other open terrain, but wooded areas comprise around one-quarter of the Project ROI (Table 3.9-18).

The approximate 43-mile Applicant Proposed Route in Region 7 traverses the Lower Mississippi Alluvial Valley and crosses Holocene epoch riverine meander belts before climbing an escarpment on the right (eastern) side of the Mississippi River onto the West Tennessee Plateau Slope (part of the Southeastern Coastal Plain). This alignment crosses the Mississippi River and begins its climb onto the West Tennessee Plateau. Approximately three-quarters of the Applicant Proposed Route in Region 7 is located on Mississippi bottomlands. In bottomlands terrain like that found in the western and central portions of Region 7, cultural resources may occur in a variety of settings. However, soil drainage is likely to be a critical factor in the frequently flooded lower Mississippi valley, with areas of good drainage preferentially occupied over more poorly drained areas, during both prehistoric and historic times. In the hilly eastern portion of this region, there is likely a tendency for the number of cultural resources, specifically prehistoric archaeological sites, to be greatest in the vicinity of water-related features, such as ravines, creeks, rivers, wetlands, and ponds. While water-related features doubtless affected the locations of certain pioneer settlement-era and statehood-period archaeological sites, buildings, and structures, resources of the historic period tend to be located along road networks. In the western and central portions of Region 7, the road network tends to follow a grid pattern, while in the eastern portion, geographic features such as stream courses and the roughness of terrain strongly influence the form of the road network. In consequence, the intervals at which the Project alignment crosses roads are apt to be more irregular than in Regions 1, 2, and 3, where section line roads dominate. No historic transportation corridors (trails and railroad lines) have been identified in the ROI for Region 7. Such alluvial activity may tend to remove or obscure archaeological resources. Region 7 has the highest frequencies of both inventoried archaeological sites and inventoried aboveground historic properties (Table 3.9-17). For sites discovered, the possible impacts of construction on such resources would be assessed.

The archaeological sensitivity of the Applicant Proposed Route and of Region 7 generally is confirmed by the 14 inventoried archaeological sites and 40 inventoried historic buildings and structures that have been documented for The Applicant's Proposed Route in Region 7. The 14 archaeological sites include prehistoric period general artifact scatters (8) and villages (2), as well as general artifact scatters for the historic period (4, 2 of which also yield prehistoric artifacts). The large number of inventoried historic buildings and structures within the ROI for the Applicant Proposed Route in Region 7 reflects the location of the eastern end of the Project near the outskirts of Memphis, Tennessee; none has been evaluated for NRHP eligibility. The Applicant Proposed Route contains no NRHP-listed properties. The overall number or density of cultural resources that may be affected by the Project cannot be estimated from the available background information.

Three minor route variations were proposed in Region 7 as discussed in Section 3.9.5.7. Examination of these variations indicates similar potential for involvement with cultural resources as compared to the original Applicant Proposed Route analyzed in the Draft EIS. Adoption of such variations would not substantively alter the analysis of potential Project effects.

3.9.6.2.3.2 Operations and Maintenance Impacts

No impacts would result from operations and maintenance of the Applicant Proposed Route in Regions 1 through 7 (see Section 3.9.6.1.3).

3.9.6.2.3.3 Decommissioning Impacts

No impacts would result from decommissioning (see Section 3.9.6.1.3).

3.9.6.3 Impacts Associated with the DOE Alternatives

3.9.6.3.1 Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area

3.9.6.3.1.1 Construction Impacts

The Arkansas Converter Station Alternative Siting Area ROI evaluated in the Draft EIS contains 23 previously recorded archaeological sites, including 2 that have been recommended as eligible for the NRHP and 21 that have no eligibility recommendation. There are also three previously recorded historic buildings, none of which has been evaluated for NRHP eligibility. The number of previously recorded cultural resources suggests a moderate to high sensitivity for the presence of sites that may be affected by the project construction. Design of the converter station would avoid currently known NRHP-eligible properties. The smaller Arkansas Converter Station Alternative and AC Interconnection Siting Area ROI evaluated in this Final EIS would have the potential to impact a smaller subset of these historic or cultural resources.

The cultural resources sensitivity of the Arkansas Converter Station AC interconnection is comparable to that described for the Arkansas Converter Station Alternative Siting Area ROI. Following cultural resources surveys, the Project design would attempt to avoid or minimize impacts to NRHP-eligible cultural resources. If avoidance or minimization is not possible, appropriate resolution of adverse impacts to NRHP-eligible cultural resources would be performed in consultation with the appropriate SHPOs and Indian Tribes that may attach religious and cultural significance to historic properties that may be affected by the undertaking.

3.9.6.3.1.2 Operations and Maintenance Impacts

No impacts would result from operations and maintenance of the Arkansas Converter Station or AC interconnection (see Section 3.9.6.1.3).

3.9.6.3.1.3 Decommissioning Impacts

No impacts would result from decommissioning (see Section 3.9.6.1.3).

3.9.6.3.2 HVDC Alternative Routes

3.9.6.3.2.1 Construction Impacts

Comparisons of the historic and cultural resources along the HVDC alternative routes with the Applicant Proposed Routes are presented in the sections that follow based on the data summarized by region in the associated tables. As described for the Applicant Proposed Route, cultural resources field surveys would be conducted in all HVDC alternative routes prior to construction to assess the possible impacts of construction on such resources if present. DOE establishes the timing and protocols for cultural resources surveys in the draft PA (Appendix P). Across all HVDC alternative routes, with effective implementation of plans and measures such as those described in Section 3.9.6.1.1, adverse effects to historic properties would be resolved through consultation with consulting parties to develop means of avoidance, minimization, or mitigation.

3.9.6.3.2.1.1 Region 1

3.9.6.3.2.1.1.1 Alternative Route 1-A

HVDC Alternative Route 1-A loops to the north of the Applicant Proposed Route, and the alternative route is longer (by 9.42 miles) than the corresponding links of the Applicant Proposed Route. While the greater length of the alternative route alone would somewhat increase its potential to impact cultural resources, its geographic location also contributes to its increased potential for impacting these resources. Unlike the corresponding links of the Applicant Proposed Route, which primarily traverses an interfluve between adjoining drainage basins, HVDC Alternative Route 1-A is located much closer to the Beaver River, where greater numbers of prehistoric archaeological sites and perhaps other types of cultural resources might be found. Information on file with state and federal agencies confirms the greater frequency of inventoried archaeological sites and shows an equal number of inventoried historic buildings and structures (Table 3.9-19). Neither contains identified NRHP-listed or -eligible properties.

Table 3.9-19:
Frequency of Previously Inventoried Historic and Cultural Resources Per Linear Mile of HVDC Alternative Route in Region 1

Length/Inventory[1]	Region 1 APR	AR 1-A		AR 1-B		AR 1-C		AR 1-D	
		AR	APR Links 2, 3, 4, 5	AR	APR Links 2, 3	AR	APR Links 2, 3	AR	APR Links 3, 4
Length (miles)	115.46	122.97	113.55	51.86	53.83	52.03	53.83	33.45	33.57
Total Archaeological Sites (n)[2]	4	9	4	2	3	0	3	1	1
Total Aboveground Historic Properties (n)[1]	6	0	1	1	0	1	0	0	1
Archaeological Sites per Mile[3]	0.03	0.07	0.04	0.04	0.06	0.00	0.06	0.03	0.03
Historic Properties per Mile[3]	0.01	0.00	0.01	0.02	0.00	0.02	0.00	0.00	0.03

1 The values in the table do not reflect the minor changes that would result from application of route variations and adjustments.
2 ROI for archaeological sites is a 1,000-foot-wide corridor; ROI for aboveground historic properties and historic routes is a 1-mile corridor.
3 Density calculations are based on statewide records available in SHPO and state archaeologist offices.
Source: Clean Line (2013)

While it appears that HVDC Alternative Route 1-A involves more cultivated crops than the equivalent links of the Applicant Proposed Route (Table 3.9-20), which might indicate an overall lower need for ground-disturbing terrain manipulation, the alternative appears to have a somewhat greater potential to contain historic and cultural resources than the corresponding links of the Applicant Proposed Route.

Table 3.9-20:
Region 1 HVDC Alternative Routes—Percentage Comparison of Land Cover Groups for Assessment of Potential Project Effects on Historic and Cultural Resources

Land Cover Group[1, 2]	Region 1 APR	AR 1-A AR	AR 1-A APR Links 2, 3, 4, 5	AR 1-B AR	AR 1-B APR Links 2, 3	AR 1-C AR	AR 1-C APR Links 2, 3	AR 1-D AR	AR 1-D APR Links 3, 4
A (Manipulated Terrain)	32.8%	19.8%	33.3%	23.0%	46.3%	23.3%	46.3%	25.3%	16.6%
B (Open Vegetation Patterns)	66.7%	79.6%	66.1%	77.0%	53.7%	76.6%	53.7%	74.2%	82.9%
C (Closed Vegetation Pattern)	0.2%	0.4%	0.2%	0.0%	0.0%	0.1%	0.0%	0.5%	0.4%
W (Water)	0.4%	0.2%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total Acres	2,926	3,168	2,875	1,315	1,361	1,333	1,361	848	845

1 The values in the table do not reflect the minor changes that would result from application of route variations and adjustments.
2 Land cover percentages and acreages based on a 200-foot-wide representative ROW and including tensioning work sites, which typically extend outside the transmission line ROW. See Section 3.10 for discussion of source data quality and limitations. Percentages may not sum to 100 due to rounding error.
GIS Data Source: Jin et al. (2013)

3.9.6.3.2.1.1.2 Alternative Route 1-B

HVDC Alternative Route 1-B parallels the corresponding links of the Applicant Proposed Route to the north at a distance of up to approximately 7 miles. HVDC Alternative Route 1-B is shorter (by 1.97 miles) than the corresponding links of the Applicant Proposed Route, but it traverses similar terrain. Information on file with state and federal agencies shows similar numbers of inventoried archaeological sites and historic buildings and structures (Table 3.9-19). Neither contains identified NRHP-listed or -eligible properties. The alternative route appears to cross more cultivated crops than the Applicant Proposed Route (Table 3.9-20), which may indicate that existing access is somewhat better for the alternative.

Given the small difference in length between the two routes and the detail of the available information, the likely number of historic and cultural resources in HVDC Alternative Route 1-B is similar to the estimated low to moderate frequencies of the corresponding links of the Applicant Proposed Route.

3.9.6.3.2.1.1.3 Alternative Route 1-C

HVDC Alternative Route 1-C parallels the Applicant Proposed Route to the north at distances of up to approximately 7 miles. HVDC Alternative Route 1-C is shorter (by 1.80 miles) than the corresponding links of the Applicant Proposed Route, but it similar terrain. Information on file with state and federal agencies shows a non-substantial difference in the number of inventoried archaeological sites and a similar number of inventoried historic buildings and structures (Table 3.9-19). Neither contains identified NRHP-listed or -eligible properties. The alternative route appears to cross more cultivated crops than the Applicant Proposed Route (Table 3.9-20), which may indicate that existing access is somewhat better for the alternative.

Given the small difference in length between the two routes and the available information, the potential for HVDC Alternative Route 1-C to contain cultural resources is similar to the estimated low to moderate frequencies of the corresponding links of the Applicant Proposed Route.

3.9.6.3.2.1.1.4 Alternative Route 1-D

HVDC Alternative Route 1-D parallels the Applicant Proposed Route to the south by approximately 0.5 mile. HVDC Alternative Route 1-D is approximately the same length (shorter by just 0.12 mile) as the corresponding links of the Applicant Proposed Route and traverses the same terrain. Information on file with state and federal agencies shows the same number of inventoried archaeological sites and a non-substantial difference in the number of inventoried historic buildings and structures (Table 3.9-19). Neither contains identified NRHP-listed or -eligible properties. Land cover appears similar between the two routes (Table 3.9-20).

Given the small difference in length between the two routes and the available information, the potential for HVDC Alternative Route 1-D to contain cultural resources is similar to the estimated low to moderate frequencies of the corresponding links of the Applicant Proposed Route.

3.9.6.3.2.1.2 Region 2

3.9.6.3.2.1.2.1 Alternative Route 2-A

HVDC Alternative Route 2-A parallels the Applicant Proposed Route to the north at a distance of up to approximately 11 miles. HVDC Alternative Route 2-A is longer (by 2.74 miles) than the corresponding link of the Applicant Proposed Route. The alternative route traverses similar terrain to that of the Applicant Proposed Route, but more of the alternative route is in the Cimarron River drainage and close to the river itself. The number of archaeological sites and inventoried historic buildings along HVDC Alternative Route 2-A and the Applicant Proposed Route are not substantially different (Table 3.9-21). Neither contains identified NRHP-listed or -eligible properties. Land cover between the Applicant Proposed Route and the alternative is broadly comparable, although the former appears to have both more cultivated crops and more woodland as compared to the latter (Table 3.9-22); these differences are minor and likely have little difference in terms of potential impacts to cultural resources.

Table 3.9-21:
Frequency of Previously Inventoried Historic and Cultural Resources Per Linear Mile of HVDC Alternative Route in Region 2

Length/Inventory[1]	Region 2 APR	AR 2-A		AR 2-B	
		AR	APR Link 2	AR	APR Link 3
Length (miles)	105.97	57.16	54.42	29.75	31.23
Total Archaeological Sites (n)[2]	0	2	0	0	0
Total Aboveground Historic Properties (n)[2]	0	2	0	0	0
Archaeological Sites per Mile[3]	0	0.03	0.00	0.00	0.00
Historic Properties per Mile[3]	0	0.03	0.00	0.00	0.00

1 The values in the table do not reflect the minor changes that would result from application of route variations and adjustments.
2 ROI for archaeological sites is a 1,000-foot-wide corridor; ROI for aboveground historic properties and historic routes is a 1-mile corridor.
3 Density calculations are based on statewide records available in SHPO and state archaeologist offices.
Source: Clean Line (2013)

Table 3.9-22:
Region 2 HVDC Alternative Routes—Percentage Comparison of Land Cover Groups for Assessment of Potential Project Effects on Historic and Cultural Resources

Land Cover Group[1, 2]	Region 2 APR	AR 2-A		AR 2-B	
		AR	APR Link 2	AR	APR Link 3
A (Manipulated Terrain)	39.7%	29.1%	36.3%	63.7%	63.2%
B (Open Vegetation Patterns)	50.5%	60.5%	46.4%	33.2%	34.4%
C (Closed Vegetation Pattern)	9.6%	9.9%	16.9%	2.2%	2.4%
W (Water)	0.2%	0.4%	0.4%	1.0%	0.0%
Total Acres	2,687	1,480	1,370	759	786

1 The values in the table do not reflect the minor changes that would result from application of route variations and adjustments.
2 Land cover percentages and acreages based on a 200-foot-wide representative ROW and including tensioning work sites, which typically extend outside the transmission line ROW. See Section 3.10 for discussion of source data quality and limitations. Percentages may not sum to 100 due to rounding error.
GIS Data Source: Jin et al. (2013)

The relatively small difference in length between the two routes and the available information suggest that the potential for HVDC Alternative Route 2-A to contain cultural resources is similar to the estimated low frequencies of the Applicant Proposed Route. However, the proximity of the roughly 13.6-mile section of HVDC Alternative Route 2-A, approximately 1.0 to 2.5 miles from the Cimarron River, may slightly increase the overall cultural resources sensitivity or potential of this route as compared to the corresponding link of the Applicant Proposed Route.

3.9.6.3.2.1.2.2 Alternative Route 2-B

HVDC Alternative Route 2-B parallels the Applicant Proposed Route to the north for up to approximately 3.5 miles. HVDC Alternative Route 2-B is shorter (by 1.48 miles) than the corresponding link of the Applicant Proposed Route, but it traverses similar terrain. Information on file with state and federal agencies shows no cultural resources have been recorded along the Applicant Proposed Route or HVDC Alternative Route 2-B (Table 3.9-21). Land cover along the Applicant Proposed Route and along the alternative is highly similar (Table 3.9-22).

Given the small difference in length between the two routes the similarity in land cover, and the available information the potential for HVDC Alternative Route 2-B to contain cultural resources is similar to the estimated low frequencies of the corresponding link of the Applicant Proposed Route.

3.9.6.3.2.1.3 Region 3

3.9.6.3.2.1.3.1 Alternative Route 3-A

HVDC Alternative Route 3-A parallels the Applicant Proposed Route to the northeast for up to approximately 7.5 miles. HVDC Alternative Route 3-A is shorter (by 2.41 miles) than the corresponding link of the Applicant Proposed Route, but it traverses similar terrain. Information on file with state and federal agencies shows no cultural resources have been recorded along the Applicant Proposed Route or HVDC Alternative Route 3-A (Table 3.9-23). There are strong similarities between the land cover of both (Table 3.9-24).

Given the small difference in length between the two routes the similarity in land cover, and the available information, the potential for HVDC Alternative Route 3-A to contain cultural resources is similar to the estimated low frequencies of the corresponding link of the Applicant Proposed Route.

Table 3.9-23:
Frequency of Previously Inventoried Historic and Cultural Resources Per Linear Mile of HVDC Alternative Route in Region 3

		AR 3-A		AR 3-B		AR 3-C		AR 3-D		AR 3-E	
Length/Inventory[1]	Region 3 APR	AR	APR Link 1	AR	APR Links 1, 2, 3	AR	APR Links 3, 4, 5, 6	AR	APR Links 5, 6	AR	APR Link 6
Length (miles)	161.69	37.61	40.02	47.73	49.92	121.63	118.56	39.33	35.08	8.49	7.74
Total Archaeological Sites (n)[2]	2	0	0	1	0	5	2	1	1	0	0
Total Aboveground Historic Properties (n)[2]	20	0	0	0	0	2	2	2	0	0	0
Archaeological Sites per Mile[3]	0.01	0.00	0.00	0.02	0.00	0.04	0.02	0.03	0.03	0.00	0.00
Historic Properties per Mile[3]	0.01	0.00	0.00	0.00	0.00	0.02	0.02	0.05	0.00	0.00	0.00

1 The values in the table do not reflect the minor changes that would result from application of route variations and adjustments.
2 ROI for archaeological sites is a 1,000-foot-wide corridor; ROI for aboveground historic properties and historic routes is a 1-mile corridor.
3 Density calculations are based on statewide records available in SHPO and state archaeologist offices.
Source: Clean Line (2013)

As described in Appendix M and summarized in Section 2.4.2.3, a route adjustment was developed for HVDC Alternative Route 3-A to maintain an end-to-end route with Applicant Proposed Route Link 1, Variation 2, and Links 1 and 2, Variation 1. Compared to HVDC Alternative Route 3-A, the route adjustment parallels more parcel boundaries and crosses less pasture/hay and agricultural land, but overall its setting is similar to the original route analyzed in the Draft EIS. There are no recorded historic or cultural resources in the ROI for this route adjustment (Appendix M). The route adjustment is illustrated in Exhibit 1 of Appendix M.

Table 3.9-24:
Region 3 HVDC Alternative Routes—Percentage Comparison of Land Cover Groups for Assessment of Potential Project Effects on Historic and Cultural Resources

		AR 3-A		AR 3-B		AR 3-C		AR 3-D		AR 3-E	
Land Cover Group[1, 2]	Region 3 APR	AR	APR Link 1	AR	APR Links 1, 2, 3	AR	APR Links 3, 4, 5, 6	AR	APR Links 5, 6	AR	APR Link 6
A (Manipulated Terrain)	13.2%	22.8%	27.3%	21.2%	25.9%	8.2%	8.5%	9.3%	4.5%	4.1%	5.6%
B (Open Vegetation Patterns)	58.2%	54.9%	48.6%	58.6%	50.1%	61.8%	60.8%	70.5%	75.9%	59.1%	50.1%
C (Closed Vegetation Pattern)	28.3%	21.5%	23.7%	19.5%	23.7%	29.7%	30.4%	19.8%	19.4%	35.6%	44.2%
W (Water)	0.3%	0.8%	0.4%	0.6%	0.3%	0.3%	0.3%	0.4%	0.3%	1.2%	0.1%
Total Acres	4,328	959	1,060	1,251	1,336	3,188	3,183	1,041	949	233	214

1 The values in the table do not reflect the minor changes that would result from application of route variations and adjustments.
2 Land cover percentages and acreages based on a 200-foot-wide representative ROW and including tensioning work sites, which typically extend outside the transmission line ROW. See Section 3.10 for discussion of source data quality and limitations. Percentages may not sum to 100 due to rounding error.
GIS Data Source: Jin et al. (2013)

3.9.6.3.2.1.3.2 Alternative Route 3-B

HVDC Alternative Route 3-B parallels the Applicant Proposed Route to the northeast for up to approximately 7.5 miles. HVDC Alternative Route 3-A is shorter (by 2.19 miles) than the corresponding links of the Applicant Proposed Route, but it traverses similar terrain. Information on file with state and federal agencies shows a non-substantial difference in the number of inventoried archaeological sites. Neither contains any inventoried historic buildings or structures (Table 3.9-23). There are strong similarities between the land cover of the Applicant Proposed Route and that of the alternative (Table 3.9-24).

Given the small difference in length between the two routes the similarity in land cover, and the available information, the potential for HVDC Alternative Route 3-B to contain cultural resources is similar to the estimated low frequencies of the corresponding links of the Applicant Proposed Route.

3.9.6.3.2.1.3.3 Alternative Route 3-C

HVDC Alternative Route 3-C parallels the Applicant Proposed Route to the southwest for up to approximately 9.25 miles. HVDC Alternative Route 3-C is longer (by 3.07 miles) than the corresponding links of the Applicant Proposed Route, but it traverses similar terrain with similar land cover (Table 3.9-24). Information on file with state and federal agencies shows a non-substantial difference in the number of inventoried archaeological sites (Table 3.9-23). Both cross the historic U.S. Route 66 corridor about 5.3 miles west-southwest of Bristow. No inventoried cultural resources are associated with the historic highway in the vicinity of this intersection. HVDC Alternative Route 3-C passes within approximately 0.10 to 0.29 mile of two NRHP-listed properties, one of which is also an NHL:

- Oktaha School, Muskogee County, Oklahoma (NRHP) (within 0.29 mile)
- Honey Springs Battlefield, MacIntosh and Muskogee Counties, Oklahoma (NRHP/NHL) (within 0.10 mile)

Depending on local terrain and vegetation and the size and design of Project structures in the vicinity of these properties, construction of HVDC Alternative Route 3-C could result in visual impacts if it substantially alters the historic setting of one or both of these properties. Therefore, given the available background information, HVDC Alternative Route 3-C has a higher potential to cause construction-related Project impacts than the corresponding links of the Applicant Proposed Route. Aside from potential Project impacts associated with the two NRHP-listed properties, the overall potential for HVDC Alternative Route 3-C to contain historic and cultural resources is similar to the estimated moderate impact potential of the corresponding links of the Applicant Proposed Route, given the modest difference in length between the two routes and the available information.

3.9.6.3.2.1.3.4 Alternative Route 3-D

HVDC Alternative Route 3-D parallels the Applicant Proposed Route to the south for approximately 9 miles. HVDC Alternative Route 3-D is longer (by 4.25 miles) than the corresponding links of the Applicant Proposed Route, but it traverses similar terrain with similar land cover (Table 3.9-24). Information on file with state and federal agencies shows the same number of inventoried archaeological sites. Two historic buildings or structures have been inventoried within the ROI for HVDC Alternative Route 3-D, which is similar to the absence of inventoried historic buildings and structures along the corresponding links of the Applicant Proposed Route (Table 3.9-23). HVDC Alternative Route 3-D passes within approximately 0.10 to 0.29 mile of two NRHP-listed properties, one of which is also an NHL:

- Oktaha School, Muskogee County, Oklahoma (NRHP) (within 0.29 mile)
- Honey Springs Battlefield, MacIntosh and Muskogee Counties, Oklahoma (NRHP/NHL) (within 0.10 mile)

Depending upon local terrain and vegetation and the size and design of Project structures in the vicinity of these properties, construction of HVDC Alternative Route 3-D could result in visual impacts if it substantially alters the historic setting of one or both of these properties. Therefore, given the available information, HVDC Alternative Route 3-D has a higher potential to cause construction-related Project impacts than the corresponding links of the Applicant Proposed Route. Aside from potential Project impacts associated with the two NRHP-listed properties, the overall potential for HVDC Alternative Route 3-D to contain historic and cultural resources is similar to the estimated moderate numbers of historic and cultural resources of the corresponding links of the Applicant Proposed Route given the modest difference in length between the two routes and the available information.

3.9.6.3.2.1.3.5 Alternative Route 3-E

HVDC Alternative Route 3-E parallels the Applicant Proposed Route up to approximately 1 mile to the south at the eastern terminus of this region. HVDC Alternative Route 3-E is longer (by 0.75 mile) than the corresponding link of the Applicant Proposed Route, but it traverses similar terrain. Information on file with state and federal agencies shows that no cultural resources have been recorded along the Applicant Proposed Route or HVDC Alternative Route 3-E (Table 3.9-23). There are strong similarities between the land cover of the Applicant Proposed Route and that of the alternative (Table 3.9-24).

Given the small difference in length between the two routes and the similarity in land cover, the potential for HVDC Alternative Route 3-E to contain historic and cultural resources is similar to that of the corresponding link of the Applicant Proposed Route.

3.9.6.3.2.1.4 Region 4

3.9.6.3.2.1.4.1 Alternative Route 4-A

HVDC Alternative Route 4-A parallels the Applicant Proposed Route to the north for approximately 5.75 miles. HVDC Alternative Route 4-A is shorter (by 1.98 miles) than the corresponding links of the Applicant Proposed Route and traverses somewhat more rugged terrain across the foothills of the Brush Mountains, part of the Boston Mountains region. Information on file with state and federal agencies shows that fewer archaeological sites have been inventoried in the area of HVDC Alternative Route 4-A as compared to the corresponding links of the Applicant Proposed Route, and that an equal number of buildings have been inventoried (Table 3.9-25). The alternative alignment intersects the Bell-Drane Route of the Trail of Tears north of Fort Smith-Van Buren, but no inventoried cultural resources are associated with the trail in the vicinity of this intersection. HVDC Alternative Route 4-A includes no NRHP-listed properties. The alternative route is more wooded than the corresponding links of the Applicant Proposed Route (Table 3.9-26). Wooded terrain may somewhat reduce the potential of visual effects on historic properties through vegetative screening, but also requires more ground disturbance for ROW clearing, road construction, and similar activities, increasing the possibility of effects to archaeological resources.

Table 3.9-25:
Frequency of Previously Inventoried Historic and Cultural Resources Per Linear Mile of HVDC Alternative Route in Region 4

Length/Inventory[1]	Region 4 APR	AR 4-A		AR 4-B		AR 4-C		AR 4-D		AR 4-E	
		AR	APR Links 3, 4, 5, 6	AR	APR Links 2, 3, 4, 5, 6, 7, 8	AR	APR Link 5	AR	APR Links 4, 5, 6	AR	APR Links 8, 9
Length (miles)	126.28	58.40	60.38	78.60	81.26	3.37	2.15	25.32	25.34	36.72	38.73
Total Archaeological Sites (n)[2]	20	9	19	25	19	0	0	1	9	7	1
Total Aboveground Historic Properties (n)[2]	8	2	2	4	3	0	0	3	2	3	3
Archaeological Sites per Mile[3]	0.16	0.15	0.31	0.32	0.23	0.00	0.00	0.04	0.36	0.19	0.03
Historic Properties per Mile[3]	0.05	0.03	0.03	0.05	0.04	0.00	0.00	0.12	0.08	0.08	0.08

1 The values in the table do not reflect the minor changes that would result from application of route variations and adjustments.
2 ROI for archaeological sites is a 1,000-foot-wide corridor; ROI for aboveground historic properties and historic routes is a 1-mile corridor.
3 Density calculations are based on statewide records available in SHPO and state archaeologist offices.
Source: Clean Line (2013)

Table 3.9-26:
Region 4 HVDC Alternative Routes—Percentage Comparison of Land Cover Groups for Assessment of Potential Project Effects on Historic and Cultural Resources

Land Cover Group[1, 2]	Region 4 APR	AR 4-A		AR 4-B		AR 4-C		AR 4-D		AR 4-E	
		AR	APR Links 3, 4, 5, 6	AR	APR Links 2, 3, 4, 5, 6, 7, 8	AR	APR Link 5	AR	APR Links 4, 5, 6	AR	APR Links 8, 9
A (Manipulated Terrain)	5.6%	2.7%	7.1%	3.0%	6.2%	2.8%	3.1%	3.8%	14.0%	5.7%	3.7%
B (Open Vegetation Patterns)	50.6%	44.9%	56.0%	32.5%	54.8%	28.5%	31.2%	51.7%	56.8%	49.9%	47.5%
C (Closed Vegetation Pattern)	43.6%	52.2%	36.8%	64.4%	38.9%	68.8%	65.7%	44.5%	29.0%	44.4%	48.8%
W (Water)	0.2%	0.1%	0.1%	0.2%	0.1%	0.0%	0.0%	0.0%	0.2%	0.0%	0.1%
Total Acres	3,570	1,615	1,735	2,119	2,306	108	59	740	751	1,044	1,089

1 The values in the table do not reflect the minor changes that would result from application of route variations and adjustments.
2 Land cover percentages and acreages based on a 200-foot-wide representative ROW and including tensioning work sites, which typically extend outside the transmission line ROW. See Section 3.10 for discussion of source data quality and limitations. Percentages may not sum to 100 due to rounding error.
GIS Data Source: Jin et al. (2013)

Given the rough similarity in length between the two routes and the available information, the potential for HVDC Alternative Route 4-A to contain cultural resources is approximately the same or somewhat higher as compared to the corresponding links of the Applicant Proposed Route.

3.9.6.3.2.1.4.2 Alternative Route 4-B

HVDC Alternative Route 4-B parallels the Applicant Proposed Route to the north by up to approximately 7.5 miles. HVDC Alternative Route 4-B is shorter (by 2.66 miles) than the corresponding links of the Applicant Proposed Route and traverses somewhat more rugged terrain across the foothills of the Brush Mountains, part of the Boston Mountains region. Information on file with state and federal agencies shows that more archaeological sites have been inventoried in the area of proposed HVDC Alternative Route 4-B as compared to the equivalent corresponding links of the Applicant Proposed Route, and roughly equal numbers of buildings have been inventoried (Table 3.9-25). The alternative alignment intersects the Bell-Drane Route of the Trail of Tears north of Fort Smith-Van Buren, but no inventoried cultural resources are associated with the trail in the vicinity of this intersection. HVDC Alternative Route 4-B includes no NRHP-listed properties. The alternative route is more wooded than the corresponding links of the Applicant Proposed Route (Table 3.9-26). HVDC Alternative Route 4-B includes one NRHP-listed property situated in the vicinity of Cedarville, Arkansas:

- Butterfield Overland Mail Route—Lucian Wood Road Segment, Crawford County, Arkansas

HVDC Alternative Route 4-B has the potential to cause adverse visual impacts to this property if its construction substantially alters the historic setting of the road, which is situated within approximately 0.08 mile of the ROI centerline. With effective implementation of plans and measures such as those described in Section 3.9.6.1.1, adverse effects to this property would be resolved through consultation with consulting parties to develop means of avoidance, minimization, or mitigation.

Given the rough similarity in length between the two routes and the available information, the potential for HVDC Alternative Route 4-B to contain cultural resources is approximately the same or somewhat higher as compared to the corresponding links of the Applicant Proposed Route.

3.9.6.3.2.1.4.3 Alternative Route 4-C

HVDC Alternative Route 4-C loops to the south of the Applicant Proposed Route at State Highway 59 north of Fort Smith-Van Buren up to approximately 1 mile away from the Applicant Proposed Route. This route avoids a subdivision now under development. HVDC Alternative Route 4-C is longer (by 1.22 miles) than the corresponding link of the Applicant Proposed Route, but it traverses similar terrain with similar land cover (Table 3.9-26). Information on file with state and federal agencies shows that no cultural resources have been recorded along the Applicant Proposed Route or this alternative (Table 3.9-25). The HVDC Alternative Route 4-C intersects the Bell-Drane Route of the Trail of Tears north of Fort Smith-Van Buren, but no inventoried cultural resources are associated with the trail in the vicinity of this intersection. HVDC Alternative Route 4-C includes no NRHP-listed properties.

Given the small difference in length between the two routes the similarity of land cover, and the available information, the potential for HVDC Alternative Route 4-C to contain cultural resources is similar to the estimated moderate to medium-high numbers of historic and cultural resources of the corresponding link of the Applicant Proposed Route.

3.9.6.3.2.1.4.4 Alternative Route 4-D

HVDC Alternative Route 4-D loops to the north of the Applicant Proposed Route by up to approximately 8.25 miles. HVDC Alternative Route 4-D is the same length as the corresponding links of the Applicant Proposed Route (0.02 mile shorter) but it traverses somewhat more rugged terrain across the foothills of the Brush Mountains, part of the Boston Mountains region. Information on file with state and federal agencies shows that fewer archaeological sites have been inventoried in the area of proposed HVDC Alternative Route 4-D as compared to the equivalent corresponding links of the Applicant Proposed Route, and non-substantially more buildings have been inventoried (Table 3.2-25). The alternative alignment intersects the Bell-Drane Route of the Trail of Tears north of Fort Smith-Van Buren, but no inventoried cultural resources are associated with the trail in the vicinity of this intersection. HVDC Alternative Route 4-D includes no NRHP-listed properties. The alternative route is more wooded than the corresponding links of the Applicant Proposed Route (Table 3.9-26).

Given the rough similarity in length between the two routes and the available information, the potential for HVDC Alternative Route 4-D to contain cultural resources is approximately the same or somewhat higher as compared to the corresponding links of the Applicant Proposed Route.

3.9.6.3.2.1.4.5 Alternative Route 4-E

HVDC Alternative Route 4-E parallels to the south the Applicant Proposed Route at a distance of up to approximately 4 miles. HVDC Alternative Route 4-E is shorter (2.01 miles) than the equivalent section of the Applicant Proposed Route. HVDC Alternative 4-E traverses similar terrain to the Applicant Proposed Route with similar land cover (Table 3.9-26), but is situated closer to the Arkansas River. Information on file with state and federal agencies shows that more archaeological sites have been inventoried in the area of proposed HVDC Alternative Route 4-E as compared to the corresponding links of the Applicant Proposed Route and that the two routes contain equal numbers of inventoried historic buildings and structures (Table 3.9-25). HVDC Alternative Route 4-E intersects the Bell-Drane Route of the Trail of Tears in south-central Johnson County, but no inventoried cultural resources are associated with the trail in the vicinity of this intersection.

HVDC Alternative Route 4-E includes two NRHP-listed properties situated 0.5 to 5 mile southeast of Hagarville, Arkansas:

- Lutherville School, Johnson County, Arkansas
- Munger House, Johnson County, Arkansas

HVDC Alternative Route 4-E has the potential to cause adverse visual impacts to these two properties if its construction substantially alters the historic setting of either, as they are situated within approximately 0.05 to 0.09 mile of the ROI centerline. With effective implementation of plans and measures such as those described in Section 3.9.6.1.1, adverse effects to these properties would be resolved through consultation with consulting parties to develop means of avoidance, minimization, or mitigation.

Given the rough similarity in length between the two routes and the available information, the potential for HVDC Alternative Route 4-E to contain cultural resources may be somewhat greater than that of the corresponding links of the Applicant Proposed Route.

3.9.6.3.2.1.5 Region 5

3.9.6.3.2.1.5.1 Alternative Route 5-A

HVDC Alternative Route 5-A parallels the Applicant Proposed Route to the north for up to just 0.7 mile. HVDC Alternative Route 5-A is approximately the same length (longer by 0.35 mile) as the equivalent section of the Applicant Proposed Route and traverses similar terrain. Information on file with state and federal agencies shows a non-substantial difference in the number of inventoried archaeological. Neither contains inventoried historic buildings or structures (Table 3.9-27). HVDC Alternative Route 5-A contains no identified NRHP-listed or -eligible properties. Land cover is very similar (Table 3.9-28).

Given the small difference in length between the two routes and the available information, the potential for HVDC Alternative Route 5-A to contain cultural resources is similar to that of the corresponding link of the Applicant Proposed Route.

Table 3.9-27:
Frequency of Previously Inventoried Historic and Cultural Resources Per Linear Mile of HVDC Alternative Route in Region 5

Length/Inventory[1]	Region 5 APR	AR 5-A		AR 5-B		AR 5-C		AR 5-D		AR 5-E		AR 5-F	
		AR	APR Link 1	AR	APR Links 3, 4, 5, 6	AR	APR Links 6, 7	AR	APR Link 9	AR	APR Links 4, 5, 6	AR	APR Links 5, 6
Length (miles)	112.8	12.62	12.27	70.96	67.07	9.19	9.39	21.71	20.46	36.26	33.11	22.33	18.73
Total Archaeological Sites (n)[2]	13	0	1	26	4	3	5	9	6	12	4	11	4
Total Aboveground Historic Properties (n)[2]	0	0	0	25	16	4	9	3	6	21	15	18	14
Archaeological Sites per Mile[3]	0.12	0.00	0.08	0.37	0.06	0.33	0.53	0.41	0.29	0.33	0.12	0.49	0.21
Historic Properties per Mile[3]	0.20	0.00	0.00	0.35	0.24	0.44	0.96	0.14	0.29	0.58	0.45	0.81	0.75

1 The values in the table do not reflect the minor changes that would result from application of route variations and adjustments.
2 ROI for archaeological sites is a 1,000-foot-wide corridor; ROI for aboveground historic properties and historic routes is a 1-mile corridor.
3 Density calculations are based on statewide records available in SHPO and state archaeologist offices.
Source: Clean Line (2013)

Table 3.9-28:
Region 3 HVDC Alternative Routes—Percentages Comparison of Land Cover Groups for Assessment of Potential Project Effects on Historic and Cultural Resources

Land Cover Group[1, 2]	Region 5 APR	AR 5-A		AR 5-B		AR 5-C		AR 5-D		AR 5-E		AR 5-F	
		AR	APR Link 1	AR	APR Links 3, 4, 5, 6	AR	APR Links 6, 7	AR	APR Link 9	AR	APR Links 4, 5, 6	AR	APR Links 5, 6
A (Manipulated Terrain)	9.6%	3.0%	2.3%	5.2%	5.1%	3.0%	3.8%	23.8%	34.7%	6.9%	5.4%	8.1%	6.6%
B (Open Vegetation Patterns)	32.7%	23.4%	24.9%	48.5%	40.8%	38.7%	32.4%	10.7%	20.9%	48.7%	46.2%	42.4%	33.9%
C (Closed Vegetation Pattern)	57.3%	73.6%	72.8%	46.3%	53.8%	58.1%	63.6%	64.3%	43.7%	44.4%	48.4%	49.5%	59.5%
W (Water)	0.3%	0.0%	0.0%	0.1%	0.3%	0.2%	0.2%	1.2%	0.7%	0.0%	0.0%	0.0%	0.0%
Total Acres	3,051	374	341	1,953	1,796	279	262	619	551	973	884	597	488

1 The values in the table do not reflect the minor changes that would result from application of route variations and adjustments.
2 Land cover percentages and acreages based on a 200-foot-wide representative ROW and including tensioning work sites, which typically extend outside the transmission line ROW. See Section 3.10 for discussion of source data quality and limitations. Percentages may not sum to 100 due to rounding error.
GIS Data Source: Jin et al. (2013)

3.9.6.3.2.1.5.2 Alternative Route 5-B

HVDC Alternative Route 5-B parallels the Applicant Proposed Route to the south by up to approximately 3.5 miles. HVDC Alternative Route 5-B is longer (by 3.89 miles) than the equivalent section of the Applicant Proposed Route, but it traverses similar terrain with generally comparable land cover (Table 3.9-28). Information on file with state and federal agencies shows that substantially more archaeological sites and historic buildings and structures have been inventoried in the area of proposed HVDC Alternative Route 5-B as compared to the equivalent segment of the Applicant Proposed Route (Table 3.9-27). HVDC Alternative Route 5-B includes two NRHP-listed properties:

- Charlie Hall House, Damascus vicinity, Faulkner County, Arkansas
- New Mount Pisgah School, Letona vicinity, White County, Arkansas

Both properties could be subject to visual impacts from Project construction if it substantially alters their historical setting. The Hall House is less than 500 feet south of the ROI centerline for HVDC Alternative Route 5-B, while the New Mount Pisgah School is approximately 0.29 mile north of the ROI centerline for the alternative. The equivalent corresponding links of the Applicant Proposed Route do not contain NRHP-listed properties. With effective implementation of plans and measures such as those described in Section 3.9.6.1.1, adverse effects to this property would be resolved through consultation with consulting parties to develop means of avoidance, minimization, or mitigation.

The available information appears to indicate that construction-related impacts are more likely to occur from HVDC Alternative Route 5-B than from the corresponding links of the Applicant Proposed Route.

As described in Appendix M and summarized in Section 2.4.2.5, a route adjustment was developed for HVDC Alternative Route 5-B to maintain an end-to-end route with Applicant Proposed Route Links 2 and 3, Variation 1. The route adjustment crosses more agricultural land and less forest land, but the setting is similar overall to the original HVDC Alternative Route 5-B analyzed in the Draft EIS. There are no recorded historic or cultural resources in the ROI for this route adjustment (Appendix M). The route adjustment is illustrated in Exhibit 1 of Appendix M.

3.9.6.3.2.1.5.3 Alternative Route 5-C

HVDC Alternative Route 5-C loops to the northwest of the Applicant Proposed Route for up to approximately 1.9 miles. HVDC Alternative Route 5-A is approximately the same length (shorter by 0.2 mile) as the equivalent section of the Applicant Proposed Route and traverses similar terrain, with similar land cover (Table 3.9-28). Information on file with state and federal agencies shows a non-substantial difference in the number of inventoried archaeological sites and inventoried historic buildings and (Table 3.9-27). In addition, one property in the ROI of HVDC Alternative Route 5-C, located in the vicinity of Letona, Arkansas, is listed on the NRHP:

- Wesley Marsh House, White County, Arkansas

The property is located about 0.34 mile from the centerline of the alternative and could be subject to visual impacts from the construction of the proposed HVDC transmission line, if construction substantially alters the property's historic setting. Given the small difference in length between the two routes and available information, the potential for HVDC Alternative Route 5-C to contain cultural resources is similar to that of the corresponding links of the Applicant Proposed Route.

3.9.6.3.2.1.5.4 Alternative Route 5-D

HVDC Alternative Route 5-D parallels the Applicant Proposed Route to the north at a distance of up to approximately 3 miles. HVDC Alternative Route 5-D is longer (by 1.25 miles) than the corresponding link of the Applicant Proposed Route, but it traverses similar terrain. Information on file with state and federal agencies shows a non-substantial difference in the number of inventoried archaeological sites and inventoried historic buildings and structures (Table 3.9-27). HVDC Alternative Route 5-D contains no identified NRHP-listed or -eligible properties. The alternative route is more wooded than the corresponding links of the Applicant Proposed Route (Table 3.9-28).

Given the small difference in length between the two routes and the available information, the potential for HVDC Alternative Route 5-D to contain cultural resources is similar to that of the corresponding link of the Applicant Proposed Route. However, the somewhat more extensive woodland cover of the alternative route possibly indicates an increased potential for construction-related impacts to archaeological resources.

3.9.6.3.2.1.5.5 Alternative Route 5-E

HVDC Alternative Route 5-E parallels the Applicant Proposed Route to the south at a distance of up to approximately 3.5 miles. HVDC Alternative Route 5-E is longer (by 3.15 miles) than the corresponding links of the Applicant Proposed Route, but it traverses similar terrain, with generally similar land cover (Table 3.9-28). Information on file with state and federal agencies shows a non-substantial difference in the number of inventoried archaeological and inventoried historic buildings and structures (Table 3.9-27). HVDC Alternative Route 5-E contains one NRHP-listed property, located in the vicinity of Letona, Arkansas:

- New Mount Pisgah School, White County, Arkansas

The property, situated 0.29 mile from the centerline of the alternative route's ROI could be subject to visual impacts from the proposed HVDC transmission line, if construction substantially alters its historic setting. The corresponding links of the Applicant Proposed Route ROI also includes this NRHP-listed property. With effective implementation of plans and measures such as those described in Section 3.9.6.1.1, adverse effects to this property would be resolved through consultation with consulting parties to develop means of avoidance, minimization, or mitigation.

Given the small difference in length between the two routes and the available information, the potential for HVDC Alternative Route 5-E to cause construction-related adverse effects to cultural resources appears to be similar or somewhat greater than the potential of the corresponding links of the Applicant Proposed Route.

As described in Appendix M and summarized in Section 2.4.2.5, a route variation was developed for HVDC Alternative Route 5-E in response to comments on the Draft EIS to maintain continuity with Applicant Proposed Route Links 3 and 4, Variation 2. The route adjustment crosses more forest land and less pasture/hay and agricultural land, but the setting is similar overall to the original HVDC Alternative Route 5-E analyzed in the Draft EIS. There are no recorded historic or cultural resources in the ROI for this route adjustment (Appendix M). The route adjustment is illustrated in Exhibit 1 of Appendix M.

3.9.6.3.2.1.5.6 Alternative Route 5-F

HVDC Alternative Route 5-F loops south of the Applicant Proposed Route at a distance of up to approximately 3.5 miles. HVDC Alternative Route 5-F is longer (by 3.6 miles) than the corresponding links of the Applicant Proposed Route, but it traverses similar terrain. Information on file with state and federal agencies shows a non-substantial difference in the number of inventoried archaeological sites and inventoried historic buildings and structures (Table 3.9-27). HVDC Alternative Route 5-E contains one NRHP-listed property, located in the vicinity of Letona, Arkansas:

- New Mount Pisgah School, White County, Arkansas

The property, situated 0.29 mile from the centerline of the alternative route's ROI could be subject to visual impacts from the proposed HVDC transmission line if construction substantially alters its historic setting. With effective implementation of plans and measures such as those described in Section 3.9.6.1.1, adverse effects to this property would be resolved through consultation with consulting parties to develop means of avoidance, minimization, or mitigation. The corresponding links of the Applicant Proposed Route ROI also includes this NRHP-listed property. Comparison of land cover groups suggests that the alternative route traverses a somewhat more open landscape than the corresponding links of the Applicant Proposed Route (Table 3.9-28).

On balance, given the modest differences in length and land cover between the two routes and the available information, the potential for HVDC Alternative Route 5-F to contain cultural resources is likely roughly similar to that of the corresponding links of the Applicant Proposed Route.

3.9.6.3.2.1.6 Region 6

3.9.6.3.2.1.6.1 Alternative Route 6-A

HVDC Alternative Route 6-A parallels the Applicant Proposed Route to the south for up to approximately 2.1 miles. HVDC Alternative Route 6-A is shorter (by 1.48 miles) than the corresponding links of the Applicant Proposed Route, but it traverses similar terrain. Information on file with state and federal agencies shows a non-substantial difference in the number of inventoried archaeological sites and the same number of inventoried historic buildings and structures (Table 3.9-29). Like the Applicant Proposed Route, HVDC Alternative Route 6-A contains no identified NRHP-listed or -eligible properties. Both routes almost entirely traverse cultivated crops (Table 3.9-30).

Given the small difference in length between the two routes and the available information, the potential for HVDC Alternative Route 6-A to contain cultural resources is similar to that of the corresponding links of the Applicant Proposed Route.

As described in Appendix M and summarized in Section 2.4.2.6, a route adjustment was developed for HVDC Alternative Route 6-A to maintain an end-to-end route with Applicant Proposed Route Link 2, Variation 1. The route cuts off the western end of HVDC Alternative Route 6-A, which is taken over by Link 2, Variation 1. The route adjustment is reported to contain one cemetery of unknown age and significance (Appendix M). It is otherwise identical to the original Alternative Route 6-A, so adoption of this route adjustment would not alter the Draft EIS analysis of the alternative. The route adjustment is illustrated in Exhibit 1 of Appendix M.

Table 3.9-29:
Frequency of Previously Inventoried Historic and Cultural Resources Per Linear Mile of HVDC Alternative Route in Region 6

Length/Inventory[1]	Region 6 APR	AR 6-A		AR 6-B		AR 6-C		AR 6-D	
		AR	APR Links 2, 3, 4	AR	APR Link 3	AR	APR Links 6, 7	AR	APR Link 7
Length (miles)	54.36	16.18	17.66	14.11	9.61	23.12	24.80	9.15	8.57
Total Archaeological Sites (n)[2]	5	1	0	3	0	5	5	0	1
Total Aboveground Historic Properties (n)[2]	0	1	1	2	1	0	0	0	0
Archaeological Sites per Mile[3]	0.09	0.06	0.00	0.21	0.00	0.22	0.20	0.00	0.12
Historic Properties per Mile[3]	0.02	0.06	0.06	0.14	0.10	0.00	0.00	0.00	0.00

1 The values in the table do not reflect the minor changes that would result from application of route variations and adjustments.
2 ROI for archaeological sites is a 1,000-foot-wide corridor; ROI for aboveground historic properties and historic routes is a 1-mile corridor.
3 Density calculations are based on statewide records available in SHPO and state archaeologist offices.
Source: Clean Line (2013)

Table 3.9-30:
Region 6 HVDC Transmission Line Alternative Routes—Percentage Comparison of Land Cover Groups for Assessment of Potential Project Effects on Historic and Cultural Resources

Land Cover Group[1, 2]	Region 6 APR	AR 6-A		AR 6-B		AR 6-C		AR 6-D	
		AR	APR Links 2, 3, 4	AR	APR Link 3	AR	APR Links 6, 7	AR	APR Link 7
A (Manipulated Terrain)	85.8%	88.4%	94.8%	85.2%	92.7%	79.4%	74.2%	92.7%	94.1%
B (Open Vegetation Patterns)	0.4%	0.0%	0.0%	0.5%	0.0%	4.0%	0.9%	0.0%	0.2%
C (Closed Vegetation Pattern)	13.0%	6.0%	4.1%	12.9%	6.1%	12.8%	24.2%	6.4%	3.9%
W (Water)	0.9%	5.6%	1.1%	1.3%	1.2%	3.8%	0.7%	0.8%	1.8%
Total Acres	1,448	458	477	376	257	616	644	241	230

1 The values in the table do not reflect the minor changes that would result from application of route variations and adjustments.
2 Land cover percentages and acreages based on a 200-foot-wide representative ROW and including tensioning work sites, which typically extend outside the transmission line ROW. See Section 3.10 for discussion of source data quality and limitations. Percentages may not sum to 100 due to rounding error.

GIS Data Source: Jin et al. (2013)

3.9.6.3.2.1.6.2 Alternative Route 6-B

HVDC Alternative Route 6-B loops north up to approximately 3.5 miles from the Applicant Proposed Route. HVDC Alternative Route 6-B is longer (by 4.5 miles) than the corresponding link of the Applicant Proposed Route, but it traverses similar terrain. Information on file with state and federal agencies shows a non-substantial difference in the number of inventoried archaeological sites and inventoried historic buildings and structures (Table 3.9-29). Neither contains identified NRHP-listed or -eligible properties. Both routes almost entirely traverse cultivated crops (Table 3.9-30).

Given the small difference in length between the two routes and the available information, the potential for HVDC Alternative Route 6-B to contain cultural resources is similar to that of the corresponding link of the Applicant Proposed Route.

3.9.6.3.2.1.6.3 Alternative Route 6-C

HVDC Alternative Route 6-C parallels the Applicant Proposed Route to the south for up to approximately 2.7 miles. HVDC Alternative Route 6-C is shorter (by 1.68 miles) than the corresponding links of the Applicant Proposed Route, but it traverses similar terrain. Information on file with state and federal agencies shows an identical number of inventoried archaeological sites and inventoried historic buildings and structures for HVDC Alternative Route 6-C as compared to the corresponding links of the Applicant Proposed Route (Table 3.9-29). Neither contains identified NRHP-listed or -eligible properties. HVDC Alternative Route 6-C traverses somewhat more open terrain than the Applicant Proposed Route, of which approximately one-quarter is situated in woodland (Table 3.9-30).

Given the small differences in length and land cover between the two routes, the potential for HVDC Alternative Route 6-C to contain cultural resources is similar or less than the potential of the corresponding links of the Applicant Proposed Route.

3.9.6.3.2.1.6.4 Alternative Route 6-D

HVDC Alternative Route 6-D parallels the Applicant Proposed Route approximately 1 mile to the northwest. HVDC Alternative Route 6-C is approximately the same length (longer by 0.58 mile) than the corresponding link of the Applicant Proposed Route, but it traverses similar terrain. Information on file with state and federal agencies shows a non-substantial difference in the number of inventoried archaeological sites and no inventoried historic buildings or structures (Table 3.9-29). Neither contains identified NRHP-listed or -eligible properties. Both routes almost entirely traverse cultivated crops (Table 3.9-30).

Given the small difference in length between the two routes and the available information, the potential for HVDC Alternative Route 6-D to contain cultural resources is similar to that of the corresponding link of the Applicant Proposed Route.

3.9.6.3.2.1.7 Region 7

3.9.6.3.2.1.7.1 Alternative Route 7-A

HVDC Alternative Route 7-A loops north up to approximately 10.5 miles from the Applicant Proposed Route and includes a separate crossing of the Mississippi River, approximately 6.75 miles upriver of the Applicant-proposed crossing. HVDC Alternative Route 7-A is longer (by 14.69 miles) than the corresponding link of the Applicant Proposed Route and traverses a greater section of Mississippi bottomland. Available Information shows a non-substantial difference in the number of inventoried archaeological sites and inventoried historic buildings and structures (Table 3.9-31). HVDC Alternative Route 7-A contains two NRHP- listed properties:

- Highway A-7 Bridges Historic District, Marked Tree vicinity, Poinsett County, Arkansas
- Nodena Site, Wilson vicinity, Mississippi County, Arkansas (NRHP/NHL)

Table 3.9-31:
Frequency of Previously Inventoried Historic and Cultural Resources Per Linear Mile of HVDC Alternative Route in Region 7

Length/Inventory[1]	Region 7 APR	AR 7-A		AR 7-B		AR 7-C		AR 7-D	
		AR	APR Link 1	AR	APR Links 3, 4	AR	APR Links 3, 4, 5	AR	APR Links 4, 5
Length (miles)	42.83	43.24	28.55	8.61	8.38	23.83	13.20	6.54	6.39
Total Archaeological Sites (n)[2]	14	7	11	2	2	13	2	2	1
Total Aboveground Historic Properties (n)[2]	0	4	0	0	0	39	40	0	40
Archaeological Sites per Mile[3]	0.33	0.16	0.39	0.23	0.24	0.55	0.15	0.31	0.16
Historic Properties per Mile[3]	0.93	0.09	0.00	0.00	0.00	1.64	3.03	0.00	6.26

1 The values in the table do not reflect the minor changes that would result from application of route variations and adjustments.
2 ROI for archaeological sites is a 1,000-foot-wide corridor; ROI for aboveground historic properties and historic routes is a 1-mile corridor.
3 Density calculations are based on statewide records available in SHPO and state archaeologist offices.
Source: Clean Line (2013)

HVDC Alternative Route 7-A intersects the Highway A-7 Bridges Historic District and is believed to pass at least 0.1 mile outside the NRHP/NHL boundaries of the Nodena Site. The HVDC transmission line would be visible from both properties. The line would span the Highway A-7 Bridge. Spanning a historic district could alter the landscape setting.

The line would not cross or span the Nodena Site, so although this route would alter the landscape setting, it would not be expected to alter it substantially.

Comparison of land cover groups suggests that the alternative route traverses a somewhat more open landscape than the corresponding link of the Applicant Proposed Route (Table 3.9-32). Based on the available information, HVDC Alternative Route 7-A appears to have an overall higher potential for impacting cultural resources than the corresponding link of the Applicant Proposed Route.

Table 3.9-32:
Region 7 HVDC Transmission Line Alternative Routes—Percentage Comparison of Land Cover Groups for Assessment of Potential Project Effects on Historic and Cultural Resources

Land Cover Group[1, 2]	Region 7 APR	AR 7-A		AR 7-B		AR 7-C		AR 7-D	
		AR	APR Link 1	AR	APR Links 3, 4	AR	APR Links 3, 4, 5	AR	APR Links 4, 5
A (Manipulated Terrain)	73.8%	88.9%	89.1%	49.6%	39.8%	66.3%	42.8%	53.5%	47.6%
B (Open Vegetation Patterns)	10.4%	0.4%	0.0%	32.4%	33.7%	21.9%	30.8%	32.4%	32.5%
C (Closed Vegetation Pattern)	13.7%	9.5%	7.5%	18.0%	26.5%	11.7%	26.4%	14.0%	19.9%
W (Water)	2.2%	1.2%	3.4%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%
Total Acres	1,221	1,218	779	264	267	691	411	190	200

1 The values in the table do not reflect the minor changes that would result from application of route variations and adjustments.
2 Land cover percentages and acreages based on a 200-foot-wide representative ROW and including tensioning work sites, which typically extend outside the transmission line ROW. See Section 3.10 for discussion of source data quality and limitations. Percentages may not sum to 100 due to rounding error.
GIS Data Source: Jin et al. (2013)

3.9.6.3.2.1.7.2 Alternative Route 7-B

HVDC Alternative Route 7-B parallels the Applicant Proposed Route to the southwest for up to approximately 1.5 miles. HVDC Alternative Route 7-B is approximately the same length (longer by 0.23 mile) as the corresponding links of the Applicant Proposed Route and traverses similar terrain. The Applicant Proposed Route appears to cross more wooded terrain than the alternative (Table 3.9-32). Information on file with state and federal agencies shows an identical number of inventoried archaeological sites and no inventoried historic buildings and structures for the HVDC Alternative Route 7-B as compared to the corresponding links of the Applicant Proposed Route (Table 3.9-31). Neither contains identified NRHP-listed or -eligible properties.

Given the small difference in length between the two routes and the available information, and the potential for HVDC Alternative Route 7-B to contain cultural resources is similar to that of the corresponding links of the Applicant Proposed Route.

3.9.6.3.2.1.7.3 Alternative Route 7-C

HVDC Alternative Route 7-C includes a portion that parallels the Applicant Proposed Route and portion that loops south of the Applicant Proposed Route by up to 4.75 miles. HVDC Alternative Route 7-C is longer (by 10.63 miles) than the corresponding links of the Applicant Proposed Route, but it traverses similar terrain. The Applicant Proposed Route appears to cross more wooded terrain than the alternative (Table 3.9-32). Information on file with state and federal agencies shows that substantially more archaeological sites have been inventoried in the area of proposed

HVDC Alternative Route 7-C as compared to the corresponding links of the Applicant Proposed Route, but that the number of inventoried historic buildings and structures is not substantially different (Table 3.9-31). Neither contains identified NRHP-listed or -eligible properties.

Given the difference in lengths between the two routes and the available information, the potential for HVDC Alternative Route 7-C to contain cultural resources appears to be somewhat greater overall than that of the corresponding links of the Applicant Proposed Route.

3.9.6.3.2.1.7.4 Alternative Route 7-D

HVDC Alternative Route 7-D loops to the north of the Applicant Proposed Route by approximately 2.7 miles. HVDC Alternative Route 7-D is approximately the same length (longer by 0.15 mile) as corresponding links of the Applicant Proposed Route and traverses similar terrain with similar land cover (Table 3.9-32). Information on file with state and federal agencies shows a non-substantial difference in the number of inventoried archaeological sites, but the number of inventoried historic buildings and structures in the Applicant Proposed Route is greater than the number for the alternative route (Table 3.9-31). Neither contains identified NRHP-listed or -eligible properties.

Given the small difference in length between the two routes and the available information, the potential for HVDC Alternative Route 7-D to contain cultural resources may be similar or somewhat less as compared to the estimated moderate potential of the corresponding links of the Applicant Proposed Route.

3.9.6.3.2.2 Operations and Maintenance Impacts

No impacts would result from the operations and maintenance activities on any of the HVDC alternative routes in Regions 1 through 7 (see Section 3.9.6.1.3).

3.9.6.3.2.3 Decommissioning Impacts

No impacts would result from decommissioning (see Section 3.9.6.1.3).

3.9.6.4 Best Management Practices

Additional BMPs are not recommended, because DOE has developed a draft PA (Appendix P) for the planning and construction phases of the Project that provides a protocol for the identification of historic and cultural resources, evaluation of their possible significance and eligibility to the NRHP, and assessment and resolution of potential Project effects, including, as appropriate and practicable, impact avoidance, minimization, and mitigation. Under the PA, DOE will require the Applicant to develop and implement plans and activities such as those described in Section 3.9.6.1.1 as needed.

3.9.6.5 Unavoidable Adverse Impacts

The Project has the potential to cause adverse impacts to historic and cultural resources in several ways. Construction could result in the loss of archaeological resources as a result of ground disturbances resulting from excavation and related actions that remove or redistribute soils and the contents of soils. The Project could also result in the loss of historic or culturally significant buildings, structures, sites, objects, or other aboveground features and properties if it is necessary to demolish, remove, or relocate them to allow construction of Project elements such as transmission towers, access roads, work and storage yards, and substations and switching stations at their locations. In addition, the Project has the potential to cause adverse impacts by altering the setting of neighboring historical and cultural resources and those spanned by the Project through the introduction of large, modernistic, visually prominent elements, such as transmission towers, and auditory effects such as noise associated with the transmission of high voltage electrical currents and the passage of wind through transmission wires and towers. Such effects would only be adverse if the setting of the resource substantively contributes to its historical or cultural character or significance. In addition, such adverse effects tend to fall off with the distance separating Project elements from the resource and vary with local terrain and vegetation. Project-specific cultural resource surveys, which will be implemented as part of the Section 106 PA, in conjunction with micrositing, would tend to diminish the number and magnitude of such impacts.

3.9.6.6 Irreversible and Irretrievable Commitment of Resources

Historic and cultural resources are nonrenewable, and adverse direct effects to these resources generally constitutes an irreversible and irretrievable commitment of resources. Any Project-related activity that results in the destruction, significant permanent alteration, removal, or relocation of a historic or cultural resource, such as the excavation of soil at an archeological site or the demolition of a building or structure within the Project ROW is irreversible and irretrievable. Some indirect adverse visual effects, such as the removal of large trees within the Project ROW, can be regarded as essentially irreversible, because they would take hundreds of years or more to be fully restored, while other visual and auditory indirect effects, such as those resulting from the presence of transmission towers and lines, persist throughout the lifespan of the Project, i.e., until Project elements are removed during decommissioning.

3.9.6.7 Relationship between Local Short-term Uses and Long-term Productivity

The impacts associated with short-term use of the environment for cultural resources would likely be minor because DOE has developed a PA that provides a protocol for the identification of historic and cultural resources, evaluation of their possible significance and eligibility to the NRHP, and assessment and resolution of potential Project effects, including, as appropriate and practicable, impact avoidance, minimization, where practicable, and mitigation. As part of the PA, DOE will require the Applicant to develop and implement plans and activities such as those described in Section 3.9.6.1.1 as needed. (The draft PA is included in Appendix P.) Long-term productivity would not be affected by short-term use of the environment for cultural resources because impacts from short-term use are expected to be minor.

3.9.6.8 Impacts from Connected Actions

3.9.6.8.1 Wind Energy Generation

The potential impacts common to all Project components (Section 3.9.6.1.1) and impacts common to construction, operations and maintenance, and decommissioning (Sections 3.9.6.1.2 and 3.9.6.1.3) apply to similar activities during wind energy generation.

The WDZs contain low densities of previously recorded prehistoric period and historic period archaeological sites (Table 3.9-12). The numbers of the previously recorded sites may reflect the lack of systematic archaeological survey within the WDZs and the region rather than the actual numbers and densities of prehistoric and historic period sites that are located within them. Most of the recorded sites have not been evaluated for their potential to be eligible to the NRHP.

Impacts to cultural resources that are potentially eligible to or listed in the NRHP could occur as a result of wind energy generation. The level of potential adverse impacts to cultural resources associated with wind energy generation would depend on the level of archaeological surveys conducted and the associated cultural resources BMPs and mitigation plans implemented by wind energy developers.

3.9.6.8.2 Optima Substation

Impacts to historic and cultural resources from construction of the future Optima Substation would be the same as described in Section 3.9.6.2.1 for the Oklahoma Converter Station and AC Interconnection Siting Areas and the common construction impacts described in Sections 3.9.6.1.1.

3.9.6.8.3 TVA Upgrades

Depending on the locations of the required TVA upgrades, ground-disturbing activities associated with upgrades to existing lines and ground-disturbing activities, tree removal, and installation of transmission structures and conductors associated with construction of the new transmission line could affect archaeological sites, historic properties, and tribal resources. The potential for adverse effects to historic properties from upgrades to already existing TVA transmission lines and substations is low. Although TVA would route the new transmission line to minimize effects on historic properties, the potential for these effects from the construction of the proposed new transmission line is greater. TVA is a signatory to the draft PA developed by DOE (Appendix P). In accordance with Section 106 of the NHPA, TVA would consult with the Tennessee SHPO on the potential effects of the new 500kV transmission line and upgrades to existing facilities. Where avoidance of adverse effects to historic properties is not practicable, TVA would, in accordance with Section 106 of the NHPA, take appropriate measures to resolve the adverse effects.

3.9.6.9 Impacts Associated with the No Action Alternative

Under the No Action Alternative, DOE assumes for analytical purposes that the Project would not be constructed. While the No Action Alternative would result in no effects to cultural resources due to Project construction, operations and maintenance, and decommissioning, it is possible that some of the archaeological sites that may be located within the areas that would be affected by the Project would never be evaluated for their potential to be eligible for the NRHP and that some potentially NRHP-eligible and listed sites would suffer degradation due to ongoing neglect, lack of managed attention, and possibly vandalism.

This page intentionally left blank.

Contents

Tables

Figures Presented in Appendix A

This page intentionally left blank.

3.10 Land Use

3.10.1 Regulatory Background

Land use laws and regulations relevant to the resources in the ROI are summarized in Table 3.10-1. Permits that may apply to the Project are discussed in further detail in Appendix C. USDA programs are discussed further in Section 3.2.1.

Table 3.10-1:
Land Use Laws and Regulations Applicable to the Project

Statute/Regulation	Agency	Applicability to the Project
Local		
City and county zoning ordinances, development regulations, and general or comprehensive plans under Arkansas Code Annotated Title 14, "Local Government"; Oklahoma Statutes Title 19, "Counties and County Officers," (Section 863.1, "City and County Planning and Zoning," through Section 863.29, "Exclusive Control by Commission"); Tennessee Statute Title 6, "Cities and Towns, Municipal Government Generally," Chapter 54, "Municipal Powers Generally," and Chapter 58, "Comprehensive Growth Plan"	Local governments (cities and counties) in Arkansas, Oklahoma, and Tennessee	May require permits for development in certain areas and determine setbacks and other requirements to protect the health, welfare, and safety of the general public.
State		
Oklahoma Administrative Code Title 385, Chapter 25	Oklahoma Commissioners of the Land Office	Lease and management of school trust lands in Oklahoma, Surface leases and other permits are designed to maximize income for the public school trust (CLO 2014).
Arkansas Code Annotated 15-20-502	Arkansas Natural Heritage Commission (ANHC)	The ANHC is granted the power to choose lands, waters, and interests to be included in the Natural Area System. The Natural Areas System preserves some of the most ecologically important areas in the state. The ANHC co-manages the Singer Forest Natural Area with the AGFC. Hunting is allowed within the Singer Forest Natural Area (ANHC 2014b). Natural areas are lands specifically managed to preserve and restore natural communities that have become rare (ANHC 2014a).
Amendment 35 to the Arkansas Constitution	Arkansas Game and Fish Commission	Approval from the AGFC would be required for construction of a transmission line through a WMA. The AGFC manages WMAs primarily for hunting (AGFC 2014).

Table 3.10-1:
Land Use Laws and Regulations Applicable to the Project

Statute/Regulation	Agency	Applicability to the Project
Federal		
United States Code Title 33, Navigation and Navigable Waters Sec. 408 (33 USC § 408)	U.S. Army Corps of Engineers (USACE)	May grant permission for the alteration or permanent occupation of public works owned by the USACE.
Multiple-Use Sustained-Yield Act of 1960, as amended (16 USC § 528 et seq.) Ozark-St. Francis National Forests' Revised Land and Resource Management Plan (USFS 2005) 36 CFR Part 251, Subpart B—Special Uses	U.S. Forest Service (USFS)	The USFS manages the National Forests for a variety of public benefits, consistent with the Multiple-Use Sustained-Yield Act and the Ozark-St. Francis National Forests' Revised Land and Resources Management Plan. A Special Use Permit would be required for a transmission line through National Forest land.
The Agricultural Act of 2014 (H.R. 2642; Pub.L. 113–79)	U.S. Department of Agriculture (USDA) Natural Resources Conservation Service	Construction of the Project on land enrolled in Wetland Reserve Program easements may require a compatible use authorization or easement modification (NRCS 2011). Refer to Table 3.2-1 for information on the Conservation Reserve Program easements managed by the USDA Farm Service Agency and Commodity Credit Corporation.
National Wildlife Refuge System Administration Act (16 USC §§ 668dd-668ee) Appropriate Refuge Uses—Policy 603 FW 1 Compatibility—Policy 603 FW 2	U.S. Fish and Wildlife Service	This act allows easements or ROWs for powerlines so long as it is determined the powerline is compatible with the purposes for which an NWR was established. This is a two-step process, first to determine compatibility and second that it is an appropriate refuge use.
25 CFR Part 169	Arkansas Riverbed Authority, Bureau of Indian Affairs	A ROW grant or easement across land managed by the Authority may be issued pursuant to regulations governing transmission line ROWs over Indian lands.

3.10.2 Data Sources

Data from the NLCD (GIS Data Source: Jin et al. 2013) were used for the desktop land use analysis. The NLCD is a 16-class categorization of land cover based on satellite imagery and provides a broad description of land cover types. In addition to the NLCD information, existing datasets for existing infrastructure and airports and aerial imagery supplemented with aerial photointerpretation and field verification were used to determine the various land uses within the ROI. GIS sources include data and maps for ArcGIS (a system for working with maps and geographic information) from Environmental Systems Research Institute, Inc. (ESRI). Ground and aerial reconnaissance by the Applicant and comments received during stakeholder outreach and the DOE scoping process supplemented the desktop information. Structure data layers were created based on ESRI 2012 data (GIS Data Source: ESRI 2013) supplemented with aerial photointerpretation and field verification surveys conducted between 2012 and 2015. Structures were categorized as agricultural, church, commercial, industrial, residential, or school (GIS Data Source: Clean Line 2015a). Conservation easement data were found in the National Conservation Easements Database (GIS Data Source: NCED 2014).

3.10.3 Region of Influence

For land use, the ROI for the Project and connected actions is the same as described Section 3.1.1.

3.10.4 Affected Environment

The majority of land in the ROI is privately owned, although some lands managed by state and federal agencies are found throughout the ROI. Table 3.10-2 summarizes the types of public land ownership by region. The ROI with the largest percentage of public land is HVDC Alternative Route 4-B in Region 4, of which 12 percent is the Ozark National Forest. Figure 3.10-1 in Appendix A shows the public land ownership in the ROI.

Several route variations to the Applicant Proposed Route in Regions 2–7 were developed in response to public comments on the Draft EIS and are described in Appendix M and summarized in Sections 2.4.2.1–2.4.2.7. Comparisons in affected environment between the Applicant Proposed Route and the route variations by Project region, including accompanying HVDC alternative route adjustments, are provided below. The variations are presented graphically in Exhibit 1 of Appendix M.

Table 3.10-2:
Public Land Ownership in the ROI

Route[1, 2]	Ownership	Acres	Percent of ROI
Region 1			
APR	State—Oklahoma School Lands	191	1.4
AR 1-A	State—Oklahoma School Lands	780	5.2
AR 1-B	State—Oklahoma School Lands	221	3.5
AR 1-C	State—Oklahoma School Lands	73	1.1
AR 1-D	State—Oklahoma School Lands	264	6.5
AC Collection System Routes			
E-1	Federal—USACE	558	1.4
	Federal—Optima National Wildlife Refuge (and WMA)	176	0.4
	State—Oklahoma School Lands	1,170	3.0
E-2	State—Oklahoma School Lands	509	1.0
	State—Schultz WMA and State Park	93	.17
	State—Shorb WMA	160	0.3
E-3	State—Oklahoma School Lands	2,005	3.7
	State—Schultz WMA and State Park	2005	3.75
NE-1	State—Oklahoma School Lands	1,963	4.9
NE-2	State—Oklahoma School Lands	1,559	4.4
NW-1	State—Oklahoma School Lands	2,591	3.8
NW-2	State—Oklahoma School Lands	1,835	2.5
SE-1	State—Oklahoma School Lands	193	0.4
	State—Schultz WMA and State Park	93	0.17

Table 3.10-2:
Public Land Ownership in the ROI

Route[1, 2]	Ownership	Acres	Percent of ROI
SE-3	State—Oklahoma School Lands	509	0.8
	State—Schultz WMA and State Park	93	0.14
	State—Shorb WMA	160	0.2
SW-2	State—Oklahoma School Lands	174	0.4
W-1	State—Oklahoma School Lands	191	0.7
Region 2			
Applicant Proposed Route	State—Oklahoma School Lands	456	3.5
AR 2-A	State—Oklahoma School Lands	123	1.8
Region 3			
Applicant Proposed Route	State—Oklahoma School Lands	430	2.2
	State—Oklahoma State University (Land Utilization Research Area)	267	1.3
	Federal—USACE (Weber Falls Lock and Dam and Reservoir Project)	12	0.1
AR 3-A	State—Oklahoma School Lands	98	2.1
	State—Oklahoma State University (Land Utilization Research Area)	64	1.4
	State—Oklahoma State University (Lake Carl Blackwell Project)	117	2.5
AR 3-B	State—Oklahoma School Lands	73	1.3
	State—Oklahoma State University (Land Utilization Research Area)	64	1.1
	State—Oklahoma State University (Lake Carl Blackwell Project)	117	2.0
AR 3-C	Federal—USACE (Webbers Falls Lock, Dam, and Reservoir)	5	0.03
	State—Oklahoma School Lands (Land Utilization Research Area)	129	0.9
AR 3-D	Federal—USACE (Webbers Falls Lock, Dam, and Reservoir)	5	0.1
AR 3-E	Federal—USACE (Webbers Falls Lock, Dam, and Reservoir)	5	0.4
Region 4			
Applicant Proposed Route	Federal—U.S. Forest Service (Ozark National Forest, portion managed as a WMA by AGFC)	88	0.6
	Federal—USACE (Webbers Falls Lock, Dam, and Reservoir)	80	0.5
	Federal—USACE (Ozark Lake WMA, managed by AGFC)	12	0.1
	State—AGFC (Frog Bayou WMA)	25	0.2
AR 4-B	Federal—U.S. Forest Service (Ozark National Forest, some land within the boundary is privately owned, a portion managed as a WMA by AGFC)	562	5.8
Region 5			
Region 5 PR	State—AGFC (Cherokee WMA, privately owned but managed by AGFC for hunting)	379	2.8
Arkansas Converter Station Siting Area	State—AGFC (Cherokee WMA, privately owned but managed by AGFC for hunting)	1,589	7.3
	State—AGFC (Rainey WMA)	485	2.2
Representative AR Interconnect	State—AGFC (Cherokee WMA, privately owned but managed by AGFC for hunting)	81	0.8
	State—AGFC (Rainey WMA)	136	1.4
Region 6			
Applicant Proposed Route	State—Arkansas Game and Fish Commission (Singer Forest Natural Area easement, managed by AGFC but owned by the ANHC)	11	0.2

Table 3.10-2:
Public Land Ownership in the ROI

Route[1, 2]	Ownership	Acres	Percent of ROI
	State—AGFC (St. Francis Sunken Lands WMA, primarily owned by AGFC but a portion owned by USACE)	10	0.1
Region 7			
	City of Millington, TN (Aycock Park)	—[3]	—[3]

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
2 Only regions and alternatives with public land are included in the table.
3 No electronic data were available for the municipally owned Aycock Park in Region 7.
GIS Data Sources: USFWS (2014a), USFS (2014a, 2014b), AHDT (2006c), OSU (2003), TPWD (2012), TWRA (2007)

This section summarizes the existing land uses in the ROI. Land cover is discussed, followed by a qualitative description of the primary land uses found in the ROI including agriculture, transportation/utility, airports, commercial, industrial, public land and easements, parks and recreational/natural areas, residential, tribal land, and planned development. Figure 3.10-2 in Appendix A illustrates the structures and infrastructure in the ROI.

Table 3.10-3 summarizes the percentage of each USGS 2011 NLCD classification within the ROI (GIS Data Source: Jin et al. 2013). Multiple land uses can occur within each land cover type. Grassland/herbaceous is the dominant land cover, constituting almost half of the ROI. Cultivated crops account for approximately 26.9 percent of land cover in the ROI (Table 3.10-2). Figure 3.10-3 in Appendix A illustrates the land cover in the ROI.

Table 3.10-3:
Land Cover in the ROI

Land Cover[1]	Acres	Percent
Barren Land (Rock/Sand/Clay)	549.4	0.1
Cultivated Crops	174,853.8	26.9
Deciduous Forest	37,227.4	5.7
Developed, High Intensity	42.4	0.0
Developed, Low Intensity	1,471.4	0.2
Developed, Medium Intensity	377.6	0.1
Developed, Open Space	28,951.3	4.4
Emergent Herbaceous Wetlands	545.0	0.1
Evergreen Forest	19,108.6	2.9
Grassland/Herbaceous	314,840.4	48.4
Mixed Forest	5,841.6	0.9
Open Water	1,661.5	0.3
Pasture/Hay	37,988.8	5.8
Shrub/Scrub	24,213.4	3.7
Woody Wetlands	2,997.4	0.5
Total	650,670.0	100.0

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
Source: Jin et al. (2013)

3.10.4.1 Agriculture

Agriculture is the predominant land use in the ROI. In Region 1 (including the AC Collection System Routes) and Region 2, rangeland/pasture is the primary type of agriculture, whereas cultivated crops are more prevalent in Regions 6 and 7 (Figure 3.10-3 in Appendix A). Agricultural structures found in the ROI include concentrated animal feeding operations, barns, and silos, which are distributed throughout the ROI. Center-pivot and mechanically irrigated agricultural fields are predominantly located in western and central Oklahoma and northern Texas. Center-pivot agricultural fields are also dispersed throughout eastern Arkansas. Precision-graded, flood-irrigated agricultural fields, such as those used for rice farming, are predominantly located west and east of the Mississippi River in Arkansas and Tennessee. Agriculture is discussed in greater detail in Section 3.2.

3.10.4.2 Transportation/Utility

Existing infrastructure in the ROI includes roadways, airports, heliports, and airstrips, electrical transmission lines, oil and gas pipelines, railroads, and communication towers. Fifty-two airports, heliports, and airstrips are located throughout the ROI (Figure 3.10-2 in Appendix A). Communication towers are illustrated on Figure 3.10-4 in Appendix A. Subsurface utilities, such as electrical distribution lines, water lines, cables, and telephone lines, are also located throughout the ROI. The linear components of the Project would be located parallel to existing infrastructure such as transmission lines, oil and gas pipelines, and roadways to the extent practicable

The ROI crosses reservoirs that are managed by the USACE along the McClellan-Kerr Arkansas River Navigation System, which provides for barge navigation on the Arkansas River and some of its tributaries. The USACE maintains the locks and navigation system of the Robert S. Kerr Lake and Webbers Falls Reservoir in Regions 3 and 4.

3.10.4.3 Commercial

Commercial land uses are scattered throughout the ROI, but they are generally sparse, given the rural character of the majority of the ROI. Commercial land uses are generally located at intersection of roadways or along major roadways such as Highway 77 near Stillwater, Oklahoma, in Region 3 and in Millington, Tennessee, in Region 7.

3.10.4.4 Industrial

The primary industrial land use in the ROI is oil and gas development and related industries. Oil and gas wells and their appurtenant facilities are very common throughout the ROI in Regions 4 and 5. Three large aboveground compressor stations associated with oil and gas production and distribution are found in the ROI: within the Applicant Proposed Route in Region 5; within the HVDC Alternative Route 1-B in Region 2, and within HVDC Alternative Route 5-B in Region 5. Additionally, there is a large oil storage facility south of Cushing, Oklahoma, crossed by the ROI in Region 3.

3.10.4.5 Public Land and Easements

Publicly owned or managed resources in the ROI include the Ozark National Forest, school trust lands (primarily leased for either oil and gas development or agriculture), WMAs, a state natural area, land and a lake owned by Oklahoma State University, and a NWR, and wetland easements held by the NRCS (NRCS 2014). Additionally, the Arkansas River south of Webbers Falls Lock and Dam 16 in Region 4 is managed by the USACE and is located in the Applicant Proposed Route (Figure 3.10-1 in Appendix A). There is a scenic overlook near the lock, and Webbers

Falls Reservoir is publicly accessible for recreational uses such as boating and fishing. These public lands are discussed in further detail by region in Section 3.10.5.

3.10.4.6 Parks and Recreational/Natural Areas

Recreational resources located in the ROI include WMAs, national forest lands, and local parks. There are no federal or state parks in the ROI. Although there are some municipal parks located near the ROI, they are not very common given the rural character of the majority of the ROI.

Recreational areas and uses are described in greater detail in Section 3.12.

3.10.4.7 Residential

The ROI is predominantly rural and the primary type of residence found in the ROI consists of single-family residences on large lots, generally surrounded by agricultural land uses. These residences are widely dispersed throughout the ROI. Higher density residential developments are found in and around cities and towns. The number of residences found within the ROI by region and alternate route is discussed in Section 3.10.5.

3.10.4.8 Community Resources (Schools and Churches)

Given the primarily rural nature of the ROI, schools and churches are the primary type of land use other than residences where people congregate. Two schools are located within the ROI in the AC Collection System Route E-1, which is located within the town of Hardesty, Oklahoma. Nine churches are within the ROI and are discussed by region in Section 3.10.5.

3.10.4.9 Tribal Land

The Arkansas Riverbed Authority manages the tribal interests of two parcels on the west and east bank of the Arkansas River, south of Webbers Falls Lock and Dam 16 in the ROI in Region 3 and Region 4. Any crossings of tribal lands, as defined by 25 CFR 169.1(d), by the HVDC route and its alternatives would be limited to a width of 400 feet (200 feet either side of the centerline) per 25 CFR 169.27(d). Title 25 CFR Part 169 is the regulation governing ROWs over Indian Lands.

3.10.5 Regional Description

This section summarizes NLCD land cover data for each component of the Project by region and discusses land uses in the ROI for each region in more detail.

3.10.5.1 Region 1

Region 1 is referred to as the Oklahoma Panhandle Region and includes the Applicant Proposed Route and HVDC Alternative Routes I-A through I-D as well as the Oklahoma converter station and AC interconnect and AC collection system routes. The predominant land cover in the ROI for all Project components and alternatives is grassland/herbaceous (Table 3.10-4; Figure 3.10-3 in Appendix A). In the 2-mile-wide ROI for the AC collection routes, grassland/herbaceous is also the primary land cover (Table 3.10-5; Figure 3.10-3 in Appendix A).

AC Collection System Routes NE-1 and SE-2 consist primarily of cultivated crops. Approximately 30 percent of AC Collection System Route E-2 consists of cultivated crops; NE-2, NW-2, NW-1, SE-1, SE-3, and W-1 also have substantial percentages of cultivated crops.

Oklahoma school trust lands are present in the ROI (Figure 3.10-1 in Appendix A). The Optima NWR and Optima Lake (managed by USACE) are located in the ROI of AC Collection System Route E-1. The ROI for Region 1 HVDC, would be located adjacent to and south of the Shorb WMA. The ROI for AC Collection System Routes SE-3 and E-2 would cross the Shorb WMA. The Shorb WMA, located southeast of Hardesty, is managed by the ODWC and offers hunting (GIS Data Source: ODWC 2014). The ROIs associated with AC Collection System Routes E-3, SE-1, SE-3, and E-2 would cross the edges of the Schultz WMA and State Park. The Schultz WMA and State Park, located south of Hardesty, is managed by the ODWC and offers hunting (ODWC 2014b). Recreational opportunities are discussed in Section 3.12.

Communities in the ROI include Goodwell and Hardesty, Oklahoma, and Waka, Texas (Figure 3.10-2 in Appendix A). All of these communities are small agricultural towns along major roadways with a central residential area and limited commercial and industrial development.

Existing infrastructure in the ROI includes roadways, railroad tracks, transmission lines, and pipelines. Three public airports are located in the ROI; airports are discussed further in Section 3.16. Within the ROI for the Applicant Proposed Route and the HVDC alternative routes are 122 agricultural structures, 48 industrial structures, 29 residential structures, 21 commercial structures, 4 abandoned structures, 4 other (unknown) structures, and 1 church. The church is in the ROI for HVDC Alternative Route 1-A. Within the ROI for the Oklahoma Converter Station Siting Area and the representative AC interconnect are 4 industrial structures. Within the 13 AC collection routes are 1,662 agricultural structures, 709 industrial structures, 649 residential structures, 49 other (unknown) structures, 42 commercial structures, 7 abandoned structures, 2 schools, and 1 church. The schools and the church are in the ROI for AC Collection Route E-1.

No route variations were proposed in Region 1.

3.10.5.2 Region 2

Region 2 is referred to as the Oklahoma Central Great Plains Region and includes the Applicant Proposed Route and HVDC Alternative Routes 2-A through 2-B. In Region 2, the primary land cover for the Applicant Proposed Route is grassland/herbaceous (Figure 3.10-3 in Appendix A; 49 percent), followed by cultivated crops (33 percent). Approximately 8 percent of the Applicant Proposed Route ROI is evergreen forest, and almost 6 percent is developed open space. The ROI for HVDC Alternative Route 2-A is primarily composed of grassland/herbaceous (59.8 percent), followed by cultivated crops (23.4 percent) and evergreen forest (6.4 percent). In contrast, 59.6 percent of the ROI for HVDC Alternative Route 2-B is composed of cultivated crops (Table 3.10-6).

State-managed lands in the ROI in Region 2 are limited to one parcel of Oklahoma school trust lands in the Applicant Proposed Route and also in HVDC Alternative Route 2-A. Major County WMA is adjacent to the ROI for HVDC Alternative Route 2-A (Figure 3.10-1 in Appendix A).

There are no communities in the Region 2 ROI. Existing infrastructure in the ROI includes roadways, railroad tracks, transmission lines, and pipelines. One private airport is located in the ROI (Figure 3.10-2 in Appendix A); airports are discussed further in Section 3.16. Within the ROI for the Applicant Proposed Route and HVDC alternative routes are 70 industrial structures, 67 agricultural structures, 26 residential structures, and 16 commercial structures.

Table 3.10-4:
Land Cover in the Region 1 ROI

Land Cover	Applicant Proposed Route		AR 1-A		AR 1-B		AR-1C		AR-1D		Oklahoma Converter Station		OK Interconnect	
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Barren Land (Rock/Sand/Clay)	2.3	0.0	4.9	0.0	2.1	0.0	0.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Cultivated Crops	3,874.1	27.6	1,538.2	10.3	707.1	11.2	855.1	13.5	564.4	13.8	0.0	0.0	75.6	8.7
Deciduous Forest	2.2	0.0	15.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Developed, Low Intensity	16.8	0.1	7.2	0.0	9.7	0.2	12.6	0.2	5.0	0.1	0.0	0.0	0.0	0.0
Developed, Medium Intensity	4.6	0.0	11.1	0.1	0.1	0.0	0.1	0.0	8.5	0.2	0.0	0.0	0.0	0.0
Developed, Open Space	528.4	3.8	922.1	6.2	407.4	6.5	350.7	5.5	267.4	6.6	25.9	4.1	26.8	3.1
Evergreen Forest	2.2	0.0	16.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Grassland/Herbaceous	8,751.3	62.4	11,571.2	77.5	4,625.5	73.3	4,571.4	72.3	2,958.8	72.9	593.3	94.8	720.2	82.7
Open Water	58.2	0.4	21.8	0.1	0.8	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0
Shrub/Scrub	758.8	5.4	772.1	5.2	557.7	8.8	529.9	8.4	236.9	5.8	6.7	1.1	48.6	5.6
Woody Wetlands	29.8	0.2	47.5	0.3	0.0	0.0	3.9	0.1	16.3	0.4	0.0	0.0	0.0	0.0
Total	14,027.9	100.0	14,929.0	100.0	6,310.4	100	6324.0	100.0	4,059.3	100.0	625.9	100.0	871.2	100.0

Source: Jin et al. (2013)

This page intentionally left blank.

Table 3.10-5:
Land Cover by AC Collection System Route

Route		Open Water	Developed, Open Space	Developed, Low Intensity	Developed, Medium Intensity	Developed, High Intensity	Barren Land (Rock/Sand/Clay)	Deciduous Forest	Shrub/Scrub	Grassland/Herbaceous	Cultivated Crops	Woody Wetlands	Emergent Herbaceous Wetlands	Total
E1	Acres	0.0	2,462.7	84.1	6.2	0.0	22.2	0.0	2,547.7	31,464.8	2,651.3	100.9	0.0	39,339.9
	Percent	0.0	6.3	0.2	0.0	0.0	0.1	0.0	6.5	80.0	6.7	0.3	0.0	100.0
E2	Acres	9.8	2,384.0	20.3	1.1	0.0	13.7	0.0	3,880.7	31,000.1	15,614.9	49.4	0.0	52,977.8
	Percent	0.0	4.5	0.0	0.0	0.0	0.0	0.0	7.3	58.5	29.5	0.1	0.0	100.0
E3	Acres	18.7	2,216.6	31.4	0.0	0.0	31.3	0.0	4,052.0	39,227.5	7,912.7	25.7	0.0	53,515.0
	Percent	0.0	4.1	0.1	0.0	0.0	0.1	0.0	7.6	73.3	14.8	0.0	0.0	100.0
NE1	Acres	71.4	2,460.0	191.8	34.9	3.1	45.1	1.8	1,885.3	17,464.3	18,172.8	15.9	12.9	40,364.4
	Percent	0.2	6.1	0.5	0.1	0.0	0.1	0.0	4.7	43.3	45.0	0.1	0.0	100.0
NE-2	Acres	56.3	1,718.8	28.7	2.7	0.0	74.6	1.6	1,795.3	22,267.0	9,215.4	38.9	8.7	35,208.0
	Percent	0.2	4.9	0.1	0.0	0.0	0.2	0.0	5.1	63.2	26.2	0.1	0.0	100.0
NW-1	Acres	9.1	3,788.5	124.8	6.7	0.0	32.9	0.0	1,409.8	51,263.7	11,524.7	1.6	0.0	68,161.7
	Percent	0.0	5.6	0.2	0.0	0.0	0.0	0.0	2.1	75.2	16.9	0.0	0.0	100.0
NW-2	Acres	99.8	3,629.2	120.2	33.3	3.1	85.8	0.0	1,896.2	37,915.4	30,061.2	25.9	26.5	73,896.0
	Percent	0.1	4.9	0.2	0.0	0.0	0.1	0.0	2.6	51.3	40.7	0.0	0.0	100.0
SE-1	Acres	38.6	2,312.4	19.6	1.1	0.0	12.2	0.0	3,304.9	28,465.8	18,582.2	302.9	0.0	53,088.4
	Percent	0.1	4.4	0.0	0.0	0.0	0.0	0.0	6.2	53.6	35.0	0.6	0.0	100.0
SE-2	Acres	10.2	797.2	59.7	9.7	0.0	4.4	0.0	476.8	8,525.0	9,040.0	4.1	0.7	18,927.8
	Percent	0.1	4.2	0.3	0.1	0.0	0.0	0.0	2.5	45.0	47.8	0.0	0.0	100.0%
SE-3	Acres	59.8	2,564.4	53.7	1.1	0.0	15.2	0.0	5,127.3	32,703.0	23,887.7	60.3	44.2	64,516.7
	Percent	0.1	4.0	0.1	0.0	0.0	0.0	0.0	7.9	50.7	37.0	0.1	0.1	100.0
SW-1	Acres	1.1	635.6	69.2	3.5	0.0	6.9	0.0	613.6	16,220.4	1,586.5	4.1	0.7	19,105.0
	Percent	0.0	3.3	0.4	0.0	0.0	0.0	0.0	3.2	84.7	8.3	0.0	0.0	100.0
SW-2	Acres	24.0	1,897.4	36.7	2.4	0.0	45.4	0.0	773.5	41,661.6	4,926.2	0.0	0.0	49,367.2
	Percent	0.0	3.8	0.1	0.0	0.0	0.1	0.0	1.6	84.4	10.2	0.0	0.0	100.0
W-1	Acres	13.1	1,397.7	78.6	59.2	0.0	20.8	0.0	486.8	21,047.9	5,401.8	0.0	0.0	28,505.8
	Percent	0.0	4.9	0.3	0.2	0.0	0.1	0.0	1.7	73.8	18.9	0.0	0.0	100.0

Source: Jin et al. (2013)

This page intentionally left blank.

Table 3.10-6:
Land Cover in the Region 2 ROI

Land Cover[1]	Applicant Proposed Route		AR 2-A		AR 2-B	
	Acres	Percent	Acres	Percent	Acres	Percent
Barren Land (Rock/Sand/Clay)	0.0	0.0	4.0	0.1	1.6	0.0
Cultivated Crops	4,241.3	33.0	1,622.7	23.4	2,148.2	59.6
Deciduous Forest	130.8	1.0	267.3	3.9	73.3	2.0
Developed, Low Intensity	69.1	0.5	44.6	0.6	4.9	0.1
Developed, Medium Intensity	14.2	0.1	13.5	0.2	0.0	0.0
Developed, Open Space	730.9	5.7	284.5	4.1	134.0	3.7
Evergreen Forest	1,058.3	8.2	440.9	6.4	13.7	0.4
Grassland/Herbaceous	6,296.8	49.0	4,153.5	59.8	1,194.3	33.2
Mixed Forest	197.7	1.5	0.0	0.0	0.0	0.0
Open Water	39.3	0.3	23.1	0.3	31.7	0.9
Pasture/Hay	15.1	0.1	18.8	0.3	0.0	0.0
Shrub/Scrub	54.6	0.4	69.1	1.0	0.0	0.0
Total	12,847.3	100.0	6,942.1	100.0	3,601.7	100.0

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
Source: Jin et al. (2013)

This page intentionally left blank.

Two route variations to the Applicant Proposed Route were developed in Region 2 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.2. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route and the land uses would remain consistent within the ROI. Land use in Link 1, Variation 1, is similar to the original Applicant Proposed Route Link 1, but it would be closer to more residences and structures. Link 2, Variation 2, generally has the same land use (see Exhibit 1 of Appendix M and Figure 3.10-3b in Appendix A).

3.10.5.3 Region 3

Region 3 is referred to as the Oklahoma Cross Timbers Region and includes the Applicant Proposed Route and HVDC Alternative Routes 3-A through 3-E. In Region 3, the land cover in the ROI of the Applicant Proposed Route is more varied than in Regions 1 and 2. It primarily consists of grassland/herbaceous (Figure 3.10-3 in Appendix A; 34.3 percent), deciduous forest (27.2 percent), and pasture/hay (23.4 percent). The land cover in the ROI for HVDC Alternative Routes 3-B and 3-C is similar. In contrast, half of the ROI for HVDC Alternative Route 3-A has grassland/herbaceous land cover, and approximately half of the land cover in the ROI for HVDC Alternative Routes 3-D and 3-E is pasture/hay (Table 3.10-7).

Federal land in the Region 3 ROI is the Webbers Falls Lock, Dam, and Reservoir. Webbers Falls Reservoir is a 10,900-acre lake on the Arkansas River near Gore, Oklahoma (Figure 3.10-1 in Appendix A). The USACE manages the dam and reservoir, which provides recreational opportunities such as boating and fishing. As discussed in Section 3.10.4.8, the Arkansas Riverbed Authority manages the tribal interests of two parcels on the west and east bank of the Arkansas River, south of Webbers Falls Lock and Dam 16. Any crossings of tribal lands, as defined by 25 CFR 169.1(d), by the HVDC route and its alternatives would be limited to a width of 400 feet (200 feet either side of the centerline) per 25 CFR 169.27(d). State lands in the Region 3 ROI include Oklahoma State University Land Utilization Research Area and Lake Carl Blackwell and school trust lands (Figure 3.10-1 in Appendix A).

Dams constructed by the USDA-NRCS are located in and near the ROI along waterways. These dams were constructed primarily for flood prevention, but also provide irrigation and recreational opportunities. Operations and maintenance of these dams is the responsibility of the local sponsor, typically a drainage district in Oklahoma and a levee district in Arkansas.

Near the Cimarron River, the Applicant Proposed Route travels by oil storage tanks near the city of Cushing and the outer limits of the town of Summit (Figure 3.10-2 in Appendix A). HVDC Alternative Route 3-B traverses a rural commercial/industrial area south of Stillwater, Oklahoma. HVDC Alternative Route 3-C is located along the eastern edge of the city of Perkins. The ROI includes primarily commercial and industrial areas on the outskirts of these communities.

Existing infrastructure in the ROI includes roadways, railroad tracks, transmission lines, and pipelines. Four public airports, four private airports, one public heliport, and three private heliports are located in the ROI; airports and heliports are discussed further in Section 3.16. Within the ROI for the Applicant Proposed Route and the HVDC alternative routes are 281 agricultural structures, 257 residential structures, 33 industrial structures, 28 commercial structures, 17 other (unknown) structures, and 9 abandoned structures.

Five route variations to the Applicant Proposed Route were developed in Region 3 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.3. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route and the land uses would remain consistent within the ROI. Link 1, Variation 2, generally has the same land use as the original Applicant Proposed Route Link 1. Links 1 and 2, Variation 1, generally has the same land use as the original Applicant Proposed Route Link 1. It should be noted that a route adjustment was made for HVDC Alternative Route 3-A to maintain an end-to-end route with the Links 1 and 2 variations. Link 4, Variation 1, is generally undeveloped land, whereas the ROI for the Applicant Proposed Route in this location crosses a quarry operation. Link 4, Variation 2, has the same land use as the original Applicant Proposed Route Link 4. Link 5, Variation 2, has generally the same land use as the original Applicant Proposed Route Link 5 (see Exhibit 1 of Appendix M and Figure 3.10-3c in Appendix A).

3.10.5.4 Region 4

Region 4 is referred to as the Arkansas River Valley Region and includes the Applicant Proposed Route and HVDC Alternative Routes 4-A through 4-E as well as the Lee Creek Variation in Link 3. Link 3 crosses Lee Creek Reservoir in Sequoyah County, Oklahoma and Crawford County, Arkansas, at the upstream end of the reservoir in a buffer zone managed by the city of Fort Smith (Figure 3.10-2 in Appendix A). The Lee Creek Variation is a 3.4-mile variation of the Applicant Proposed Route that was created in response to scoping comments from the city of Fort Smith, Arkansas, expressing concern about the proximity of the proposed route to the Lee Creek Dam and Reservoir.

Land cover in the ROI of the Applicant Proposed Route is predominantly pasture/hay (Figure 3.10-3 in Appendix A; 45.8 percent) and deciduous forest (26.2 percent). There is also a higher percentage of evergreen forest (13.4 percent) than in the western portions (Regions 1, 2, and 3) of the Project. The ROI of HVDC Alternative Routes 4-D and 4-E have similar land cover distributions; in contrast, the ROI for HVDC Alternative Routes 4-A and 4-B is predominantly deciduous forest (Table 3.10-8). The Lee Creek Variation is dominated by forest land (92.6 percent of land cover).

Federally managed lands in the ROI include the USACE-managed Webbers Falls Lock, Dam, and Reservoir, the Ozark National Forest, and approximately 38 acres of land enrolled in the WRP. As discussed in Section 3.10.4.8, the Arkansas Riverbed Authority manages the tribal interests of two parcels on the west and east bank of the Arkansas River, south of Webbers Falls Lock and Dam 16. Any crossings of tribal lands, as defined by 25 CFR 169.1(d), by the HVDC route and its alternatives would be limited to a width of 400 feet (200 feet either side of the centerline) per 25 CFR 169.27(d). State lands in the ROI in Region 4 include Ozark Lake WMA and Frog Bayou WMA.

The ROI for HVDC Alternative Route 4-B and a small portion of the ROI for the Applicant Proposed Route cross portions of the Ozark National Forest and Ozark National Forest WMA (Figure 3.10-1 in Appendix A). These portions are owned by both the federal government (as managed by the USFS) and private citizens. The privately held land within the National Forest lies within the boundary of land approved for acquisition by the federal government for incorporation into the Forest. According to the Revised Land and Resource Management Plan for the Ozark and St. Francis National Forests (USFS 2005), the two forests are managed for multiple uses, including recreation, timber, grazing, minerals extraction, and wildlife habitat. The Arkansas Game and Fish Commission (AGFC) manages hunting in the WMA.

Table 3.10-7:
Land Cover in the Region 3 ROI

Land Cover[1]	Applicant Proposed Route		AR 3-A		AR 3-B		AR 3-C		AR 3-D		AR 3-E	
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Barren Land (Rock/Sand/Clay)	18.8	0.1	0.0	0.0	4.0	0.1	6.2	0.0	0.0	0.0	0.0	0.0
Cultivated Crops	1,629.6	8.3	833.8	18.2	964.5	16.6	645.2	4.4	279.2	5.8	0.0	0.0
Deciduous Forest	5,344.8	27.2	939.0	20.5	1,090.5	18.8	4,303.1	29.1	900.2	18.8	355.9	33.3
Developed, High Intensity	0.6	0.0	0.0	0.0	13.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Developed, Low Intensity	30.0	0.2	0.0	0.0	9.2	0.2	22.4	0.2	10.0	0.2	3.8	0.4
Developed, Medium Intensity	8.1	0.0	2.5	0.1	10.6	0.2	9.8	0.1	7.6	0.2	3.8	0.4
Developed, Open Space	910.8	4.6	220.1	4.8	251.5	4.3	448.7	3.0	170	3.6	47.3	4.4
Emergent Herbaceous Wetlands	0.0	0.0	0.0	0.0	0.0	0.0	8.4	0.3	0.0	0.0	0.0	0.0
Evergreen Forest	275.2	1.4	29.9	0.7	46.7	0.8	47.3	0.3	10.0	0.2	0.0	0.0
Grassland/Herbaceous	6,725.4	34.3	2,498.2	54.6	3,238.0	55.8	5,286.5	35.8	957.0	20.0	115.2	10.8
Open Water	84.2	0.4	33.3	0.7	39.9	0.7	71.2	0.5	15.9	0.3	7.4	0.7
Pasture/Hay	4,603.0	23.4	20.7	0.5	139.0	2.4	3,915.3	26.5	2,441.7	51.0	533.8	50.0
Shrub/Scrub	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Woody Wetlands	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.0	0.0	0.0	0.0	0.0
Total	19,634.0	100.0	4577.6	100.0	5,807.3	100.0	14,767.0	100.0	4,790.1	100.0%	1,067.2	100.0

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
Source: Jin et al. (2013)

This page intentionally left blank.

Table 3.10-8:
Land Cover in the Region 4 ROI

Land Cover[1]	Applicant Proposed Route		Lee Creek Variation		AR 4-A		AR 4-B		AR 4-C		AR 4-D		AR 4-E	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Barren Land (Rock/Sand/Clay)	7.5	0.0	0.0	0.0	0.0	0.0	5.8	0.1	0.0	0.0	0.0	0.0	7.1	0.2
Cultivated Crops	332.6	2.2	0.0	0.0	7.5	0.1	7.5	0.1	0.0	0.0	7.5	0.2	12.1	0.3
Deciduous Forest	4014.6	26.2	327.3	78.4	3,087.9	43.4	4,280.8	44.9	172.6	40.8	845.8	27.4	626.9	14.1
Developed, Low Intensity	113.1	0.7	0.0	0.0	22.1	0.3	34.4	0.4	4	0.9	17.3	0.6	31.2	0.7
Developed, Medium Intensity	3.8	0.0	0.0	0.0	5.5	0.1	4.5	0.0	0.0	0.0	3.4	0.1	3.2	0.1
Developed, Open Space	447.7	2.9	0.0	0.0	180.5	2.5	229.7	2.4	9.2	2.2	89.9	2.9	193.9	4.3
Emergent Herbaceous Wetlands	22.1	0.1	0.0	0.0	8.8	0.1	6.8	0.1	0.0	0.0	6.8	0.2	0.0	0.0
Evergreen Forest	2,058.1	13.4	41.8	10.0	378.9	5.3	1,270.1	13.3	66.0	15.6	359.3	11.6	1,128.1	25.3
Grassland/Herbaceous	373.8	2.4	24.1	5.8	624.2	8.8	673.4	7.1	21.8	5.1	94.3	3.1	41.9	0.9
Mixed Forest	570.8	3.7	17.6	4.2	227.6	3.2	461.5	4.8	42.6	10.1	140.2	4.5	270.7	6.1
Open Water	65.9	0.4	2.9	0.7	17.9	0.3	22.3	0.0	0.0	0.0	8.0	0.3	5.7	0.1
Pasture/Hay	7,014.0	45.8	0.0	0.0	2,441.7	34.3	2,399.8	25.2	107.3	25.3	1,501.2	48.6	1,922.6	43.1
Shrub/Scrub	174.2	1.1	2.9	0.7	84.2	1.2	121.9	1.3	0.0	0.0	8.1	0.3	158.9	3.6
Woody Wetlands	114.6	0.7	1.0	0.2	24.1	0.3	22.6	0.2	0.0	0.0	7.5	0.2	56.8	1.3
Total	15,312.9	100.0	417.5	100.0	6,992	100.0	9,541.1	100.0	423.5	100.0	3,089.3	100.0	4,459.1	100.0

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
Source: Jin et al. (2013)

This page intentionally left blank.

The ROI does not traverse any communities. Existing infrastructure in the ROI includes roadways, railroad tracks, transmission lines, and pipelines. Two public airports, two private airports, two public heliports, and one private heliport are located in the ROI (Figure 3.10-2 in Appendix A); airports and heliports are discussed further in Section 3.16. USDA dams are present along waterways such as Sallisaw Creek (Figure 3.10-2 in Appendix A). Within the ROI for the HVDC Applicant Proposed Route, the Lee Creek Variation, and the HVDC alternative routes are 460 residential structures, 436 agricultural structures, 11 commercial structures, 8 industrial structures, 7 abandoned structures, 3 other (unknown) structures, and 2 churches. One church is present in the ROI of the Applicant Proposed Route and another is present in the ROI for HVDC Alternative Route 4-D.

Seven route variations to the Applicant Proposed Route were developed in Region 4 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.4. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route and the land uses would remain consistent within the ROI. Link 3, Variation 1, would parallel parcel boundaries but otherwise generally has the same land use as the original Applicant Proposed Route Link 3. Link 3, Variation 2, generally has the same land use as the original Applicant Proposed Route Link 3. Link 3, Variation 3, generally has the same land use as the original Applicant Proposed Route Link 3, but it has 14 more residences and 7 more structures present within the ROI compared to the original Applicant Proposed Route Link 3. Link 6, Variation 1, generally has the same land uses as the original Applicant Proposed Route Link 6, but it would parallel parcel boundaries. Link 6, Variation 2, would avoid a WRP easement but otherwise generally has the same land use as the original Applicant Proposed Route Link 6. Link 6, Variation 3, and Link 9, Variation 1, generally have the same general land use as the original Applicant Proposed Route Links 6 and 9 (see Exhibit 1 of Appendix M and Figure 3.10-3d in Appendix A).

3.10.5.5 Region 5

Region 5 is referred to as the Central Arkansas Region and includes the Applicant Proposed Route and HVDC Alternative Routes 5-A through 5-F. The primary land cover categories in the Applicant Proposed Route in Region 5 is pasture/hay (29.1 percent), deciduous forest (28.9 percent), and evergreen forest (16.0 percent). Mixed forest makes up a much higher percentage of the Applicant Proposed Route in this region than any other at 10.3 percent (Table 3.10-9; Figure 3.10-3 in Appendix A). Evergreen forest is the primary land cover in the ROI of HVDC Alternative Route 5-A, deciduous forest is the primary land cover in the ROI of HVDC Alternative Routes 5-C and 5-D, and pasture/hay is the primary land cover in the ROI of HVDC Alternative Routes 5-B, 5-E, and 5-F. The land cover in the ROI of the Arkansas Converter Station Alternative Siting Area is deciduous forest (32.8 percent), pasture/hay (26.7 percent), evergreen forest (21.9 percent), and mixed forest (10.0 percent). The land cover in the ROI of the Arkansas AC Interconnection Siting Area is primarily pasture/hay (72.2 percent), followed by evergreen forest (11.5 percent) and deciduous forest (6.3 percent). The area where the new substation would be required adjacent to the existing transmission line is primarily grassland with some forest land.

There are no federal lands in the ROI in Region 5. State-managed lands in the ROI in Region 5 include the state-owned Rainey WMA (in the ROI for the Arkansas converter station) and the state-leased Cherokee WMA (Figure 3.10-1 in Appendix A).

No towns or cities with municipal boundaries are located within the ROI. Existing infrastructure in the ROI includes roadways, railroad tracks, transmission lines, and pipelines. Seven private airports are located in the ROI (Figure 3.10-2 in Appendix A); airports are discussed further in Section 3.16. Within the ROI for the Applicant Proposed

Route, the HVDC alternative routes, the Arkansas Converter Station Siting Area, and the associated AC Interconnection Siting Area, there are 241 residential structures, 218 agricultural structures, 56 industrial structures, 19 commercial structures, 7 abandoned structures, 8 other (unknown) structures, and 2 churches. There are no structures in the area for the new substation associated with the AC interconnection. One church is present in the ROI for HVDC Alternative Routes 5-B and 5-E.

Five route variations to the Applicant Proposed Route were developed in Region 5 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.5. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route and the land uses would remain consistent within the ROI. Link 1, Variation 2, has three more residences and seven more structures in the ROI than does the original Applicant Proposed Route Link 1. Link 2, Variation 2, crosses more forest land and less pasture/hay than the ROI for the original Applicant Proposed Route Link 2. Links 2 and 3, Variation 1, has generally the same land use as the original Applicant Proposed Route Links 2 and 3; it should be noted that a route adjustment was made for HVDC Alternative Route 5-B to maintain an end-to-end route with Links 2 and 3, Variation 1. Links 3 and 4, Variation 2, more closely parallels parcel boundaries than does the original Applicant Proposed Route Links 3 and 4; it should be noted that a route adjustment was made for HVDC Alternative Route 5-E to maintain an end-to-end route with this proposed variation. Link 7, Variation 1, generally has the same land use as the original Applicant Proposed Route Link 7 (see Exhibit 1 of Appendix M and Figure 3.10-3e in Appendix A).

3.10.5.6 Region 6

Region 6 is referred to as the Cache River and Crowley's Ridge Region and includes the Applicant Proposed Route and HVDC Alternative Routes 6-A through 6-D. Land cover in the ROI in Region 6 is more uniform and consists primarily of cultivated crops; this land cover category accounts for approximately 78 percent of the Applicant Proposed Route and at least 73 percent of each HVDC alternative route (Figure 3.10-3 in Appendix A; Table 3.10-10). Open water and woody wetlands are also more prevalent than in western portions of the ROI for the Project, at approximately 4 percent and 6 percent, respectively, of the Applicant Proposed Route. Open water and woody wetlands comprise 2 to 5 percent and 4 to 14 percent, respectively, of the HVDC Alternative Routes in Region 6.

A natural/recreational area found in the ROI is the Singer Forest Natural Area easement, within the St. Francis Sunken Lands WMA (Applicant Proposed Route) (Figure 3.10-1 in Appendix A). Singer Forest Natural Area was Arkansas's first natural area and was donated to ANHC by the Singer Company in 1973 (ANHC 2010a). The Singer Forest Natural Area is currently owned by AGFC but co-managed by both agencies. Although hunting is permitting, travel within the natural area is limited to foot traffic (ANHC 2010b). Recreational opportunities are discussed in Section 3.12.

There are no communities that have towns or cities with municipal boundaries located within the ROI. Existing infrastructure in the ROI includes roadways, railroad tracks, transmission lines, and pipelines. One public airport and 16 private airports are located in the ROI (Figure 3.10-2 in Appendix A); airports are discussed further in Section 3.16. Within the ROI for the Applicant Proposed Route and the HVDC alternative routes there are 43 residential structures, 40 agricultural structures, and 1 other (unknown) structure.

Table 3.10-9:
Land Cover in the Region 5 ROI

Land Cover[1]	Applicant Proposed Route		AR 5-A		AR 5-B		AR 5-C		AR 5-D		AR 5-E		AR 5-F		AR Converter Station Siting Area		AR Interconnect	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Barren Land (Rock/Sand/Clay)	76.8	0.6	2.4	0.2	23.3	0.3	8.7	0.8	0.0	0.1	12.4	0.3	9.5	0.3	0.0	0.0	0.0	0.0
Cultivated Crops	765.1	5.6	0.0	0.0	234.8	2.7	3.6	0.3	464.8	17.6	200.8	4.5	161.5	5.9	0.0	0.0	0.0	0.0
Deciduous Forest	3,949.0	28.9	421.2	27.3	2,113.7	24.5	469.0	41.5	1,214.7	45.9	1,128.6	25.5	733.2	26.8	118.0	32.8	41.6	6.3
Developed, High Intensity	14.9	0.1	0.0	0.0	4.4	0.1	0.0	0.0	2.0	0.1	1.5	0.0	1.5	0.1	0.0	0.0	0.0	0.0
Developed, Low Intensity	62.7	0.5	1.5	0.1	59.1	0.7	5.4	0.5	12.7	0.5	32.7	0.7	13.8	0.5	0.0	0.0	3.8	0.6
Developed, Medium Intensity	61.5	0.4	0.0	0.0	26.6	0.3	7.3	0.6	6.0	0.2	12.9	0.3	7.0	0.3	0.0	0.0	1.2	0.2
Developed, Open Space	349.3	2.6	50.9	3.3	192.0	2.2	19.0	1.7	116.7	4.4	85.3	1.9	61.8	2.3	10.57	2.9	14.4	2.2
Emergent Herbaceous Wetlands	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Evergreen Forest	2,192.3	16.0	616.2	39.9	1,093.4	12.7	26.4	2.3	103.1	3.9	454.8	10.3	362.3	13.2	78.7	21.9	76.0	11.5
Grassland/Herbaceous	415.5	3.0	70.3	4.6	386.4	4.5	58.0	5.1	110.0	4.2	214.5	4.8	86.9	3.2	16.0	4.5	2.0	0.3
Mixed Forest	1,407.1	10.3	95.3	6.2	525.3	6.1	163.2	14.4	291.1	11.0	285	6.4	213.5	7.8	36.1	10.0	0.4	0.1
Open Water	51.5	0.4	0.8	0.1	4.9	0.1	4.8	0.4	33.3	1.3	0.7	0.0	0.7	0.0	1.7	0.5	4.5	0.7
Pasture/Hay	3,979.7	29.1	269.7	17.5	3,864.4	44.8	363.3	32.1	217.0	8.2	1,980.5	44.8	1,074.3	39.3	96.0	26.7	477.7	72.2
Shrub/Scrub	211.1	1.5	13.2	0.9	69.5	0.8	0.0	0.0	1.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	15.2	2.3
Woody Wetlands	145.7	1.1	2.3	0.1	29.9	0.3	2.6	0.2	72.4	2.7	13.0	0.3	8.9	0.3	2.7	0.8	24.9	3.8
Total	13,648.0	100.0	1,543.9	100.0	8,627.7	100.0	1,131.2	100.0	2,645.5	100.0	4,422.6	100.0	2,734.9	100.0	359.7	100.0	661.6	100.0

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
Source: Jin et al. (2013)

This page intentionally left blank.

Table 3.10-10:
Land Cover in the Region 6 ROI

Land Cover[1]	Applicant Proposed Route		AR 6-A		AR 6-B		AR 6-C		AR 6-D	
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Barren Land (Rock/Sand/Clay)	3.8	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cultivated Crops	5,144.8	77.8	1,612.5	82.0	1,361.8	79.2	2,075.7	73.2	899.1	79.7
Deciduous Forest	443.8	6.7	0.4	0.0	4.2	0.2	221.3	7.8	5.2	0.5
Developed, Low Intensity	8.6	0.1	2.5	0.1	10.2	0.6	3.1	0.1	0.0	0.0
Developed, Medium Intensity	7.3	0.1	0.0	0.0	2.4	0.1	2.1	0.1	0.0	0.0
Developed, Open Space	305.8	4.6	65.4	3.3	72.7	4.2	182.4	6.4	52.2	4.6
Emergent Herbaceous Wetlands	3.1	0.0	0.0	0.0	2.9	0.2	0.0	0.0	1.1	0.0
Grassland/Herbaceous	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mixed Forest	29.2	0.4	0.0	0.0	0.0	0.0	50.8	1.8	62.0	5.5
Open Water	265.8	4.0	106.3	5.4	31.9	1.9	90.7	3.2	22.9	2.0
Pasture/Hay	16.7	0.3	0.0	0.0	0.0	0.0	93.5	3.3	0.0	0.0
Woody Wetlands	378.0	5.7	179.8	9.1	232.7	13.5	114.9	4.1	86.0	7.6
Total	6,608.7	100.0	1,966.9	100.0	1,718.9	100.0	2,834.4	100.0	1,128.6	100.0

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.

Source: Jin et al. (2013)

This page intentionally left blank.

One route variation was developed to the Applicant Proposed Route in Region 6 in response to public comments on the Draft EIS. The route variation is described in Appendix M and summarized in Section 2.4.2.6. The variation is illustrated in Exhibit 1 of Appendix M. This variation represents minor adjustments to the Applicant Proposed Route and the land uses would remain consistent within the ROI. Link 2, Variation 1, generally has the same land uses as the ROI for the original Applicant Proposed Route Link 2 (see Exhibit 1 of Appendix M and Figure 3.10-3f in Appendix A). It should be noted that a route adjustment was made for HVDC Alternative Route 6-A to maintain an end-to-end route with Link 2, Variation 1.

3.10.5.7 Region 7

Region 7 is referred to as the Arkansas Mississippi River Delta and Tennessee Region and includes the Applicant Proposed Route and HVDC Alternative Routes 7-A through 7-D, as well as the Tennessee Converter Station Siting Area. Similar to the ROI in Region 6, the primary land cover in the Applicant Proposed Route in Region 7 is cultivated crops, at approximately 69.1 percent (Figure 3.10-3 in Appendix A; Table 3.10-11). Cultivated crops are also the primary land cover in the ROI for the four HVDC alternative routes in Region 7, whereas the primary land covers in the Tennessee Converter Station Siting Area are deciduous forest and pasture/hay. Pasture/hay accounts for at least 15 percent of the ROI for HVDC Alternative Routes 7-B, 7-C, and 7-D and approximately 30.6 percent of the ROI for the Tennessee Converter Station Siting Area.

Public lands in the ROI in Region 7 include city-owned Aycock Park in the city of Millington, Tennessee (Figure 3.10-1 in Appendix A). There are also approximately 17 acres of WRP land in the ROI.

The ROI does not traverse any communities that have towns or cities with municipal boundaries, although the eastern end of the ROI is near residential developments between the town of Atoka and the city of Millington. There is also a commercial area located near South Millington, Tennessee (i.e., Millington Funeral Home) as well as a number of churches near Alternative Route 7-C (Figure 3.10-2 in Appendix A). Existing infrastructure in the ROI includes roadways, railroad tracks, transmission lines, and pipelines. Three public airports and three private airports are located in the ROI; airports are discussed further in Section 3.16. Within the ROI for the Applicant Proposed Route, the HVDC alternative routes, and the Tennessee Converter Station Siting Area are 125 residential structures, 73 agricultural structures, 5 abandoned structures, 4 commercial structures, 4 other (unknown) structures, and 3 churches. One church is present in the ROI for the Applicant Proposed Route and two churches are present in the ROI for the HVDC Alternative Route 7-C.

Three route variations to the Applicant Proposed Route were developed in Region 7 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.7. The variations are illustrated in Exhibit 1 of Appendix M. Link 1, Variation 1; Link 1, Variation 2; and Link 5, Variation 1, all generally have the same land uses as the ROI for the original Applicant Proposed Route Links 1 and 5 (see Exhibit 1 of Appendix M and Figure 3.10-3f in Appendix A).

3.10.5.8 Connected Actions

3.10.5.8.1 Wind Energy Generation

Land cover in the WDZs is primarily cultivated crops and grassland/herbaceous. The land cover in each WDZ is listed in Table 3.10-12.

This page intentionally left blank

Table 3.10-11:
Land Cover in the Region 7 ROI

Land Cover[1]	Applicant Proposed Route		AR 7-A		AR 7-B		AR 7-C		AR 7-D		Tennessee Converter Station Siting Area	
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Barren Land (Rock/Sand/Clay)	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cultivated Crops	3,588.4	69.1	4,434.2	84.6	451.2	42.9	1,687.5	58.5	388.1	48.5	43.9	20.1
Deciduous Forest	393.1	7.6	1.8	0.0	187.9	17.9	271.1	9.4	80.1	10.0	71.4	32.7
Developed, Low Intensity	40.0	0.8	27.0	0.5	3.1	0.3	54.6	1.9	9.7	1.2	1.3	0.6
Developed, Medium Intensity	3.2	0.1	11.8	0.0	0.0	0.0	5.4	0.2	0.0	0.0	0.0	0.0
Developed, Open Space	254.2	4.9	344.3	6.8	38.4	3.7	83.8	2.9	30.9	3.9	4.3	2.0
Emergent Herbaceous Wetlands	7.3	0.1	10.0	0.2	0.0	0.0	15.7	0.5	3.0	0.4	0.0	0.0
Evergreen Forest	4.6	0.1	0.0	0.0	2.0	0.2	6.1	0.2	1.0	0.1	0.0	0.0
Grassland/Herbaceous	9.5	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Mixed Forest	3.7	0.1	0.0	0.0	0.0	0.0	1.8	0.1	1.6	0.2	1.1	0.5
Open Water	114.3	2.2	98.7	1.9	0.4	0.0	1.3	0.0	30.9	3.9	0.0	0.0
Pasture/Hay	182.5	3.5	5.9	0.1	210.5	20.0	430.1	14.9	138.1	17.3	66.8	30.6
Shrub/Scrub	258.4	5.0	0.0	0.0	158.7	15.1	235.9	8.2	107.0	13.4	4.3	2.0
Woody Wetlands	336.3	6.5	307.9	5.9	0.2	0.0	92.3	3.2	41.0	5.1	25.2	11.5
Total	5,196.0	100.0	5,241.8	100.0	1,052.6	100.0	2,885.6	100.0	800.5	100.0	218.3	100.0

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.

Source: Jin et al. (2013)

This page intentionally left blank.

Table 3.10-12:
Land Cover in Wind Development Zones

WDZ	A		B		C		D		E		F		G		H		I		J		K		L	
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Open Water	111.6	0.1	92.2	0.1	185.9	0.1	45.8	0.1	114.8	0.2	59.4	0.1	32.2	0.0	46.0	0.0	57.3	0.1	4.4	0.0	17.3	0.0	102.0	0.1
Developed, Open Space	3,872.3	3.5	5,090.0	4.1	6,318.1	3.9	3,633.6	5.3	3,205.9	6.8	5,228.4	4.6	8,622.0	4.6	4,593.0	4.0	5,708.1	5.4	4,173.1	4.5	4,287.1	4.6	6,459.7	3.9
Developed, Low Intensity	1,345.3	1.2	225.7	0.2	419.3	0.3	81.0	0.1	115.0	0.2	869.7	0.8	147	0.1	28.8	0.0	583.2	0.6	145.9	0.2	67.9	0.1	487.8	0.3
Developed, Medium Intensity	259.2	0.2	24.9	0.0	52.3	0.0	8.5	0.0	19.8	0.0	214.1	0.2	10.0	0.0	0.0	0.0	66.3	0.1	8.3	0.0	8.9	0.0	29.4	0.0
Developed, High Intensity	62.3	0.1	0.0	0.0	9.8	0.0	0.0	0.0	3.1	0.0	8.5	0.0	0.0	0.0	0.0	0.0	20.9	0.0	0.0	0.0	0.0	0.0	2.2	0.0
Barren Land	47.8	0.0	59.8	0.0	41.4	0.0	57.0	0.1	64.0	0.1	59.8	0.1	17.1	0.0	80.5	0.1	37.6	0.0	12.7	0.0	19.8	0.0	163.5	0.1
Deciduous Forest	0.0	0.0	25.6	0.0	22.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	3.3	0.0	27.4	0.0	0.0	0.0	0.0	0.0	1.6	0.0
Evergreen Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	49.2	0.0
Shrub/Scrub	9,143.7	8.3	5,627.9	4.5	6,595.2	4.1	5,055.2	7.3	1,725.7	3.7	2,002.5	1.8	3,171.0	1.7	1,682.9	1.4	9,149.1	8.7	8,070.2	8.7	6,040.2	6.5	17,683.5	10.7
Grassland/Herbaceous	28,649.1	26.1	47,473.5	37.8	84,957.5	52.8	47,914.3	69.3	15,015.4	31.9	75,363.0	67.0	99,333.5	53.0	94,755.5	81.5	25,086.2	23.8	68,122.3	73.6	39,204.8	42.2	47,079.7	28.4
Pasture/Hay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cultivated Crops	66,151.1	60.3	66,784.3	53.2	62,440.5	38.8	12,341.6	17.8	26,819.3	57.0	28,608.2	25.4	75,833.0	40.5	15,030.1	12.9	64,325.1	61.1	11,946.2	12.9	43,194.6	46.5	91,474.2	55.2
Woody Wetlands	19.1	0.0	15.1	0.0	1.6	0.0	51.9	0.1	8.9	0.0	21.1	0.0	1.6	0.0	3.6	0.0	49.1	0.0	83.7	0.1	49.6	0.1	18.9	0.0
Emergent Herbaceous Wetlands	79.0	0.1	60.3	0.0	3.9	0.0	0.0	0.0	0.0	0.0	17.8	0.0	146.3	0.1	2.0	0.0	92.7	0.1	0.0	0.0	1.1	0.0	2,286.7	1.4
Total	109,746.7	100.0	125,479.2	100.0	161,048.1	100.0	69,188.9	100.0	47,091.8	100.0	112,460.6	100.0	187,314.9	100.0	116,225.7	100.0	105,202.9	100.0	92,567.5	100.0	92,893.9	100.0	165,848.4	100.0

Source: Jin et al. (2013)

This page intentionally left blank

Existing land uses in the WDZs includes agriculture (irrigated and dry crops, feedlots), residences, recreation (municipal parks, hunting areas), wind energy, and oil/gas development. Existing infrastructure includes roadways, railroads, airports, and transmission lines.

State land in the WDZs includes Optima WMA, Schultz WMA, and Oklahoma school trust lands. No federal or tribal lands were identified within the WDZs.

Structures in the WDZs includes residences, agricultural structures such as barns and silos, businesses, oil/gas wells and associated infrastructure, hospitals, churches, and schools, and airports. Residences, businesses, hospitals, and schools are typically concentrated in or near cities and towns. Rural residences are scattered on large parcels of land and generally surrounded by agricultural land uses.

3.10.5.8.1.1 WDZ-A

The land cover in WDZ-A is 60.3 percent cultivated crops, 26.1 percent grassland/herbaceous, 8.3 percent shrub/scrub, and less than 4 percent of all other categories.

Portions of the city of Perryton are within the WDZ, including recreational uses such as Leatherman Park, Murphy Park, Whigham Park, Stark Park, and Whippo Park (all city parks). No state or federal lands are located in the WDZ. Existing uses in the WDZ includes transmission lines north of Perryton and center-pivot irrigation scattered throughout the WDZ. Perryton-Ochiltree County Airport is partially within the WDZ along the eastern border.

3.10.5.8.1.2 WDZ-B

The land cover in WDZ-B is 53.2 percent cultivated crops, 37.8 percent grassland/herbaceous, and less than 5 percent of all other categories.

There are no municipalities or state or federal lands. Recreational uses include Miller’s Lake Public Hunting Area in the central portion of the WDZ. Central-pivot irrigation is found throughout the WDZ. One transmission line crosses the WDZ, and an operating wind energy facility is adjacent to it. Another wind energy facility is present in the northern portion of the WDZ.

3.10.5.8.1.3 WDZ-C

The land cover in WDZ-C is 52.8 percent grassland/herbaceous, 38.8 percent cultivated crops, and less than 5 percent of all other categories.

No municipalities or state or federal lands are present.

Center-pivot irrigation is found throughout the WDZ and a concentrated animal feeding operation is located in the western portion of the WDZ southeast of Stratford, Texas. Transmission lines cross the WDZ. One existing wind energy facility is present in the northeast portion of the WDZ.

3.10.5.8.1.4 WDZ-D

The land cover in WDZ-D is 69.3 percent grassland/herbaceous, 17.8 percent cultivated crops, 7.3 percent shrub/scrub, and less than 6 percent of all other categories.

The town of Hardesty is in the WDZ. No federal lands are present in the WDZ. State lands compose 4.6 percent of the WDZ, including the 256-acre Optima WMA, the 260-acre Schultz WMA, and 2,643 acres of school trust lands. Transmission lines and center-pivot irrigation are present in the northern and southern portions of the WDZ. Two operating wind energy facilities are present in the southwestern portion of the WDZ.

3.10.5.8.1.5 WDZ-E

The land cover in WDZ-E is 57 percent cultivated crops, 31.9 percent grassland/herbaceous, 6.8 percent developed and open space, and less than 4 percent of all other categories.

No municipalities or federal lands are present in the WDZ. There are 404 acres of school trust lands, comprising less than 1 percent of the WDZ. There is an existing wind energy facility in the southwestern portion of the WDZ. Existing uses include transmission lines, wind turbines, center-pivot irrigation, and a concentrated animal feeding operation.

3.10.5.8.1.6 WDZ-F

The land cover in WDZ-F is 67.0 percent grassland/herbaceous, 25.4 percent cultivated crops, and less than 5 percent all other categories.

No federal lands are present in the WDZ. There are 7,263 acres of school trust lands, comprising 6.5 percent of the WDZ. The city of Texhoma and the town of Goodwell are within the WDZ. Center-pivot irrigation is found throughout the WDZ. An existing wind energy facility is present in the southern portion of the WDZ. Existing infrastructure includes transmission lines and a railroad. Texhoma Municipal Airport is located in the southwest corner of the WDZ.

3.10.5.8.1.7 WDZ-G

The land cover in WDZ-G is 53.0 percent grassland/herbaceous, 40.5 percent cultivated crops, and less than 5 percent of all other categories.

No municipalities or federal lands are present in the WDZ. There are 4,886 acres of school trust lands, comprising 2.6 percent of the WDZ. A few parcels with central-pivot irrigation are present in the northern portion of the WDZ. Existing infrastructure includes transmission lines and a railroad.

3.10.5.8.1.8 WDZ-H

The land cover in WDZ-H is 81.5 percent grassland/herbaceous, 12.9 percent cultivated crops, and less than 4 percent of all other categories.

No municipalities or federal lands are present in the WDZ. There are 2,464 acres of school trust lands, or approximately 2 percent of the WDZ. A few parcels have center-pivot irrigation. Existing infrastructure includes a transmission line crossing the central portion of the WDZ.

3.10.5.8.1.9 WDZ-I

The land cover in WDZ-I is 61.1 percent cultivated crops, 23.8 percent grassland/herbaceous, 8.7 percent shrub/scrub, and less than 6 percent of all other categories.

No federal lands are present in the WDZ. There are 975 acres of school trust lands, or approximately 1 percent of the WDZ. The city of Hooker and Hooker Municipal Airport located within the WDZ. Center-pivot irrigation is found primarily in the central portion of the WDZ. Concentrated animal feeding operations are also found in the WDZ. Existing infrastructure includes transmission lines, center-pivot irrigation, and a railroad.

3.10.5.8.1.10 WDZ-J

The land cover in WDZ-J is 73.6 percent grassland/herbaceous, 12.9 percent cultivated crops, 8.7 percent shrub/scrub, and less than 5 percent of all other categories.

No federal lands are present in the WDZ. There are 2,612 acres of school trust lands, or 2.8 percent of the WDZ. Transmission lines cross the WDZ. Center-pivot irrigation structures are present in the central portion of the WDZ. Active oil/gas development is ongoing.

3.10.5.8.1.11 WDZ-K

The land cover in WDZ-K is 46.5 percent cultivated crops, 42.2 percent grassland/herbaceous, 6.5 percent shrub/scrub, and less than 5 percent of all other categories.

No federal lands are present in the WDZ. There are 963 acres of school trust lands, or approximately 1 percent of the WDZ. Existing infrastructure includes transmission lines and some scattered center-pivot irrigation.

3.10.5.8.1.12 WDZ-L

The land cover in WDZ-L is 55.2 percent cultivated crops, 28.4 percent grassland/herbaceous, 10.7 percent shrub/scrub, and less than 4 percent of all other categories.

No state or federal lands are located in the WDZ. The southern portion of the city of Spearman is located within the WDZ, including Spearman Park. Center-pivot irrigation is found throughout the WDZ.

3.10.5.8.2 Optima Substation

The future Optima substation would be constructed on approximately 160 acres partially within the area identified on Figure 2.1-3 in Appendix A as the AC Interconnection Siting Area. The land cover in the future Optima substation location is primarily grassland herbaceous, with some shrub/scrub and developed open space. No structures or existing infrastructure are located on the 160-acre site, although there are roads and an operating wind farm nearby. Irrigated cultivated crops are also in the vicinity.

3.10.5.8.3 TVA Upgrades

The ROI for the direct assignment facilities (which are included in the Applicant Proposed Project) would occur within the Tennessee Converter Station Siting Area and more specifically within the Shelby Substation. The ROI for the network upgrades, and in particular TVA's future 500kV transmission line, cannot be fully determined at this time. The 500kV transmission line would be constructed in western Tennessee, where cultivated crops and grassland/herbaceous are typically the dominant land covers. Its ROW would occupy about 785 acres, assuming a ROW width of 175 feet. The upgrades to existing facilities would mostly be in western and central Tennessee. Upgrades to existing infrastructure would include upgrading terminal equipment at three existing 500kV substations and six existing 161kV substations, making appropriate upgrades to increase heights on 16 existing 161kV transmission lines to increase line ratings, and replacing the conductors on eight existing 161kV transmission lines.

Where possible, general impacts associated with the required TVA upgrades are discussed in the impact sections that follow.

3.10.6 Impacts to Land Use

Comments regarding land use received during the scoping period indicate that the public is concerned about impacts to oil and gas drilling activities and the restrictions the Project would place on future land use and development. The public also expressed concern about impacts to conservation efforts and agreements as well as impacts to public lands.

3.10.6.1 Methodology

To identify potential impacts that may result from construction and operations and maintenance of the Project, the analysis of the HVDC transmission line route alternatives, the Oklahoma and Arkansas AC interconnect lines, and the AC collection system routes in Oklahoma was based on a desktop review of existing land uses within a representative 200-foot-wide ROW (100 feet on either side of a representative centerline). The analysis for other elements of the Project, such as the Oklahoma and Tennessee converter stations, was based on a desktop review of the footprint of the layout dated February 2014 and subsequent revisions provided by the Applicant in their revised Project Description (Appendix F). Quantitative data regarding the resources directly intersected by the 200-foot-wide representative ROW were used to analyze the likely effects of the Project on land use in the context of the EPMs that would be included as part of the Project. Land cover, jurisdictional areas, and structures within the representative ROW were identified through GIS analysis[1]. In the impacts discussion, the number and type of structures within the representative ROW are listed for informational purposes and for comparisons between Project alternatives, although it is likely that the displacement of structures would be avoided in the final engineering and design of the Project. Existing transmission lines, pipelines, and roadways within 50 feet of the representative ROW were also identified through GIS analysis.

Tensioning or pulling sites outside the ROW have been identified, and the land cover and structures within them were identified by GIS analysis. Because the location of other temporary construction areas, such as the 45 multi-use construction yards (approximately 25 acres each) and fly yards, as well as the access roads, have not yet been determined, these impacts were evaluated in a general quantitative way.

With regard to access roads associated with the converter stations, although exact locations have not yet been determined, to quantify impacts, it was assumed each converter station would have an access road 20 feet wide by up to 1 mile long (2.4 acres), with temporary disturbance up to 35 feet wide (1.8 acres temporary, 4.2 acres total).

Most construction impacts would be short term, while the visual impact of the installed transmission structures would be long term until the Project is decommissioned. Cumulative impacts are addressed in Section 4.3.10.

The Applicant has developed a comprehensive list of EPMs that will be implemented with the Project to avoid and minimize impacts to existing land use. Implementation of these EPMs is assumed throughout the impact analysis that follows for both the Applicant Proposed Project and the DOE Alternatives. A complete list of EPMs for the Project is

---

[1] The analysis is based on GIS information available at the time of the analysis in September 2014 and subsequent revisions provided by the Applicant in their revised Project Description (Appendix F).

provided in Appendix F; those EPMs that would specifically avoid or minimize impacts to existing land use are listed below:

- GE-7: Roads not otherwise needed for maintenance and operations will be restored to preconstruction conditions. Restoration practices may include decompacting, recontouring, and re-seeding. Roads needed for maintenance and operations will be retained.
- GE-8: Access controls (e.g., cattle guards, fences, gates) will be installed, maintained, repaired, replaced, or restored as required by regulation, road authority, or as agreed to by landowner.
- GE-9: Clean Line will avoid and/or minimize damage to drainage features and other improvements such as ditches, culverts, levees, tiles, and terraces; however, if these features or improvements are inadvertently damaged, they will be repaired and or restored.
- GE-10: Clean Line will work with landowners to repair damage caused by construction, operation, or maintenance activities of the Project. Repairs will take place in a timely manner, weather and landowner permitting.
- GE-11: Clean Line will conduct construction, operation, and maintenance activities to minimize the creation of dust. This may include measures such as limitations on equipment, speed, and/or travel routes utilized. Water, dust palliative, gravel, combinations of these, or similar control measures may be used. Clean Line will implement measures to minimize the transfer of mud onto public roads.
- GE-20: Clean Line will conduct construction and scheduled maintenance activities on the facilities during daylight hours, except in rare circumstances that may include, for example, to address emergency or unsafe situations, to avoid adverse environmental effects, to minimize traffic disruptions, or to comply with regulatory or permit requirements.
- GE-23: Clean Line will maximize the distance between stationary equipment and sensitive noise receptors consistent with engineering design criteria.
- GE-24: Clean Line will minimize the number and distance of travel routes for construction equipment near sensitive noise receptors.
- GE-27: Clean Line will minimize compaction of soils and rutting through appropriate use of construction equipment (e.g., low ground pressure equipment and temporary equipment mats).
- GE-29: Clean Line will work with landowners and operators of active oil and gas wells, utilities, and other infrastructure to identify and verify the location of facilities and to minimize adverse impacts. Identification may include use of the One Call system (a database that is used to locate underground facilities) and surveying of existing facilities.
- LU-1: Clean Line will work with landowners and operators to ensure that access is maintained as needed to existing operations (e.g., to oil/gas wells, private lands, agricultural areas, pastures, hunting leases).
- LU-2: Clean Line will minimize the frequency and duration of road closures.
- LU-3: Clean Line will work with landowners to avoid and minimize impacts to residential landscaping.
- LU-4: Clean Line will coordinate with landowners to site access roads and temporary construction areas to avoid and/or minimize impacts to existing operations and structures.
- LU-5: Clean Line will make reasonable efforts, consistent with design criteria, to accommodate requests from individual landowners to adjust the siting of the ROW on their properties. These adjustments may include consideration of routes along or parallel to existing divisions of land (e.g., agricultural fields and parcel boundaries) and existing compatible linear infrastructure (e.g., roads, transmission lines, and pipelines), with the intent of reducing the impact of the ROW on private properties.

3.10.6.2 Impacts Associated with the Applicant Proposed Project

This section describes the potential impacts from the Project that would be common to the converter stations, AC interconnection, AC collection system, and Applicant Proposed Route. Impacts from the construction, operations and maintenance, and decommissioning of the Project are discussed separately by Project component.

3.10.6.2.1 Converter Stations and AC Interconnection Siting Areas

This section describes the impacts from the converter stations on either end of the HVDC transmission line and their associated AC interconnection lines.

3.10.6.2.1.1 Construction Impacts

Direct land use impacts during construction would consist of the long-term conversion of land for the converter station and temporary conversion of land within the ROW for the AC interconnection lines. Potential indirect temporary impacts on residences, businesses, schools, and other areas near the construction area would include noise, dust, transportation, health and safety, and visual impacts; all of these are discussed in Sections 3.11, 3.3, 3.16, 3.8, and 3.18, respectively. Utilities such as oil and gas pipelines, water lines, and electrical distribution lines in and near the ROW may be affected for a limited time during construction at a particular location. Construction of a single converter station is estimated to take 32 months.

3.10.6.2.1.1.1 Oklahoma Converter Station Siting Area and AC Interconnection Siting Area

The Oklahoma converter station would be located on undeveloped rangeland; approximately 95 percent of the land cover in the siting area is grassland/herbaceous (Figure 3.10-3 in Appendix A). Construction of this converter station would convert 45 to 60 acres of rangeland to a utility land use. During construction, an additional 5 to 10 acres would be used as laydown areas for equipment. An additional 4.2 acres of rangeland would be converted to access roads (2.4 acres permanent, 1.8 acres temporary).

The Oklahoma AC interconnection would be approximately 3 miles long and would temporarily convert approximately 65.5 acres of primarily undeveloped rangeland to an industrial use. Approximately 0.3 mile, or 12 percent of the route, would be parallel to existing transmission lines (within 50 feet) in an existing ROW and less than 0.1 mile (1.2 percent) of the route would be parallel to existing roads. The land cover in the representative ROW is currently composed of approximately 58 acres of grassland, 5.4 acres of shrub/scrub, and 1.9 acres of developed, open space.

During construction, assembly areas for the pole structures (either lattice or tubular structures) would be required, as well as wire splicing sites and tensioning or pulling sites. Within the 65.5-acre ROW, an assembly area 150 feet wide by 150 feet long would be required for each structure. Assuming five to seven structures per mile would be required, the assembly areas would require up to 10.7 acres within the ROW. Approximately two wire splicing sites, each 100 feet by 100 feet (0.2 acre), would be used within the ROW during construction. Approximately four tensioning or pulling sites, 150 feet wide by 600 feet long, also would be required within the ROW, although it is estimated that 1 acre of the total would be located outside the ROW (2.0 acres each, minus 1 acre, for a total of 7 acres).

Tensioning or pulling sites would be located partially outside the ROW at locations where the line turns more than 8 degrees, estimated at 1 acre.

Approximately 74 acres would be required for the Oklahoma converter station (including access road) and approximately 19 acres would be required for the Oklahoma AC interconnection during construction.

3.10.6.2.1.1.2 Tennessee Converter Station Siting Area and AC Interconnection Tie

The land cover in the Tennessee Converter Station Siting Area is approximately 33 percent deciduous forest, 31 percent pasture/hay, 20 percent cultivated crops, and 12 percent woody wetlands. No existing structures are known to occur. Although the exact location within the 218-acre siting area has not yet been determined, construction of this converter station would convert 45 to 60 acres of currently undeveloped land to a utility land use. During construction, an additional 5 to 10 acres would be required. An additional 4.2 acres of rangeland would be converted to access roads (2.4 acres permanent, 1.8 acres temporary).

Approximately 74 acres would be required for the Tennessee converter station (including access road) during construction; it is anticipated that any temporary construction areas would be contained within the footprint of the Tennessee converter station and the Shelby Substation.

3.10.6.2.1.2 Operations and Maintenance Impacts

Operation and maintenance would result in direct long-term impacts to the land crossed by the ROW because of the vegetation that would be allowed to grow and structures and uses that would be permitted. The presence of the converter stations would remove certain areas from other uses until decommissioning and transmission line structures may interfere with other uses in the ROW, such as farming equipment.

As noted in Section 2.1.5.1, limitations on land uses would be described in individual landowner easement agreements and would be based on site-specific conditions and/or coordination with landowners. Land uses that generally may not be permitted in the ROW include constructing buildings or structures, changing the grading and land contours such that the ground surface elevation within the ROW would change and alter the required electrical clearance, and installing fences or irrigation lines without coordination with the Applicant. Access would be restricted during the performance of maintenance activities.

Maintenance for an individual alternative or Project component would be similar to construction impacts, except maintenance would require shorter work duration and would be at a smaller scale. Maintenance would typically occur on an annual basis and as needed.

Because the locations of access roads to the converter stations are not known at this time, it is possible that the access roads could be located in such a way that small areas of agricultural land would be isolated and no longer practicable to be used for farmland or grazing.

3.10.6.2.1.2.1 Oklahoma Converter Station Siting Area and AC Interconnection Siting Area

Once construction has been completed, only the 45- to 60-acre converter station and 20-foot-wide paved access road totaling 2.4 acres would remain; all other temporary construction areas would be returned to their previous use, primarily rangeland. Approximately 45 acres would be fenced for the Oklahoma converter station.

Within the 3-mile-long Oklahoma AC interconnect ROW, only the pole structures would remain. For lattice structures, the operational footprint would be 5 to 7 structures per mile, or 15 to 21 structures total, each 28 feet by 28 feet (less than 0.1 acre), up to 0.4 acre total. For tubular structures, the operational footprint would be 5 to 7 structures per mile, or 15 to 21 structures total, each 7 feet by 7 feet (less than 0.1 acre), and less than 0.1 acre total. For both lattice and tubular structures, each structure would be 75 to 180 feet tall. All other land in the ROW could return to previous land uses, primarily grazing. Access roads that are not needed for operations and maintenance of the Project would be restored.

3.10.6.2.1.2.2 Tennessee Converter Station Siting Area and AC Interconnection Tie

Once construction has been completed, only the 45- to 60-acre converter station, the AC interconnect facilities, and 20-foot-wide paved access road totaling 2.4 acres would remain; all other temporary construction areas would be returned to their previous use, primarily cultivated crops and pasture/hay. The interconnection facilities are anticipated to be contained within the existing Shelby Substation and the Tennessee converter station. Approximately 45 acres would be fenced for the Tennessee converter station.

3.10.6.2.1.3 Decommissioning Impacts

Potential impacts during decommissioning of the Project would be similar to those of the construction phase for all Project components. Once decommissioning has been completed, all land could return to the preconstruction land uses described in Section 3.10.4 and Section 3.10.5.

3.10.6.2.2 AC Collection System

This section discusses the impacts from the AC collection system. The Applicant Proposed Project would include four to six AC collection lines of up to 345kV from the Oklahoma converter station to points in the Oklahoma and Texas panhandles.

3.10.6.2.2.1 Construction Impacts

The AC collection system would consist of four to six 345kV lines, each extending up to 40 miles from the Oklahoma converter station. Within the 150–200-foot-wide ROW for each transmission line, an assembly area for the pole structures (whether lattice, tubular, or H-frame, the assembly area footprint is the same) would be required. Each assembly area would be 150 feet wide by 150 feet long (0.5 acre) and five to seven assembly areas per mile would be required. Assuming 300 miles of AC collection lines, the total acreage of assembly areas would range between 765 and 1,071 acres. Total disturbance from the construction of access roads (inside and outside the ROW) for the AC collection system would be approximately 301 miles, or 669 acres.

Approximately six fiber optic regeneration sites would be required for the AC collection system. Each fiber optic regeneration site would be approximately 100 feet by 100 feet, with a fenced area of approximately 75 feet by 75 feet. The regeneration equipment would be enclosed in a small control building made of either metal or concrete, approximately 12 feet by 32 feet by 9 feet tall. An access road and power supply to the site would be required, but the same road would be used to access the transmission line, so those access road impacts are included in the impacts for the transmission line. Typically, these sites would be adjacent to or within 750 feet of the ROW. A total of approximately 3 acres of undeveloped land would be converted to a utility use for the six fiber optic regeneration sites anticipated to be required for the entire AC collection system.

Temporary work areas that would be required during construction include wire splicing sites and tensioning or pulling sites. One wire splicing site 100 feet by 100 feet (0.2 acre) would be required every 2 miles; assuming 150 sites, these would total 30 acres. A tensioning or pulling site 150 feet wide by 600 feet long (2 acres) would be required at least every 18,000 feet; assuming a total of 200 sites (400 acres), 64 acres would be located outside the ROW, 336 acres would be located inside the ROW. Additional temporary construction areas that would be required outside the ROW include multi-use construction yards and fly yards. Multi-use construction yards would each be approximately 25 acres in size and would be located approximately 25 miles apart and typically within 10 miles of the ROW. Assuming the AC collection system requires approximately 15 multi-use construction yards, the total footprint would be 375 acres for all 15 yards. Fly yards would each require 10 to 15 acres each and would be located at approximately 5-mile intervals along the ROW and typically within 10 miles of the ROW. Assuming a total of 60 fly yards, 15 of which would be located within multi-use construction yards, 45 fly yards would have a total footprint of 450 to 675 acres. In total, approximately 3,223 acres would be required for the construction of the AC collection system, although construction would only occur in particular construction segments for a limited time.

Potential temporary impacts on residences, businesses, schools, and other areas near the construction area would include noise, dust, transportation, health and safety, and visual impacts; all of these are discussed in Sections 3.11, 3.3, 3.16, 3.8, and 3.18, respectively. Utilities such as oil and gas pipelines, water lines, and electrical distribution lines in and near the ROW may be affected for a limited time during construction at a particular location. The majority of the impacts to agriculture would be temporary. Construction would temporarily prevent the use of rangeland and cultivated crops in the ROW. Impacts to agriculture are addressed in greater detail in Section 3.2.

The duration of construction for the complete AC collection system will be approximately 24 months from mobilization to restoration.

The sections below and Table 3.10-13 describe the land cover that would be affected within each alternative. The sections below also describe the structures that would be affected by each alternative. For each route, it is assumed that the entire acreage within the ROW would be temporarily disturbed during construction, although construction would not occur on the entire length of a route at the same time.

3.10.6.2.2.1.1 Route E-1

AC Collection System Route E-1 would disturb approximately 708 acres. The predominant land cover is grassland herbaceous (574.2 acres, or 81.1 percent of the representative ROW). Less than 0.1 mile (0.1 percent) of the representative ROW is parallel to existing transmission lines and less than 0.1 mile (0.1 percent) is parallel to existing roads. One agricultural structure and one industrial structure are present in the representative ROW.

3.10.6.2.2.1.2 Route E-2

AC Collection System Route E-2 would disturb approximately 974 acres. The land cover is primarily grassland/ herbaceous (572.8 acres, or 58.8 percent of the representative ROW) and cultivated crops (298.6 acres, or 30.6 percent of the ROW). Approximately 18 acres (2 percent of the representative ROW) are Oklahoma school trust lands that would be temporarily unavailable for agriculture and oil/gas development. Approximately 0.1 mile (0.3 percent) of the representative ROW is parallel to existing transmission lines and approximately 1.1 miles (2.8 percent) is parallel to existing roads. No structures are present in the representative ROW.

This page intentionally left blank

Table 3.10-13:
Land Cover in the AC Collection System Representative ROW, by Route

		Barren Land (Rock/Sand/Clay)	Cultivated Crops	Developed, High Intensity	Developed, Low Intensity	Developed, Medium Intensity	Developed, Open Space	Emergent Herbaceous Wetlands	Grassland/ Herbaceous	Open Water	Shrub/ Scrub	Woody Wetlands	Total
E-1	Acres	0.0	48.8	0.0	0.6	0.0	32.8	0.0	574.2	0.0	50.9	0.7	708.0
	Percent	0.0	76.9	0.0	0.1	0.0	4.6	0.0	81.1	0.0	7.2	0.1	100.0
E-2	Acres	0.0	280	0.0	0.5	0.0	26.3	0.0	572.8	0.0	74.5	1.8	974.4
	Percent	0.0	30.7	0.0	0.1	0.0	2.7	0.0	58.8	0.0	7.6	0.2	100.0
E-3	Acres	0.0	105.2	0.0	0.9	0.0	174.0	0.0	650.3	0.0	47.1	0.0	977.5
	Percent	0.0	10.8	0.0	0.1	0.0	17.8	0.0	66.5	0.0	4.8	0.0	100.0
NE-1	Acres	0.0	247.2	0.0	7.3	0.5	141.7	1.2	291.1	0.0	40.7	0.0	729.8
	Percent	0.0	33.9	0.0	1.0	0.1	19.4	0.2	39.9	0.0	5.6	0.0	100.0
NE-2	Acres	0.5	50.2	0.0	0.8	0.0	103.8	0.0	450.2	0.0	32.1	0.0	637.4
	Percent	0.1	7.9	0.0	0.1	0.0	16.3	0.0	70.6	0.0	45.0	0.0	100.0
NW-1	Acres	0.0	85.0	0.0	15.1	0.0	540.2	0.0	609.5	0.0	15.6	0.0	1,265.4
	Percent	0.0	6.7	0.0	1.2	0.0	42.7	0.0	48.2	0.0	1.2	0.0	100.0
NW-2	Acres	0.0	410.9	0.0	6.2	0.5	292.0	0.0	629.3	0.0	26.1	0.0	1,365.0
	Percent	0.0	30.1	0.0	0.5	0.0	21.4	0.0	46.1	0.0	1.9	0.0	100.0
SE-1	Acres	0.0	340.0	0.0	0.2	0.0	64.2	0.0	513.2	1.9	59.4	0.0	979.4
	Percent	0.0	34.7	0.0	0.0	0.0	6.6	0.0	52.4	0.2	6.1	0.0	100.0
SE-2	Acres	0.0	130.6	0.0	0.0	0.0	20.6	0.0	169.9	0.0	4.4	0.0	325.4
	Percent	0.0	40.1	0.0	0.0	0.0	6.3	0.0	52.2	0.0	1.3	0.0	100.0
SE-3	Acres	0.0	483.9	0.0	10.9	0.0	71.8	0.0	565.7	0.0	59.6	1.8	1,193.6
	Percent	0.0	40.5	0.0	0.9	0.0	6.0	0.0	47.4	0.0	5.0	0.1	100.0
SW-1	Acres	0.0	0.0	0.0	0.7	0.0	9.5	0.0	312.8	0.0	2.6	0.0	325.6
	Percent	0.0	0.0	0.0	0.2	0.0	2.9	0.0	96.1	0.0	0.8	0.0	100.0
SW-2	Acres	0.0	33.6	0.0	1.5	0.0	122.7	0.0	733.0	0.0	10.6	0.0	901.4
	Percent	0.0	3.7	0.0	0.2	0.0	13.6	0.0	81.3	0.0	1.2	0.0	100.0
W-1	Acres	0.0	47.2	0.0	1.8	1.1	69.4	0.0	377.0	0.0	11.5	0.0	507.8
	Percent	0.0	9.3	0.0	0.4	0.2	13.7	0.0	74.2	0.0	2.3	0.0	100.0

Source: Jin et al. (2013)

This page intentionally left blank.

3.10.6.2.2.1.3 Route E-3

AC Collection System Route E-3 would disturb approximately 978 acres. The land cover is primarily grassland/herbaceous (650.3 acres, or 66.5 percent of the representative ROW). Approximately 50 acres (5 percent of the representative ROW) are Oklahoma school lands that would be temporarily unavailable for agriculture and oil/gas development. Less than 0.1 mile (0.2 percent) of the representative ROW is parallel to existing transmission lines and 1.4 miles (3.6 percent) is parallel to existing roads. Two agricultural structures and one residential structure are present in the representative ROW.

3.10.6.2.2.1.4 Route NE-1

AC Collection System Route NE-1 would disturb approximately 730 acres. The land cover is primarily grassland/herbaceous (291.1 acres, or 39.9 percent of the representative ROW) and cultivated crops (247.2 acres, or 33.9 percent of the ROW). Approximately 27 acres (4 percent of the representative ROW) are Oklahoma school lands that would be temporarily unavailable for agriculture and oil/gas development. Approximately 0.2 mile (0.6 percent) of the representative ROW is parallel to existing transmission lines; none of the route is parallel to existing roads. No structures are present in the representative ROW.

3.10.6.2.2.1.5 Route NE-2

AC Collection System Route NE-2 would disturb approximately 637 acres. The land cover is primarily grassland/herbaceous (450.2 acres, or 70.6 percent of the representative ROW). Approximately 25 acres (4 percent of the representative ROW) are Oklahoma school lands that would be temporarily unavailable for agriculture and oil/gas development. Approximately 0.2 mile (0.8 percent) of the representative ROW is parallel to existing transmission lines; none of the route is parallel to existing roads. One residence and one agricultural structure are present in the representative ROW.

3.10.6.2.2.1.6 Route NW-1

AC Collection System Route NW-1 would disturb approximately 1,265 acres. The land cover is primarily grassland/herbaceous (609.5 acres, or 48.2 percent of the representative ROW) and developed, open space (540.2 acres, or 42.7 percent of the ROW). Approximately 71 acres (6 percent of the representative ROW) are Oklahoma school lands that would be temporarily unavailable for agriculture and oil/gas development. Approximately 12 miles (22.8 percent) of the representative ROW is parallel to existing transmission lines; none of the route is parallel to existing roads. One agricultural structure and one industrial structure are present in the representative ROW.

3.10.6.2.2.1.7 Route NW-2

AC Collection System Route NW-2 would disturb is approximately 1,365 acres. The land cover is primarily grassland/herbaceous (629.3 acres, or 46.1 percent of the representative ROW), cultivated crops (410.9 acres, or 30.1 percent of the ROW), and developed, open space (292.0 acres, or 21.4 percent of the ROW). Approximately 25 acres (2 percent of the representative ROW) are Oklahoma school lands that would be temporarily unavailable for agriculture and oil/gas development. Approximately 0.1 mile (0.2 percent) of the representative ROW is parallel to existing transmission lines; none of the route is parallel to existing roads. No structures are present in the representative ROW.

3.10.6.2.2.1.8 Route SE-1

AC Collection System Route SE-1 would disturb is approximately 979 acres. The land cover is primarily grassland/ herbaceous (513.2 acres, or 52.4 percent of the representative ROW) and cultivated crops (340.0 acres, or 34.7 percent of the ROW). Approximately 0.1 mile (0.3 percent) of the representative ROW is parallel to existing transmission lines and 2.7 miles (6.6 percent) is parallel to existing roads. No structures are present in the representative ROW.

3.10.6.2.2.1.9 Route SE-2

AC Collection System Route SE-2 would disturb is approximately 325.4 acres. The land cover is primarily grassland/ herbaceous (169.9 acres, or 52.2 percent of the representative ROW) and cultivated crops (130.6 acres, or 40.1 percent of the ROW). Approximately 0.3 mile (1.9 percent) of the representative ROW is parallel to existing transmission lines and 0.1 mile (0.8 percent) is parallel to existing roads. No structures are present in the representative ROW.

3.10.6.2.2.1.10 Route SE-3

AC Collection System Route SE-1 would disturb approximately 1,194 acres. The land cover is primarily grassland/ herbaceous (565.7 acres, or 47.4 percent of the representative ROW) and cultivated crops (483.9 acres, or 40.5 percent of the ROW). Approximately 18 acres (2 percent of the representative ROW) are Oklahoma school that would be temporarily unavailable for agriculture and oil/gas development. Approximately 0.1 mile (0.2 percent) of the representative ROW is parallel to existing transmission lines and 11.9 miles (24.2 percent) is parallel to existing roads. No structures are present in the ROW.

3.10.6.2.2.1.11 Route SW-1

AC Collection System Route SW-1 would disturb approximately 326 acres. The land cover is almost entirely grassland/herbaceous (312.8 acres, or 96.1 percent of the representative ROW). Approximately 0.2 mile (1.6 percent) of the representative ROW is parallel to existing transmission lines and 0.2 mile (1.2 percent) is parallel to existing roads. No structures are present in the representative ROW.

3.10.6.2.2.1.12 Route SW-2

AC Collection System Route SW-2 would disturb approximately 901 acres. The predominant land cover is grassland/ herbaceous (733.0 acres, or 81.3 percent of the representative ROW). Less than 0.1 mile (0.1 percent) of the representative ROW is parallel to existing transmission lines and 4.2 miles (11.2 percent) is parallel to existing roads. One industrial structure is present in the ROW.

3.10.6.2.2.1.13 Route W-1

AC Collection System Route W-1 would disturb is approximately 508 acres. The predominant land cover is grassland/herbaceous (377.0 acres, or 74.2 percent of the representative ROW). Less than 0.1 mile (0.4 percent) of the representative ROW is parallel to existing transmission lines; none of the route is parallel to existing roads. One agricultural structure and one industrial structure are present in the ROW.

3.10.6.2.2.2 Operations and Maintenance Impacts

Within the AC collection system ROW (four to six ROWs, each extending up to 40 miles from the converter station), the only Project components that would remain during operations and maintenance would be the pole structures, fiber optic regeneration sites, and most access roads.

Because the type of transmission structure that would be used has not yet been determined, the potential disturbance for each type was estimated. For lattice structures, the operational footprint would be five to seven structures per mile, and each would have 28 feet by 28 feet foundation (less than 0.1 acre). Assuming 300 miles of lattice structures at 7 per mile, the operational footprint would be up to 42 acres. For tubular pole structures, the operational footprint would be five to seven structures per mile, each 49 square feet, up to 2.4 acres total. For H-frame structures, the operational footprint would be two poles spaced 25 feet apart, each with a 7 feet x 7 feet footprint. All of the structures would be 75 to 180 feet tall. Impact calculations assumed lattice structures would be used for a conservative estimate of potential impacts.

A total of approximately 3 acres of undeveloped land would be converted to a utility use for the six fiber optic regeneration sites anticipated to be required for the entire AC collection system.

It is anticipated that all existing roads and existing roads with repairs/improvements would be retained for operations and maintenance of the Project. It is estimated that approximately 75 percent of the new overland roads with no improvements and 90 percent of the new overland roads with clearing and new bladed roads would be retained for operations and maintenance access. These roads would be up to 20 feet wide and would total approximately 489 acres. Access roads that are not needed for operations and maintenance would be restored.

All other land in the ROW could return to most previous land uses if they are compatible with operations and maintenance of the Project. As noted in Section 2.1.5.1, limitations on land uses would be described in individual landowner easement agreements that could be modified in the easement based on site-specific conditions and/or coordination with landowners. Some land uses, such as forest land, would not be permitted due to height restrictions for vegetation below the transmission lines. Some uses may be impeded in the ROW, such as using farming equipment near the pole structures or crop-dusting planes that would not be able to approach the transmission lines. Land uses that generally may not be permitted in the ROW include constructing buildings or structures, changing the grading and land contours such that the ground surface elevation within the ROW would change and alter the required electrical clearance, and installing fences or irrigation lines without coordination with the Applicant. In addition, access would be restricted during the performance of maintenance activities. All of the tensioning or pulling areas and other temporary construction areas could return to existing uses once construction has been completed.

Because the locations of access roads to the AC collection system are not known at this time, it is possible that the access roads could be located in such a way that small areas of agricultural land would be isolated and no longer practicable to be used for farmland or grazing.

The long-term impacts by route are summarized in Table 3.10-14 for structures. No permanent impacts are described for access roads, because the location of access roads has not yet been determined.

Table 3.10-14:
Impacts During the Operational Phase of the AC Collection Lines

AC Collection System Route	Length (miles)	Estimated Footprint of Structures (acres)[1]
E-1	29	4.06
E-2	40	5.6
E-3	40	5.6
NE-1	30	4.2
NE-2	26	3.6
NW-1	52	7.3
NW-2	56	7.8
SE-1	40	5.6
SE-2	13	1.8
SE-3	49	6.9
SW-1	13	1.8
SW-2	37	5.2
W-1	21	2.9

1 For a conservative estimate of impacts, the anticipated footprint of structures assumes seven lattice structures per mile; each would have a 28-foot by 28-foot foundation (less than 0.1 acre).

3.10.6.2.2.3 Decommissioning Impacts

Potential impacts during decommissioning of the Project would be similar to those of the construction phase for all Project components. Once the decommissioning has been completed, all land could return to the pre-construction land uses described in Sections 3.10.4 and 3.10.5.

3.10.6.2.3 HVDC Applicant Proposed Route

This section identifies the potential land use impacts of the approximate 720 mile-long transmission facility during the three phases of the Project: construction, operations and maintenance, and decommissioning. Specific EPMs developed to avoid and minimize land use impacts are described in Section 3.10.6.1 and Section 3.10.6.7 and are referenced in the discussion below in parentheses. Changes to impacts related to the route variations and adjustments developed in response to public comments on the Draft EIS are described at the end of applicable sections.

3.10.6.2.3.1 Construction Impacts

Construction would begin with clearing and grading for access roads, pole structure sites and assembly areas, wire splicing sites, and tensioning or pulling sites. These areas would not be available for agricultural use during construction. Within the ROW, trees would need to be removed. Individual transmission structure sites would be cleared. Hand, mechanized, and chemical clearing may be used. For tensioning or pulling sites, clearing would be limited to the removal of larger woody vegetation or dense brush that may interfere with tensioning equipment; grading would also be limited to what is necessary to provide temporary access for tensioning equipment.

Within or adjacent to the ROW for the transmission line, all trees would be removed. In the border zone adjacent to the ROW, some small trees may remain if they would not pose a risk of falling into the conductors.

The ROW would be 200 feet wide by approximately 720 miles. Within the ROW, assembly areas for the pole structures, tensioning or pulling sites, and wire-splicing sites would be required during construction. The lattice structures would require assembly areas 200 feet wide by 200 feet long for each structure, four to six areas per mile. Monopole structure assembly would also require areas 200 feet wide by 200 feet long for each structure, five to seven structures per mile. Guyed structures (structures that are stabilized by tensioned cables) would require an assembly area 200 feet wide by 300 feet long and would be required in limited situations, such as in turns in the line and deadends. Lattice crossing structures would require an assembly area 200 feet wide by 300 feet long and would be required in limited situations (e.g., Mississippi River and Arkansas River crossings). Assuming six lattice structure assembly areas per mile for 720 miles, assembly areas could require up to 3,888 acres. Tensioning or pulling sites inside the ROW would require areas 200 feet wide by 650 feet long, or 3.0 acres for approximately 755 sites, for a total of 2,265 acres, although only 2,035 acres would be located within the ROW. (It is estimated that 230 acres will be outside the ROW.) Each wire-splicing site would require 100 feet wide by 100 feet long (0.2 acre) and would be spaced 1 to 3 miles apart. Assuming a site every 2 miles or 360 sites, the total footprint of wire-splicing sites for the HVDC transmission line would be 72 acres.

Both inside and outside the ROW, roads to access the transmission line and all temporary construction areas during construction would be required. Total disturbance for all access roads for the transmission lines would be approximately 2,230 acres, 79 percent (1,753 acres) of which would be within the ROW and 21 percent (477 acres) of which would be outside the ROW.

Access roads would include existing roads, existing roads with repairs/improvements, and new roads. New roads would include overland roads with no clearing or grading, overland roads with clearing and minor grading, new bladed roads, and new temporary matted or aggregate roads used to access structures or temporary work areas in soft and wet conditions. Paving of roads would be limited to the approach aprons at intersections with existing paved roads, unless otherwise required by local jurisdictional authorities.

Construction would not impact existing roads that do not need any improvements. For existing roads that would require repairs or improvements, the disturbance areas would include a total width of 35 feet, minus the width of the existing road.

Disturbance areas for new roads would be 35 feet wide for most of the Project, but in areas with steep side slopes (greater than 15 percent), the construction disturbance may be up to 50 feet wide. For new overland roads with no vegetation clearing, vehicular traffic would use an area 14-20 feet wide. For overland roads that require vegetation clearing, up to 20 feet wide would be cleared within a total disturbance corridor 35 feet wide.

Also outside the ROW, additional areas for fiber optic regeneration sites, tensioning or pulling sites, multi-use construction yards, and fly yards would be required. Approximately four fiber optic regeneration sites (one site every 180–200 miles) would be required. Each site would be approximately 100 feet wide by 100 feet long (0.2 acre), with a fenced area of approximately 75 feet by 75 feet. The regeneration equipment would be enclosed in a small control building made of either metal or concrete, approximately 12 feet by 32 feet by 9 feet tall. An access road and power supply to the site would be required. Typically, these sites would be adjacent to or within 750 feet of the ROW. A total of 0.8 acre of undeveloped land would be converted to a utility use for the four fiber optic regeneration sites. Tensioning or pulling sites outside the ROW (or partially outside the ROW) would be required where the line turns more than 8 degrees. Approximately 230 acres of tensioning or pulling sites across the HVDC route would be outside the ROW.

Multi-use construction yards would each be approximately 25 acres in size and would be located approximately 25 miles apart and typically within 10 miles of the ROW. Assuming approximately 29 yards, the total footprint would be approximately 725 acres. Fly yards would each require 10 to 15 acres and would be located at approximate 5-mile intervals along the ROW and typically within 10 miles of the ROW. Of a total of 144 fly yards, 29 of which would be located within multi-use construction yards, 115 would have a total footprint of 1,150 to 1,725 acres. All of these areas would be temporary and would be revegetated once the construction phase has been completed.

In total, approximately 10,906 acres would be required during construction of the HVDC line, although construction would only occur in particular construction segments for a limited time.

Potential temporary impacts on residences, businesses, schools, and other areas near the construction area would include noise, dust, transportation, safety issues, and visual impacts; all of these are discussed in Sections 3.11, 3.3, 3.16, 3.8, and 3.18, respectively. Utilities such as oil and gas pipelines, water lines, and electrical distribution lines in and near the ROW may be affected during construction, although identification and verification of the location of these facilities by the Applicant would minimize impacts.

The majority of the impacts to agriculture would be temporary. Construction would prevent the use of rangeland and cultivated crops in the ROW in a specific location and may change the contour of the land and affect irrigation infrastructure. Impacts to agriculture are addressed in greater detail in Section 3.2.

Potential impacts to oil and gas wells would occur in Regions 1, 2, 3, and 5 of the Project. Construction of the Project could conflict with drilling equipment, but would be minimized by coordination with landowners and/or well operators during construction. Impacts to subsurface collection systems and other infrastructure would be minimized by locating these facilities prior to clearing, grading, and foundation excavation activities were conducted for the Project.

The duration of construction is expected to be approximately 36 to 42 months for the entire Project, although the duration of construction for a single HVDC segment is anticipated to be approximately 24 months from mobilization to restoration.

3.10.6.2.3.1.1 Region 1

The Applicant Proposed Route in Region 1 is approximately 115 miles long. Approximately 2 miles (1.4 percent) is parallel to existing transmission lines and 8 miles (7.0 percent) is parallel to existing roads. The land cover in the 200-foot-wide representative ROW for Region 1, listed in Table 3.10-15, is primarily grassland herbaceous (1,742.3 acres or 61.7 percent) and cultivated crops (748.8 acres or 26.5 percent).

Table 3.10-15:
Land Cover in the Applicant Proposed Route—Region 1

Land Cover	Link 1		Link 2		Link 3		Link 4		Link 5		Total Region 1	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Barren Land (Rock/Sand/ Clay)	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.1	0.0	0.0	0.8	0.0
Cultivated Crops	0.0	0.0	535.1	41.1	0.0	0.0	108.8	13.5	104.8	16.0	748.8	26.5
Deciduous Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0
Developed, Low Intensity	0.0	0.0	0.9	0.1	0.0	0.0	0.0	0.0	2.7	0.4	3.6	0.1
Developed, Medium Intensity	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.1	0.7	0.1	1.3	0.0
Developed, Open Space	1.9	4.0	77.3	5.9	0.0	0.0	23.4	2.9	67.3	10.3	169.6	6.0
Grassland/Herbaceous	42.8	90.0	590.4	45.4	14.1	93.6	641.0	79.4	456.6	69.8	1,742.3	61.7
Open Water	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	11.7	1.8	12.1	0.4
Shrub/Scrub	2.8	26.0	96.6	7.4	1.0	6.4	29.1	3.6	9.6	1.5	139.0	4.9
Woody Wetlands	0.0	0.0	0.7	0.0	0.0	0.0	3.7	0.5	0.4	0.1	4.8	0.2
Total	3.0	100.0	1,301.0	100.0	15.0	100.0	807.8	100.0	654.0	100.0	2,822.3	100.0

Source: Jin et al. (2013)

Approximately 18 acres of Oklahoma school trust lands is present in Applicant Proposed Route Link 2, 4 acres in Link 4, and 31 acres in Link 5 that would be temporarily unavailable for other uses, totaling 54 acres (2 percent of the representative ROW). One commercial structure and one agricultural structure (in Link 4) are present in the representative ROW.

Outside the ROW, tensioning or pulling areas totaling approximately 100.8 acres would be required during construction and would be unavailable for other uses. The land cover in these areas is primarily grassland/herbaceous land and cultivated crops. Approximately 0.5 acre is school trust lands. No structures are present in these areas.

No route variations were proposed in Region 1.

3.10.6.2.3.1.2 Region 2

The Applicant Proposed Route in Region 2 is approximately 106 miles long. Approximately 1 mile (1.2 percent) is parallel to existing transmission lines and 12 miles (11.7 percent) is parallel to existing roads. The land cover in the 200-foot-wide representative ROW for Region 2 is listed in Table 3.10-16. The land cover in the ROW is primarily grassland herbaceous (1,299.9 acres or 50.3 percent), cultivated crops (788.0 acres or 30.5 percent), evergreen forest (200.0 acres, or 7.7 percent), and developed, open space (218.0 acres or 8.4 percent).

Table 3.10-16:
Land Cover in the Applicant Proposed Route—Region 2

Land Cover[1]	Link 1		Link 2		Link 3		Total	
	Acres	%	Acres	%	Acres	%	Acres	%
Cultivated Crops	46.1	9.3	414.7	31.2	328.7	43.0	788.0	30.5
Deciduous Forest	0.0	0.0	7.5	0.6	14.9	1.9	22.3	0.9
Developed, Low Intensity	1.5	0.3	8.7	0.7	0.7	0.1	10.9	0.4
Developed, Medium Intensity	0.0	0.0	1.9	0.1	0.6	0.1	2.5	0.1
Developed, Open Space	17.5	3.6	51.5	3.9	149.0	19.5	218.0	8.4
Evergreen Forest	5.6	1.1	193.4	14.5	1.0	0.1	200.0	7.7
Grassland/Herbaceous	421.7	85.4	609.5	45.8	268.8	35.2	1,299.9	50.3
Mixed Forest	0.0	0.0	30.6	2.3	0.0	0.0	30.6	1.2
Open Water	0.0	0.0	5.3	0.4	0.1	0.0	5.3	0.2
Shrub/Scrub	1.3	0.3	7.8	0.6	0.0	0.0	9.2	0.4
Total	493.7	100.0	1,330.7	100.0	763.6	100.0	2,586.7	100.0

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
Source: Jin et al. (2013)

Approximately 31 acres of Oklahoma school trust lands are present in Applicant Proposed Route Link 1, 55 acres in Link 2, and 12 acres in Link 3 that would be temporarily unavailable for other uses, totaling 97 acres (4 percent of the representative ROW). Two commercial structures (one each in Link 2 and Link 3), two industrial structures (in Link 2), and two agricultural structures (in Link 3) are present in the representative ROW.

Outside the ROW, tensioning or pulling areas totaling approximately 99.0 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover types are grassland/herbaceous and cultivated crops. The 3 acres of school trust lands in Applicant Proposed Route Link 1 and 3 acres in Link 3 would be temporarily unavailable for other uses. No structures are present in these areas.

Two route variations to the Applicant Proposed Route were developed in Region 2 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.2. The variations are illustrated in Exhibit 1 of Appendix M. A description of the impacts of the variations compared to the original Applicant Proposed Route follows. Link 1, Variation 1, has similar land use, but would affect approximately 4 more acres of grassland and approximately 4 acres less of forest land, and would be closer to more residences and structures than the original Applicant Proposed Route Link 1. The variation was developed to reduce impacts to cultivated fields and structures. Link 2, Variation 2, would run closer to the quarter-section line that parallels parcel boundaries than the original Applicant Proposed Route Link 2, and approximately 30 acres more grassland and 24 acres less agricultural land would be impacted compared to the original Applicant Proposed Route Link 2. There is one more residence in the representative ROW of Variation 2.

3.10.6.2.3.1.3 Region 3

The Applicant Proposed Route in Region 3 is approximately 162 miles long. Approximately 3 miles (2 percent) is parallel to existing transmission lines and 8.8 miles (5.4 percent) is parallel to existing roads. The land cover in the 200-foot-wide representative ROW for Region 3 is listed in Table 3.10-17. Land cover in Region 3 is more variable than the two westernmost regions (regions 1 and 2); specifically, there are more forested areas. The land cover in the Applicant Proposed Route is grassland/herbaceous (1,339.5 acres or 33.9 percent), deciduous forest (1,098.2 acres or 27.8 percent), and pasture/hay (941.3 acres or 23.9 percent).

Approximately 48 acres of Oklahoma State University land in Applicant Proposed Route Link 1 is currently used as a research area. Eighty-seven acres of school trust land (33 acres in Link 1, 1 acre in Link 2, 26 acres in Link 3, and 27 acres in Link 4) are present in the representative ROW. Approximately 4 acres in Link 6 are part of the Webbers Falls Lock and Dam and Reservoir and managed by Arkansas Riverbed Authority. All of these areas would be temporarily unavailable during construction in this location. Flood control dams constructed by NRCS would be crossed by and adjacent to Link 4. Two residences (one each in Link 2 and Link 5), two industrial structures (one each in Link 1 and Link 4), and five agricultural structures (one in Link 1, one in Link 2, two in Link 4, and one in Link 6) are present in the representative ROW.

Outside the ROW, tensioning or pulling areas totaling approximately 379 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover in these areas is grassland/herbaceous. Approximately 1 acre in Applicant Proposed Route Link 1 is Oklahoma State University land used for research. Sixteen acres of school trust lands are present (9 acres in Link 1, less than 0.1 acre in Link 2, 6 acres in Link 3, and 2 acres in Link 4). Approximately 1 acre of Link 6 is part of the Webbers Falls Lock and Dam and Reservoir. All of these areas would be temporarily unavailable for other uses during construction. No existing structures are present in these areas.

Five route variations to the Applicant Proposed Route were developed in Region 3 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.3. The variations are illustrated in Exhibit 1 of Appendix M. A description of the impacts of the variations compared to the original Applicant Proposed Route follows. The representative ROW for Link 1, Variation 2, would cross approximately 6 acres less of cropland, 11 acres more of forested land, and 5 acres more of grassland. This variation would be farther from a residence and reduce impacts to cultivated cropland compared to the original Applicant Proposed Route Link 1. Links 1 and 2, Variation 1, would cross half as many parcels, has approximately 21 acres more grassland, and, while it would no longer have a residence within 100 feet, it would have six additional residences within 250 feet compared to the original Applicant Proposed Route Links 1 and 2. This variation would parallel parcel boundaries; it should be noted that a route adjustment was made for HVDC Alternative Route 3-A to maintain an end-to-end route with this variation. Link 4, Variation 1, would avoid impacts to a quarry operation and crosses approximately 3 acres more grassland and 1 acre more forest land compared to the original Applicant Proposed Route Link 4. The representative ROW for Link 4, Variation 2, would cross approximately 4 acres more forest land than the original Applicant Proposed Route Link 4 but would avoid a residence. Link 5, Variation 2, avoids a residence, parallels more existing infrastructure, and crosses four fewer parcels than the original Applicant Proposed Route Link 5. The representative ROW of this variation would also cross approximately 9 acres more forest land and 8 acres less pasture/hay.

3.10.6.2.3.1.4 Region 4

The Applicant Proposed Route in Region 4 is approximately 126 miles long. Approximately 2 miles (1.4 percent) is parallel to existing transmission lines and 7 miles (5.5 percent) is parallel to existing roads. The land cover in the 200-foot-wide representative ROW for Region 4 is listed in Table 3.10-18. In contrast to the two westernmost regions (Regions 1 and 2), the land cover in Region 4 is dominated by pasture/hay and forest land. The land cover in the representative ROW is 1,436.1 acres (46.6 percent) pasture/hay, 813.7 acres (26.4 percent) deciduous forest, and 404.7 acres (13.1 percent) evergreen forest.

The Lee Creek Variation is 3.4 miles long. None of the route is parallel to existing infrastructure. The land cover in the 200-foot-wide representative ROW is 94.4 percent forest land. Like all forested areas in the ROW, the height of trees would be restricted within the ROW for the life of the Project if this route is selected.

Approximately 17 acres (8 percent of the Applicant Proposed Route Link 1 representative ROW) includes the USACE-managed Webbers Falls Lock and Dam and Reservoir (managed by Arkansas Riverbed Authority) and 2.5 acres (less than 1 percent of the representative ROW) crosses the edge of the USFS-managed Ozark National Forest.

The representative ROW of Link 6 also crosses through an edge of the Frog Bayou WMA and a thin arm of the Ozark Lake WMA, so disturbance to the primary portions of both WMAs are likely to be minimal. Approximately 2 acres cross the Ozark Lake WMA, and 4 acres cross the Frog Bayou WMA. These areas would be temporarily unavailable for other uses such as hunting during construction.

The representative ROW of Link 6 includes two parcels of land enrolled in the WRP totaling approximately 6 acres. Under these easements, most land use rights are transferred to the USDA, and getting approval for development of the Project on these lands may be difficult because the Project may not be viewed as compatible with the protection and restoration of wetlands. Flood control dams constructed by NRCS are adjacent to Link 3.

One residence (in Link 6) and four agricultural structures (one in Link 6, one in Link 7, and two in Link 9) are present in the representative ROW. There is a hunting cabin immediately adjacent to the representative ROW in Link 9.

Outside the ROW, tensioning or pulling areas totaling approximately 483 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover in these areas is pasture/hay followed by deciduous forest. Less than 0.1 acre in Applicant Proposed Link 1 is part of Webbers Falls Lock and Dam and Reservoir, and 4 acres in Link 6 are part of Frog Bayou WMA. These areas would be temporarily unavailable for existing uses during construction. Two residences and one agricultural structure are present in these areas.

Table 3.10-17:
Land Cover in the Applicant Proposed Route—Region 3

Land Cover[1]	Link 1		Link 2		Link 3		Link 4		Link 5		Link 6		Total	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Barren Land (Rock/Sand/ Clay)	0.0	0.0	0.0	0.0	0.0	0.0	2.6	0.1	0.0	0.0	0.0	0.0	2.6	0.1
Cultivated Crops	196.2	20.1	7.0	10.4	34.4	20.6	68.9	3.7	6.2	0.9	0.0	0.0	312.6	7.9
Deciduous Forest	210.7	21.6	5.2	6.7	41.8	25.1	675.4	36.1	84.4	12.6	80.8	42.6	1,098.2	27.8
Developed, High Intensity	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Developed, Low Intensity	0.7	0.1	0.2	0.2	0.0	0.0	2.5	0.1	0.8	0.1	1.0	0.5	5.2	0.1
Developed, Medium Intensity	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.6	0.3	1.2	0.0
Developed, Open Space	67.0	6.5	2.6	3.3	4.9	3.0	79.2	4.2	21.3	3.2	9.4	5.0	184.4	4.7
Evergreen Forest	25.8	2.6	1.9	2.5	8.3	5.0	9.0	0.5	2.2	0.3	0.0	0.0	47.2	1.2
Grassland/Herbaceous	467.6	47.9	49.1	64.0	75.8	45.5	562.1	30.0	161.1	24.1	24.4	12.9	1,339.5	33.9
Mixed Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Open Water	3.2	0.3	0.3	0.3	0.0	0.0	6.6	0.4	2.3	0.3	0.2	0.1	12.5	0.3
Pasture/Hay	5.9	0.6	9.9	12.9	1.5	0.9	464.8	24.8	388.2	58.2	73.2	38.6	941.3	23.9
Shrub/Scrub	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Woody Wetlands	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.7	0.0
Total	862.0	100.0	76.8	100.0	166.7	100.0	1,871.8	100.0	667.1	100.0	189.7	100.0	3,945.5	100.0

The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
Source: Jin et al. (2013)

This page intentionally left blank.

Table 3.10-18:
Land Cover in the Applicant Proposed Route—Region 4

Land Cover[1]	Link 1		Link 2		Link 3		Link 4		Link 5		Link 6		Link 7		Link 8		Link 9		Total		Lee Creek Variation	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Barren Land (Rock/Sand/ Clay)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	0.1	0.0	0.0
Cultivated Crops	1.8	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	60.1	11.1	0.0	0.0	0.0	0.0	2.0	0.2	63.9	2.1	0.0	0.0
Deciduous Forest	113.8	56.1	45.7	44.6	305.5	35.7	10.0	38.7	25.0	46.3	67.3	12.5	47.0	13.1	3.9	7.7	197.8	22.1	813.7	26.4	63.2	75.6
Developed, Low Intensity	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.7	9.8	1.8	1.3	0.4	0.0	0.0	3.8	0.4	15.3	0.5	0.0	0.0
Developed, Medium Intensity	0.7	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0
Developed, Open Space	11.1	5.5	1.2	1.1	14.8	1.7	0.5	1.8	1.0	1.9	17.1	3.2	8.2	2.3	1.2	2.4	27.6	3.1	82.6	2.7	0.0	0.0
Emergent Herbaceous Wetlands	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.3	0.0	0.0	0.0	0.0	0.6	0.1	2.0	0.1	0.0	0.0
Evergreen Forest	1.6	0.8	0.0	0.0	41.1	4.8	1.6	6.0	5.2	9.7	32.0	5.9	107.3	29.8	6.9	13.7	209.6	23.4	404.7	13.1	9.5	11.4
Grassland/Herbaceous	13.1	6.4	6.7	6.5	37.4	4.4	0.0	0.0	1.0	1.9	1.3	0.2	1.4	0.4	0.0	0.0	16.6	41.9	77.5	2.5	3.0	3.6
Mixed Forest	11.3	5.6	0.9	0.9	17.9	2.1	5.5	21.3	4.9	9.2	5.6	1.0	22.8	6.3	2.3	4.6	44.1	4.9	115.1	3.7	6.2	7.4
Open Water	6.0	3.0	0.0	0.0	0.8	0.1	0.0	0.0	0.0	0.0	0.7	0.1	0.0	0.0	0.0	0.0	0.9	0.1	8.3	0.3	0.4	0.5
Pasture/Hay	38.6	19.0	46.4	45.2	428.2	50.0	8.3	32.2	15.9	29.7	328.5	60.8	169.2	47.1	35.8	71.6	368.2	41.1	1,436.1	46.6	0.0	0.0
Shrub/Scrub	4.5	2.2	1.8	1.7	8.5	1.0	0.0	0.0	0.0	0.0	0.3	0.1	1.9	0.5	0.0	0.0	23.2	2.6	40.1	1.3	0.8	1.0
Woody Wetlands	0.6	0.3	0.0	0.0	2.4	0.3	0.0	0.0	0.0	0.0	13.3	2.5	0.5	0.1	0.0	0.0	2.4	0.3	19.1	0.6	0.5	0.6
Total	203.0	100.0	102.6	100.0	865.5	100.0	25.8	100.0	53.3	100.0	540.0	100.0	359.6	100.0	50.0	100.0	896.7	100.0	3,081.8	100.0	83.5	100.0

The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
Source: Jin et al. (2013)

This page intentionally left blank.

Seven route variations to the Applicant Proposed Route were developed in Region 4 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.4. The variations are illustrated in Exhibit 1 of Appendix M. A description of the impacts of the variations compared to the original Applicant Proposed Route follows. As compared to the original Links 3, 6, and 9 of the Applicant Proposed Route, Link 3, Variation 1, would parallel parcel boundaries and increase the distance from residences and a cemetery. Link 3, Variation 2, would avoid one airstrips, a residence, and a business while increasing the length parallel to existing infrastructure and following existing parcel boundaries. The representative ROW of this variation would cross approximately 34 acres more forest land and 37 fewer acres of pasture/hay land. Link 3 Variation 2 would cross 17 land parcels, 32 percent fewer land parcels than the Applicant Proposed Route which would cross 25 land parcels. Link 3, Variation 2 parallels 4.4 miles of existing parcel lines and infrastructure including transmission lines and roads, which is more than twice that of the Applicant Proposed Route, which parallels existing parcel lines and infrastructure for 1.9 miles. Link 3, Variation 2 would have 1 residence within 500 feet, while the Applicant Proposed Route would have 9 residences within 500 feet. One private airstrip would be impacted by Link 3, Variation 2 while the Applicant Proposed Route would potentially impact two private airstrips. Link 3, Variation 2 was proposed by landowners, deemed technically feasible by Clean Line, and independently reviewed by DOE.

Link 3, Variation 3, would cross 12 fewer parcels and more closely follow parcel boundaries, although there are seven more residences and four more agricultural structures within 500 feet of the representative ROW. The representative ROW of this variation would cross approximately 13 acres more pasture/hay land and 20 acres less forest land. Link 6, Variation 1, would more closely parallel parcel boundaries and increase the distance from residences. Link 6, Variation 2, would avoid a WRP easement and would cross approximately 4 acres more pasture/hay and 3 acres less crop land. Link 6, Variation 3, would increase the length parallel to existing infrastructure, cross two fewer parcels, and increase the distance from a residence in the representative ROW. The representative ROW of this variation crosses approximately 3 acres less pasture/hay land. Link 9, Variation 1, crosses two more parcels, but would increase the distance from a residence and campground while maintaining the length parallel to existing infrastructure. The representative ROW of this variation would cross approximately 3 acres more pasture/hay land and 5 acres less forest land.

3.10.6.2.3.1.5 Region 5

The Applicant Proposed Route in Region 5 is approximately 113 miles long. Approximately 0.3 mile (0.3 percent) is parallel to existing transmission lines and 7 miles (6.2 percent) is parallel to existing roads. The land cover in the 200-foot-wide representative ROW for Region 5 is listed in Table 3.10-19. The land cover in Region 5 is dominated by forest land. The land cover in the representative ROW is approximately 811 acres (29.4 percent) deciduous forest and 773 acres (28.1 percent) pasture/hay.

Approximately 77 acres of the Cherokee WMA are within the representative ROW for the Applicant Proposed Route 52 acres in Link 2 and 25 acres in Link 5 and would temporarily be unavailable for other uses during construction in this location. WMAs are primarily used for recreation, such as hunting (see Section 3.12). Two abandoned structures (one each in Link 4 and Link 5), one residence (in Link 7), one agricultural structure (in Link 2), and one other structure (in Link 6, use unknown) are present in the representative ROW.

Outside the ROW, tensioning or pulling areas totaling approximately 291 acres would be required during construction. The land cover in these areas is primarily pasture/hay and deciduous forest. Approximately 6 acres of the Cherokee WMA is within the tensioning or pulling area for Link 2 and would be temporarily unavailable during construction at this location. No existing structures are present in these areas.

Five route variations to the Applicant Proposed Route were developed in Region 5 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.5. The variations are illustrated in Exhibit 1 of Appendix M. A description of the impacts of the variations compared to the original Applicant Proposed Route follows. As compared to the original Applicant Proposed Route Links 1, 2, 3, 4, and 7, Link 1, Variation 2, would cross four fewer parcels and would increase the distance from a residence. The representative ROW for this variation crosses approximately 5 acres more pasture/hay land and 3 acres less grassland. Link 2, Variation 2, crosses two more parcels, although it would reduce impacts to a commercial forestry operation and would reduce impacts to the Cherokee WMA by crossing it only one time and doing so along a parcel boundary. The representative ROW for Links 2 and 3, Variation 1, crosses approximately 2 acres more pasture/hay. This variation would increase the distance from a newly identified home and reduce the number of landowners affected; it should be noted that a route adjustment was made for HVDC Alternative Route 5-B to maintain an end-to-end route with this variation. Links 3 and 4, Variation 2, crosses 5 fewer parcels and more closely parallels parcel boundaries while avoiding a homestead site and parcels with conservation easements. The representative ROW for this variation would cross approximately 7 acres less forest land and 4 acres less agricultural land. It should be noted that a route adjustment was made for HVDC Alternative Route 5-E to maintain an end-to-end route with this variation. Link 7, Variation 1, would parallel parcel boundaries and existing infrastructure to avoid a newly identified residence. One less parcel would be crossed, and the representative ROW crosses approximately 3 acres more pasture/hay land and 2 acres more forest land.

3.10.6.2.3.1.6 Region 6

The Applicant Proposed Route in Region 6 is approximately 54 miles long. Approximately 0.3 mile (0.5 percent) is parallel to existing transmission lines and 7 miles (12.7 percent) is parallel to existing roads. The land cover in the 200-foot-wide representative ROW for Region 6 is listed in Table 3.10-20. The land cover in the representative ROW consists of approximately 1,056 acres (79.6 percent) cultivated crops. Typical crops include winter wheat, soybeans, rice, and corn (NASS 2013).

In Link 7, approximately 0.5 acre (less than 1 percent of the representative ROW) crosses the Singer Forest Natural Area easement and approximately 0.3 acre crosses the St. Francis Sunken Lands WMA. The natural area and WMA share approximate boundaries. This area would be temporarily unavailable for other uses (primarily hunting) during construction in this location. Hunting and wildlife viewing may also be temporarily reduced in areas near construction due to noise and removal of vegetation; this would be an indirect short-term impact. The representative ROW of Link 7 includes a parcel of land enrolled in the WRP totaling approximately 0.3 acre. Five agricultural structures (one in Link 4 and four in Link 6) are present in the representative ROW.

Outside the ROW, tensioning or pulling areas totaling approximately 115.6 acres would be required during construction and would be temporarily unavailable for other uses. The land cover in these areas is primarily cultivated crops. No existing structures are present in these areas.

Table 3.10-19:
Land Cover in the Applicant Proposed Route—Region 5

Land Cover[1]	Link 1		Link 2		Link 3		Link 4		Link 5		Link 6		Link 7		Link 8		Link 9		Total	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Barren Land (Rock/Sand/ Clay)	0.0	0.0	0.0	0.0	0.8	0.0	4.8	1.4	8.9	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.1	14.9	0.5
Cultivated Crops	0.0	0.0	0.0	2.4	12.8	1.5	0.0	0.0	5.4	1.5	1.0	0.9	0.0	0.0	0.0	0.0	130.0	26.0	149.3	5.4
Deciduous Forest	102.7	34.2	48.9	31.1	260.0	31.3	68.3	19.4	132.9	38.0	18.7	17.1	58.1	48.2	16.4	41.2	106.4	21.3	810.8	29.4
Developed, High Intensity	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0
Developed, Low Intensity	0.0	0.0	0.8	0.5	2.1	0.3	2.0	0.6	1.9	0.5	1.2	1.1	0.0	0.0	0.0	0.0	5.4	1.1	13.5	0.5
Developed, Medium Intensity	0.0	0.0	0.0	0.0	0.0	0.0	2.2	0.6	2.3	0.7	1.6	1.4	0.2	0.2	0.0	0.0	2.7	0.5	10.5	0.4
Developed, Open Space	7.3	2.4	1.4	0.9	20.9	2.5	5.6	1.6	4.3	1.2	3.0	2.7	1.2	1.0	0.0	0.0	39.4	7.9	83.1	3.0
Emergent Herbaceous Wetlands	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.0
Evergreen Forest	100.4	33.4	68.2	43.3	185.5	22.3	25.0	7.1	45.3	13.0	5.6	5.1	0.5	0.4	1.9	4.9	12.6	2.5	444.3	16.1
Grassland/ Herbaceous	11.0	3.7	4.9	3.1	27.4	3.3	11.6	3.3	12.5	3.6	0.0	0.0	2.7	2.2	1.3	3.3	7.2	1.4	78.5	2.8
Mixed Forest	20.9	7.0	21.1	13.4	48.2	5.8	27.1	7.7	35.4	10.1	28.6	26.2	27.1	22.5	13.7	34.4	80.6	16.1	301.1	10.9
Open Water	0.0	0.0	0.0	0.0	4.2	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.4	0.0	0.0	3.7	0.7	8.3	0.3
Pasture/Hay	53.7	17.9	12.1	7.7	248.6	29.9	198.8	56.5	87.7	25.1	41.4	37.9	30.3	25.1	6.4	16.2	96.4	19.3	773.4	28.1
Shrub/Scrub	4.2	1.4	0.0	0.0	17.4	2.1	6.7	0.0	13.3	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41.6	1.5
Woody Wetlands	0.0	0.0	0.0	0.0	1.1	0.1	0.0	0.0	0.0	0.0	8.2	7.5	0.0	0.0	0.0	0.0	15.0	3.0	24.3	0.9
Total	300.1	100.0	157.6	100.0	830.4	100.0	352.1	100.0	349.9	100.0	109.2	100.0	120.0	100.0	39.8	100.0	499.9	100.0	2,753.8	100.0

The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
Source: Jin et al. (2013)

This page intentionally left blank.

Table 3.10-20:
Land Cover in the Applicant Proposed Route—Region 6

Land Cover[1]	Link 1		Link 2		Link 3		Link 4		Link 5		Link 6		Link 7		Link 8		Total	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Cultivated Crops	127.1	84.7	39.2	94.3	198.3	84.1	140.9	90.6	43.6	94.4	238.3	60.0	193.2	92.3	80.3	83.4	1,056.5	79.6
Deciduous Forest	1.4	0.9	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	85.6	21.6	1.7	0.8	0.0	0.0	88.8	6.7
Developed, Low Intensity	0.5	0.3	0.0	0.0	0.0	0.0	0.4	0.3	0.0	0.0	0.4	0.1	0.0	0.0	0.0	0.0	1.3	0.1
Developed, Medium Intensity	0.0	0.0	0.0	0.0	1.9	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.1
Developed, Open Space	17.2	11.4	1.9	4.5	17.7	7.5	8.6	5.5	2.6	5.6	21.2	5.3	6.2	3.0	7.0	7.2	81.9	6.2
Emergent Herbaceous Wetlands	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.3	0.0	0.0	0.0	0.0	1.1	0.1
Evergreen Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Grassland/Herbaceous	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.2	0.0	0.0	0.5	0.0
Mixed Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.7	1.9	0.0	0.0	0.0	0.0	7.7	0.6
Open Water	1.3	0.9	0.0	0.0	3.1	1.3	2.1	1.4	0.0	0.0	0.5	0.1	2.2	1.0	1.4	1.5	10.7	0.8
Pasture/Hay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	0.8	0.0	0.0	0.0	0.0	3.1	0.2
Shrub/Scrub	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Woody Wetlands	2.7	1.8	0.5	1.2	14.7	6.2	3.4	2.2	0.0	0.0	39.2	9.9	5.6	2.7	7.6	7.9	73.5	5.5
Total	150.1	100.0	41.6	100.0	235.7	100.0	155.5	100.0	46.2	100.0	397.1	100.0	209.4	100.0	96.3	100.0	1,326.9	100.0

The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
Source: Jin et al. (2013)

This page intentionally left blank.

One route variation to the Applicant Proposed Route was developed in Region 6 in response to public comments on the Draft EIS. The route variation is described in Appendix M and summarized in Section 2.4.2.6. The variation is illustrated in Exhibit 1 of Appendix M. Link 2, Variation 1, would parallel parcel boundaries more closely to minimize impacts to agricultural operations than the original Applicant Proposed Route Link 2. The representative ROW for this variation would cross approximately 15 acres more crop land. It should be noted that a route adjustment was made for HVDC Alternative Route 6-A to maintain an end-to-end route with this variation.

3.10.6.2.3.1.7 Region 7

The Applicant Proposed Route in Region 7 is approximately 43 miles long. Approximately 0.3 mile (0.6 percent) is parallel to existing transmission lines and 4 miles (9.4 percent) is parallel to existing roads. The land cover in the 200-foot-wide representative ROW for Region 7 is listed in Table 3.10-21. The land cover in Region 7 is generally dominated by cultivated crops, although there is more variation than in Region 6. The land cover in the representative ROW consists of 691.8 acres (66.2 percent) cultivated crops, 86.8 acres (8.3 percent) of developed, open space, 79.1 acres (7.6 percent) of deciduous forest, 59.5 acres (5.7 percent) of woody wetlands, and 52.7 acres (5.0 percent) of shrub/scrub land. All other land cover types represent less than five percent of the total representative ROW.

Table 3.10-21:
Land Cover in the Applicant Proposed Route—Region 7

Land Cover[1]	Link 1		Link 2		Link 3		Link 4		Link 5		Total	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Cultivated Crops	545.2	78.1	16.5	61.5	59.3	35.6	19.1	49.5	52.6	44.5	691.8	66.2
Deciduous Forest	0.7	0.1	0.0	0.0	53.5	32.1	0.0	0.0	24.8	21.0	79.1	7.6
Developed, Low Intensity	3.6	0.5	0.0	0.0	2.3	1.4	0.0	0.0	2.0	1.7	7.8	0.7
Developed, Medium Intensity	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Developed, Open Space	67.8	9.7	10.3	38.5	2.5	1.5	0.7	1.7	6.1	5.1	86.8	8.3
Emergent Herbaceous Wetlands	0.0	0.0	0.0	0.0	0.6	0.4	0.0	0.0	0.0	0.0	0.6	0.1
Evergreen Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.9	1.1	0.1
Grassland/Herbaceous	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	1.3	1.5	0.1
Mixed Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	1.4	1.6	0.2
Open Water	26.2	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.2	2.5
Pasture/Hay	0.0	0.0	0.0	0.0	11.1	6.7	18.9	48.8	7.6	6.4	36.1	3.5
Shrub/Scrub	0.0	0.0	0.0	0.0	36.9	22.1	0.0	0.0	15.9	13.4	52.7	5.0
Woody Wetlands	54.1	7.8	0.0	0.0	0.2	0.0	0.0	0.0	5.2	4.4	59.5	5.7
Total	697.7	100.0	26.8	100.0	166.4	100.0	38.7	100.0	118.4	100.0	1,045.0	100.0

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
Source: Jin et al. (2013)

The representative ROW of Link 1 includes a parcel of land enrolled in the WRP totaling approximately 2 acres. Two agricultural structures are present in the representative ROW for Applicant Proposed Route Link 5 and one other structure (type unknown) is present in the representative ROW for Link 1.

Outside the ROW, tensioning or pulling areas totaling approximately 162.4 acres would be required during construction and would be temporarily unavailable for other uses. The land cover in these areas is primarily cultivated crops. No existing structures are present in these areas.

Three route variations to the Applicant Proposed Route were developed in Region 7 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.7. The variations are illustrated in Exhibit 1 of Appendix M. A description of the impacts of the variations compared to the original Applicant Proposed Route follows. Link 1, Variation 1, would parallel more parcel boundaries to minimize impacts to agricultural operations compared to the original Applicant Proposed Route Link 1, and would cross two fewer parcels but 5 acres more crop land. Link 1, Variation 2, would cross four fewer parcels and also follow parcel boundaries more closely to avoid impacts to agricultural operations, including center pivot irrigation, a precision-leveled field, and aerial spraying to these fields. The representative ROW for this variation would cross approximately 8 acres less crop land. Link 5, Variation 1, would cross three more parcels and approximately 2 acres more forest land than the original Applicant Proposed Route as well as move the route farther from a new residential area.

3.10.6.2.3.2 Operations and Maintenance Impacts

Within the transmission line ROW (200 feet wide by 720 miles long), only the transmission structures, fiber optic regeneration sites, and access roads would remain. For lattice structures, the operational footprint would be four to six structures per mile, and each foundation would measure 28 feet by 28 feet (less than 0.02 acre). Assuming 720 miles of lattice structures, the operational footprint would be 86 acres. Each structure would be 120 to 200 feet tall. For tubular pole structures, the operational footprint would be five to seven structures per mile, each 49 square feet, up to 5.6 acres total. Each structure would be 120 to 160 feet tall. Lattice crossing structures, which would be required in limited situations, would each have a structural footprint of 64 feet by 64 feet (approximately 0.09 acre) and each structure would be 350 feet tall. Guyed structures would also be required in limited situations, and would each have a structural footprint (not including guy wires) of 7 feet by 7 feet (0.001 acre) and each structure would be 120 to 200 feet tall. Impact calculations assumed lattice structures would be used for a conservative estimate of potential impacts.

The estimated four fiber optic regeneration sites would remain, each consisting of a fenced area 75 feet wide by 75 feet long (0.13 acre) including a control building 12 feet by 32 feet. The estimated operational footprint for all four sites is 0.8 acre. A permanent access road to the fenced area, a power supply to the control building, and a backup power generator and fuel supply would also remain.

It is anticipated that all existing roads and existing roads with repairs/improvements would be retained for operations and maintenance of the Project. It is estimated that approximately 75 percent of the new overland roads with no improvements and 90 percent of the new overland roads with clearing and new bladed roads would be retained for operations and maintenance access. These roads would be up to 20 feet wide, and would total an estimated 1,851 acres. Access roads that are not needed for operations and maintenance of the Project would be restored (GE-7).

In total, approximately 1,938 acres would be required for the operation of the HVDC transmission line, including 86 acres for the structures, 1,851 acres for the roads, and 0.8 acre for the fiber optic regeneration sites. All other land in the ROW could return to most previous land uses, primarily agriculture (grazing and crops). As noted in Section 2.1.5.1, limitations on land uses would be described in individual landowner easement agreements, and these agreements could be modified in the easement based on site-specific conditions and/or coordination with landowners. Land uses that generally may not be permitted in the ROW include constructing buildings or structures, changing the grading and land contours such that the ground surface elevation within the ROW would change and alter the required electrical clearance, and installing fences or irrigation lines without coordination with the Applicant. All of the tensioning or pulling areas and other temporary construction areas could return to existing uses once construction has been completed.

Because the locations of access roads for the HVDC transmission line are not known at this time, it is possible that the access roads could be located in such a way that small areas of agricultural land would be isolated and no longer practicable to be used for farmland or grazing.

As described in Section 2.3, the Applicant's routing criteria included maximizing opportunities for paralleling existing compatible infrastructure. In segments where that is not practical, the route would bisect parcels and may thereby limit larger types of new development in a particular area.

Pursuant to the NERC Reliability Standard FAC-003, during operations and maintenance, the ROW would be maintained according to a Transmission Vegetation Management Plan developed for the Project. The TVMP may require additional analysis under NEPA depending on whether and under what conditions DOE decides to participate in the Project. Vegetation within the wire zone would be limited to low-growing grasses, legumes, herbs, crops, and shrubs where the conductor is 50 feet or less from the ground. Tall shrubs and short trees would be permitted in the border zone (i.e., to the edge of the ROW). Tree-trimming and brush removal would be conducted as needed to maintain the vegetation within the ROW.

During operations and maintenance, the transmission line would be inspected regularly and as necessary using fixed-wing aircraft, helicopters, ground vehicles, and/or personnel on foot. Maintenance would be performed as needed. Maintenance activities would generally be smaller in scale and more localized than construction activities. Maintenance activities may cause temporary impacts within the ROW such as damage to crops. Access would be restricted during the performance of maintenance activities.

Nearby residents would experience long-term visual impacts from the vegetation removed from the ROW and the permanent (until decommissioning) presence of the transmission structures and lines. Impacts to visual resources are discussed in more detail in Section 3.18.

The permanent impacts by region are summarized in Table 3.10-22 for pole structures. No permanent impacts are described for access roads, because the location of access roads has not yet been determined.

Table 3.10-22:
Impacts During the Operational Phase of the Applicant Proposed Route, by Region

Region	Length (miles)	Estimated Footprint of Structures (acres) [1, 2]
1	116	16.2
2	106	14.8
3	162	22.7
4	126	17.6
5	113	15.8
6	54	7.6
7	43	6.0

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
2 For a conservative estimate of impacts, the anticipated footprint of structures assumes seven lattice structures per mile; each would have a 28-foot by 28-foot foundation (less than 0.02 acre).

3.10.6.2.3.3 Decommissioning Impacts

Potential impacts during decommissioning of the Project would be similar to those of the construction phase for all Project components. Once the decommissioning is complete, all land could return to the pre-construction land uses described in Section 3.10.4 and Section 3.10.5.

3.10.6.3 Impacts Associated with the DOE Alternatives

This section discusses land use impacts for the DOE Alternatives, which include the Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area, the HVDC alternative routes and their associated access roads, multi-use construction yards and other temporary construction areas, and communications sites.

3.10.6.3.1 Arkansas Converter Station Siting Area and AC Interconnection Siting Area

3.10.6.3.1.1 Construction Impacts

The land cover in the Arkansas Converter Station Siting Area consists primarily of deciduous forest (32.8 percent), pasture/hay (26.7 percent), evergreen forest (21.9 percent), and mixed forest (10.0 percent). Although the exact location of the converter station has not yet been determined, construction of this converter station would convert 20 to 35 acres of undeveloped land to a utility land use. An additional 5 to 10 acres would be required for construction only. These areas would be used as laydown areas for equipment during construction. An additional 4.2 acres of undeveloped land would be converted to access roads (2.4 acres permanent, 1.8 acres temporary).

The Arkansas AC interconnect siting area is approximately 1,000 feet wide and the permanent ROW would be 150 to 200 feet wide and approximately 5 miles long with a total acreage of approximately 661.6 acres. During construction, approximately 477.7 acres of primarily pasture/hay land cover would be temporarily converted to an industrial use. Approximately 0.1 mile, or 2.2 percent of the route, would be parallel to existing roads. Table 3.10-23 lists the various types of land cover in the ROW, which is primarily composed of pasture/hay (477.7 aces, or 72.2 percent), evergreen forest (76.0 acres, or 11.5 percent), and deciduous forest (41.6 acres or 6.3 percent).

Table 3.10-23:
Land Cover in the Arkansas AC Interconnect ROW

Land Cover	Acres	%
Deciduous Forest	41.6	6.3
Developed, Low Intensity	3.8	0.6
Developed, Open Space	14.42.8	2.2
Evergreen Forest	76.0	11.5
Grassland/Herbaceous	2.0	0.3
Mixed Forest	0.4	0.0
Open Water	4.5	0.7
Pasture/Hay	477.7	72.2
Shrub/Scrub	15.2	2.3
Woody Wetlands	24.9	3.8
Total	661.6	100.0

Source: Jin et al. (2013)

A 25- to 35-acre site for a substation where the alternative AC transmission line would interconnect with an existing 500kV transmission line would be required, and an additional 5 acres would be temporarily required during the construction phase. This substation will be located near an existing transmission line in an area that is primarily grassland with some forest land.

During construction, within the 661.6-acre ROW, assembly areas for the pole structures (either lattice or tubular structures) would be required, as well as tensioning or pulling sites. An assembly area 150 feet wide by 150 feet long (0.5 acre) for each structure would be required. Assuming five to seven structures per mile would be required, the assembly areas would require up to 17.9 acres within the ROW. Also within the ROW, approximately six tensioning or pulling sites 150 feet wide by 600 feet long would be required (2.0 acres each, minus 1.6 acres outside the ROW, for a total of 10.4 acres). Three wire-splicing sites, each 100 feet by 100 feet (0.2 acres), would require a total of 0.6 acre.

Approximately 1.6 acres of the total 12 acres required for the six tensioning or pulling sites would be located outside the ROW. In total, approximately 120 acres would be required for the construction of the Arkansas converter station and AC interconnect.

Within the ROW, trees would need to be removed. Individual transmission structure sites would be cleared. Hand, mechanized, and chemical clearing may be used. Within or adjacent to the ROW for the transmission line, all trees would be removed. In the border zone adjacent to the ROW, some small trees may remain if they would not pose a risk of falling into the conductors.

3.10.6.3.1.2 Operations and Maintenance Impacts

After construction is complete, only the 20- to 35-acre converter station and 20-foot-wide paved access road would remain; all other temporary construction areas would be returned to their previous use, primarily rangeland. Approximately 35 acres would be fenced. The 25- to 35-acre substation where the alternative AC transmission line would interconnect with the existing 500kV transmission line, and an associated access road, would also remain as a utility use.

Within the 5-mile-long Arkansas AC Interconnect ROW, only the pole structures would remain. For lattice structures, the operational footprint would be 5 to 7 structures per mile for 5 miles, or 25 to 35 structures total, each 28 feet by 28 feet (less than 0.02 acre), up to 0.7 acre total. For tubular structures, the operational footprint would be 5 to 7 structures per mile, or 25 to 35 structures total, each 7 feet by 7 feet (less than 0.1 acre), and less than 0.1 acre total. All structures would be 75 to 180 feet tall. Access roads that are not needed for operations and maintenance of the Project would be restored, and all temporary construction areas could return to previous uses.

All other land in the ROW could return to previous land uses, except that only low-growing vegetation would be permitted in the ROW. Short trees (up to 25 feet in height at maturity) would be permitted adjacent to the ROW. As noted in Section 2.1.5.1, limitations on land uses would be described in individual landowner easement agreements, and could be modified in the easement based on site-specific conditions and/or coordination with landowners. Land uses that generally may not be permitted in the ROW include constructing buildings or structures, changing the grading and land contours such that the ground surface elevation within the ROW would change and alter the required electrical clearance, and installing fences or irrigation lines without coordination with the Applicant. Access would be restricted during the performance of maintenance activities.

Because the locations of access roads to the converter station are not known at this time, it is possible that the access roads could be located in such a way that small areas of agricultural land would be isolated and no longer practicable to be used for farmland or grazing.

3.10.6.3.1.3 Decommissioning Impacts

Potential impacts during decommissioning of the Project would be similar to those of the construction phase for all Project components. Once decommissioning has been completed, all land could return to the pre-construction land uses described in Section 3.10.4 and Section 3.10.5.

3.10.6.3.2 HVDC Alternative Routes

This section discusses the potential impacts within the 200-foot-wide representative ROWs of the HVDC alternative routes during the construction, operations and maintenance, and decommissioning phases of the Project.

3.10.6.3.2.1 Construction Impacts

Construction impacts would be similar to those discussed for the Applicant Proposed Route (Section 3.10.6.2.3.1). The ROW would be temporarily unavailable for existing uses during construction at a specific location.

Construction would begin with clearing and grading for access roads, pole structure sites and assembly areas, wire splicing sites, and tensioning or pulling sites. These areas would not be available for agricultural use during construction at a specific location. Within the ROW, trees would need to be removed. Individual transmission structure sites would be cleared Hand, mechanized, and chemical clearing may be used. For tensioning or pulling sites, clearing would be limited to the removal of larger woody vegetation or dense brush that may interfere with tensioning equipment; grading would also be limited to what is necessary to provide temporary access for tensioning equipment.

Within or adjacent to the ROW for the transmission line, all trees would be removed. In the border zone adjacent to the ROW, some small trees may remain if they would not pose a risk of falling into the conductors.

3.10.6.3.2.1.1 Region 1

Table 3.10-24 presents the land cover in the representative ROW for each of the four HVDC alternative routes in Region 1. Each route is discussed in more detail below.

Table 3.10-24:
Land Cover in the HVDC Alternative Routes—Region 1

Land Cover	AR 1-A		AR 1-B		AR 1-C		AR 1-D	
	Acres	%	Acres	%	Acres	%	Acres	%
Barren Land (Rock/Sand/Clay)	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cultivated Crops	288.9	9.6	122.5	9.7	146.8	11.5	113.2	13.8
Deciduous Forest	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Developed, High Intensity	0.5	0.0	0.0	0.0	0.0	0.0	1.3	0.2
Developed, Low Intensity	2.1	0.1	6.8	0.5	8.5	0.7	1.0	0.1
Developed, Medium Intensity	2.9	0.1	0.1	0.0	0.1	0.0	3.5	0.4
Developed, Open Space	299.7	10.0	164.1	12.9	136.0	10.7	86.9	10.6
Evergreen Forest	3.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Grassland/Herbaceous	2,265.4	75.4	886.6	69.9	892.3	70.1	568.9	69.4
Open Water	5.9	0.2	0.0	0.0	0.0	0.0	0.3	0.0
Shrub/Scrub	123.9	4.1	88.3	7.0	87.3	6.9	40.2	4.9
Woody Wetlands	8.5	0.3	0.0	0.0	1.6	0.1	3.9	0.5
Total	3,003.1	100.0	1,268.4	100.0	1,272.5	100.0	819.2	100.0

Source: Jin et al. (2013)

3.10.6.3.2.1.1.1 *Alternative Route 1-A*

HVDC Alternative Route 1-A is approximately 123 miles long and corresponds to Applicant Proposed Route Links 2, 3, 4, and 5. Approximately 5 miles (4.1 percent) would be parallel to existing transmission lines, compared to 1.7 miles (1.4 percent) for the corresponding links of the Applicant Proposed Route. Approximately 9 miles (7.0 percent) would be parallel to existing roads, compared to 8 miles (7.0 percent) for the corresponding links of the Applicant Proposed Route. The land cover within the representative ROW is primarily grassland/herbaceous (approximately 2,265 acres or 75.4 percent). Approximately 168 acres (6 percent of the representative ROW) are school trust lands that would be temporarily unavailable for existing uses, primarily agriculture or oil/gas development. HVDC Alternative Route 1-A has more grasslands and school trust lands than the Applicant Proposed Route. Thirteen agricultural structures, four industrial structures, one commercial structure, one abandoned structure, and one other structure (use unknown) are present in the representative ROW, whereas in the corresponding links of the Applicant Proposed Route, one commercial structure and one agricultural structure are in the representative ROW.

Outside the ROW, tensioning or pulling areas totaling approximately 165 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover in these areas is grassland/herbaceous. Approximately 11 acres of school trust lands would be temporarily unavailable for existing uses, primarily agriculture or oil/gas development. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 1-A.

3.10.6.3.2.1.1.2 *Alternative Route 1-B*

HVDC Alternative Route 1-B is approximately 52 miles long and corresponds to Applicant Proposed Route Links 2 and 3. Approximately 0.1 mile, or 0.3 percent of the route, would be parallel to existing transmission lines, which is comparable to the corresponding links of Applicant Proposed Route. Approximately 2 miles, or 3.4 percent of the route, would be parallel to existing roads, which is less than half of that for the corresponding links of the Applicant Proposed Route. The land cover within the representative ROW is primarily grassland/herbaceous (approximately 887 acres or 69.9 percent), similar to Link 3. Approximately 52 acres (4 percent of the representative ROW) has school trust lands that would be temporarily unavailable for existing uses, primarily agriculture or oil/gas development. HVDC Alternative Route 1-B has more school trust lands than the corresponding links of the Applicant Proposed Route. One agricultural structure is present in the representative ROW, whereas no structures are present in the corresponding links of the Applicant Proposed Route (Links 2 and 3).

Outside the ROW, tensioning or pulling areas totaling approximately 46 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover in these areas is grassland/herbaceous. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 1-B.

3.10.6.3.2.1.1.3 *Alternative Route 1-C*

HVDC Alternative Route 1-C is approximately 52 miles long and corresponds to Applicant Proposed Route Links 2 and 3. Approximately 0.1 mile, or 0.2 percent of the route, would be parallel to existing transmission lines, which is less than the corresponding links of the Applicant Proposed Route. Approximately 2 miles (4.3 percent) would be parallel to existing roads, which is less than half of that for the corresponding links of the Applicant Proposed Route. The land cover within the representative ROW is primarily grassland/herbaceous (approximately 892 acres or 70.1 percent). Approximately 9 acres (less than 1 percent of the representative ROW) are school trust lands that would be temporarily unavailable for existing uses, primarily agriculture or oil/gas development. HVDC Alternative Route 1-C has more cultivated crops, developed, and open space and less school trust land than the corresponding links of the Applicant Proposed Route. Seven agricultural structures and two industrial structures are present in the representative ROW, whereas no structures are present in the corresponding links of the Applicant Proposed Route (Links 2 and 3).

Outside the ROW, tensioning or pulling areas totaling approximately 60 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is grassland/herbaceous. Approximately 3 acres of school trust lands would be temporarily unavailable for existing uses. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 1-C.

3.10.6.3.2.1.1.4 *Alternative Route 1-D*

HVDC Alternative Route 1-D is approximately 34 miles long and corresponds to Applicant Proposed Route Links 3 and 4. Approximately 0.2 mile, or 0.5 percent of the route, would be parallel to existing transmission lines, compared to 1.4 miles for the corresponding links of the Applicant Proposed Route. The land cover within the ROW is primarily grassland/herbaceous (approximately 569acres or 69.4 percent). Approximately 54 acres (7 percent of the representative ROW) are school trust lands that would be temporarily unavailable for existing uses, primarily agriculture or oil/gas development. HVDC Alternative Route 1-D has comparable land cover but more school trust lands than the corresponding links of the Applicant Proposed Route. Five agricultural structures and one abandoned structure are present in the representative ROW, whereas one commercial structure and one agricultural structure are present in Link 4 of the Applicant Proposed Route.

Outside the ROW, tensioning or pulling areas totaling approximately 29 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is grassland/herbaceous. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 1-D.

3.10.6.3.2.1.2 Region 2

Table 3.10-25 presents the land cover in the representative ROW for each of the two HVDC alternative routes in Region 2. Each alternative route is discussed in more detail below.

Table 3.10-25:
Land Cover in the HVDC Alternative Routes—Region 2

Land Cover	AR 2-A		AR 2-B	
	Acres	%	Acres	%
Barren Land (Rock/Sand/Clay)	0.5	0.0	0.1	0.0
Cultivated Crops	311.6	22.3	440.3	60.5
Deciduous Forest	55.4	4.0	14.6	2.0
Developed, Low Intensity	11.2	0.8	1.0	0.1
Developed, Medium Intensity	3.0	0.2	0.0	0.0
Developed, Open Space	69.5	5.0	22.6	3.1
Evergreen Forest	89.1	6.4	2.0	0.3
Grassland/Herbaceous	833.5	59.7	240.0	33.0
Open Water	5.6	0.4	7.0	1.0
Pasture/Hay	2.6	0.2	0.0	0.0
Shrub/Scrub	14.3	1.0	0.0	0.0
Total	1,396.3	100.0	727.7	100.0

Source: Jin et al. (2013)

3.10.6.3.2.1.2.1 Alternative Route 2-A

HVDC Alternative Route 2-A is approximately 57 miles long and corresponds to Applicant Proposed Route Link 2. Approximately 0.2 mile, or 0.4 percent of the route, would be parallel to existing transmission lines, compared to 0.9 mile for Link 2. Approximately 3 miles (4.9 percent) would be parallel to existing roads, compared to 2 miles for Link 2.The land cover within the representative ROW is primarily grassland/herbaceous (approximately 834 acres or 59.7 percent). Approximately 23 acres (2 percent of the representative ROW) are school trust lands that would be temporarily unavailable for existing uses, primarily agriculture and oil/gas development. HVDC Alternative Route 2-A has more grasslands but fewer cultivated crops and school trust lands than Link 2. Two industrial structures and three agricultural structures are present in the representative ROW, whereas one commercial structure and two industrial structures are present in the representative ROW for the Applicant Proposed Route Link 2.

Outside the ROW, tensioning or pulling areas totaling approximately 84 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is grassland/herbaceous followed by cultivated crops. Approximately 5 acres of school trust lands would be temporarily unavailable for other uses. No structures are present in the tensioning or pulling areas for Alternative Route 2-A.

3.10.6.3.2.1.2.2 Alternative Route 2-B

HVDC Alternative Route 2-B is approximately 30 miles long and corresponds to Applicant Proposed Route Link 3. Less than 0.1 mile, or 0.3 percent of the route, would be parallel to existing transmission lines, which is comparable to Link 3. Approximately 1.5 miles (4.9 percent) of the route would be parallel to existing roads, which is comparable to Link 3.The land cover within the representative ROW is primarily cultivated crops (approximately 440 acres or 60.5 percent). HVDC Alternative Route 2-B has more cultivated crops but less developed open space than Link 3. One commercial structure and two industrial structures are present in the representative ROW, whereas two agricultural structures and one commercial structure are present in the representative ROW for the Applicant Proposed Route Link 3.

Outside the ROW, tensioning or pulling areas totaling approximately 31 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is cultivated crops. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 2-B.

3.10.6.3.2.1.3 Region 3

Table 3.10-26 presents the land cover in the representative ROW for each of the five HVDC alternative routes in Region 3. Each alternative route is discussed in more detail below.

Table 3.10-26:
Land Cover in the HVDC Alternative Routes—Region 3

Land Cover[1]	AR 3-A		AR 3-B		AR 3-C		AR 3-D		AR 3-E	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Barren Land (Rock/Sand/Clay)	0.0	0.0	0.3	0.0	1.7	0.1	0.0	0.0	0.0	0.0
Cultivated Crops	150.4	16.4	181.5	15.6	145.5	4.9	53.5	5.6	0.0	0.0
Deciduous Forest	187.7	20.4	219.0	18.8	869.2	29.3	184.3	19.2	74.1	35.7
Developed, Low Intensity	0.0	0.0	3.2	0.3	3.7	0.1	1.6	0.2	0.0	0.0
Developed, Medium Intensity	0.5	0.1	0.8	0.1	2.3	0.1	1.8	0.2	1.3	0.6
Developed, Open Space	64.1	7.0	71.2	6.1	89.9	3.0	32.7	3.4	8.1	3.9
Emergent Herbaceous Wetlands	0.0	0.0	0.0	0.0	2.2	0.1	0.0	0.0	0.0	0.0
Evergreen Forest	6.6	0.7	10	0.9	9.1	0.3	0.7	0.1	0.0	0.0
Grassland/Herbaceous	497.3	54.1	645.2	55.3	1,061.2	35.8	188.9	19.7	23.2	11.2
Open Water	7.6	0.8	7.7	0.7	8.7	0.3	3.6	0.4	2.8	1.3
Pasture/Hay	5.1	0.6	27.9	2.4	773.4	26.1	491.8	51.3	98.3	47.3
Shrub/Scrub	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Woody Wetlands	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0
Total	919.1	100.0	1,166.6	100.0	2,967.5	100.0	958.8	100.0	207.8	100.0

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
Source: Jin et al. (2013)

3.10.6.3.2.1.3.1 Alternative Route 3-A

HVDC Alternative Route 3-A is approximately 38 miles long and corresponds to Applicant Proposed Route Link 1. Approximately 0.3 mile, or 0.7 percent of the route, would be parallel to existing transmission lines, compared to 1.7 miles for Link 1. Approximately 2 miles (4.9 percent) of the route would be parallel to existing roads, compared to 3.1 miles for Link 1. The land cover within the representative ROW is primarily grassland/herbaceous (approximately 497 acres or 54.1 percent) and deciduous forest (188 acres or 20.4 percent) and is comparable to Link 1. Three types of state land are present: 22 acres of Lake Carl Blackwell, 13 acres of Oklahoma State University land being used as research area, and 20 acres of school trust lands (use unknown), compared to 48 acres of Oklahoma State University land, and 33 acres of school trust lands in Link 1. These state land areas would be temporarily unavailable for other uses during construction in these locations. One agricultural structure is present in the representative ROW, whereas one industrial structure and one agricultural structure are present in the representative ROW for the Applicant Proposed Route Link 1.

Outside the ROW, tensioning or pulling areas totaling approximately 40 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is grassland/herbaceous. Approximately 0.2 acre of Lake Carl Blackwell and 6 acres of school trust lands (use unknown) are in these areas and would be temporarily unavailable for existing uses. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 3-A.

As described in Appendix M and summarized in Section 2.4.2.3, a route adjustment was developed for HVDC Alternative Route 3-A to maintain an end-to-end route with Applicant Proposed Route Link 1, Variation 2, and Links 1 and 2, Variation 1. The route adjustment is illustrated in Exhibit 1 of Appendix M. The route adjustment parallels more parcel boundaries and crosses less pasture/hay and agricultural land than the original HVDC Alternative 3-A. Land use impacts would generally be the same as for the original HVDC Alternative Route 3-A.

3.10.6.3.2.1.3.2 *Alternative Route 3-B*

HVDC Alternative Route 3-B is approximately 48 miles long and corresponds to Applicant Proposed Route Links 1, 2, and 3. Approximately 1.5 miles, or 3.1 percent of the route, would be parallel to existing transmission lines, which is comparable to the corresponding links of the Applicant Proposed Route. Approximately 2 miles (4.8 percent) would be parallel to existing roads, compared to 3.5 miles for Links 1, 2, and 3. The land cover within the representative ROW is primarily grassland/herbaceous (approximately 645 acres or 55.3 percent) and deciduous forest (219 acres or 18.8 percent) and is comparable to Links 1, 2, and 3. Three types of state land are present: 22 acres of Lake Carl Blackwell, 13 acres of Oklahoma State University land being used as research area, and 15 acres of school trust lands (use unknown), compared to 48 acres of Oklahoma State University land and 60 acres school trust lands in Links 1, 2, and 3. These areas would be temporarily unavailable for existing uses during construction in these locations. One commercial structure and two agricultural structures are present in the representative ROW, compared to one residence, one industrial structure, and two agricultural structures in the representative ROW for the Applicant Proposed Route Links 1, 2, and 3.

Outside the ROW, tensioning or pulling areas totaling approximately 85 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is grassland/herbaceous. Approximately 0.2 acre of Lake Carl Blackwell and 6 acres of school trust lands (use unknown) are in these areas and would be temporarily converted to a utility use. One residence and two industrial structures in the tensioning or pulling areas for HVDC Alternative Route 3-B that may be affected by short-term effects from construction such as noise and dust.

3.10.6.3.2.1.3.3 *Alternative Route 3-C*

HVDC Alternative Route 3-C is approximately 122 miles long and corresponds to Applicant Proposed Route Links 3, 4, 5, and 6. Approximately 1 mile, or 0.8 percent of the route, would be parallel to existing transmission lines, comparable to the corresponding links of the Applicant Proposed Route. Approximately 6 miles (4.5 percent) of the route would be parallel to existing roads, comparable to Links 3, 4, 5, and 6. The land cover within the representative ROW is primarily composed of grassland/herbaceous (approximately 1,061 acres or 35.8 percent), deciduous forest (869 acres or 29.3 percent), and pasture/hay (773 acres or 26.1 percent) and is comparable to Links 3, 4, 5, and 6. Approximately 26 acres of school trust lands and 1 acre of Webbers Falls Lock and Dam and Reservoir would be temporarily unavailable for existing uses during construction at these locations, compared to 53 acres of school trust lands and 4.3 acres of Webbers Falls Lock and Dam and Reservoir in Links 3, 4, 5, and 6. One residence, two industrial structures, one commercial structure, and seven agricultural structures are present in the representative ROW, whereas three agricultural structures, one residence, and one industrial structure are present in the representative ROW for Links 3, 4, 5, and 6.

Outside the ROW, tensioning or pulling areas totaling approximately 221 acres would be required during construction and would be temporarily unavailable for other uses. The land cover is a mix of grassland/herbaceous, deciduous forest, and pasture/hay. Three residences are present in the tensioning or pulling areas for Alternative Route 3-C that may be affected by short-term effects from construction such as noise, dust, and access restrictions.

3.10.6.3.2.1.3.4 *Alternative Route 3-D*

HVDC Alternative Route 3-D is approximately 39 miles long and corresponds to Applicant Proposed Route Links 5 and 6. Approximately 0.5 mile, or 1.2 percent of the route, would be parallel to existing transmission lines, comparable to Links 5 and 6. Approximately 2 miles (4.8 percent) of the route would be parallel to existing roads, comparable to Links 5 and 6. The land cover within the representative ROW is primarily pasture/hay (approximately 492 acres or 51.3 percent) and deciduous forest and grassland/herbaceous (189 acres or 19.7 percent each) and is comparable to Links 5 and 6. Approximately 1 acre of Webbers Falls Lock and Dam and Reservoir would be temporarily unavailable for existing uses during construction at this location, compared to 4.3 acres in Links 3, 4, 5, and 6. One residence and four agricultural structures are present in the representative ROW, whereas one residence and one agricultural structure are present in the representative ROW for the Applicant Proposed Route Links 5 and 6.

Outside the ROW, tensioning or pulling areas totaling approximately 82 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is pasture/hay, followed by deciduous forest. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 3-D.

3.10.6.3.2.1.3.5 *Alternative Route 3-E*

HVDC Alternative Route 3-E is approximately 9 miles long and corresponds to Applicant Proposed Route Link 6. Approximately 0.2 mile, or 2.4 percent of the route, would be parallel to existing transmission lines, comparable to Link 6. Approximately 0.6 mile (7.1 percent) of the route would be parallel to existing roads, comparable to Link 6. The land cover within the representative ROW is primarily pasture/hay (approximately 98 acres or 47.3 percent) and deciduous forest (74 acres or 35.7 percent), whereas Link 6 has a higher percentage of deciduous forest and grasslands. Approximately 1 acre of Webbers Falls Lock and Dam and Reservoir would be temporarily unavailable for existing uses during construction at this location, compared to 4.3 acres in Links 3, 4, 5, and 6. One residence is present in the representative ROW, whereas one agricultural structure is present in the representative ROW for the Applicant Proposed Route Link 6.

Outside the ROW, tensioning or pulling areas totaling approximately 2 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is pasture/hay. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 3-E.

3.10.6.3.2.1.4 Region 4

Table 3.10-27 presents the land cover in the representative ROW for each of the four HVDC alternative routes in Region 4. Each alternative route is discussed in more detail below.

Table 3.10-27:
Land Cover in the HVDC Alternative Routes—Region 4

Land Cover	AR 4-A		AR 4-B		AR 4-C		AR 4-D		AR 4-E	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Barren Land (Rock/Sand/Clay)	0.0	0.0	1.5	0.1	0.0	0.0	0.0	0.0	0.8	0.1
Cultivated Crops	1.5	0.1	1.5	0.1	0.0	0.0	1.5	0.2	4.1	0.5
Deciduous Forest	624.0	43.8	873.2	45.5	32.4	39.2	179.6	29.1	121.6	13.6
Developed, Low Intensity	3.7	0.3	5.9	0.3	0.9	1.1	2.7	0.4	5.4	0.6
Developed, Medium Intensity	0.6	0.0	0.6	0.0	0.0	0.0	0.6	0.1	0.4	0.0
Developed, Open Space	29.6	2.1	46.3	2.4	1.1	1.4	14.3	2.3	37.9	4.2
Emergent Herbaceous Wetlands	1.4	0.1	0.9	0.0	0.0	0.0	0.9	0.1	0.0	0.0
Evergreen Forest	73.1	5.1	265.6	13.8	15.4	18.6	66.0	10.7	218.7	24.4
Grassland/Herbaceous	120.4	8.4	132.9	6.9	4.8	5.8	18.0	2.9	11.1	1.2
Mixed Forest	52.0	3.6	100.6	5.2	9.0	10.9	31.0	5.0	53.8	6.0
Open Water	0.6	0.0	2.1	0.1	0.0	0.0	0.3	0.0	0.0	0.0
Pasture/Hay	497.4	34.9	459.6	23.9	19.0	23.0	299.9	48.6	395.5	44.1
Shrub/Scrub	17.3	1.2	24.5	1.3	0.0	0.0	1.3	0.2	31.7	3.5
Woody Wetlands	4.3	0.3	4.7	0.2	0.0	0.0	1.4	0.2	16.2	1.8
Total	1,426.0	100.0	1,919.9	100.0	82.6	100.0	617.6	100.0	897.2	100.0

Source: Jin et al. (2013)

3.10.6.3.2.1.4.1 Alternative Route 4-A

HVDC Alternative Route 4-A is approximately 58 miles long and corresponds to Applicant Proposed Route Links 3, 4, 5, and 6. Approximately 0.2 mile, or 0.3 percent of the route, would be parallel to existing transmission lines, compared to 0.9 mile for the corresponding links of the Applicant Proposed Route. Approximately 2.5 miles (4.4 percent) of the route would be parallel to existing roads, comparable to Links 3, 4, 5, and 6. The land cover within the representative ROW is primarily deciduous forest (approximately 624 acres or 43.8 percent) and pasture/hay (497 acres 34.9 percent), comparable to Links 3, 4, 5, and 6. Flood control dams constructed by NRCS are adjacent to this route as well as Link 3. Two residences and nine agricultural structures are present in the representative ROW, whereas one residence and one agricultural structure are present in the representative ROW for the Applicant Proposed Route Link 6.

Outside the ROW, tensioning or pulling areas totaling approximately 189 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land covers are pasture/hay and deciduous forest. No structures are present in these areas.

3.10.6.3.2.1.4.2 *Alternative Route 4-B*

HVDC Alternative Route 4-B is approximately 79 miles long and corresponds to Applicant Proposed Route Links 2–8. Less than 0.1 mile, or 0.1 percent of the route, would be parallel to existing transmission lines, compared to 1.2 miles for Links 2–8. Approximately 4 miles (5.5 percent) of the route would parallel existing roads, which is comparable to Links 2–8. The land cover within the representative ROW is primarily deciduous forest (approximately 873 acres or 45.5 percent) and pasture/hay (460 acres or 23.9 percent) and is generally comparable to Links 2–8.

Approximately 387 acres of the Ozark National Forest is within the representative ROW; 230 acres are federally owned and 157 acres are private land within the Ozark National Forest boundary (use unknown). This area also crosses the Ozark National Forest WMA, which shares a boundary with the National Forest. The AGFC regulates hunting in the WMA. Hunting could be temporarily disturbed in and near the ROW during construction (see Section 3.12 for further discussion of impacts to recreation). Whereas most areas within the ROW would only be temporarily unavailable for existing uses, any forested lands in the ROW would not be allowed to return to the existing use after construction is complete because timber would not be a permitted use within the ROW. The Applicant Proposed Route crosses approximately 2.5 acres of the USFS-managed Ozark National Forest and approximately 6 acres of state land (two WMAs) is present in Link 6. Six residences, 1 industrial structure, and 10 agricultural structures are present in the representative ROW, whereas 4 agricultural structures and 1 residence are present in the representative ROW for the Applicant Proposed Route Links 2–8.

The representative ROW crosses the southern boundary of the Ozark National Forest, where federal land and privately held land is a patchwork. The USFS has expressed several concerns regarding this alternative. According to the USFS, the ROW would create linear breaks in National Forest land and could adversely affect timber production. The USFS has also stated that, in places, HVDC Route Alternative 4-B would undermine the use for which the National Forest land was originally acquired, that is conservation of natural resources.

Outside the ROW, tensioning or pulling areas totaling approximately 199 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land covers are deciduous forest and pasture/hay. Approximately 10 acres of federal land and 30 acres of private land in the Ozark National Forest boundary are within these areas and would be temporarily unavailable for existing uses during construction in these locations. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 4-B.

3.10.6.3.2.1.4.3 *Alternative Route 4-C*

HVDC Alternative Route 4-C is approximately 3 miles long and corresponds to Applicant Proposed Route Link 5. If this route is selected, 82.6 acres would be removed from existing uses. None of the route is parallel to existing transmission lines, and Link 5 is parallel to less than 0.1 mile of existing transmission line. Approximately 0.2 mile (6.4 percent) of the route is parallel to existing roads, compared to 0.1 mile for Link 5. Approximately 0.4 mile, or 11 percent of the route, would be parallel to existing infrastructure (within 50 feet) (transmission lines, pipelines, or roads), slightly more than Link 5.The land cover within the ROW is primarily deciduous forest (approximately 32.4 acres or 39.2 percent) and pasture/hay (19.0 acres or 23.0 percent) and is generally comparable to Link 5. One residence is present in the ROW, whereas no structures are present in the representative ROW for the Applicant Proposed Route Link 5.

Outside the ROW, tensioning or pulling areas totaling approximately 25.7 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land covers are deciduous and evergreen forest. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 4-C.

3.10.6.3.2.1.4.4 Alternative Route 4-D

HVDC Alternative Route 4-D is approximately 25 miles long and corresponds to Applicant Proposed Route Links 4, 5, and 6. Less than 0.1 mile, or 0.3 percent of the route, would be parallel to existing transmission lines, compared to 0.3 mile in the corresponding links of the Applicant Proposed Route. Approximately 1.4 miles (5.6 percent) of the route would parallel existing roads, compared to 2.1 miles for Links 4, 5, and 6. The land cover within the representative ROW is primarily pasture/hay (approximately 300 acres or 48.6 percent) and deciduous forest (180 acres or 29.1 percent), which is comparable to Links 4, 5, and 6. HVDC Alternative Route 4-D does not cross any federal or state land, whereas Link 6 crosses approximately 6 acres of state WMAs. One church, one residence, and seven agricultural structures are present in the representative ROW, whereas one residence and one agricultural structure are present in the representative ROW for the Applicant Proposed Route Link 6.

Outside the ROW, tensioning or pulling areas totaling approximately 122 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land covers are pasture/hay and deciduous forest. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 4-D.

3.10.6.3.2.1.4.5 Alternative Route 4-E

HVDC Alternative Route 4-E is approximately 37 miles long and corresponds to Applicant Proposed Route Links 8 and 9. Approximately 0.6, or 1.5 percent of the route, would be parallel to existing transmission lines, compared to 0.1 for Links 8 and 9. Approximately 3.7 miles (10.1 percent) of the route would parallel existing roads, compared to 2.5 miles for Links 8 and 9. The land cover within the representative ROW is primarily pasture/hay (approximately 396 acres or 44.1 percent) and evergreen forest (218.7 acres or 24.4 percent), comparable to Links 8 and 9. Two residences, one industrial structure, two agricultural structures, and two other structures (use unknown) are present in the representative ROW, whereas two agricultural structures are present in the representative ROW for the Applicant Proposed Route Link 9.

Outside the ROW, tensioning or pulling areas totaling approximately 147 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is pasture/hay. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 4-E.

3.10.6.3.2.1.5 Region 5

Table 3.10-28 presents the land cover in the representative ROW for each of the six HVDC alternative routes in Region 5. Each alternative route is discussed in more detail below.

Table 3.10-28:
Land Cover in the HVDC Alternative Routes—Region 5

Land Cover[1]	AR 5-A		AR 5-B		AR 5-C		AR 5-D		AR 5-E		AR 5-F	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Barren Land (Rock/Sand/Clay)	0.0	0.0	2.2	0.1	1.6	0.7	0.0	0.0	2.0	0.2	3.2	0.6
Cultivated Crops	0.0	0.0	42.0	2.4	0.2	0.1	92.0	17.4	37.5	4.2	29.9	5.5
Deciduous Forest	78.8	25.4	479.5	27.7	99.9	44.5	246.5	46.5	249.3	28.2	153.2	28.1
Developed, High Intensity	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.1	0.0	0.0	0.0	0.0
Developed, Low Intensity	0.0	0.0	9.4	0.5	0.5	0.2	1.3	0.2	4.7	0.5	2.0	0.4
Developed, Medium Intensity	0.0	0.0	0.1	0.0	0.1	0.0	1.9	0.3	0.1	0.0	0.0	0.0
Developed, Open Space	9.1	2.7	35.7	2.1	4.4	2.0	22.8	4.3	15.9	1.8	10.3	1.9
Emergent Herbaceous Wetlands	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Evergreen Forest	130.4	42.6	211.7	12.2	5.0	2.2	28.1	5.3	81.8	9.2	67.4	12.4
Grassland/Herbaceous	13.1	5.1	79.2	4.6	10.7	4.8	22.2	4.2	46.2	5.2	18.6	3.4
Mixed Forest	17.4	5.7	113.0	6.5	30.6	13.6	63.8	12.0	63.9	7.2	49.8	9.2
Open Water	0.0	0.0	1.0	0.1	0.5	0.2	6.9	1.3	0.0	0.0	0.0	0.0
Pasture/Hay	53.6	17.1	740.3	42.7	70.9	31.6	30.4	5.7	383.5	43.3	209.9	38.6
Shrub/Scrub	6.2	1.3	14.0	0.8	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0
Woody Wetlands	0.0	0.0	4.3	0.2	0.3	0.1	13.4	2.5	0.1	0.0	0.1	0.0
Total	308.5	100.0	1,732.3	100.0	224.6	100.0	529.6	100.0	885.1	100.0	544.5	100.0

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
Source: Jin et al. (2013)

3.10.6.3.2.1.5.1 *Alternative Route 5-A*

HVDC Alternative Route 5-A is approximately 13 miles long and corresponds to Applicant Proposed Route Link 1. The route would not be parallel to any transmission lines, and neither would Link 1. Approximately 0.9 mile (6.9 percent) of the route would be parallel to existing roads, compared to 0.7 mile for Link 1. The land cover within the representative ROW is primarily composed evergreen forest (130.4 acres or 42.3 percent) and deciduous forest (78.8 acres or 25.5 percent), comparable to Link 1. No structures are present in the representative ROW of HVDC Alternative Route 5-A, as is the case for the Applicant Proposed Route Link 1.

Outside the ROW, tensioning or pulling areas totaling approximately 65 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land covers are deciduous and evergreen forests. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 5-A.

3.10.6.3.2.1.5.2 *Alternative Route 5-B*

HVDC Alternative Route 5-B is approximately 71 miles long and corresponds to Applicant Proposed Route Links 3, 4, 5, and 6. Approximately 0.2 mile (0.3 percent) of the route would be parallel to existing transmission lines, compared to 0.3 mile for the corresponding links of the Applicant Proposed Route. Approximately 3.3 miles (4.7 percent) of the route would be parallel to existing roads, compared to 3.7 miles for the corresponding links of the Applicant Proposed

Route. The land cover within the representative ROW is primarily pasture/hay (740.3 acres or 42.7 percent) and deciduous forest (479.5 acres or 27.7 percent), compared to Links 3, 4, 5 and 6. Three residences, two industrial structures, and one agricultural structure are present in the representative ROW, whereas two abandoned structures and one other structure (use unknown) are present in the representative ROW for the Applicant Proposed Route Links 4, 5, and 6.

Outside the ROW, tensioning or pulling areas totaling approximately 221 acres would be required during construction and would be temporarily unavailable to other uses. The predominant land cover is pasture/hay. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 5-B.

As described in Appendix M and summarized in Section 2.4.2.5, a route adjustment was developed for HVDC Alternative Route 5-B to maintain an end-to-end route with Applicant Proposed Route Links 2 and 3, Variation 1. The route adjustment is illustrated in Exhibit 1 of Appendix M. The route adjustment crosses approximately 4 acres more agricultural land and approximately 7 acres less forest land than the original HVDC Alternative Route 5-B. Land use impacts would generally be the same as for the original HVDC Alternative Route 5-B.

3.10.6.3.2.1.5.3 *Alternative Route 5-C*

HVDC Alternative Route 5-C is approximately 9 miles long and corresponds to Applicant Proposed Route Links 6 and 7. Less than 0.1 mile, or 0.9 percent of the route, would be parallel to existing transmission lines, compared to 0.1 for Links 6 and 7. Approximately 0.4 mile (4.6 percent) would be parallel to existing roads, compared to 0.5 mile for Links 6 and 7. The land cover within the representative ROW is primarily deciduous forest (99.9 acres or 44.5 percent) and pasture/hay (70.9 acres or 31.6 percent), comparable to Link 7; the representative ROW for Link 6 has more mixed forest. One residence, one commercial structure, and one agricultural structure are present in the representative ROW, whereas one other structure (use unknown) is present in the representative ROW for the Applicant Proposed Route Link 6.

Outside the ROW, tensioning or pulling areas totaling approximately 54 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land covers are pasture/hay and deciduous forest. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 5-C.

3.10.6.3.2.1.5.4 *Alternative Route 5-D*

HVDC Alternative Route 5-D is approximately 22 miles long and corresponds to Applicant Proposed Route Link 9. Less than 0.1 mile (0.2 percent) would be parallel to existing transmission lines, comparable to Link 9. Approximately 1.6 miles (7.3 percent) would be parallel to existing roads, compared to 1.9 miles for Link 9. The land cover within the representative ROW is primarily deciduous forest (246.5 acres or 46.5 percent) and cultivated crops (92.0 acres or 17.4 percent) compared to the representative ROW for Link 9, which has more cultivated crops. No structures are present in the representative ROW, as is the case in the Applicant Proposed Route Link 9.

Outside the ROW, tensioning or pulling areas totaling 89.3 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is deciduous forest. No existing structures are present in the tensioning or pulling areas for Alternative Route 5-D.

3.10.6.3.2.1.5.5 Alternative Route 5-E

HVDC Alternative Route 5-E is approximately 36 miles long and corresponds to Applicant Proposed Route Links 4, 5, and 6. Approximately 0.2 mile (0.5 percent) of the route would be parallel to existing transmission lines, comparable to the corresponding links of the Applicant Proposed Route. Approximately 1.6 miles (4.4 percent) of the route would be parallel to existing roads, comparable to Links 4, 5, and 6. The land cover within the representative ROW is primarily pasture/hay (383.5 acres or 43.3 percent) and deciduous forest (383.5 acres or 43.3 percent), comparable to the representative ROW for Links 4, 5, and 6. Three residences, one industrial structure, and one agricultural structure are in the representative ROW, whereas two abandoned structures and one other structure (use unknown) are present in the representative ROW for the Applicant Proposed Route Links 4, 5, and 6.

Outside the ROW, tensioning or pulling areas totaling 88.4 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is pasture/hay. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 5-E.

As described in Appendix M and summarized in Section 2.4.2.5, a route variation was developed for HVDC Alternative Route 5-E in response to public comments on the Draft EIS to maintain an end-to-end route with Applicant Proposed Route Links 3 and 4, Variation 2. The route adjustment is illustrated in Exhibit 1 of Appendix M. The route adjustment crosses approximately 3 more acres forest land than the original HVDC Alternative Route 5-E, and land use impacts would generally be the same for both.

3.10.6.3.2.1.5.6 Alternative Route 5-F

HVDC Alternative Route 5-F is approximately 22 miles long and corresponds to Applicant Proposed Route Links 5 and 6. Approximately 0.1 mile (0.6 percent) of the route would be parallel to existing transmission lines, compared to 0.2 mile for Links 5 and 6. Approximately 1.2 miles (5.4 percent) of the route would be parallel to existing roads, compared to 1.1 miles for Links 5 and 6. The land cover within the representative ROW is primarily pasture/hay (209.9 acres or 38.6 percent) and deciduous forest (153.2 acres or 28.1 percent), comparable to Links 5 and 6. Two residences are present in the representative ROW, whereas one abandoned structure is present in the representative ROW for the Applicant Proposed Route Link 5 and one other structure (use unknown) is present in the representative ROW for the Applicant Proposed Route Link 6.

Outside the ROW, tensioning or pulling areas totaling 52.1 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is pasture/hay. No structures are present in the tensioning or pulling areas for Alternative Route 5-F.

3.10.6.3.2.1.6 Region 6

Table 3.10-29 presents the land cover in the representative ROW for each of the four HVDC alternative routes in Region 6. The land cover for all the routes is primarily cultivated crops. Each alternative route is discussed in more detail below.

Table 3.10-29:
Land Cover in the HVDC Alternative Routes—Region 6

Land Cover[1]	AR 6-A		AR 6-B		AR 6-C		AR 6-D	
	Acres	%	Acres	%	Acres	%	Acres	%
Barren Land (Rock/Sand/Clay)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cultivated Crops	328.6	83.0	272.1	79.2	410.6	72.6	205.3	91.8
Deciduous Forest	0.0	0.0	0.0	0.0	40.3	7.1	0.0	0.0
Developed, Low Intensity	1.6	0.4	1.3	0.4	0.2	0.0	0.0	0.0
Developed, Medium Intensity	0.0	0.0	0.7	0.2	0.5	0.1	0.0	0.0
Developed, Open Space	21.8	5.5	19.6	5.7	39.6	7.0	2.9	1.3
Emergent Herbaceous Wetlands	0.0	0.0	1.4	0.4	0.0	0.0	0.0	0.0
Evergreen Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Grassland/Herbaceous	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mixed Forest	0.0	0.0	0.0	0.0	12.2	2.2	4.0	1.8
Open Water	17.6	4.4	4.1	1.2	20.2	3.6	2.0	0.9
Pasture/Hay	0.0	0.0	0.0	0.0	20.0	3.5	0.0	0.0
Shrub/Scrub	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Woody Wetlands	26.1	6.6	44.6	13.0	22.1	3.9	9.4	4.2
Total	395.7	100.0	343.7	100.0	565.6	100.0	223.6	100.0

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
Source: Jin et al. (2013)

3.10.6.3.2.1.6.1 *Alternative Route 6-A*

HVDC Alternative Route 6-A is approximately 16 miles long and corresponds to Applicant Proposed Route Links 2, 3, and 4. None of the route would be parallel to existing transmission lines, compared to 0.1 mile in Links 2, 3, and 4. Approximately 1.6 miles (10.0 percent) of the route would be parallel to existing roads, compared to 1.4 miles for the corresponding links of the Applicant Proposed Route. The land cover within the representative ROW is primarily composed of cultivated crops (328.6 acres or 83.0 percent), comparable to the corresponding links of the Applicant Proposed Route. One residence is present in the representative ROW, whereas one agricultural structure is present in the representative ROW for the Applicant Proposed Route Link 4.

Outside the ROW, tensioning or pulling areas totaling 62.5 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is cultivated crops. No structures are present in the tensioning or pulling areas for Alternative Route 6-A.

As described in Appendix M and summarized in Section 2.4.2.6, a route adjustment was developed for HVDC Alternative Route 6-A to maintain an end-to-end route with Applicant Proposed Route Link 2, Variation 1. The route adjustment is illustrated in Exhibit 1 of Appendix M. The route adjustment reduces the acreage of the route by approximately 4 acres of land, and contains approximately 12 fewer acres of agricultural land than the original HVDC Alternative Route 6-A, and the land use impacts would generally be the same for both.

3.10.6.3.2.1.6.2 *Alternative Route 6-B*

HVDC Alternative Route 6-B is approximately 14 miles long and corresponds to Applicant Proposed Route Link 3. Approximately 0.1 mile (0.9 percent) of the route would be parallel to existing transmission lines, whereas there are no existing transmission lines parallel to the Applicant Proposed Route Link 3. Approximately 1.8 miles (12.4 percent) would be parallel to existing roads, compared to 0.9 mile for Link 3. The land cover within the representative ROW is primarily cultivated crops (272.1 acres or 79.2 percent) and woody wetlands (44.6 acres or 13 percent) compared to 80.7 percent cultivated crops and 3.9 percent woody wetlands in Link 3. One residence is present in the representative ROW, whereas no structures are present in the representative ROW for the Applicant Proposed Route Link 3.

Outside the ROW, tensioning or pulling areas totaling 32.3 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is cultivated crops. No structures are present in the tensioning or pulling areas for Alternative Route 6-B.

3.10.6.3.2.1.6.3 *Alternative Route 6-C*

HVDC Alternative Route 6-C is approximately 23 miles long and corresponds to Applicant Proposed Route Links 6 and 7. Approximately 0.1 mile (0.5 percent) of the route would be parallel to existing transmission lines, comparable to Links 6 and 7. Approximately 2.5 miles (10.7 percent) of the route would be parallel to existing roads, compared to 4.3 miles for Links 6 and 7. The land cover within the representative ROW is primarily cultivated crops (410.6 acres or 72.6 percent), comparable to the Applicant Proposed Route Links 6 and 7, although Link 6 has more deciduous forest and woody wetlands. HVDC Alternative Route 6-C does not cross any federal or state land, compared to the Applicant Proposed Route Link 7 which crosses approximately 0.5 acre of the Singer Forest Natural Area. One agricultural structure is present in the representative ROW, whereas four agricultural structures in the representative ROW for the Applicant Proposed Route Link 6.

Outside the ROW, tensioning or pulling areas totaling 50.7 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is cultivated crops. No structures are present in the tensioning or pulling areas for Alternative Route 6-C.

3.10.6.3.2.1.6.4 *Alternative Route 6-D*

HVDC Alternative Route 6-D is approximately 9 miles long and corresponds to Applicant Proposed Route Link 7. The route would not be parallel to any existing transmission lines, like Link 7. Approximately 0.2 mile (2.5 percent) of the route would be parallel to existing roads, compared to 0.7 mile in the Applicant Proposed Route Link 7. The land cover within the representative ROW is primarily cultivated crops (205.3 acres or 91.8 percent) similar to Link 7. HVDC Alternative Route 6-D does not cross any federal or state land, whereas the Applicant Proposed Route Link 7 crosses approximately 0.5 acre of the Singer Forest Natural Area. No structures are present in the representative ROW, as is the case with the representative ROW for the Applicant Proposed Route Link 7.

Outside the ROW, tensioning or pulling areas totaling 17.8 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is cultivated crops. No structures are present in the tensioning or pulling areas for Alternative Route 6-D.

3.10.6.3.2.1.7 Region 7

Table 3.10-30 presents the land cover in the representative ROW for each of the four HVDC alternative routes in Region 7. Each alternative route is discussed in more detail below.

Table 3.10-30:
Land Cover in the HVDC Alternative Routes—Region 7

Land Cover	AR 7-A		AR 7-B		AR 7-C		AR 7-D	
	Acres	%	Acres	%	Acres	%	Acres	%
Barren Land (Rock/Sand/Clay)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cultivated Crops	827.8	78.7	86.4	41.2	350.6	53.5	76.8	48.1
Deciduous Forest	0.5	0.0	42.7	20.3	58.4	10.1	15.1	9.4
Developed, Low Intensity	5.7	0.5	0.6	0.3	6.2	1.1	1.4	0.9
Developed, Medium Intensity	0.1	0.0	0.0	0.0	0.9	0.1	0.0	0.0
Developed, Open Space	89.8	8.5	12.6	6.0	20.4	3.5	3.6	2.3
Emergent Herbaceous Wetlands	1.7	0.2	0.0	0.0	4.2	0.7	1.2	0.8
Evergreen Forest	0.0	0.0	0.9	0.4	2.6	0.5	0.0	0.0
Grassland/Herbaceous	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mixed Forest	0.0	0.0	0.0	0.0	1.4	0.2	1.0	0.6
Open Water	14.9	1.4	0.0	0.0	0.0	0.0	0.0	0.0
Pasture/Hay	1.0	0.1	34.0	16.2	72.2	12.5	32.2	20.2
Shrub/Scrub	0.0	0.0	32.7	15.6	49.6	8.6	20.6	12.9
Woody Wetlands	110.5	10.5	0.0	0.0	12.1	2.1	7.7	4.8
Total	1,052.0	100.0	209.9	100	578.6	100	159.5	100

Source: Jin et al. (2013)

3.10.6.3.2.1.7.1 *Alternative Route 7-A*

HVDC Alternative Route 7-A is approximately 43 miles long and corresponds to Applicant Proposed Route Link 1. Approximately 0.2 mile (0.4 percent) of the route would be parallel to existing transmission lines, comparable to the Applicant Proposed Route Link 1. Approximately 3.7 miles (8.5 percent) of the route would be parallel to existing roads, compared to 2.7 miles for Link 1. The land cover within the representative ROW is primarily cultivated crops (827.8 acres or 78.7 percent) and woody wetlands (110.5 acres or 10.5 percent), similar to the Applicant Proposed Route Link 1, although the latter has slightly less woody wetlands and more developed open space. No structures are present in the representative ROW, whereas one “other” structure (use not known) is present in the representative ROW for the Applicant Proposed Route Link 1.

Outside the ROW, tensioning or pulling areas totaling 166 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is cultivated crops. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 7-A.

3.10.6.3.2.1.7.2 *Alternative Route 7-B*

HVDC Alternative Route 7-B is approximately 9 miles long and corresponds to Applicant Proposed Route Links 3 and 4. The route would not be parallel to any existing transmission lines, comparable to the Applicant Proposed Route Links 3 and 4. Approximately 1.4 miles (16.0 percent) of the route would be parallel to existing roads, compared to 0.3 mile in the Applicant Proposed Route Links 3 and 4. The land cover within the representative ROW is primarily cultivated crops (86.4 acres or 41.2 percent), deciduous forest (42.7 acres or 20.3 percent), pasture/hay (34.0 acres or 16.2 percent), and shrub/scrub (32.7 acres or 15.6 percent), similar to the Applicant Proposed Route Links 3 and 4, although Link 4 has no deciduous forest. One agricultural structure is present in the representative ROW, whereas no structures are present in the representative ROW for the Applicant Proposed Route Links 3 and 4.

Outside the ROW, tensioning or pulling areas totaling 54 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is cultivated crops. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 7-B.

3.10.6.3.2.1.7.3 *Alternative Route 7-C*

HVDC Alternative Route 7-C is approximately 24 miles long and corresponds to Applicant Proposed Route Links 3, 4, and 5. Approximately 0.7 miles (3.0 percent) of the route would be parallel to existing transmission lines, compared to less than 0.1 mile in the corresponding links of the Applicant Proposed Route. Two miles (8.4 percent) of the route would be parallel to existing roads, compared to 0.7 mile for Links 3, 4, and 5. The land cover within the representative ROW is primarily cultivated crops (350.6 acres or 60.6 percent), pasture/hay (72.2 acres or 12.5 percent), and deciduous forest (58.4 acres or 10.1 percent), whereas the Applicant Proposed Route Links 3, 4, and 5 have more deciduous forest and shrub/scrub. One agricultural structure is present in the representative ROW, whereas two agricultural structures are present in the representative ROW for the Applicant Proposed Route Link 5.

Outside the ROW, tensioning or pulling areas totaling approximately 112 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is cultivated crops. No structures are present in the tensioning or pulling areas for HVDC Alternative Route 7-C.

3.10.6.3.2.1.7.4 *Alternative Route 7-D*

HVDC Alternative Route 7-D is approximately 7 miles long and corresponds to Applicant Proposed Route Links 4 and 5. Approximately 0.1 mile (0.8 percent) of the route would be parallel to existing transmission lines, compared to less than 0.1 mile in the Applicant Proposed Route Links 4 and 5. Approximately 0.3 mile (4.7 percent) of the route would be parallel to existing roads, compared to 0.4 mile for the Applicant Proposed Route Links 4 and 5. The land cover within the representative ROW is primarily cultivated crops (76.8 acres or 48.1 percent), pasture/hay (32.2 acres or 20.2 percent), and shrub/scrub (20.6 acres or 12.9 percent) and is generally comparable to the Applicant Proposed Route Links 4 and 5. No structures are present in the representative ROW, whereas two agricultural structures are present in the representative ROW for the Applicant Proposed Route Link 5.

Outside the ROW, tensioning or pulling areas totaling approximately 30 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is cultivated crops. No structures exist in the tensioning or pulling areas for HVDC Alternative Route 7-D.

3.10.6.3.2.2 Operations and Maintenance Impacts

Impacts from operations and maintenance of the HVDC alternative routes would be similar to those from the Applicant Proposed Route (see Section 3.10.6.2.3).The long-term impacts by region are summarized in Table 3.10-31 for pole structures. No long-term impacts are described for access roads, because the location of access roads has not yet been determined.

Because the locations of access roads to the HVDC alternative routes are not known at this time, it is possible that the access roads could be located in such a way that small areas of agricultural land would be isolated and no longer practicable to be used for farmland or grazing.

Table 3.10-31:
Impacts During the Operational Phase of the Alternative Routes

Region[1]	Length (miles)	Estimated Footprint of Structures (acres)[2]
Region 1		
1-A	123	17.2
1-B	52	7.3
1-C	52	7.3
1-D	34	4.8
Region 2		
2-A	57	8.0
2-B	30	4.2
Region 3		
3-A	38	5.3
3-B	48	10.9
3-C	122	17.0
3-D	39	5.5
3-E	8.5	1.2
Region 4		
4-A	58	8.1
4-B	79	11.1
4-C	3	0.4
4-D	25	3.5
4-E	37	5.2
Region 5		
5-A	13	1.8
5-B	71	9.9
5-C	9	1.3
5-D	22	3.1
5-E	36	5.0
5-F	22	3.1
Region 6		
6-A	16	2.2
6-B	14	2.0
6-C	23	3.2
6-D	9	1.3
Region 7		
7-A	43	6.0
7-B	9	1.3
7-C	24	3.4
7-D	6.5	0.9

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.

2 For a conservative estimate of impacts, the anticipated footprint of structures assumes seven lattice structures per mile; each would have a 28-foot by 28-foot foundation (less than 0.02 acre).

Although the majority of the land in the ROW could return to most previous uses, forested areas such as the ROW within the Lee Creek Variation in Region 4 of the Application Proposed Route or HVDC Alternative Route 4-B, which includes the Ozark National Forest, would not be permitted to return to timber production because trees could interfere with the reliability and safety of the HVDC facilities.

Short trees (up to 25 feet in height at maturity) would be permitted adjacent to the ROW. As noted in Section 2.1.5.1, limitations on land uses would be described in individual landowner easement agreements, and could be modified in the easement based on site-specific conditions and/or coordination with landowners. Land uses that generally may not be permitted in the ROW include constructing buildings or structures, changing the grading and land contours such that the ground surface elevation within the ROW would change and alter the required electrical clearance, and installing fences or irrigation lines without coordination with the Applicant.

3.10.6.3.2.3 Decommissioning Impacts

Potential impacts during decommissioning of the Project would be similar to those of the construction phase for all Project components. Once the decommissioning is complete, all land could return to the pre-construction land uses described in Section 3.10.4 and Section 3.10.5.

3.10.6.4 Best Management Practices

In addition to the EPMs described in Section 3.10.6.1 and Section 3.10.6.7, the following BMPs have been identified to avoid or minimize potential land use impacts:

- In existing forested areas where temporary construction areas require tree clearing, replant with appropriate tree species and/or reclaim temporary construction areas, in coordination with landowners.
- In addition to EPM LU-5, make reasonable efforts to avoid displacing structures on private property.

3.10.6.5 Unavoidable Adverse Impacts

Unavoidable adverse impacts to land uses from the Project include the removal of vegetation and conversion of primarily rangeland and cultivated crops and some forested lands and developed open space to a utility use. The Applicant Proposed Route would result in the conversion of up to approximately 2,598 acres of land to utility use for the life of the Project, including 2,345 acres for access roads, 120 acres for two converter stations, 129 acres for all pole structures, and 4 acres for fiber regeneration sites.

Under the Applicant Proposed Route, 33 structures are present in the representative ROW: 4 residences, 3 commercial structures, 19 agricultural structures, 3 industrial structures, 2 abandoned structures, and 2 other structures (use unknown). These structures may have to be removed if the Project features could not avoid them, although the Applicant will continue to work with affected landowners to minimize the impact of siting the ROW on their property, including micrositing to avoid residences and other structures. Yields from cultivated crops, pasture/hay, and timberlands would be temporarily affected in the construction areas, and uses that are incompatible with the operation of the transmission line, such as tall trees for timber, would be removed from the ROW for the life of the Project. The height of orchard trees within the ROW could be restricted for the life of the Project.

Because the locations of Project access roads are not known at this time, it is possible that the access roads could be located in such a way that small areas of agricultural land would be isolated and no longer practicable to be used for farmland or grazing, resulting in a conversion of additional land from agricultural to non-agricultural use.

If DOE opts to participate in the Project and the Project included the Arkansas converter station, an additional 73 acres would be committed to utility use, including 35 acres for the converter station, 35 acres for the new substation, 2.4 acres for access roads, and 0.7 acre for 5-mile AC interconnect structures.

3.10.6.6 Irreversible and Irretrievable Commitment of Resources

The use of the approximately 2,598 acres for the life of the Project would be irreversible since these areas would be converted to a utility use as transmission structures, access roads, converter stations, or fiber regeneration sites. In addition, some land use restrictions may result within the ROW depending on the limitations determined for each individual landowner's lease agreement. As discussed above, it is possible that some small areas may no longer be practicable for agricultural use depending on the location of Project access roads. Once the Project has been decommissioned, all land could return to previous uses; therefore, there would be no irretrievable commitment of land use resources.

3.10.6.7 Relationship between Local Short-term Uses and Long-term Productivity

Local short-term use effects from the Project would result from the removal of vegetation and conversion of primarily agricultural and undeveloped land to a utility use. Other short-term and local impacts include the disruption to access to local land uses that may occur, such as agriculture, oil and gas development, and residences and businesses during construction.

The short-term impacts would be minimized, however, because of multiple EPMs incorporated into the Project (Appendix F).

EPMs that should ensure long-term productivity of during operations and maintenance of the Project include:

- Clean Line will avoid or minimize adverse effects to surface and subsurface irrigation and drainage systems (e.g., tiles). Clean Line will work with landowners to minimize the placement of structures in locations that would interfere with the operation of irrigation systems (AG-1).
- Agricultural soils temporarily impacted by construction, operation, or maintenance activities will be restored to pre-activity conditions. For example, soil remediation efforts may include decompaction, recontouring, liming, tillage, fertilization, or use of other soil amendments (AG-2).
- Clean Line will consult with landowners and/or tenants to identify the location and boundaries of agriculture or conservation reserve lands and to understand the criteria for maintaining the integrity of these committed lands (AG-3).
- Clean Line will work with landowners and/or tenants to identify specialty agricultural crops or lands (e.g., certified organic crops or products that require special practices, techniques, or standards) that may require protection during construction, operation, or maintenance. Clean Line will avoid and/or minimize impacts that could jeopardize standards or certifications that support specialty croplands or farms (AG-4).
- Clean Line will stabilize slopes exposed by its activities to minimize erosion (GEO-1).

The use of native seed mixes and tree species when revegetating the ROW would increase the likelihood that native grasslands and forestlands would return to their previous conditions. The Project is not expected to have any long-term impacts on land use productivity.

3.10.6.8 Impacts from Connected Actions

3.10.6.8.1 Wind Energy Generation

Based on the maximum capacity of the Project and information from wind energy developers[2], it is estimated that 20 to 30 percent of the potentially suitable land, or between 216,400 and 324,600 acres, would actually be developed for wind energy facilities using transmission capacity from the Project.

It is estimated that during the construction phase, approximately 2 percent of land within a wind energy facility is affected (Denholm et al. 2009). Assuming between 20 and 30 percent of the WDZs would be built out, between 4,328 and 6,492 acres would be temporarily disturbed (2 percent of the 20 percent for the low end, 2 percent of the 30 percent for the high end). This range includes the construction of access roads, turbine pads and foundations, underground collection lines, collector substation, and often a generation tie line. An operations and maintenance building and at least one or two meteorological towers are also typically included.

During the operations and maintenance phase of wind energy facilities, approximately 1 percent or less of the land would be affected (Denholm et al. 2009). For the 12 WDZs, assuming 20 to 30 percent build-out, between 2,164 and 3,246 acres would be disturbed (until decommissioning). Once construction has been completed, temporary construction areas would revert to their previous use. Only turbines, access roads, generation tie-lines (if necessary), substations, and operations and maintenance buildings would remain. Existing land uses, primarily agriculture and grazing, would be expected to return to almost all areas of the facilities, unless deemed incompatible with the operation of a wind farm.

Wind turbines and associated facilities are typically located outside municipal boundaries and densely populated communities. The facilities are also typically microsited to accommodate the wishes of participating landowners, avoid affecting sensitive land uses, and to meet local zoning and other setback requirements, so most residences, businesses, cemeteries, churches, hospitals, and schools and other sensitive uses are expected to be avoided.

Temporary impacts during construction may include increased noise, dust, and traffic. Impacts to rangeland/pasture and cultivated crops would result from disturbing vegetation and soils. Construction would temporarily prevent the existing uses in the construction area, including growing crops and animal grazing. Wind energy developers typically coordinate with landowners to minimize impacts to agricultural operations, such as timing construction to begin after crops are harvested; installing fencing to prevent injuries to, or the loss of, livestock; and types of seed to use during revegetation.

Temporary impacts to transportation infrastructure, such as state and local roadways, as well as to aboveground and subsurface utilities, may occur during construction of wind energy facilities. Wind energy developers would be required to acquire the appropriate state and county permits for work in ROWs, and typically return roadways to the

[2] The Applicant requested confidential information from wind energy developers considering development in the region, including confidential information regarding project nameplate, and proposed general location.

same or improved conditions. Wind energy developers also typically coordinate with landowners and operators of existing utilities to locate these utilities and avoid or minimize impacts to existing structures to the extent practicable.

Wind developers must comply with FAA regulations, including submitting planned turbine locations for approval and installing hazard navigation lighting. FAA would determine whether the turbine locations would compromise the operation of nearby airports. Regional airports and airstrips are identified in Section 3.16.

Wind lease agreements typically include provisions to minimize the losses, including minimizing soil compaction and revegetating temporary construction areas. In addition, the agreements typically stipulate compensation for landowners for any losses, such as damage or loss of crops, gates, fences, landscaping and trees, irrigation, and livestock. Once construction is complete, agricultural operations would be able to continue in most of the wind farm. Agricultural activities such as cultivating crops and livestock grazing are generally permitted up to the wind turbine pads, so only a very minimal area of existing agricultural land would be permanently removed from production. Permanent access roads may change the configuration of fields for crops and grazing.

Oil and gas development could be temporarily affected during construction if access to drilling equipment is prevented. These and more direct impacts to drilling infrastructure are expected to be minimized through coordination with landowners. Once construction is complete, oil and gas development in the vicinity of the wind energy facilities could continue.

If a wind energy facility is developed on school trust lands, the existing uses may be temporarily reduced during construction, but may be able to continue once the wind energy facility is operating, depending on the terms of the lease.

Potential effects on hunting and recreation are discussed in Section 3.12. Potential effects on agriculture are discussed in Section 3.2. Potential effects on airports are discussed in Section 3.16.

3.10.6.8.2 Optima Substation

The future Optima substation is anticipated to be constructed on 160 acres of currently undeveloped land partially within the Oklahoma AC Interconnection Siting Area and near an operating wind energy facility. The land cover of the site is primarily grassland/herbaceous. This area would be converted to a utility use for the life of the Project.

3.10.6.8.3 TVA Upgrades

Land uses in areas affected by the required TVA upgrades could include different distributions of land cover and development levels than described in Section 3.10.6 for the Project. The new 500kV line would be in western Tennessee. The upgrades to existing facilities would mostly be in western and central Tennessee. Upgrades to existing infrastructure would include upgrading terminal equipment at three existing 500kV substations and six existing 161kV substations, making appropriate upgrades to increase heights on 16 existing 161kV transmission lines to increase line ratings, and replacing the conductors on eight existing 161kV transmission lines. These upgrades, with the exception of substation modifications, are linear projects, with relatively small amounts of ground disturbance (except in forested areas where ground disturbance resulting from ROW clearing can impact large areas) considering the amount of area crossed, which tends to minimize the amount of land use changes on a regional basis. Also, once the construction is complete, much of the affected land could return to previous land uses such as agriculture (grazing and crops).

Potential land use impacts associated with the required upgrades to existing TVA facilities are not anticipated to result in significant effects to land use. The degree of potential impacts associated with the new electric transmission line would depend on the types of existing land uses within the 37-mile long transmission line ROW, which would occupy about 785 acres (assuming a ROW width of 175 feet). The majority of the ROW would be disturbed during construction only for both the new transmission line and the upgrades to existing facilities. Areas of fully dedicated use (e.g., sites of converter stations, structures, and permanent access roads) would experience longer-term impacts than ROW areas, where existing land use may continue after construction, with certain limitations. Anticipated effects from upgrades to existing structures, conductor, or substations would be expected to include ground disturbance that is typically limited to the immediate vicinity of the structure, and no changes to the existing utility use. Operations and maintenance impacts would be similar to those described above in Section 3.10.6.2.3.2.

3.10.6.9 Impacts Associated with the No Action Alternative

Under the No Action Alternative, DOE assumes for analytical purposes that the Project would not be constructed. No impacts on land uses on private, federal, state, or tribal lands, or their corresponding land management policies and regulations would occur. The existing land uses within the ROW would be expected to continue.

Contents

Tables

3.11 Noise

This section presents the affected environment related to noise and addresses the potential noise impacts on noise sensitive areas (Noise Sensitive Areas [NSAs]; e.g., residences and schools) from the construction, operations, and decommissioning of the Project. The following subsections describe the regulatory background as it pertains to noise, discuss existing acoustic conditions, and assess potential noise impacts related to the Project.

3.11.1 Regulatory Background

This section describes noise regulations at the federal, state, and local level that may be applicable to the Project.

3.11.1.1 Federal

Two federal regulatory guidelines have been identified for assessing noise impacts from the Project. The EPA guidelines are applicable to operational and maintenance noise from the Project and the DOT guidelines are applicable to construction noise from the Project.

3.11.1.1.1 U.S. Environmental Protection Agency

In 1974, the EPA published a study that includes the only large database of community reaction to noise to which a project can be readily compared called Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety (EPA 1974). The EPA has developed widely accepted recommendations for long-term exposure to environmental noise with the goal of protecting public health and safety; however, they are not regulatory limits. Instead, the study evaluates the effects of environmental noise with respect to health and safety, and provides information for state and local governments to use in developing their own ambient noise standards. For outdoor residential areas and other locations in which quiet is a basis for use, the recommended EPA guideline is 55 dBA (or decibels weighted on the A-scale) L_{dn}. The L_{dn} is calculated by averaging the 24-hour L_{eq} levels at a given location after adding 10 decibels to the nighttime period (10:00 p.m.–7:00 a.m.) to account for the increased sensitivity of people to noises that occur at night. For a steady 24-hour noise source such as a converter station, an L_{eq} of 48.6 dBA is equal to the L_{dn} criterion of 55 dBA. The EPA also suggests an L_{eq} (24) of 70 dBA (24-hour) limit to avoid adverse effects on public health and safety at publicly accessible property lines or extents of work areas where extended periods public exposure is possible. The EPA criteria are summarized in Table 3.11-1, which identifies levels of environmental noise below which there is no evidence that the general population would be at risk to EPA-identified health effects.

Table 3.11-1:
Summary of EPA Environmental Noise Guidelines

Location	Level	Effect
All public accessible areas with prolonged exposure	70 dBA $L_{eq(24)}$	Safety/Hearing loss
Outdoor at residential structure and other noise sensitive receptors where a large amount of time is spent	55 dBA L_{dn}	Outdoor activity interference and annoyance
Outdoor areas where limited amounts of time are spent, e.g., park areas, school yards, golf courses, etc.	55 dBA $L_{eq(24)}$	Outdoor activity interference and annoyance
Indoor residential	45 dBA L_{dn}	Indoor activity interference and annoyance
Indoor non-residential	55 dBA $L_{eq(24)}$	Indoor activity interference and annoyance

Source: EPA (1974)

3.11.1.1.2 U.S. Department of Transportation

The DOT has identified criteria for the assessment of short- and long-term construction activities for both stationary and mobile projects, and specifically for linear projects. The Federal Transit Administration (FTA) recommends abatement of construction noise that exceeds absolute noise levels at NSAs. These construction noise criteria take into account the diurnal pattern of construction activities, the absolute noise levels during construction activities, the duration of the construction, and adjacent land use. While these criteria were not developed to address construction noise impacts for power transmission line projects, the guidelines shown in Table 3.11-2 provide reasonable criteria for the construction noise assessment. If these criteria are exceeded, adverse community reaction may result.

Table 3.11-2:
DOT Guidelines for Construction Noise Assessment

Land Use	L_{eq}, 1-hr (dBA)	
	Day	Night
Residential	90	80
Commercial	100	100
Industrial	100	100

Source: FTA (2012)

3.11.1.2 State and Local

The states of Oklahoma, Arkansas, Tennessee, and Texas and the local jurisdictions to which DOE's Proposed Action is in proximity do not have environmental noise regulations with numerical decibel limits applicable to the Project. The EPA guideline of 55 dBA L_{dn}, has therefore been used in the evaluation potential noise impacts associated with the Project.

3.11.2 Data Sources

Data sources used in characterizing the existing acoustic environment and evaluating noise impacts are those provided in Table 3.11-3.

Table 3.11-3:
Noise Analysis Data Sources

Specific Noise Analysis	Data Source
Background sound levels	2011 National Land Cover Database used to characterize land use (e.g., mixed forest, developed land, agriculture, etc.) within the ROI. (GIS Data Source: Jin et al. 2013)
	USGS Topographic Maps (http://nationalmap.gov/ustopo/index.html) used to characterize land relief within the ROI.
	Federal Transit Administration High-Speed Ground Transportation Noise and Vibration Impact Assessment. (FTA 2012)
Predicted project sound levels	DOT Construction Noise Handbook. (FHWA 2006)
	Expected construction equipment is listed in the Project description (Appendix F). Construction sound source levels were obtained from FHWA. (2006)
	Expected operational equipment is listed in the Project description (Appendix F). Operational sound source levels were obtained from the Project Electrical Environment Assessment (Section 3.4 of this EIS).
Noise sensitive receptors	See Section 3.10 of this EIS.

3.11.3 Region of Influence

For noise, the ROI for the Project and connected actions is the same as described in Section 3.1.1.

3.11.4 Affected Environment

The affected environment includes the NSAs in the ROI. As mentioned previously NSAs can include residences, and schools, etc. or other places where quiet is a basis for use. Locations of residences and schools are shown in Figure 1.0-2 located in Appendix A of the EIS. The only two schools within the ROI are within AC Collection System Route E-1, located within the town of Hardesty. Using the applicable noise thresholds for the various Project facilities as a guide, potentially impacted NSAs were identified in the ROI. Conversely for connected actions, some of the ROIs are not known at this time; therefore, potentially impacted NSAs will have to be identified when those ROIs have been defined.

Several route variations to the Applicant Proposed Route in Regions 2–7 were developed in response to public comments on the Draft EIS and are described in Appendix M and summarized in Sections 2.4.2.1–2.4.2.7. The variations are presented graphically in Exhibit 1 of Appendix M. Many of the route variations were developed specifically to increase the distance to NSAs to reduce impacts from construction noise. Nonetheless, the number of NSAs located within the threshold distances of the route variations and adjustments would be similar.

3.11.5 Regional Description

Chapter 2 of this EIS includes detailed descriptions of the routing alternatives broken down by seven geographic regions, or Regions 1 through 7. Construction and operational noise sources vary by region and generally differ based on specific Project components as listed in Section 2.1. Access road construction would be required to construct and maintain the Project components regardless of region. Chapter 2 describes each region and Section 3.10 describes land uses within the ROI.

3.11.5.1 Connected Actions

3.11.5.1.1 Wind Energy Generation

The WDZs are all located within the Oklahoma Panhandle and the adjacent portions of Texas, so the regional description is the same as that of Region 1.

3.11.5.1.2 Optima Substation

The future Optima Substation is partially located within the Oklahoma AC Interconnection Siting Area. There are no NSAs located within 0.75 mile from the future Optima Substation.

3.11.5.1.3 TVA Upgrades

The ROI for the direct assignment facilities (which are included in the Applicant Proposed Project) would occur within the Tennessee Converter Station Siting Area and more specifically within the Shelby Substation. The ROI for the network upgrades, and in particular TVA's future 500kV transmission line, cannot be fully determined at this time. The new 500kV line would be constructed in western Tennessee. The upgrades to existing facilities would mostly be in western and central Tennessee. Upgrades to existing infrastructure would include upgrading terminal equipment at three existing 500kV substations and six existing 161kV substations, making appropriate upgrades to increase heights on 16 existing 161kV transmission lines to increase line ratings, and replacing the conductors on eight existing 161kV transmission lines. Where possible, general impacts associated with the required TVA upgrades are discussed in the impact sections that follow.

3.11.6 Noise Impacts

Noise impacts from the Project are classified as temporary impacts associated with construction and permanent impacts associated with operations and maintenance of the Project.

3.11.6.1 Methodology

Sound is described as a rapid fluctuation or oscillation of air pressure above and below atmospheric pressure creating a sound wave. Sound energy is characterized by the properties of sound waves, which include frequency, wave length, period, amplitude, and velocity. Noise is highly subjective and defined as unwanted sound. It is largely dependent on its magnitude and/or intensity of the sound source, its duration, the proximity of noise-sensitive land uses, and the time of day the noise occurs (i.e., higher sensitivities would be expected during the quieter overnight periods).

The range of frequencies that humans hear can span from 20 to 20,000 Hz; however, humans have varying sensitivities to noise at different frequencies, even though the energy content is the same. The amplitude of a sound wave is measured in terms of its sound pressure level where a logarithmic decibel scale is used. The A-weighting filter attenuates low and high frequency energy to simulate the hearing response of the human auditory system. Sound levels that are A-weighted to reflect human response are designated as dBA.

To take into account sound fluctuations, environmental noise is commonly described in terms of the L_{eq}. The L_{eq} value, conventionally expressed in dBA, is the energy-averaged, A-weighted sound level for the time period of interest. It is defined as the steady, continuous sound level, over a specified time, which has the same acoustic energy as the actual varying sound levels over that same time period. Another common noise descriptor used when assessing environmental noise is the L_{dn}, which includes the addition of 10 dB to noise emitted during the nighttime period (10:00 p.m. to 7:00 a.m.) to account for the increased sensitivity of people to noises that occur at night. The maximum sound level (L_{max}) is the maximum instantaneous sound level as measured during a specified time period. It can also be used to quantify the time-varying maximum instantaneous sound pressure level (as generated by equipment or an activity) or a manufacturer maximum source emission level.

An acoustic analysis was conducted for Project construction and operations and maintenance using criteria and guidelines discussed in Section 3.11.1. The analysis methods included determining a threshold distance from Project construction and operations and maintenance activities for the converter stations, Applicant Proposed Route, AC collection system, and HVDC alternative routes. Each threshold distance correlated with a selected noise criterion; therefore, an NSA located within a threshold distance would experience received sound levels in excess of that criterion.

The analysis of operational noise (long-term impacts) from the converter stations, Applicant Proposed Route, AC collection system, and HVDC alternative routes, was based on a representative centerline as described in Section 3.1. Construction noise (short-term impacts) threshold distances were calculated by generating a composite, or summed, noise level for all construction equipment required for a certain construction phase. Sound attenuation calculations were then completed to determine the distance from the Project ROW at which construction noise would decrease to levels corresponding to the DOT construction noise thresholds. Once this distance was determined, the number of NSAs within that distance from Project construction activities was quantified. The DOT construction noise thresholds were used to determine the threshold distances, which includes a daytime $L_{eq(1\text{-}hr)}$ 90 dBA threshold and a nighttime $L_{eq(1\text{-}hr)}$ 80 dBA threshold, both applicable at residential land uses. A similar methodology was used to evaluate potential noise impacts associated with Project operations, but the EPA 55 dBA L_{dn} noise guideline was used to determine the threshold distance. Threshold distances would vary greatly depending on the Project activity. For instance, during the construction phase, heightened received sound levels would result from use of heavy equipment and helicopters, whereas noise associated with transmission line operation (termed corona noise) would be substantially lower. Where impacts were identified, noise mitigation measures were recommended. The Applicant has developed a comprehensive list of EPMs that will aid in minimizing noise impacts. A complete list of EPMs for the Project is provided in Appendix F; those EPMs that would specifically minimize the potential for noise impacts are listed below:

- GE-6: Clean Line will restrict vehicular travel to the ROW and other established areas within the construction, access, or maintenance easement(s).
- GE-17: Clean Line will consider noise and radio/television interference in the design of bundle configurations and conductors. To minimize noise and radio/television interference, the Applicant will maintain tension on insulator assemblies and protect the conductor surface from damage during construction.
- GE-20: Clean Line will maintain construction equipment in good working order. Equipment and vehicles that show excessive emissions of exhaust gasses and particulates due to poor engine adjustments or other inefficient operating conditions will be repaired or adjusted.
- GE-23: Clean Line will maximize the distance between stationary equipment and sensitive noise receptors consistent with engineering design criteria.
- GE-24: Clean Line will minimize the number and distance of travel routes for construction equipment near sensitive noise receptors.
- GE-25: Clean Line will turn off idling equipment when not in use.

3.11.6.2 Impacts Associated with the Applicant Proposed Project

Impacts include those from construction, operations and maintenance, and decommissioning of the converter stations, AC transmission lines, and HVDC transmission lines. Construction noise levels would be temporary, lasting 36 to 42 months for the Applicant Proposed Project; however, construction would last for much shorter durations of several days to weeks in any given area for the AC transmission lines and HVDC transmission lines and up to 32 months for construction of each converter station. Temporary construction noise can be a source of annoyance for NSAs located nearby and is characterized as a short-term impact. Operational noise is generally lower level but long term in nature and characterized as a long-term impact. The following sections describe construction and operations and maintenance noise impacts expected for the converter stations, AC transmission lines, and HVDC transmission lines.

3.11.6.2.1 Converter Stations

The Applicant Proposed Project includes two proposed converter stations in Oklahoma and Tennessee. Potential noise impacts associated with construction, operations and maintenance, and decommissioning of the converter stations are discussed in the following subsections.

3.11.6.2.1.1 Construction Impacts

Construction of the proposed converter stations would be completed in three stages: site preparation, foundation installation, and erection of the station. Because detailed design has not been completed to date, representative converter station sites were used within the converter station siting areas, located approximately where the HVDC and AC connector lines meet. Each converter station site is assumed to be approximately 50 acres in size for the purposes of this analysis. Construction of the converter stations would require the short-term use of heavy equipment such as cranes, loaders, bulldozers, graders, excavators, compressors, generators, and various trucks. Pile driving is not expected during construction. Construction noise is usually made up of intermittent peaks and continuous lower levels of noise from equipment cycling through use. Noise levels associated with individual pieces of equipment at 50 feet away would generally range between 55 and 85 dBA L_{max} (FHWA 2006). Maximum instantaneous construction noise levels would range from 91 to 95 dBA L_{eq} at 50 feet from any work site. Table 3.11-4 provides noise level data for the three converter station construction stages; the highest construction noise levels are associated with erecting the stations. Predicted L_{eq} values are given at several reference distances to provide an indication of sound levels generated during the various converter station construction stages and how those levels attenuate with distance.

Using the construction stage anticipated to generate the highest noise level (erecting of station), the threshold distance to the DOT construction noise thresholds described in Section 3.11.1 using the methodology described in Section 3.11.6.1, was calculated from each converter station construction area. The threshold distances were determined to be 95 feet and 275 feet for the daytime (90 dBA L_{eq}) and nighttime (80 dBA L_{eq}) thresholds, respectively, so any NSAs located within those distances to the construction areas would potentially experience an exceedance of the DOT guidelines. Review of aerial mapping used to identify NSAs near the analyzed converter station areas indicates that no NSAs would be located within either of these threshold distances, so no exceedances of the DOT guidelines are expected.

Table 3.11-4:
Construction Noise Levels—Converter Stations

Stage	Construction Equipment	Quantity	Reference Noise Level L_{max} at 50 feet	Usage Factor (%)	Composite Sound Pressure Level (L_{eq}) at Distance from Sound Source				
					50 feet	100 feet	200 feet	400 feet	1,000 feet
Site Preparation	Scrapers	4	85	40	93	87	81	75	67
	Bulldozer	2	85	40					
	Motor Grader	2	85	40					
	Roller Compacter	2	80	20					
	Excavator	2	85	40					
	Dump Trucks	4	84	40					
	Water Truck	3	84	20					
	Mechanic's Truck	1	84	20					
	Fuel Truck	1	84	20					
	Pick-up Truck	2	55	40					

Table 3.11-4:
Construction Noise Levels—Converter Stations

Stage	Construction Equipment	Quantity	Reference Noise Level L_{max} at 50 feet	Usage Factor (%)	Composite Sound Pressure Level (L_{eq}) at Distance from Sound Source				
					50 feet	100 feet	200 feet	400 feet	1,000 feet
Foundation Installation	Boom Trucks	2	85	40	91	85	79	73	65
	Excavator	1	85	40					
	Concrete Trucks	3	85	40					
	Dump Truck	1	85	40					
	Roller Compactor	1	85	20					
	Plate Compactor	2	80	20					
	Backhoe	1	80	40					
	Bobcats	2	70	40					
	Mechanics' Truck	1	84	20					
	Fuel Truck	1	84	20					
	Water Truck	1	84	20					
	Pick-up Truck	2	55	40					
Erecting of Station	Pick-up Truck	6	55	40	95	89	83	77	69
	Truck (2-ton)	6	84	40					
	Truck (1-ton)	3	84	40					
	Forklift (Telescopic)	6	85	40					
	Fuel Truck	1	84	20					
	Boom Lift	6	85	20					
	Crane (15-ton Boom Truck)	3	85	40					
	Crane (30-ton)	3	85	40					
	Crane (120- to 300-ton)	3	85	20					
	Welder Truck	6	55	20					
	Air Compressor	3	80	20					
	Generator	3	82	40					

3.11.6.2.1.2 Operations and Maintenance Impacts

Noise generated from operations and maintenance of the converter stations was analyzed. Converter station maintenance activities are expected to require minimal equipment such as trucks and lifts, which would not generate much noise. Because of the nature of the equipment likely needed for maintenance and the periodic basis that maintenance would be conducted, noise levels associated with converted station maintenance are expected to be low at nearby NSAs.

As mentioned above, detailed design of the converter stations has not been completed at this stage of permitting. Typical equipment that would be installed at the converter stations would include AC filters, coolers, converter valves, chillers, reactors, capacitors, and transformers. The principal noise sources in the converter stations are the transformers with second and third highest sound sources being the filter reactors and valve coolers, respectively.

Converter station noise would propagate and attenuate at different rates depending on the locations and specifications of sound producing equipment. For example, the sound generated by transformers depends on several factors including the transformer size, voltage rating, and design. Table 3.11-5 provides the equipment type, quantity, and sound power level used in assessing noise generated during converter station operation.

Table 3.11-5:
Converter Station Equipment Noise Sources

Equipment Type	Quantity	Sound Power (dBA)
AC Filters	12	77
Filter Capacitor	12	82
Filter Reactor	12	95
Converter Transformers	12	112
Coolers	6	88
Smoothing Reactors	2	72
Valve Coolers	2	92
Chillers	2	77
Converter Valves	2	82

Both converter stations share the same equipment types, quantities, and sound power levels. To the extent practicable, the Applicant would orient the converter stations such that the noisiest side of the station, the AC side, is facing away from the nearest NSA. In addition, sound from the converter station transformers would be partially mitigated by barrier walls on two sides of the transformers each exceeding the transformer height. The valve hall building would be acoustically insulated with metal outer sheeting.

Acoustic modeling was conducted using the information provided in Table 3.11-5 implementing the general configuration planned for the converter stations. The model used was Datakustik's CadnaA version 4.5.151 implementing the International Organization for Standardization standard 9613-2, Acoustics—Attenuation of Sound During Propagation Outdoors (ISO 1996). The engineering methods specified in this standard consist of full octave band algorithms that incorporate geometric spreading due to wave divergence, reflection from surfaces, atmospheric absorption, screening by topography and obstacles, ground effects, source directivity, heights of sources and receptors (i.e., NSAs), seasonal foliage effects, and meteorological conditions. The following subsections provide the results of this acoustic modeling analysis.

3.11.6.2.1.2.1 Oklahoma Converter Station Siting Area and AC Interconnection Siting Area

The analysis conducted for the Oklahoma converter station showed that the predicted sound level at the nearest NSA, located 7,000 feet from the center point of the converter station, inclusive of the assumed background sound level of 43 dBA (L_{dn}), is 48 dBA L_{dn}, which is below the EPA environmental noise guideline of 55 dBA L_{dn}. It should be noted that final design of the converter station has not been completed. Based on the analysis, however, compliance with the EPA noise guideline is expected and NSAs located further away are expected to experience lower sound levels, so no noise impacts are anticipated at the Oklahoma converter station.

The Oklahoma converter station includes one 5-mile 345kV interconnection line. No NSAs are located within the threshold distance for 345kV single circuit transmission lines as described in Section 3.11.6.2.2 and using the methodology described in Section 3.11.6.1.

3.11.6.2.1.2.2 Tennessee Converter Station Siting Area and AC Interconnection Siting Area

The analysis conducted for the Tennessee converter station showed that the predicted converter station sound level at the nearest NSA, located 1,030 feet from the center point of the converter station, inclusive of the assumed background sound level of 43 dBA (L_{dn}), is 53 dBA L_{dn}, which is below the EPA environmental noise guideline of 55 dBA L_{dn}. It should be noted that final design of the converter station has not been completed. Based on the analysis, however, compliance with the EPA noise guideline is expected and NSAs located further away are expected to experience lower sound levels, so no noise impacts are anticipated at the Tennessee converter station.

The Tennessee converter station would include an AC interconnect tie located entirely within the footprints of the Tennessee converter station and Shelby Substation. Sound generated by on-site converter transformers and other facilities will be dominant relative to sound generated by the AC interconnect tie; therefore, noise impacts at NSAs resulting from the interconnect tie are expected to be negligible.

3.11.6.2.1.3 Decommissioning Impacts

Decommissioning noise impacts are expected to be similar to construction noise impacts because similar equipment would be required. However, decommissioning activities would take less time than construction activities, so NSAs would not experience decommissioning noise impacts for as long as those associated with construction. Because no impacts are expected from construction of the Project, and because sound levels with decommissioning would be similar, no impacts are expected from decommissioning.

3.11.6.2.2 AC Collection System

Potential noise impacts associated with the AC collection system for construction and operations and maintenance are discussed in the following subsections.

3.11.6.2.2.1 Construction Impacts

Construction of the AC transmission lines would be completed in stages such as ROW clearing, foundation installation, structure assembly, and conductor stinging. Construction of the AC transmission lines would occur as a series of sequential events distributed over several miles along the transmission line route at any one time. Noise levels associated with individual pieces of equipment at 50 feet would generally range between 55 and 103 dBA L_{max} (FHWA 2006). Maximum instantaneous construction noise levels would range from 88 to 96 dBA L_{eq} at 50 feet from any work site. Table 3.11-6 provides noise level data for the four stages of AC transmission line construction; the highest construction noise levels would be associated with structure assembly and conductor stringing. Similar to data provided for converter station construction, sound levels generated during transmission line construction are provided at a set of reference distances.

It is likely that blasting would be required for some tower installations; however, in these cases, a detailed Blasting Plan would be developed and implemented to avoid noise impacts. Examples of measures that could be included in the Blasting Plan to minimize blasting impacts are:

- Use tamping or stemming into the collars of blast holes and smooth-wall perimeter holes (stemming is defined as inserted material, such as crushed stone, sand, or any other inert objects placed in the top of the blast hole for the purpose of confining explosive charges and limiting rock movement and air-overpressure).
- Use blasting mats.
- Unless otherwise coordinated with landowners and adjacent landowners, plan blasting to take place only between the hours of 10:00 a.m. and 4:00 p.m., Monday through Friday. No blasting shall take place on weekends.
- Notify landowners and tenants, including owners of adjacent utilities or structures, prior to blasting.

Detailed Blasting Plans would be developed for the Project based on site-specific activities and nearby conditions.

Table 3.11-6:
Construction Noise Levels—AC Collection Lines

Stage	Construction Equipment	Quantity	Reference Noise Level L_{max} at 50 feet	Usage Factor (%)	Composite Sound Pressure Level (L_{eq}) at Distance from Sound Source				
					50 feet	100 feet	200 feet	400 feet	1,000 feet
ROW Clearing	Bulldozer	1	85	40	88	82	76	70	62
	Chipper	1	75	40					
	Excavator	1	85	40					
	Feller Buncher	1	75	40					
	Flail Mower or Bush Hog	1	84	40					
	Hydra-Ax or Mulcher	1	84	40					
	Loader	1	80	40					
	Pick-up Trucks	4	55	40					
	Skidder	1	85	40					
Foundation	Bobcat	1	70	40	91	85	79	73	65
	Bulldozer	1	85	40					
	Concrete Trucks	3	85	40					
	Cranes (20-ton)	2	85	16					
	Drill Rig	1	84	20					
	Dump Truck	1	84	40					
	Excavator	1	85	40					
	Generator	1	82	50					
	Loader	1	80	40					
	Pick-up Truck	3	55	40					
	Plate Compactor	1	80	20					
	Truck (1-ton)	1	84	40					
	Wagon Drill	1	85	20					

Table 3.11-6:
Construction Noise Levels—AC Collection Lines

Stage	Construction Equipment	Quantity	Reference Noise Level L_{max} at 50 feet	Usage Factor (%)	Composite Sound Pressure Level (L_{eq}) at Distance from Sound Source				
					50 feet	100 feet	200 feet	400 feet	1,000 feet
Structure Assembly	3-drum pullers (heavy)	2	85	16	96	90	84	78	70
	3-drum pullers (medium)	1	82	50					
	Helicopter (large)	1	103	20					
	Cranes (20-ton)	4	55	40					
	Crane (30-ton)	1	85	40					
	Double Bull-Wheel Tensioner (heavy)	1	85	40					
Conductor Stringing	3-drum pullers (heavy)	2	80	50	96	90	84	78	70
	3-drum pullers (medium)	2	80	50					
	Bulldozers	2	85	40					
	Cranes (20-ton)	2	85	16					
	Crane (30-ton)	1	85	16					
	Double Bull-Wheel Tensioner (heavy)	1	82	25					
	Double Bull-Wheel Tensioner (medium)	1	82	25					
	Helicopter (small)	1	97	50					
	Pick-up Truck	4	55	40					
	Single-Drum Puller (Large)	1	80	50					
	Splicing Trucks	2	55	40					
	Trucks (5-ton)	4	85	40					
	Wire Reel Trailers	6	85	20					

Source: FHWA (2006)

The calculated threshold distance from each AC transmission line construction area using the methodology in Section 3.11.6.1, was determined to be 100 feet and 325 feet for the daytime (90 dBA L_{eq}) and nighttime (80 dBA L_{eq}) thresholds, respectively. An analysis was conducted to evaluate the number of NSAs within these threshold distances from the transmission line for each transmission line alternative under consideration. The results of this analysis are provided below in Table 3.11-7 by alternative. While noise levels would be elevated during Project construction, noise impacts are considered short-term and temporary. The use of EPMs would aid in minimizing construction noise impacts.

Table 3.11-7:
Construction Noise Impacts for the AC Collection System by Route

Line Voltage/Structure	Number of NSAs within 100 feet	Number of NSAs within 325 feet
E-1	—	7
E-2	—	1
E-3	1	2
NE-1	—	5

Table 3.11-7:
Construction Noise Impacts for the AC Collection System by Route

Line Voltage/Structure	Number of NSAs within 100 feet	Number of NSAs within 325 feet
NE-2	1	3
NW-1	—	11
NW-2	1	6
SE-1	—	1
SE-2	—	—
SE-3	1	3
SW-1	—	—
SW-2	—	—
W-1	—	5

GIS Data Sources: Clean Line (2013a); Tetra Tech (2014a)

3.11.6.2.2.2 Operations and Maintenance Impacts

Operations and maintenance impacts include those associated with the AC collection system. Maintenance would include the use of trucks, lifts, or other equipment as needed proximate to the converter stations on a periodic basis along the AC collection system.

The proposed AC transmission lines have the potential to emit noise under certain operating and environmental conditions. Transmission line noise (also called corona noise) is caused by the partial electrical breakdown of the insulating properties of air around the electrical conductors and overhead power lines as described in Section 3.4. When audible, corona-generated noise is often described as a raspy hum or buzz. Corona noise is primarily affected by weather and (to a lesser degree) by altitude and temperature. Audible corona noise from transmission lines occurs primarily in foul weather. Foul weather is a weather condition when there is precipitation or high humidity present that can cause the transmission-line conductors to be wet. In addition, while fog is not a form of precipitation it may cause conductors to be wet. Dry snow, conversely, is a form of precipitation, but it may not cause the conductors to be wet (EPRI 2005). Water droplets on the conductors act as electric field concentrators, and produce a large number of corona discharges, each of them creating a burst of noise. During fair weather conditions, corona noise levels are typically low and often confined to occurrences of scratches or other imperfections on the conductor surface or where dust has settled on the line. Corona activity increases with increasing altitude, and with increasing voltage in the line, but is generally not affected by system loading.

Sound levels emitted from transmission lines are related to line voltage. Audible noise calculations for the AC transmission lines were performed as described in Section 3.4. The methods used to calculate audible noise from transmission lines were developed by DOE, specifically by the Bonneville Power Administration (BPA), and have been validated and used by engineers and scientists for many years. The inputs to the model include such parameters as line voltage, load flow (current), altitude, meteorological conditions, the physical dimensions of the line, conductor diameter, spacing, and height of the conductors and receivers above ground level. The BPA method of calculating audible noise from transmission lines is based on long-term statistical data collected from operating and test transmission lines. This method calculates the L_{50} noise level during rainy conditions of 1 millimeter per hour or more up to 5 millimeters per hour, at which point the sound of rain hitting the ground, foliage, and/or structures masks the audible noise from the line (BPA 1991).

Potential noise impacts resulting from operation of the AC transmission lines were assessed assuming conditions that would generate the highest noise emissions. These conditions are when the conductors are wet and the AC line is at its highest altitude for the proposed alignments, approximately 3,000 feet. The audible noise results were then used to determine threshold distances using the methodology described in Section 3.11.6.1, corresponding to the 55 dBA L_{dn} EPA guideline threshold, for the proposed 345kV and 500kV lines. The threshold distance for the 335kV line was calculated to be 146 feet and the threshold distance for the 500kV line was calculated to be 659 feet. The 500kV lines are required to connect the converter stations to the existing AC grid. A noise impact is assumed to occur if an NSA is located within the identified threshold distances.

All AC collection system routes were analyzed to determine potential noise impacts associated with operation. Of all of the routes under consideration, the only ones with NSAs located within the threshold distance of 146 feet were AC Collection System Routes E-3 and NE-2. Both of these alternatives showed one NSA that would be located within the 146-foot distance corresponding to the EPA guideline threshold of 55 dBA L_{dn} for a transmission line of 345kV line voltage. Therefore, there is the potential that both of those NSAs may experience adverse noise impacts from transmission line operation if those alternatives are constructed; however, impacts would be less under different weather conditions or if the transmission line is located at an altitude less than 3,000 feet.

3.11.6.2.2.3 Decommissioning Impacts

Decommissioning noise impacts are expected to be similar to construction noise impacts because similar equipment would be required. However, decommissioning activities would take less time than construction activities, so NSAs would not experience decommissioning noise impacts for as long as those associated with construction.

3.11.6.2.3 HVDC Applicant Proposed Route

HVDC transmission lines have the potential to result in noise impacts during the construction, operations and maintenance, and decommissioning phases of the Project. The following sections describe the expected impacts from construction and operations and maintenance of the Applicant Proposed Route.

3.11.6.2.3.1 Construction Impacts

Construction impacts from the Applicant Proposed Route would be similar to those sound levels associated with constructing the AC collection system lines. The main difference with construction of the HVDC lines is that construction would cover a much larger area, spanning from the panhandle of Oklahoma through Arkansas and into eastern Tennessee. Project construction of a single segment of HVDC lines is also expected to last 24 months. Construction would last for much shorter durations of several days to weeks in any given area of HVDC transmission lines. The construction process for HVDC transmission lines would be the same as that for the AC collection lines for which noise levels are provided in Table 3.11-6.

It is likely that blasting would be required for some tower installations; however, in these cases, a detailed Blasting Plan would be developed and implemented to avoid noise impacts. Examples of measures that could be included in the Blasting Plan to minimize blasting impacts are:

- Use tamping or stemming into the collars of blast holes and smooth-wall perimeter holes.
- Use blasting mats.

- Unless otherwise coordinated with landowners and adjacent landowners, plan blasting to take place only between the hours of 10:00 a.m. and 4:00 p.m., Monday through Friday. No blasting shall take place on weekends.
- Notify landowners and tenants, including owners of adjacent utilities or structures, prior to blasting.

Detailed Blasting Plans would be developed for the Project based on site-specific activities and nearby conditions.

The Applicant Proposed Route was analyzed using the methodology described in Section 3.11.6.1 to identify NSAs that would be within the nighttime DOT guideline threshold of 80 dBA, a threshold distance of 325 feet, and to the daytime DOT guideline threshold of 90 dBA, a threshold distance of 100 feet. Table 3.11-8 provides the number of NSAs located within these threshold distances by region. The NSAs located within these threshold distances may experience short-term and temporary elevated noise levels during Project construction; the implementation of EPMs would minimize construction noise impacts.

Table 3.11-8:
Construction Noise Impacts for the Applicant Proposed Route by Region

Line Voltage/Structure[1]	Number of NSAs within 100 feet	Number of NSAs within 325 feet
Applicant Proposed Route—Region 1	1	7
Applicant Proposed Route—Region 2	1	15
Applicant Proposed Route—Region 3	6	78
Applicant Proposed Route—Region 4	12	107
Applicant Proposed Route—Region 5	2	47
Applicant Proposed Route—Region 6	6	24
Applicant Proposed Route—Region 7	2	28

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments in the Applicant Proposed Route in Regions 2–7.

Twenty-three route variations to the Applicant Proposed Route, Regions 2–7, were developed in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.1–2.4.2.7. Many of the route variations were developed specifically to increase the distance to NSAs to reduce impacts from construction noise. Nonetheless, the number of NSAs located within the threshold distances would be similar, and construction noise impacts would generally be the same as for the original Applicant Proposed Route in Regions 1–7.

3.11.6.2.3.2 Operations and Maintenance Impacts

Operations and maintenance impacts include those associated with maintaining the operability of the HVDC transmission lines. Maintenance would include the use of trucks, lifts, or other equipment as needed proximate to the converter stations on a periodic basis along the AC collection system.

The HVDC transmission lines have the potential to emit environmental noise under certain operating and environmental conditions referred to as corona noise. Unlike AC lines, HVDC transmission lines emit higher noise levels under fair weather conditions than under foul weather, although generally corona noise is lower for HVDC transmission lines in comparison to AC transmission lines of similar voltage operating under foul weather. The noise is lower because of the increased space charge around the transmission line conductors in foul weather, making the effective size of the conductor larger, which reduces the surface gradient and the audible noise produced. HVDC transmission lines, therefore, generate the highest noise emissions during fair weather conditions. Corona activity increases with increasing altitude, and with increasing voltage in the line, and is loudest in a single-polarity operation as opposed to bipolar operation. Negligible audible noise results in a single-polarity negative operation. Section 3.4 discusses in detail the differences between AC transmission line and HVDC transmission line corona noise emissions and how the sound power levels were calculated for these sound sources.

For the purposes of assessing noise impacts at NSAs, conditions corresponding to the highest noise emissions were assumed. Audible noise calculations for the HVDC transmission lines were performed as described in Section 3.4. The audible noise results were then used to determine the threshold distance using the methodology described in 3.11.6.1, corresponding to the 55 L_{dn} EPA guideline for the proposed HVDC lines, which was a distance of 130 feet. Table 3.11-9 provides the number of NSAs within that threshold distance by region.

Table 3.11-9:
Operational Noise Impacts for the Applicant Proposed Route by Region

Line Voltage/Structure[1]	Number of NSAs within 130 feet
Applicant Proposed Route—Region 1	—
Applicant Proposed Route—Region 2	—
Applicant Proposed Route—Region 3	2
Applicant Proposed Route—Region 4	—
Applicant Proposed Route—Region 5	—
Applicant Proposed Route—Region 6	—
Applicant Proposed Route—Region 7	—

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments in the Applicant Proposed Route in Regions 2–7.

Sound levels from the HVDC transmission line were also calculated under fair (worst case) and foul weather conditions at various distances from the line, out to 2,000 feet for the highest altitude (3,000 feet) and lowest altitude (200 feet), and assuming flat, open terrain. The results of these additional calculations show that at a distance of 2,000 feet, sound levels would attenuate to 25 dBA under fair weather and 19 dBA under foul weather, assuming an altitude of 3,000 feet; whereas at an altitude of 200 feet, sound levels would attenuate to 22 dBA under fair weather and 16 dBA under foul weather. For comparison, the sound level inside a quiet library is approximately 30 dBA. In addition, considering the conservative measures incorporated into the analysis, received sound levels at NSAs would be expected to be lower on average than those reported.

For the route variations, the number of NSAs located within the threshold distances would be similar, and operation and maintenance noise impacts would generally be the same as for the original Applicant Proposed Route in Regions 1–7.

3.11.6.2.3.3 Decommissioning Impacts

Decommissioning noise impacts are expected to be similar to construction noise impacts because similar equipment would be required. However, decommissioning activities would take less time than construction activities, so NSAs would not experience decommissioning noise impacts for as long as those associated with construction.

3.11.6.3 Impacts Associated with DOE Alternatives

Methods to assess construction and operations and maintenance noise impacts for DOE Alternatives would be the same as described for the Applicant Proposed Route in Section 3.11.6.2.3. The difference is in the location of each alternative relative to nearby NSAs. The following sections describe the number of NSAs that would be impacted by each of the alternatives under consideration.

3.11.6.3.1 Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area

Construction, operations and maintenance, and decommissioning of the Arkansas converter station and its associated substation would result in increased noise levels nearby. Construction and operations and maintenance noise impacts are summarized in the following sections.

3.11.6.3.1.1 Construction Impacts

Using the construction stage (erecting of station) anticipated to generate the highest noise level and the methodology described in Section 3.11.6.1, the threshold distance to the DOT construction noise thresholds provided in Table 3.11-4 were calculated from the alternative converter station construction area. The threshold distances were determined to be 95 feet and 275 feet for the daytime (90 dBA L_{eq}) and nighttime (80 dBA L_{eq}) thresholds, respectively, so any NSAs located closer than those distances to the construction area would potentially experience an exceedance of the DOT guidelines. A review of aerial mapping conducted to identify NSAs near the analyzed alternative converter station indicates that no NSAs would be located within either of these threshold distances, so no exceedances of the DOT guidelines are expected.

3.11.6.3.1.2 Operations and Maintenance Impacts

The analysis conducted for the Arkansas converter station showed that the predicted converter station sound level at the nearest NSA, located 710 feet from the center point of the converter station, inclusive of the assumed background sound level of 43 dBA (L_{dn}), is 50 dBA L_{dn}, which is below the EPA environmental noise guideline of 55 dBA L_{dn}. NSAs located further away are expected to experience lower sound levels, so no noise impacts are anticipated at the Arkansas converter station.

In addition, the Arkansas converter station would include a relatively short distance (less than 5 miles in length) 500kV AC transmission interconnection lines. Six NSAs would be located within 659 feet of the Arkansas interconnection line, which using the methodology described in Section 3.11.6.1, corresponds to the threshold distance to the 500kV single circuit AC transmission line.

The Arkansas converter station would also require a new substation located where the 500kV AC transmission interconnection line connects taps the existing Arkansas Nuclear One-Pleasant 500kV line. The new substation is estimated to have a footprint of approximately 25 to 35 acres but would mainly function as a switchyard. There are no transformers or other significant sound sources proposed for installation at the new substation; therefore, no additional noise impacts are expected to result from the operation of the new substation.

3.11.6.3.1.3 Decommissioning Impacts

Decommissioning noise impacts are expected to be similar to construction noise impacts because similar equipment would be required. However, decommissioning activities would take less time than construction activities, so NSAs would not experience decommissioning noise impacts for as long a time period as those associated with construction.

3.11.6.3.2 HVDC Alternative Routes

Construction and operations and maintenance of the HVDC alternative routes would result in increased noise levels nearby. Construction and operations and maintenance noise impacts are summarized in the following sections.

3.11.6.3.2.1 Construction Impacts

Construction impacts for the HVDC alternative routes were calculated using the same methods described for the Applicant Proposed Route. The following sections provide the number of NSAs that would be impacted by construction noise for each alternative by region. A noise impact is assumed to occur if an NSA is located within the identified threshold distances from the work site.

All proposed HVDC alternative routes were analyzed to determine the number of NSAs located within the threshold distance of 325 feet, which corresponds to the nighttime DOT guideline threshold of 80 dBA, and the number of NSAs located within the threshold distance of 100 feet, which corresponds to the daytime DOT guideline threshold of 90 dBA. Table 3.11-10 provides the number of NSAs located within these threshold distances by region and alternative. These NSAs may experience short-term and temporary elevated noise levels during Project construction. The implementation of EPMs would minimize construction noise impacts.

Table 3.11-10:
Construction Noise Impacts by HVDC Alternative Route and Region

Line Voltage/Structure[1]	Number of NSAs within 100 feet	Number of NSAs within 325 feet
AR 1-A	—	5
AR 1-B	—	1
AR 1-C	—	1
AR 1-D	6	11
AR 2-A	1	5
AR 2-B	—	3
AR 3-A	—	9
AR 3-B	1	19
AR 3-C	9	68
AR 3-D	2	28
AR 3-E	1	9
AR 4-A	13	83
AR 4-B	18	86
AR 4-C	2	8
AR 4-D	5	43
AR 4-E	6	33
AR 5-A	1	9
AR 5-B	5	40
AR 5-C	1	6
AR 5-D	1	19

Table 3.11-10:
Construction Noise Impacts by HVDC Alternative Route and Region

Line Voltage/Structure[1]	Number of NSAs within 100 feet	Number of NSAs within 325 feet
AR 5-E	5	18
AR 5-F	3	14
AR 6-A	1	4
AR 6-B	2	8
AR 6-C	1	14
AR 6-D	—	—
AR 7-A	0	13
AR 7-B	6	42
AR 7-C	6	53
AR 7-D	0	5

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments to Routes 3-A, 5-B, 5-E, and 6-A.

As described in Appendix M and summarized in Section 2.4.2, five route adjustments were developed for HVDC Alternative Routes 3-A, 5-B, 5-E, and 6-A. The HVDC alternative route adjustments were developed to maintain end-to-end routes with the Applicant Proposed Route variations. The number of NSAs located within the threshold distances would be similar, and construction noise impacts would generally be the same as for the original HVDC alternative routes.

3.11.6.3.2.2 Operations and Maintenance Impacts

Operational and maintenance impacts discussed in this section include those associated with the HVDC alternative routes. The methods are the same as those used for the Applicant Propose Route. A noise impact is assumed to occur if an NSA is located within the identified threshold distances from the transmission line centerline. All HVDC alternative routes were analyzed to determine the number of NSAs located within the threshold distance of 130 feet, which corresponds to the EPA guideline threshold of 55 dBA L_{dn}. Table 3.11-11 provides the number of NSAs located within these threshold distances by region and alternative. These NSAs may experience adverse noise impacts from the HVDC alternative routes under certain operational and weather conditions.

Table 3.11-11:
Operational Noise Impacts by HVDC Alternative Route and Region

Line Voltage/Structure[1]	Number of NSAs within 130 feet
Region 1	
AR 1-A	—
AR 1-B	—
AR 1-C	—
AR 1-D	4
Region 2	
AR 2-A	—
AR 2-B	—

Table 3.11-11:
Operational Noise Impacts by HVDC Alternative Route and Region

Line Voltage/Structure[1]	Number of NSAs within 130 feet
Region 3	
AR 3-A	—
AR 3-B	—
AR 3-C	3
AR 3-D	2
AR 3-E	1
Region 4	
AR 4-A	5
AR 4-B	10
AR 4-C	1
AR 4-D	4
AR 4-E	2
Region 5	
AR 5-A	—
AR 5-B	3
AR 5-C	1
AR 5-D	—
AR 5-E	3
AR 5-F	2
Region 6	
AR 6-A	1
AR 6-B	1
AR 6-C	—
AR 6-D	—
Region 7	
AR 7-A	—
AR 7-B	1
AR 7-C	1
AR 7-D	—

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments to HVDC Alternative Routes 3-A, 5-B, 5-E, and 6-A.

As described in Appendix M and summarized in Section 2.4.2, five route adjustments were developed for HVDC Alternative Routes 3-A, 5-B, 5-E, and 6-A. The HVDC alternative route adjustments were developed to maintain an end-to-end route with the Applicant Proposed Route variations. The number of NSAs located within the threshold distances would be similar, and operations and maintenance noise impacts would generally be the same as for the original HVDC alternative routes.

3.11.6.3.2.3 Decommissioning Impacts

Decommissioning noise impacts are expected to be similar to construction noise impacts because similar equipment would be required. However, decommissioning activities would take less time than construction activities, so NSAs would not experience decommissioning noise impacts for as long as those associated with construction.

3.11.6.4 Best Management Practices

It is likely that blasting would be required for some tower installations; however, in these cases, a detailed Blasting Plan would be developed and implemented to avoid noise impacts. Examples of measures that could be included in the Blasting Plan to minimize blasting impacts are:

- Use tamping or stemming into the collars of blast holes and smooth-wall perimeter holes (stemming is defined as inserted material, such as crushed stone, sand, or any other inert objects placed in the top of the blast hole for the purpose of confining explosive charges and limiting rock movement and air-overpressure).
- Use blasting mats.
- Unless otherwise coordinated with landowners and adjacent landowners, plan blasting to take place only between the hours of 10:00 am and 4:00 pm, Monday through Friday. No blasting shall take place on weekends.
- Notify landowners and tenants, including owners of adjacent utilities or structures, prior to blasting.

Detailed Blasting Plans would be developed for the Project based on site-specific activities and nearby conditions.

In addition to the Applicant's EPMs, DOE has identified one BMP to address unavoidable noise impacts from the Project (Section 3.11.6.5 below). This BMP would involve the use of a Communications Program that is described in Section 3.1. Noise complaints from construction and/or operation of the Project would be handled via the Applicant's Communications Program.

3.11.6.5 Unavoidable Adverse Impacts

Unavoidable adverse impacts would result from operations and maintenance of the Project as described in Sections 3.11.6.2 and 3.11.6.3. Construction impacts, while a source of potential annoyance to nearby NSAs, would be temporary and avoided to the extent practicable via use of EPMs. Sound levels generated by the converter stations are not expected to exceed the EPA guidelines (e.g., 55 dBA L_{dn}) at nearby NSAs; however, the EPA guidelines would be exceeded at some NSAs from operations and maintenance of the proposed AC and HVDC transmission lines.

Impacts associated with AC collection system would be mainly associated with the operation of the line under foul weather conditions defined as being conditions where the line is saturated with water. These conditions typically occur when rain is of sufficient strength to saturate the line, an approximate rate of 1 millimeter/hour. Because people tend to remain indoors during foul weather, the likelihood of an impact occurring at NSAs diminishes because received sound levels indoors would generally be 10–20 dBA lower. Additionally, under foul weather conditions, ambient sound levels are typically higher because of rain impacting the ground, vegetation, and/or nearby structures. As a result, foul weather may partially or completely mask the sound of the AC transmission lines. The AC transmission line operations and maintenance noise impacts are therefore classified as being unavoidable, but not necessarily adverse.

Unlike AC transmission line noise, noise levels associated with HVDC transmission line operation are highest under fair weather conditions. The likelihood of people being outdoors during peak HVDC transmission line conditions is therefore more likely than with AC transmission lines. Additionally, because transmission lines are a sound source that is elevated above ground, typical mitigation options, such as noise barriers or berms, are not feasible. Impacts discussed in this EIS are associated with conditions corresponding to the highest noise emissions, so impacts are expected to be less during more typical operations and maintenance conditions. Furthermore, people outdoors may experience sound from the HVDC transmission lines, but that sound would be attenuated indoors, where people typically sleep. With windows closed, under fair weather HVDC line conditions, operations and maintenance sound levels would be 10–20 dBA lower than those predicted outside, so sleep disturbance is unlikely.

The Applicant would investigate noise complaints obtained via their Communications Plan.

3.11.6.6 Irreversible and Irretrievable Commitment of Resources

With the implementation of EPMs and identified BMP to resolve potential noise impacts to NSAs, no irreversible or irretrievable commitments of resources related to noise are anticipated.

3.11.6.7 Relationship between Local Short-term Uses and Long-term Productivity

Construction noise would temporarily impact nearby NSAs. Noise levels associated with operations and maintenance of the Project would not impact long-term productivity. Changes in sound level associated with the Project would not be expected to negatively impact current land use and activities.

3.11.6.8 Impacts from Connected Actions

3.11.6.8.1 Wind Energy Generation

The impacts from connected actions include those associated with the wind energy generation facilities that would interconnect to the Project as a result of the Project. The anticipated connected actions are all located within Region 1, in the Oklahoma Panhandle and the adjacent portions of Texas. Although site-specific layouts of wind energy generation facilities in the wind energy development zones identified in Region 1 have yet to be designed, noise impacts from these potential wind energy generation facilities have been qualitatively studied. Noise impacts from the connected actions would result from construction and operations and maintenance of the wind energy generation facilities.

3.11.6.8.2 Construction Noise

Construction noise would result from the use of construction equipment to build the wind energy generation facilities. Construction of wind energy generation facilities typically includes the following stages: site clearing, excavation, foundation work, and wind turbine installation. The layouts and design of each wind energy facility are unknown, so the mix of construction equipment needed, the schedule, and duration of construction noise are also unknown. Nevertheless, construction noise would result from motorized construction equipment used for general construction, some of which is included in Tables 3.11-4 and 3.11-5. Because of the temporary nature of construction noise, construction noise impacts from connected actions are not considered significant as they would not permanently impact nearby NSAs.

3.11.6.8.3 Operational Noise

Noise from operation of wind energy generation facilities would result from the operation of wind turbines, and maintenance of the wind energy developments. Because there are no site-specific plans for the wind energy development areas, it is not possible to analyze noise impacts for each potential wind energy generation development area. Site-specific acoustic analyses would be required for each wind energy development to assess potential impacts to the affected NSAs. Nevertheless, for the purposes of this qualitative discussion, operations and maintenance noise levels at referenced distances are provided for wind turbine types with power output capacities ranging from 1.5MW to 3.5MW in Table 3.11-12. Noise levels associated with modern wind turbine generators are mainly a result of aerodynamic noise produced from air flow and the interaction with the wind turbine tower structure and moving rotor blades. Recent improvements in the design of wind turbine mechanical components and the use of improved noise damping materials within the nacelle, including elastomeric elements supporting the generator and gearbox, have minimized mechanical noise emissions (Hau 2006). The sound levels presented in Table 3.11-12 are approximate values only meant to provide the reader a rough representation of potential noise impacts from one wind turbine operating in isolation over an intentionally conservative acoustically hard surface like pavement. If more than one wind turbine generator is operating in relative proximity, the received sound levels at those set distances would be expected to increase. For example, if two GE 1.5sle turbines are located within 1,000 feet of a given NSA, the resulting sound level would be 3 dBA higher than that listed in Table 3.11-12, or approximately 50 dBA L_{eq}.

Table 3.11-12:
Representative Sound Levels for Selected Wind Turbine Generators

Wind Turbine Generator[1]	Rotor Diameter (meter)	Hub Height (meter)	Megawatts	Sound Power Level (dBA L_W)	Received Sound Level (dBA L_{eq})		
					1,000 feet	1,200 feet	1,500 feet
GE 1.5sle	87	77	1.5	106	47	45	43
Siemens 2.3-101	101	80	2.3	108.5	49	48	46
Siemens 3.0-113	113	99.5	3.0	108.5	50	48	46

1 Includes a k-factor or uncertainty factor of +/- 2 dB for the GE 1.5sle and +/- 1.5 dB for the Siemens turbines
Source: GE (2005), Siemens (2008), Bodwell (2013)

As wind development projects are established in the WDZs, each would be required to proceed through state, local, and other permitting efforts as applicable.

3.11.6.8.4 Optima Substation

There are no NSAs located within 0.75 mile from the future Optima Substation, so noise levels from construction, operations and maintenance, and decommissioning of the substation are not anticipated to result in impacts.

3.11.6.8.5 TVA Upgrades

The ROI for the direct assignment facilities cannot be determined at this time as described in Section 3.11.5.1.3. Where possible, general impacts associated with the required TVA upgrades are discussed in the impacts sections below.

Noise impacts associated with upgrades to existing TVA facilities are not likely to affect NSAs assuming that upgrades would not include addition of transformers or other noise-generating equipment, whereas the required new TVA electric transmission line could cause previously unaffected NSAs to be impacted by noise generated during construction or operations and maintenance. Since the proposed new TVA line is a 500kV AC transmission line, it is expected that construction activities and noise levels would be similar to those described for the Project AC collection system in Section 3.11.6.2.2.1. Construction activities exceeding the FTA guidelines of 90 dBA L_{eq} for daytime activities and 80 dBA L_{eq} for nighttime activities could result in adverse impacts to nearby NSAs. In addition, it is expected that operational noise associated with the TVA line would be similar to noise generated by the Project 500kV AC transmission line as described in Section 3.11.6.2.2.2. Operations and maintenance activities exceeding the EPA guideline of 55 dBA L_{dn} could result in adverse impacts to nearby NSAs.

3.11.6.9 Impacts Associated with the No Action Alternative

Under the No Action Alternative, DOE assumes for analytical purposes that the Project would not be constructed. Accordingly, no impacts related to noise from the Project would occur.

This page intentionally left blank.

Contents

Tables

This page intentionally left blank.

3.12 Recreation

This section provides baseline information regarding outdoor recreation uses on public and private lands that could be affected by the Project. Included within this section is a description of the regulations and standards of federal, state, and local land management agencies that provide recreation opportunities; existing recreational opportunities and activities; and an assessment of potential impacts that might result from the Project.

3.12.1 Regulatory Background

Recreation laws, regulations, and standards relevant to the resources in the ROI are summarized in Table 3.12-1. Permits that may apply to the Project are discussed in further detail in Appendix C. The regulatory background for the ODWC WMAs, AGFC WMAs, ANHC Natural Areas, USFWS NWRs, USFS lands, and USACE lands are described in Section 3.10.

Table 3.12-1:
Recreation Laws and Regulations Applicable to the Project

Statute/Regulation	Agency	Applicability to the Project
Federal		
The National Trails System Act (16 USC § 1241 *et seq.*)	National Park Service (NPS)	The Trail of Tears crosses eight states, including Tennessee, Oklahoma, and Arkansas, and the ROI crosses some portions of the trail in each state. Recreation is available along the trail itself in the form of driving or walking and at developed sites and communities along the trail; however, there are no developed Trail of Tears sites that are crossed by the Project (NPS 2014c). While the ROI would cross the Trail of Tears National Historic Trail, there are no specific permits or authorizations required from the NPS. The Chisholm and Great Western Trail is under consideration for designation as a National Historic Trail (NPS 2015). The proposed Chisholm and Great Western National Historic Trail commemorates the routes followed by upwards of 10 million cattle as they traveled northbound from southern Texas to Kansas and adjacent destinations between 1867 and the 1880s. In recognition of the perceived national importance of these two routes, and in response to public advocacy for the inclusion of these routes in the National Trails System, Congress passed the Omnibus Public Land Management Act of 2009 (Public Law 111-11), which includes a provision (Sec. 5303 of) that calls for a study of "The Chisholm Trail (also known as the 'Abilene Trail'), from the vicinity of San Antonio, Texas ... to Enid, Oklahoma, Caldwell, Kansas, Wichita, Kansas, Abilene, Kansas, and commonly used segments running to alternative Kansas destinations" as well as "The Great Western Trail (also known as the 'Dodge City Trail'), from the vicinity of San Antonio, Texas, north-by-northwest [to] Oklahoma, north through Kansas to Dodge City, and north through Nebraska to Ogallala." In compliance with Public Law 111-11, National Park Service staff led by the National Trails Intermountain Region office in Santa Fe, New Mexico, will complete a feasibility study for the proposed Chisholm and Great Western National Historic Trail. Public meetings for scoping purposes were held in June 2010. A planning newsletter and a scoping report are available online at http://parkplanning.nps.gov/projectHome.cfm?projectID=30803. The reviewed statement of national significance has been posted as well. The draft study was released for a 60-day public review and comment period beginning January 5, 2015.
1979 Presidential Directive, Memorandum for the Heads of Departments and Agencies regarding Nationwide Rivers Inventory	National Park Service	The Nationwide Rivers Inventory (NRI) rivers are free-flowing river segments that are believed to possess one or more "outstandingly remarkable" natural or cultural values believed to be more than locally or regionally significant (NPS 2011d). A presidential directive requires each federal agency, as part of its normal planning and environmental review processes, to take care to avoid or mitigate adverse effects on rivers identified in the Nationwide Rivers Inventory compiled by NPS. Further, all agencies are required to consult with the National Park Service prior to taking actions

Table 3.12-1:
Recreation Laws and Regulations Applicable to the Project

Statute/Regulation	Agency	Applicability to the Project
		which could effectively foreclose wild, scenic or recreational status for rivers on the inventory (NPS 2011a). Guidance issued by CEQ on the NRI recommends that federal agencies should take care to avoid or mitigate adverse effects on rivers identified in the NRI and should consult with the National Park Service to ensure that a federal agency action does not adversely affect the natural, cultural and recreational values of the NRI river segment. Further, this guidance recommends that where a federal agency determines that its action may have adverse effects, the agency should incorporate avoidance/mitigation measures into the proposed action to maximum extent feasible within the agency's authority (NPS 2011d).
National Scenic Byways Program (23 USC § 162) Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA; Public Law 102-240)	The Federal Highway Administration (FHA)	A scenic byway is a public road with special scenic, historic, recreational, cultural, archaeological, and/or natural qualities that have been recognized as such through legislation or official declaration. Easements associated with scenic byway ROWs may prohibit construction of transmission structures or other structures that degrade the scenic quality of the road. Federal regulations governing utility use/crossings of a highway ROW note that utilities provide “an essential public service to the general public. Traditionally, as a matter of sound economic public policy and law, utilities have used public road ROW for transmitting and distributing their services” (23 CFR 645.209a).
Historic Route 66 Corridor Preservation Program (Public Law 106-45)	National Park Service (NPS)	Historic Route 66 is a national scenic byway administered by the FHWA, but is also part of the Historic Route 66 Corridor Preservation Program (Pub. L. 106-45) administered by the National Park Service (NPS 2014a). The program collaborates with private property owners; non-profit organizations; and local, state, federal, and tribal governments to identify, prioritize, and address Historic Route 66 preservation needs.
State		
Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) (Public Law 102-240) Arkansas Code Annotated (ACA) 27-67-203	Arkansas State Highway Commission	The act created the National Scenic Byways program, but also encouraged states to develop their own scenic byway program. The Arkansas Highway Commission created criteria by which routes could be designated into the state program (AHTD 2007d). Arkansas has two designations for scenic roads within the state: Scenic Highway and Scenic Byways. Arkansas Scenic Highways are designated by the Arkansas General Assembly; however, there are no requirements or prerequisites to designation. Designated Arkansas Scenic Highways are codified and listed in Arkansas Code 27-67-203. Arkansas Scenic Byways are established by the Arkansas Highway Commission under the IS TEA. State Scenic Byway Designation is a prerequisite for nomination and designation as a National Scenic Byway. A roadway must first be designated as an Arkansas Scenic Highway by the Arkansas General Assembly before it can become an Arkansas Scenic Byway under IS TEA.
Local		
City and county zoning ordinances, development regulations, and general or comprehensive plans under Arkansas Code Title 14 Local Government; Oklahoma Statutes Title 19 Counties and County Officers, Section 863.1 City and County Planning and Zoning through Section 863.29 Exclusive Control	Local governments (cities and counties) in Arkansas, Oklahoma, and Tennessee	These resources are managed by the individual rules and regulations of cities, counties, and towns in which they occur, which may include zoning regulations, comprehensive plans, recreation plans, open space plans, trail plans, and similar land use planning documents.

Table 3.12-1:
Recreation Laws and Regulations Applicable to the Project

Statute/Regulation	Agency	Applicability to the Project
by Commission; Tennessee Statute Title 6 Cities and Towns, Municipal Government Generally, Chapter 54 Municipal Powers Generally and Chapter 58 Comprehensive Growth Plan		
Oklahoma Scenic Rivers Act (Oklahoma Statues Title 82-1451– 1471)	Oklahoma Water Resources Board (OWRB)	The OWRB is responsible for administration of the state Scenic Rivers Act to preserve the high quality and unique characteristics of outstanding water resources. There are five streams protected under the program in Oklahoma, including Lee Creek and Little Lee Creek. No other rivers designated under the Oklahoma Scenic Rivers Act occur within the ROI.

In addition to the regulations applicable to the project listed above, commenters requested a description of impacts to the America's Great Outdoors Initiative projects and the Arkansas Water Trail System.

The America's Great Outdoors Report (DOI 2013) is the Obama Administration's action plan under the America's Great Outdoors Initiative to achieve lasting conservation of the outdoor spaces that power our nation's economy, shape our culture, and build our outdoor traditions. To implement this initiative, individual projects are set up under the America's Great Outdoors 50 State Report and the All American Rivers Demonstration Projects. No current projects listed in the 50 State Report would be crossed by the Project. The Cache River, located in eastern Arkansas, is part of the All American Rivers Demonstration Projects. As the Cache River and surrounding landscape are restored, the landscape will be managed to benefit water quality, aquatic and wetland ecosystems, wildlife, local communities, and the public. The areas for improvement are located to the south and outside the ROI for the Project in the Cache River National Wildlife Refuge and surrounding private land. The Project in Region 6 are located far to the north of the Cache River National Wildlife Refuge boundaries. The portion of the All American Rivers Demonstration Projects performed along the Cache River National Wildlife Refuge was completed in 2013. Future project nomination and execution under both the America's Great Outdoors 50 State Report and the All American Rivers Demonstration Projects are chosen by local agencies and proposed to the America's Great Outdoors Initiative for inclusion in the program.

The Arkansas Water Trail System (AGFC 2011e), which is managed by the AGFC, develops public paddling trails throughout the state, creating well-mapped accessible day trips in a variety of settings and for all levels of paddling experience. None of the waterways established as water trails would be crossed by the proposed Project and alternatives. Landowners and communities nominate Water Trails for inclusion in the system.

3.12.2 Data Sources

Recreational resources identified through review of existing datasets for land ownership, and aerial imagery were used to determine the various recreation land uses within the ROI. GIS data sources include ESRI (2013). Ground and aerial reconnaissance by Clean Line and comments received during stakeholder outreach and the DOE scoping process supplemented the desktop information.

Jurisdiction and land ownership in Oklahoma and Arkansas were obtained from the Oklahoma Gap Analysis Project and Arkansas GeoStor (GIS Data Sources: USGS 2012; AHTD 2006a, 2006b, 2006c), respectively. Scenic byways data were obtained from the National Scenic Byways Program and Arkansas GeoStor (GIS Data Sources: FHWA 2013; AHTD 2006a). Scenic byways data were not available for Oklahoma.

NRI data and National Wild and Scenic Rivers data were obtained from the NPS and the USGS (GIS Data Sources: IWSRCC 1999; USGS 1996), respectively. Oklahoma and Arkansas scenic rivers data were obtained from the Oklahoma Scenic Rivers Program (Oklahoma Statutes 82-1451–1471), the ADEQ (*Arkansas Natural and Scenic Rivers System Act* [ACA 15-23-301–315]) and the National Hydrography Dataset (GIS Data Source: USGS 2014a).

3.12.3 Region of Influence

For recreation, the ROI for the Project and connected actions is the same as described in Section 3.1.1.

3.12.4 Affected Environment

The affected environment includes the recreation resources described for the ROI in Regions 1 through 7. A review of the existing recreational opportunities in the ROI provides the context for assessing potential effects to recreational resources and opportunities. Recreational areas include federal, state, and local parks; forests, lakes, rivers, museums, historic sites, and hunting grounds.

Recreation opportunities range from active pursuits such as hiking, water sports, hunting, and fishing, to sedentary recreation like sightseeing, car tours, and picnicking at many of the recreation areas throughout the ROI.

Several route variations to the Applicant Proposed Route in Regions 2–7 were developed in response to public comments on the Draft EIS and are described in Appendix M and summarized in Sections 2.4.2.1–2.4.2.7. Assessments of the impacts related to the route variations by Project region, including accompanying HVDC Alternative Route adjustments, are provided below. The variations are presented graphically in Exhibit 1 of Appendix M.

3.12.5 Regional Description

3.12.5.1 Region 1

Region 1 is referred to as the Oklahoma Panhandle Region and includes the Applicant Proposed Route, HVDC Alternative Routes I-A through I-D, and the AC collection system. The ROI for Region 1 HVDC would cross the Chisholm and Great Western Trail, which is being considered for addition to the National Historic Trail System. The Chisholm and Great Western Trail would cross Applicant Proposed Route Link 5 and HVDC Alternative Route 1-A in Region 1. The ROI for Region 1 HVDC would be located adjacent to and south of the Shorb WMA. The Shorb WMA, located southeast of Hardesty, is managed by the ODWC and offers hunting (GIS Data Source: ODWC 2014).

The ROI for the AC collection system would cross portions of the following recreational areas:

- The Optima NWR
- Optima WMA
- Schultz WMA and State Park
- Shorb WMA

The southern edges of the Optima NWR and WMA would be located within the ROI for AC Collection System Route E-1. The Optima NWR is managed by the USFWS and offers opportunities for public shotgun or archery hunting and wildlife watching. The Optima NWR is part of a larger complex of conservation lands near Hardesty, Oklahoma, that includes the Optima WMA. The Optima WMA includes land adjacent to the Optima NWR along the Beaver River and the Optima Reservoir. The Optima WMA is managed by the ODWC and is open to public hunting (USFWS 2014). The Optima WMA also offers two designated primitive camping areas and a rifle range (ODWC 2014a).

The ROIs associated with AC Collection System Routes E-3, SE-1, SE-3, and E-2 would cross the edges of the Schultz WMA and State Park. The Schultz WMA and State Park, located south of Hardesty, is managed by the ODWC and offers hunting (ODWC 2014b).

The ROI associated with AC Collection System Route SE-3 and E-2 would cross the Shorb WMA. The Shorb WMA located southeast of Hardesty, is managed by the ODWC and offers hunting (GIS Data Source: ODWC 2014).

There are no Texas-managed recreation areas or state designated recreational rivers in the AC collection system ROI in Texas (TPWD 2014a).

No route variations were proposed in Region 1.

3.12.5.2 Region 2

Region 2 is referred to as the Oklahoma Central Great Plains Region and includes the Applicant Proposed Route and HVDC Alternative Routes 2-A and 2-B. Facilities in Region 2 include the HVDC transmission line; the ROI would cross portions of the Major County WMA. The Chisholm and Great Western Trail crosses the ROI in Region 2. The trail which is being considered for addition to the National Historic Trail System. The Chisholm and Great Western Trail would cross Region 2 Applicant Proposed Route Link 3, and Alternative Route 2-B in Region 2.

The Major County WMA would be directly adjacent to the ROI for HVDC Alternative Route 2-A east of Woodward, Oklahoma, and north of Chester, Oklahoma, in Major County. Major County WMA is located in Major County in northwest Oklahoma. This WMA is managed by the ODWC. Hunting is allowed in this WMA, and fishing opportunities are very limited. Camping is not allowed in the WMA (ODWC 2011).

Two route variations to the Applicant Proposed Route were developed in Region 2 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.2. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route and would not cross any additional designated recreation areas or remove crossing locations than those described for the original Applicant Proposed Route.

3.12.5.3 Region 3

Region 3 is referred to as the Oklahoma Cross Timbers Region and includes the Applicant Proposed Route and HVDC Alternative Routes 3-A through 3-E. Facilities in Region 3 include the HVDC transmission line. The ROI would cross portions of the following recreational areas:

- Robert S. Kerr Lake and Webbers Falls Reservoir
- Historic Route 66
- Lake Carl Blackwell

Robert S. Kerr Lake Recreation Area and Webbers Falls Reservoir are interconnected waterways and would be crossed by the ROI associated with the Applicant Proposed Route Link 6 near the Muskogee-Sequoyah county line, west of Gore, Oklahoma. Robert S. Kerr Lake is located on the McClellan-Kerr Arkansas River Navigation System. The lake features fishing, hunting, camping, picnicking, water sports, sightseeing, swimming, and hiking for recreation (USACE 2014a).

Historic Route 66 would be crossed by the ROI associated with Applicant Proposed Route Link 4 north of Bristow, Oklahoma and HVDC Alternative Route 3-C north of Depew, Oklahoma. Historic Route 66 is a national scenic byway administered by the FHWA but is also part of the Historic Route 66 Corridor Preservation Program (PL 106-45) administered by the NPS. The program collaborates with private property owners; non-profit organizations; and local, state, federal, and tribal governments to identify, prioritize, and address Historic Route 66 preservation needs (NPS 2014a; FHWA 2014d).

Lake Carl Blackwell would be crossed by the ROI associated with HVDC Alternative Routes 3-A and 3-B and Proposed Route Link 1, west of Stillwater, Oklahoma. Lake Carl Blackwell, managed by the Oklahoma State University, is located west of Stillwater and provides camping and cabins, horseback riding trails, fishing, water sports, hunting, and hiking (OSU 2014).

Five route variations to the Applicant Proposed Route were developed in Region 3 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.3. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route, and they would not cross any additional designated recreation areas or remove crossing locations from those described for the original Applicant Proposed Route. It should be noted that a route adjustment was made for HVDC Alternative Route 3-A to maintain an end-to-end route with the Links 1 and 2 variations.

3.12.5.4 Region 4

Region 4 is referred to as the Arkansas River Valley Region and includes the Applicant Proposed Route and HVDC Alternative Routes 4-A through 4-E as well as the Lee Creek Variation. Facilities in Region 4 include the HVDC transmission line. The ROI would cross portions of several recreational areas including:

- Robert S. Kerr Lake and Webbers Falls Reservoir
- Ozark National Forest
- Ozark National Forest WMA
- Frog Bayou WMA
- Ozark Lake WMA
- Scenic Byways
- Portions of the Lee and Little Lee Creeks rivers managed by the Oklahoma Water Resources Board (OWRB) and listed on the NRI
- Arkansas Scenic Byways: State Highway 540/Boston Mountains Scenic Loop; State Highway 23/Pig Trail Byway; and State Highway 21/Ozark Highlands Scenic Byway
- Arkansas Scenic Highways: State Highway 220, State Highway 59, Interstate Highway 40, U.S. Highway 71
- The Trail of Tears National Historic Trail

Robert S. Kerr Lake and Webbers Falls Reservoir would be crossed by the ROI associated with the Applicant Proposed Route Link 1 of Region 4 west of Salisaw, Oklahoma. Robert S Kerr Lake and Webbers Falls Reservoir is located on the Oklahoma portion of the McClellan-Kerr Arkansas River Navigation System. Webbers Falls Reservoir features fishing, hunting, camping, picnicking, water sports, and sightseeing for recreation (USACE 2014b). Robert S. Kerr Lake features fishing, hunting, camping, picnicking, water sports, sightseeing, swimming, and hiking for recreation (USACE 2014a).

Ozark National Forest would be crossed by the ROI associated with HVDC Alternative Route 4-B. The crossing would take place along the southern end of the National Forest north of Fort Smith Arkansas. Many opportunities for recreation exist in the Ozark National Forest including biking, camping, climbing, fishing, hiking, horseback riding, hunting, nature and wildlife viewing, water sports (both motorized and non-motorized), and scenic driving (USFS 2014). No specific recreation areas, such as boat launches, campgrounds, or shooting ranges, are located within the ROI or crossed by the Applicant Proposed Route and HVDC alternative routes (USFS 2014). Within the Ozark National Forest there are public and private land holdings. The recreation opportunities are available only in the publicly held tracts of land. Impacts to private inholdings within the Ozark National Forest are addressed in Section 3.10 (Land Use).

The Ozark National Forest WMA, where it is crossed by the HVDC Alternative Route 4-B, shares the same boundaries as the Ozark National Forest (located in the Boston Mountain Ranger District). The Ozark National Forest WMA is located within the National Forest of the same name and is located in parts of Conway, Crawford, Franklin, Johnson, Madison, Newton, Pope, Searcy, Van Buren, and Washington counties in Oklahoma. Hunting is allowed in the WMA with the exception of alligator and elk hunting. All other species are allowed (AGFC 2011d). The Ozark National Forest WMA represents a zone where the AGFC manages the wildlife, but the USFS is the landowner. Each WMA is a separate zone for which the AGFC may establish and apply hunting regulations (AGFC 2014).

Frog Bayou WMA would be crossed by the ROI associated with the Applicant Proposed Route Link 6, west of Mulberry and south of Dyer, Arkansas. Frog Bayou WMA is managed by the AGFC and is located east of Van Buren along the Arkansas River. This WMA features hunting, with the exception of alligator and elk, and wildlife viewing, and it abuts USACE-managed land along the Arkansas River (AGFC 2011b).

Ozark Lake would be crossed by the ROI associated with the Applicant Proposed Route Link 6, west of Mulberry and east of Dyer, Arkansas. Ozark Lake WMA is managed by the AGFC and is located east of Van Buren along the Arkansas River on land managed by the USACE. The WMA features hunting with the exception of bear, alligator, and elk (AGFC 2011c).

Some segments of the Big Piney Creek are considered part of the NRI for Arkansas. The segments of the Big Piney Creek that are listed on the NRI are located from the upper Dardanelle Reservoir, to the headwaters near Fallsville, Arkansas. The Big Piney Creek segments on the NRI have the outstanding remarkable values of scenery, recreation, geology, fish, and wildlife (NPS 2004).

Lee Creek and Little Lee Creek NRI segments would be crossed by the ROI associated with HVDC Alternative Routes 4-A and 4-B and Applicant Proposed Route Link 3 north of Fort Smith, Arkansas. Lee Creek NRI segments would be crossed by the ROI associated with the Lee Creek Variation. Lee and Little Lee Creeks OWRB state natural and scenic river segments would be crossed by the ROI associated with HVDC Alternative Routes 4-A and 4-B north of Fort Smith in Sequoyah County, Oklahoma. Lee Creek is not considered a federally designated Wild and Scenic River, although it is included on the NRI for Oklahoma and Arkansas. The Lee Creek segments included on the NRI encompass 49 miles of river in Sequoyah County, Oklahoma, to the headwaters near Moffet, Arkansas, and have the outstanding remarkable values of scenery, recreation, fish, wildlife, and cultural (NPS 2011b, 2010). The OWRB manages the Lee and Little Lee Creeks state natural and scenic river segments in Sequoyah County, Oklahoma, and have the outstanding remarkable values of scenery, recreation, fish, wildlife, and cultural (NPS 2010). Review of available data shows that the Lee Creek and Little Lee Creek segments are part of the NRI and the OWRB Natural and Scenic Rivers System.

Oklahoma Highway 100, or the Cherokee Hills National Scenic Byway, would be crossed by the ROI associated with the Applicant Proposed Route Link 1 west of Sallisaw, Oklahoma. The Cherokee Hills National Scenic Byway is located on the western foothills of the Ozark Mountains and has scenic, cultural, and historic values (FHWA 2014a). Arkansas Highway 21, also known as the Ozark Highlands Scenic Byway, is crossed by Proposed Route Link 9 and Alternative Route 4-E north of Clarksville, Arkansas. The Ozark Highlands Scenic Byway is designated under the Arkansas State Scenic Byways program and is a scenic drive with recreational opportunities through the Boston Mountains region of the Ozark Mountains (AHTD 2007b).

The Boston Mountains Scenic Loop (Interstate 540 and US Highway 71) would be crossed by the ROI associated with HVDC Alternative Routes 4-A, 4-B, and 4-D north of Van Buren, Arkansas. This scenic loop, designated under the Arkansas State Scenic Byways program, has several high-span bridges and scenic and historic views (AHTD 2007a).

Pig Trail Scenic Byway would be crossed by the Applicant Proposed Route and HVDC Alternative Route 4B. The Pig Trail Scenic Byway is designated for 19 miles between the southern boundary of the Ozark National Forest to the intersection with Arkansas Highway 16 (Arkansas.com 2014).

State Scenic Highway 220 would be crossed by HVDC Alternative Routes 4-A and 4-B. State Scenic Highway 59 would be crossed by HVDC Alternative Routes 4-C, 4-D and the Applicant Proposed Route. Interstate-40 would be crossed twice by both HVDC Alterative Route 4-A and the Applicant Proposed Route. U.S. Highway 71 would be crossed by HVDC Alternative Route 4-D.

The Trail of Tears is located across eight states including Tennessee, Oklahoma, and Arkansas. Recreation is available along the trail itself in the form of driving or walking (NPS 2014c). There are no interpretive centers or sites along the Trail of Tears; the only park facility is the trail itself, which can be used for hiking (NPS 2014b). The Trail of Tears locations mapped by the NPS are representative of the historic location of the trail and the extent of the trail at each crossing location is not known. The historic significance of the Trail of Tears is addressed in detail in Section 3.9.

Seven route variations to the Applicant Proposed Route were developed in Region 4 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.4. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route, and they would not cross any additional designated recreation areas or remove crossing locations from those described for the original Applicant Proposed Route. Link 6, Variation 3, would cross the Trail of Tears at a different location; however, recreational land uses are expected to be similar at the original Applicant Proposed Route location and at the route variation location.

3.12.5.5 Region 5

Region 5 is referred to as the Central Arkansas Region and includes the Applicant Proposed Route and HVDC Alternative Routes 5-A through 5-F. Facilities located in Region 5 include the HVDC transmission line, the Arkansas Converter Station Alternative Siting Area, and the Alternative AC Interconnection Siting Area. A new substation would be required at the point where the 500kV AC interconnection line taps the existing Arkansas Nuclear One-Pleasant Hill 500kV line. This new substation area would be located within the current Arkansas Converter Station Alternative AC Interconnection Siting Area; no recreational resources are located within these areas. Portions of the Cherokee WMA, segments of Cadron Creek listed on the NRI, and scenic byways would be crossed by Project features. Region 5 also crosses Arkansas Scenic 7 Byway, and Arkansas State Scenic Highways: State Highway 27, State Highway 9, U.S. Highway 65, State Highway 25, State Highway 5, and State Highway 16.

The Cherokee WMA is located in the ROI associated with the Applicant Proposed Routes Links 2 and 5. Portions of the Cherokee WMA are located in eight different counties in Arkansas (AGFC 2011a). Permitted game hunting on the overall WMA includes turkey, deer, bear, quail, rabbit, squirrel, and crow.

Cadron Creek segments listed on the NRI would be crossed by the ROI associated with HVDC Alternative Routes 5B, 5E, and 5F west of Guy, Arkansas. Cadron Creek is in the ROI associated with the Applicant Proposed Route Link 3 east of Damascus, Arkansas. Cadron Creek is crossed by the ROI associated with the Applicant Proposed Route Link 4 southeast of Quitman, Arkansas. Cadron Creek is not considered a federally designated Wild and Scenic River, although it is included on the NRI for Arkansas. The segments of Cadron Creek included on the NRI are located from the confluence of Cadron Creek with the Arkansas River near Gleason, Arkansas, to the headwaters, east of Pearson, Arkansas. The east fork of Cadron Creek also has segments included on the NRI that are located from the confluence of the East Fork and Cadron Creek north of Gleason, Arkansas, to the headwaters east of Rose Bud, Arkansas. The Cadron Creek and East Fork segments on the NRI have the outstanding remarkable values of scenery, recreation, geology, fish, and wildlife (NPS 2004).

The East Fork of Cadron Creek would be crossed by the ROI associated with HVDC Alternative Routes 5B, 5E, and 5F in Faulkner and White counties, Arkansas and is designated as part of the NRI system from the confluence of the East Fort and Cadron Creek north of Gleason upstream to the headwaters east of Rose Bud, Arkansas. The East Fork of Cadron Creek segments on the NRI have the following Outstanding and Remarkable Values (ORVs): scenic, recreational, geologic, fish and wildlife (NPS 2004).

Arkansas Scenic 7 Byway would be crossed by the ROI associated with the Applicant Proposed Route Link 1 and HVDC Alternative Route 5-A. The Arkansas Scenic 7 Byway travels almost 300 miles and provides views of several different regions of the state. The route is known for scenic views and proximity to recreation (AHTD 2007c).

Arkansas State Scenic Highway 27 would be crossed by HVDC Alternative Route 5-A, and the Applicant Proposed Route. Arkansas State Scenic Highway 9 would be crossed by HVDC Alternative Route 5-B and the Applicant Proposed Route. U.S. Highway 65 would be crossed by HVDC Alternative Route 5-B and the Applicant Proposed Route. Arkansas State Scenic Highway 25 would be crossed by HVDC Alternative Route 5-E and the Applicant Proposed Route. Arkansas State Scenic Highway 5 would be crossed by HVDC Alternative Route 5-B and the

Applicant Proposed Route. Arkansas State Scenic Highway 16 would be crossed by HVDC Alternative Route 5-B, 5-C and the Applicant Proposed Route.

Five route variations to the Applicant Proposed Route were developed in Region 5 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.5. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route, and they would not cross any additional designated recreation areas or remove crossing locations from those is described for the original Applicant Proposed Route. Links 3 and 4, Variation 2, would cross the Cadron Creek at a different location; however, recreational land uses are expected to be similar at the original Applicant Proposed Route location and at the route variation location.

3.12.5.6 Region 6

Region 6 is referred to as the Cache River and Crowley's Ridge Region and includes the Applicant Proposed Route and HVDC Alternative Routes 6-A through 6-D. Facilities located in Region 6 include the HVDC transmission line. The ROI would cross portions of the following recreational areas: USFWS acquisition areas, the Singer Forest Natural Area/St. Francis Sunken Lands WMA, portions of the L'Anguille River on the NRI, and scenic byways/highway.

Portions of USFWS acquisition areas, associated with the Cache River NWR, would be crossed by the ROI associated with HVDC Alternative Route 6-B near Amagon, Arkansas, and by the ROIs associated with the Applicant Proposed Route Links 3 and 4, and HVDC Alternative Route 6-A north and west of Fisher, Arkansas. An acquisition area is an area that has been identified for purchase by the agency, should the opportunity arise. These areas are typically identified surrounding federally owned land in an attempt to expand the boundaries of the federal land holding. Acquisition areas are not owned, nor are they managed by the USFWS, although they have been identified for future purchase. No proposed or alternative routes or ROIs cross portions the Cache River NWR.

The Singer Forest Natural Area/St. Francis Sunken Lands WMA would be crossed by the ROI associated with the Applicant Proposed Route Link 7. The portion of the Singer Forest Natural Area/St. Francis Sunken Lands WMA that occurs within the Applicant Proposed Route is located in Pointsett County, Arkansas. This section of the lands encompasses a total of 520 acres in the Mississippi Alluvial Plain. The Natural Area consists of forested wetlands, bottomland forest, and overflow swamp. Hunting is allowed for turkey, deer, quail, rabbit, squirrel, and crow, and disallowed for alligator, elk, bear, and deer hunted with a muzzleloader (ANHC 2014b).

Portions of the L'Anguille River included in the NRI system would be crossed by the ROI associated with HVDC Alternative Route 6-C, and Applicant Proposed Route Link 6 west of Marked Tree, Arkansas. The L'Anguille River is not considered a federally designated Wild and Scenic River, although it is included on the NRI for Arkansas. The segments of L'Anguille River included on the NRI are located from the confluence of the L'Anguille River with the St. Francis Floodway near Marianna, Arkansas, to the Poinsett-Cross county line. The segments of the L'Anguille River included on the NRI have the outstanding remarkable values of scenic, recreation, fish, and wildlife (NPS 2004).

Crowley's Ridge Parkway National Scenic Byway would be crossed by the ROI associated with the Applicant Proposed Route Link 6 and HVDC Alternative Route 6-C south of Harrisburg, Arkansas. Recreational opportunities include wildlife and vegetation viewing, natural and historic sites, and Civil War battlefields along Crowley's Ridge

Parkway National Scenic Byway (FHWA 2014b). Arkansas State Scenic Highway 14 would be crossed by HVDC Alternative 6-C.

One route variation was developed in Region 6 in response to public comments on the Draft EIS to parallel more parcel boundaries to minimize impacts to agricultural operations and is shown in Exhibit 1 of Appendix M. This variation represents a minor adjustment to the Applicant Proposed Route, and it would not cross any additional designated recreation areas or remove crossing locations from those described for the original Applicant Proposed Route.

3.12.5.7 Region 7

Region 7 is referred to as the Arkansas Mississippi River Delta and Tennessee Region and includes the Applicant Proposed Route and HVDC Alternative Routes 7-A through 7-D. Facilities located in the ROIs for Region 7 include portions of the Trail of Tears National Historic Trail and the Great River Road National Scenic Byway and Arkansas State Scenic Highway 63. The ROIs associated with the HVDC transmission line also cross the Mississippi River in Region 7.

The Trail of Tears would be crossed by the ROI associated with the Applicant Proposed Route Link 1 and HVDC Alternative Route 7-A across the Mississippi River. The Trail of Tears locations mapped by the NPS are representative of the historic location of the trail, and the extent of the trail at each crossing location is not known.

The Great River Road National Scenic Byway would be crossed by the ROI associated with HVDC Alternative Route 7-A west of the Mississippi River crossing (west of Millington, Tennessee, in Arkansas). It is also crossed by the Applicant Proposed Route north of Birdsong, Arkansas, and the Mississippi River Crossing (west of Millington Tennessee in Arkansas). The Great River Road has many historic and cultural resources and scenic views into the River Valley (FHWA 2014c). The Arkansas State Scenic Highway 63 would be crossed by HVDC Alternative Route 7-A and the Applicant Proposed Route.

The Coon Valley Road Boat Launch area on the eastern bank of the Mississippi River in Tennessee would be crossed by the ROI associated with HVDC Alternative Route 7A. The Coon Valley Road Boat Launch appears to be a primitive ramp and parking lot for use by recreational watercraft. It is not clear whether this boat launch is maintained. The Mississippi River in this area is popular for recreational water sports, sightseeing, and fishing from the river even though the banks are steep and wooded and do not provide much access to the waterfront.

Three route variations to the Applicant Proposed Route were developed in Region 7 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.7. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route, and they would not cross any additional designated recreation areas or remove crossing locations from those described for the original Applicant Proposed Route.

3.12.5.8 Connected Actions

3.12.5.8.1 Wind Energy Generation

There are several municipal parks within WDZ-A, including Leatherman Park, Stark Park, Murphy Park, Whippo Park, and Whighem Park that would be located in Perryton, Texas, in WDZ-A. The parks are located in the city limits of Perryton and have improved ball fields and running trails.

Palo Duro Reservoir is located in WDZ-B, 10 miles north of Spearman, Texas. The lake is a man-made reservoir used mainly for fishing and bird-watching. Palo Duro Reservoir is stocked with many fish species for recreational fishing (TPWD 2014b). Millers Lake and County Road 18 hunting areas in Hansford County, Texas, are used for hunting upland game birds. Hunting areas near Millers Lake are part of the Hansford County complex in the panhandle region of the Texas Parks and Wildlife public hunting lands. The Miller's Lake unit allows for teal, pheasant, sandhill crane, high plains mallard, and western zone goose hunting. The County Road 18 unit allows only pheasant hunting (TPWD 2012).

The Schultz WMA and Optima WMA would be located in WDZ-D. The Schultz WMA is located approximately 4.7 miles south of Hardesty, Oklahoma; 260 acres of the Schultz WMA would be located within the WDZ-D analysis area. The Schultz WMA is managed by the ODWC and offers hunting (ODWC 2014b). Parts of the Optima WMA are located in WDZ-D, 13.9 miles east of Guymon, Oklahoma. There are 256 acres of the Optima WMA located within WDZ-D. The Optima WMA is part of a larger complex of conservation lands near Hardesty, Oklahoma. The Optima WMA includes land adjacent to the Optima NWR along the Beaver River and the Optima Reservoir. The Optima WMA is managed by the ODWC and is open to public hunting (ODWC 2014a).

There are several municipal parks, including the City Park, Jaycee Park, and Womble Park in Spearman, Texas, that would be located in WDZ-L. The parks are located within the city limits of Spearman and have improved ball fields and a swimming pool.

Hunting may also take place in undesignated deciduous forest, evergreen forest, mixed forest, shrub/scrub, grassland/herbaceous, woody wetland, and emergent herbaceous wetland land cover types on both public and private land in all of the WDZs.

There are no recreational resources in WDZ-C, WDZ-E, WDZ-F, WDZ-G, WDZ-H, WDZ-I, WDZ-J, and WDZ-K.

3.12.5.8.2 Optima Substation

There are no recreation resources located within the future Optima Substation Siting Area.

3.12.5.8.3 TVA Upgrades

The ROI for the direct assignment facilities (which are included in the Applicant Proposed Project) would occur within the Tennessee Converter Station Siting Area and more specifically within the Shelby Substation. The ROI for the network upgrades, and in particular TVA's future 500kV transmission line, cannot be fully determined at this time. The new 500kV line would be constructed in western Tennessee. The upgrades to existing facilities would mostly be in western and central Tennessee. The upgrades to existing facilities would mostly be in western and central Tennessee. Upgrades to existing infrastructure would include upgrading terminal equipment at three existing 500kV substations and six existing 161kV substations, making appropriate upgrades to increase heights on 16 existing

161kV transmission lines to increase line ratings, and replacing the conductors on eight existing 161kV transmission lines. Where applicable, general impacts associated with the required TVA upgrades are discussed in the impact sections that follow.

3.12.6 Impacts to Recreation

Comments related to recreation received during the scoping period indicate that the public is concerned about impacts to public lands designated for recreation, including national forests and parks, state forests and parks, Scenic Byways and Highways, and Extraordinary Resource Waters specifically regarding fishing, hunting, hiking, camping, and canoeing opportunities within all regions of the Project. The public also expressed concern about impacts to recreation on private lands and requested that the EIS examine the use of the transmission line easement areas for recreational activities.

3.12.6.1 Methodology

To identify potential impacts that may result from construction and operations and maintenance of the Project, the Applicant Proposed Route, HVDC route alternatives, the Oklahoma and Arkansas AC interconnection areas, and the AC collection system were analyzed based on a desktop review of existing recreational uses within a representative 200-foot-wide corridor—100 feet on either side of a representative centerline. Quantitative data regarding the resources directly intersected by the 200-foot-wide corridor, the representative ROW for the purposes of this analysis, were used to analyze the likely effects of the Project on recreation. For the converter stations, it was assumed that 45 to 60 acres would be required within the Oklahoma and Tennessee Converter Station Siting Areas, and 40 to 50 acres would be affected within the Arkansas converter station, although the exact locations have not yet been determined. Because the exact location of access roads, 45 multi-use construction yards (approximately 25 acres each), and other anticipated temporary construction areas and access roads have not yet been determined, these impacts were evaluated in a general qualitative way.

Although exact access road locations have not yet been determined, it has been assumed each converter station would have an access road 20 feet wide by up to 1 mile long (2 acres), with temporary disturbance up to 35 feet wide (4 acres total, 2 acres temporary and 2 permanent).

The Applicant has developed a comprehensive list of EPMs that would avoid and minimize impacts to recreation resources. Implementation of these EPMs is assumed throughout the impact analysis that follows for both the Applicant Proposed Project and the DOE Alternatives. A complete list of EPMs for the Project is provided in Appendix F; those EPMs that would specifically avoid or minimize impacts on recreation resources are listed below:

- GE-1: Clean Line will train personnel on health, safety, and environmental matters. Training will include practices, techniques, and protocols required by federal and state regulations and applicable permits.
- GE-6: Clean Line will restrict vehicular travel to the ROW and other established areas within the construction, access, or maintenance easement(s).
- GE-7: Roads not otherwise needed for maintenance and operations will be restored to preconstruction conditions. Restoration practices may include decompacting, recontouring, and re-seeding. Roads needed for maintenance and operations will be retained.
- GE-8: Access controls (e.g., cattle guards, fences, gates) will be installed, maintained, repaired, replaced, or restored as required by regulation, road authority, or as agreed to by landowner.

- GE-23: Clean Line will maximize the distance between stationary equipment and sensitive noise receptors consistent with engineering design criteria.
- GE-24: Clean Line will minimize the number and distance of travel routes for construction equipment near sensitive noise receptors.
- GE-26: When needed, Clean Line will use guard structures, barriers, flaggers, and other traffic controls to minimize traffic delays and road closures.
- LU-1: Clean Line will work with landowners and operators to ensure that access is maintained as needed to existing operations (e.g., to oil/gas wells, private lands, agricultural areas, pastures, hunting leases).
- LU-2: Clean Line will minimize the frequency and duration of road closures.
- LU-4: Clean Line will coordinate with landowners to site access roads and temporary construction areas to avoid and/or minimize impacts to existing operations and structures
- LU-5: Clean Line will make reasonable efforts, consistent with design criteria, to accommodate requests from individual landowners to adjust the siting of the ROW on their properties. These adjustments may include consideration of routes along or parallel to existing divisions of land (e.g., agricultural fields and parcel boundaries) and existing compatible linear infrastructure (e.g., roads, transmission lines, and pipelines), with the intent of reducing the impact of the ROW on private properties.
- FVW-1: Clean Line will identify environmentally sensitive vegetation (e.g., wetlands, protected plant species, riparian areas, large contiguous tracts of native prairie) and avoid and/or minimize impacts to these areas.
- FVW-3: Clean Line will clearly demarcate boundaries of environmentally sensitive areas during construction to increase visibility to construction crews.
- W-2: Clean Line will identify, avoid, and/or minimize adverse effects to wetlands and waterbodies. Clean Line will not place structure foundations within the Ordinary High Water Mark of Waters of the United States.
- W-6: Clean Line will not construct counterpoise or fiber optic cable trenches across waterbodies.

Impacts to recreation on non-designated private property is not quantifiable because no land designations, regulations, or use data exist. In addition, any public recreation on private lands is likely either allowed or not allowed by the landowner and considered an unauthorized use. Dispersed recreation on private land by the landowners and their acquaintances is likely widespread in all regions of the Project and more prevalent among landowners who have large acreages. It is difficult to pinpoint these types of uses and frequencies, although general recreation use of private land is confirmed through the public comments on the Draft EIS.

In general, impacts to recreation use on private lands would be temporary in nature and limited to noise and heightened activity during construction. Users displaced as a result of construction of the Project may be able to recreate on another portion of their property. Once the Project is in operation, no impacts to recreation, including hunting and fishing, are expected from the Project. During construction, the Applicant will use EPMs listed above to help reduce impacts to recreation. In some cases, these EPMs may even benefit local recreational users of private lands.

For example, an access road may be used by landowners to better access portions of their property, which could open up new areas to recreation or improve access to existing areas. It is expected that the landowner and the Applicant would work together to site access roads, and the transmission line may be microsited to alleviate impacts to some recreational resources; however, these would occur on a case-by-case basis.

3.12.6.2 Impacts Associated with the Applicant Proposed Project

This section describes the potential impacts from the Project that would be common to the converter stations, AC interconnection siting areas, AC collection system, and Applicant Proposed Route that are a part of the Applicant Proposed Project. Impacts from the construction, operations and maintenance, and decommissioning of the Project are discussed separately by Project component.

3.12.6.2.1 Converter Stations and AC Interconnection Siting Areas

3.12.6.2.1.1 Construction Impacts

Impacts to recreation resources are not expected from construction of the Project converter stations, AC interconnection siting areas, and interconnection ties and would not impact any recreation resources because no recreational resources are located in these areas.

3.12.6.2.1.2 Operations and Maintenance Impacts

No impacts to recreation resources are expected from operations and maintenance of the Converter Stations or associated AC interconnections because no recreation resources are located within these areas.

3.12.6.2.1.3 Decommissioning Impacts

No impacts to recreation resources are expected from decommissioning of the converter stations or AC interconnections because no recreation resources are located within these areas.

3.12.6.2.2 AC Collection System

This section discusses the data reviewed within the 200-foot-wide representative ROWs of the AC collection system.

3.12.6.2.2.1 Construction Impacts

Construction of the AC collection system is not expected to permanently preclude the use of or access to any existing recreation areas or activities since no recreation resources have been identified within the representative ROW for any AC collection system routes. No impacts to recreation resources are anticipated from construction of AC Collection System Routes E-1, E-2, E-3, NE-1, NE-2, NW-1, NW-2, SE-1, SE-2, SW-1, SW-2, and W-1 because no recreation resources are located within the representative ROW.

Three of the AC Collection System Routes are located in close proximity to recreation resources. The southern boundaries of the Optima NWR and the Optima WMA are located to the north of AC Collection System Route E-1. At the closest point, the Optima NWR and the Optima WMA are approximately 1,500 feet from this route, and about 1.5 miles from the Optima lake shoreline, which is within the NWR and WMA areas. The boundaries of the Schultz Lake State Park and Schultz WMA are located to the north of AC Collection System Route SE-1. At the closest point, the Schultz Lake State Park and Schultz WMA are approximately 0.5 mile from the alternative. The boundary of Shorb WMA is located approximately 0.16 miles to the north of the AC Collection System Route SE-3 and E-2.

Long-term indirect impacts would result from vegetation clearing and structure erection and could have impacts on recreational visitors due to changes in the scenic landscapes provided by the Optima NWR and Optima WMR the Schultz Lake State Park and Schultz WMA, and Shorb WMA. Operations and Maintenance Impacts

No impacts to recreation resources are anticipated from operations and maintenance of any of the AC collection system routes because no recreation resources are located within the representative ROW.

3.12.6.2.2.2 Decommissioning Impacts

Potential impacts during decommissioning of the Project would be similar to those of the construction phase for all Project components. Once the decommissioning has been completed, all land would return to the preconstruction recreational land uses.

3.12.6.2.3 HVDC Applicant Proposed Route

This section identifies the potential impacts from the Applicant Proposed Route on recreation based on the three phases of the Project: construction, operations and maintenance, and decommissioning. The Applicant would conduct each phase in compliance with applicable state and federal laws, regulations, and permits related to environmental protection. Specific EPMs developed to avoid and minimize impacts are described in Section 3.12.6.1. Changes to impacts due to route variations and adjustments developed in response to public comments on the Draft EIS are described at the end of applicable sections.

3.12.6.2.3.1 Construction Impacts

This section describes the potential impacts to recreation during the construction phase of the Project within the 200-foot-wide representative ROWs of the Applicant Proposed Route.

Construction of the Project is not expected to permanently preclude the use of or access to any existing recreation areas or activities; however, some direct short-term impacts to these resources, such as noise, visual disturbance, or restricted access may diminish the quality of a recreational visit. The Applicant expects the duration of construction in each 140-mile segment to be approximately 24 months from mobilization of equipment to site restoration; however, construction at a discrete site would be shorter in duration. The duration of disturbance at any one location along a segment would be less, with the length of disturbance affected by the land use and progress of the individual work crews. Recreational areas are typically more popular on the weekends and during the summer, and since construction activities would be scheduled Monday through Saturday, recreationists would generally be most affected on Saturdays and during the summer months when the recreational lands in the Project regions commonly experience the most use. In most regions of the Project, alternate recreation areas can be found, including private or public land with similar habitat conditions, and hunting seasons vary depending upon each state department of wildlife.

Hunting and wildlife viewing opportunities could be temporarily impacted by the Project if wildlife species are displaced from areas near construction activities to suitable habitats adjacent to, but beyond the extent of, construction disturbances. Alternately, some wildlife may be temporarily attracted to cleared areas due to an increased availability of food. In such areas, food resources, such as nuts and seeds, left on the ground can be easily found by wildlife. Such displacement could improve hunting and wildlife viewing opportunities in some areas for a short period of time following clearing activities. These impacts would be limited to the immediate area of construction activity and would be short term in nature and, in some areas, may be mitigated by vegetation that is outside the ROW and not subject to clearing. Vegetation outside of the ROW may provide visual and noise screening to the affected areas within the ROW.

Direct long-term impacts would result from vegetation clearing and structure erection. The transmission structures could have impacts on scenic landscapes by reducing the quality of the natural or rural landscapes. The extent of these impacts would, however, depend on existing visual conditions in the affected areas, with impacts lower in those areas where high-voltage transmission lines and other types of development are already present. Impacts would also vary based on the distance of the recreation area from the proposed transmission line. Potential effects would tend to be greater in locations where the Project would be visible on the horizon. Site-specific visual impacts are evaluated in detail in Section 3.18.

The sections below describe the recreation resources that would be affected within each region of the Applicant Proposed Route.

3.12.6.2.3.1.1 Region 1 and Region 2

Applicant Proposed Route Link 5 in Region 1 near May, Oklahoma, and Link 3 in Region 2, near Enid, Oklahoma, would cross the Chisholm and Great Western Trail, which is proposed for inclusion in the National Historic Trail system. Applicant Proposed Route Link 2 in Region 1, southeast of Hardesty, Oklahoma would be located south and adjacent to the Shorb WMA. Locations mapped by the NPS are representative of the historical location of the trail, but the extent of the trail at each crossing location is not known. These impacts would be direct and temporary, similar to those described for construction in Section 3.12.6.

Construction of the Applicant Proposed Route is not expected to permanently preclude the use of or access to any existing recreation areas or activities related to the Chisholm and Great Western Trail and Shorb WMA; however, some direct short-term impacts to these resources, such as noise, visual disturbance, or restricted access, would likely diminish the quality of a recreational visit. These impacts would be limited to the immediate area of construction activity and would be short term in nature and, in some areas, may be mitigated by vegetation that is outside the ROW and not subject to clearing. Vegetation outside the ROW may provide visual and noise screening to the affected areas within the ROW.

No route variations were proposed in Region 1. Two route variations to the Applicant Proposed Route in Region 2 were developed in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.2. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route, and they would not cross any additional designated recreation areas or remove crossing locations from those described for the original Applicant Proposed Route.

3.12.6.2.3.1.2 Region 3

The Applicant Proposed Route could potentially impact 4 acres of the Webbers Falls Lock and Dam Reservoir lands in Link 6 if the Project is routed on the representative centerline. The tensioning areas associated with the Applicant Proposed Route could potentially impact 1 acre of Webbers Falls Lock and Dam Reservoir lands and would have similar construction impacts. Short-term direct impacts during construction may include noise and visual disturbance, which could diminish the quality of a recreational visit.

The Webbers Falls Lock and Dam Reservoir is crossed by the Applicant Proposed Route in Region 3 and is also crossed by several existing transmission lines:

- Gore to Weleetka 161kV

- Gore to Webbers Falls 115kV
- Eufaula to Gore 138kV
- Muskogee to Pittsburg 345kV

Applicant Proposed Route Link 4 would cross Historic Route 66 near Bristow, Oklahoma. Tensioning areas associated with Applicant Proposed Route Links 3 and 4 would be located adjacent to the Historic Route 66 crossings, and construction equipment may be located next to the roadway during construction. Short-term direct impacts during construction may include visual disturbance, which could diminish the visual quality of driving along the historic route. It is not anticipated that traffic flow would be restricted during construction.

Five route variations to the Applicant Proposed Route were developed in Region 3 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.3. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route, and they would not cross any additional designated recreation areas or remove crossing locations from those described for the original Applicant Proposed Route. It should be noted that a route adjustment was made for HVDC Alternative Route 3-A to maintain an end-to-end route with the Links 1 and 2 variations.

3.12.6.2.3.1.3 Region 4

The Applicant Proposed Route could potentially impact 2 acres of the Ozark Lake WMA, 4 acres of the Frog Bayou WMA, 2 acres of the Ozark National Forest, two Arkansas State Scenic Byways, and two Arkansas State Scenic Highways. The Applicant Proposed Route in Region 4, Link 1, could potentially impact 17 acres of the Webbers Falls Lock and Dam Reservoir lands. There is no HVDC alternative route to this link of the Applicant Proposed Route. The tensioning areas associated with the Applicant Proposed Route could potentially impact less than 0.1 acre of Webbers Falls Lock and Dam Reservoir lands and 4 acres of the Frog Bayou WMA.

The Mulberry River and Big Piney Creek are designated as an Arkansas Natural and Scenic Rivers where they are crossed by Applicant Proposed Route Link 6. Applicant Proposed Route Link 3 (the Lee Creek Variation) would cross a section of Lee Creek that is designated on the NRI. Applicant Proposed Route Link 9 would cross a section of the Piney Creek that is designated on the NRI. The rivers would likely be spanned.

Applicant Proposed Route Links 1, 5, 6, and 8 would cross the Trail of Tears National Historic Trail. Tensioning areas associated with the Applicant Proposed Route Links 6 and 8 would be located adjacent to the Trail of Tears crossing and construction equipment may be located near the trail during construction. Applicant Proposed Route Link 1 would cross the Cherokee Hills Scenic Byway. The Trail of Tears locations mapped by the NPS are representative of the historic location of the trail and the extent of the trail at each crossing location is not known. These impacts would be direct and temporary impacts as defined in Section 3.12.6.2.

The Applicant Proposed Route would cross Arkansas State Scenic Highway 59, Arkansas State Scenic Highway Interstate-40, Arkansas State Scenic Byway 23/Pig Trail Scenic Byway, and Arkansas State Scenic Byway 21/Ozark Highlands Scenic Byway.

Construction of the Applicant Proposed Route is not expected to permanently preclude the use of or access to any existing recreation areas or activities; however, some direct short-term impacts to these resources, such as noise, visual disturbance, or restricted access, would likely diminish the quality of a recreational visit. These impacts would be limited to the immediate area of construction activity and would be short term in nature and, in some areas, may be mitigated by vegetation that is outside the ROW and not subject to clearing. Vegetation outside of the ROW may provide visual and noise screening to the affected areas within the ROW.

Long-term direct impacts to Ozark Lake WMA, Frog Bayou WMA, the Mulberry River, and the Big Piney Creek would result from vegetation clearing and structure erection. The Webbers Falls Lock and Dam Reservoir is crossed by the Applicant Proposed Route in Region 3 and is also crossed by several existing transmission lines:

- Gore to Weleetka 161kV
- Gore to Webbers Falls 115kV
- Eufaula to Gore 138kV
- Muskogee to Pittsburg 345kV

Seven route variations to the Applicant Proposed Route were developed in Region 4 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.4. The variations are illustrated in Exhibit 1 of Appendix M. In general, these variations represent minor adjustments to the Applicant Proposed Route, and they would not cross any additional designated recreation areas or remove crossing locations from those described for the original Applicant Proposed Route. The only exception is Applicant Proposed Route Link 6, Variation 3, which would cross the Trail of Tears National Historic Trail at a new location. The potential impacts for this variation are expected to be the same as those described for the original Applicant Proposed Route.

3.12.6.2.3.1.4 Region 5

The Applicant Proposed Route could potentially impact 77 acres of the Cherokee WMA and cross several Arkansas Scenic Highways and Byways. The tensioning areas associated with the Applicant Proposed Route could potentially impact 6 acres of the Cherokee WMA. The boundary of the Rainey WMA would be approximately 0.25 miles northeast of the Applicant Proposed Route. Applicant Proposed Route Link 1 would cross the Arkansas Scenic 7 Byway and would span the road. Applicant Proposed Route Link 4 would cross a section of the Cadron Creek listed on the NRI. The rivers would likely be spanned and structures would not be placed within the riparian zones. The Applicant proposed Route would cross the following Arkansas Scenic Highways:

- State Scenic Highway 27
- State Scenic Highway 9
- State Scenic Highway 65
- State Scenic Highway 25
- State Scenic Highway 5
- State Scenic Highway 16

The Cherokee WMA in Region 5 is used for hunting. Hunting opportunities could be temporarily disturbed by the Applicant Proposed Route if wildlife species are displaced from areas near construction activities to suitable habitats adjacent to, but beyond the extent of, construction disturbances. These impacts would be limited to the immediate area of construction activity and would be short term in nature and, in some areas, may be mitigated by vegetation that is outside the ROW and not subject to clearing.

Five route variations to the Applicant Proposed Route were developed in Region 5 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.5. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route, and they would not cross any additional designated recreation areas or remove crossing locations from those described for the original Applicant Proposed Route.

3.12.6.2.3.1.5 Region 6

The Applicant Proposed Route could potentially impact approximately 1 acre of the Singer Forest Natural Area/St. Francis Sunken Lands. The Applicant Proposed Route Link 6 would cross Crowley's Ridge Parkway National Scenic Byway. The Applicant Proposed Route Link 6 would also cross a section of the L'Anguille River listed on the NRI; the transmission line would likely span the river. No tensioning areas that are associated with the Applicant Proposed Route would affect any recreation resources.

The Singer Forest Natural Area/St. Francis Sunken Lands WMA is used for hunting. Hunting opportunities could be temporarily disturbed by the Applicant Proposed Route if wildlife species are displaced from areas near construction activities to suitable habitats adjacent to, but beyond the extent of, construction disturbances. These impacts would be limited to the immediate area of construction activity and would be short term in nature and, in some areas, may be mitigated by vegetation that is outside the ROW and not subject to clearing.

One route variation was developed in Region 6 in response to public comments on the Draft EIS and is shown in Exhibit 1 of Appendix M. This variation represents a minor adjustment to the Applicant Proposed Route, and it would not cross any additional designated recreation areas or remove crossing locations from those described for the original Applicant Proposed Route. It should be noted that a route adjustment was made for HVDC Alternative Route 6-A to maintain an end-to-end route with this variation.

3.12.6.2.3.1.6 Region 7

The Applicant Proposed Route would cross the Great River Road National Scenic Byway at two points, the Trail of Tears National Historic Trail, and Arkansas Scenic Highway 63. The Project is expected to span both the byway and the trail. No tensioning areas that are associated with the Applicant Proposed Route would affect any recreation resources.

Recreation opportunities could be temporarily impacted by the Applicant Proposed Route if construction was visible from the Great River Road and the Trail of Tears. The recreational experience for the Great River Road and Trail of Tears is based in part on the scenic views from these resources and may be impacted by visible construction activities and vegetation clearing. Visual resources are discussed in more detail in section 3.18. The Trail of Tears locations mapped by the NPS are representative of the historic location of the trail and the extent of the trail at each crossing location is not known. These impacts would be limited to the immediate area of construction activity and would be short term in nature and, in some areas, may be mitigated by vegetation that is outside the ROW and not subject to clearing. Long-term direct impacts to the Great River Road and the Trail of Tears would result from vegetation clearing and structure erection and may diminish the recreational experience if visible from the road or trail.

Three route variations to the Applicant Proposed Route were developed in Region 7 in response to public comments on the Draft EIS. The route variations are illustrated in Exhibit 1 of Appendix M and summarized in Section 2.4.2.7.

These variations represent minor adjustments to the Applicant Proposed Route, and they would not cross any additional designated recreation areas or remove crossing locations from those described for the original Applicant Proposed Route.

3.12.6.2.3.2 Operations and Maintenance Impacts

Operation and maintenance activities for facilities would be similar to activities during construction but generally smaller in scale, more localized, and shorter in duration.

The Applicant Proposed Route is not expected to permanently preclude the use of or access to any existing recreation areas or activities; however, some direct short-term impacts to these resources, such as noise, visual disturbance, or restricted access, would likely diminish the quality of a recreational visit.

3.12.6.2.3.3 Decommissioning Impacts

Potential impacts during decommissioning of the Project would be similar to those of the construction phase for all Project components, except they would last a shorter duration of time. Once the decommissioning is complete, all land would return to the preconstruction recreational land uses.

3.12.6.3 Impacts Associated with the DOE Alternatives

The impacts discussed in the sections below are common to all aspects of the DOE Alternatives, which include the Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area, including the new substation at the interconnection point, the HVDC alternative routes, access roads, multi-use construction yards and other temporary construction areas, and communications sites.

3.12.6.3.1 Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area

3.12.6.3.1.1 Construction Impacts

Impacts to recreation resources are not expected from construction of the Project converter station and AC interconnection siting areas, including the new substation at the interconnection point. Construction would not impact any recreation resources because no recreational resources exist in these areas.

3.12.6.3.1.2 Operations and Maintenance Impacts

Impacts to recreation resources are not expected from operations and maintenance of the Project converter station and AC interconnection siting areas, including the new substation at the interconnection point in Arkansas. Operations and maintenance would not impact any recreation resources because no recreational resources exist in these areas.

3.12.6.3.1.3 Decommissioning Impacts

Impacts to recreation resources are not expected from decommissioning of the Project converter station and AC interconnection siting areas, including the new substation at the interconnection point. Decommissioning would not impact any recreation resources because no recreational resources exist in these areas.

3.12.6.3.2 HVDC Alternative Routes

This section discusses the potential impacts within the 200-foot-wide representative ROWs of the HVDC alternative routes during the construction, operations and maintenance, and decommissioning phases of the Project.

3.12.6.3.2.1 Construction Impacts

Construction impacts from the HVDC alternative routes would be the same as impacts from the HVDC Applicant Proposed Route and are described in Section 3.12.6.2.3. The sections below describe the recreation resources that would be affected within each HVDC alternative route.

3.12.6.3.2.1.1 Region 1 and Region 2

HVDC Alternative Route 1-A in Region 1 near May, Oklahoma, and HVDC Alternative Route 2-B in Region 2, near Enid, Oklahoma, would cross the Chisholm and Great Western Trail, which is proposed to be part of the National Historic Trail system. Locations mapped by the NPS are representative of the historical location of the trails, but the extent of the trails at each crossing location is not known. These impacts would be direct and temporary similar to those described for construction in Section 3.12.6.

Construction of the HVDC alternative routes is not expected to permanently preclude the use of or access to any existing recreation areas or activities related to Chisholm and Great Western Trails; however, some direct short-term impacts to these resources, such as noise, visual disturbance, or restricted access, would likely diminish the quality of a recreational visit. These impacts are expected to be limited to the immediate area of construction activity and would be short term in nature and, in some areas, may be mitigated by vegetation that is outside the ROW and not subject to clearing. Vegetation outside of the ROW may provide visual and noise screening to the affected areas within the ROW.

3.12.6.3.2.1.2 Region 3

3.12.6.3.2.1.2.1 Alternative Route 3-A

HVDC Alternative Route 3-A could potentially impact 22 acres of the OSU-owned and -managed Lake Carl Blackwell if the Project is routed on the representative centerline. The tensioning areas associated with the HVDC Alternative Route 3-A could potentially impact 0.2 acre of Lake Carl Blackwell. HVDC Alternative Route 3-A and tensioning areas associated with HVDC Alternative Route 3-A crosses Historic Route 66 southwest of Bristow, Oklahoma. Corresponding Applicant Proposed Route Link 1 would not have impacts to recreation resources because no recreation resources are located in the representative ROW.

As described for the Applicant Proposed Route in Region 3, hunting opportunities could be temporarily impacted by construction of HVDC Alternative Route 3-A if wildlife species are displaced from areas near construction activities to suitable habitats adjacent to, but beyond the extent of, construction disturbances as described in Section 3.12.6.2.3.1. Views from Route 66 may also be affected from construction of the Project; however, Route 66 would likely be spanned.

As described in Appendix M and summarized in Section 2.4.2.3, a route adjustment was developed for HVDC Alternative Route 3-A to maintain an end-to-end route with Applicant Proposed Route Link 1, Variation 2, and Links 1 and 2, Variation 1. This route adjustment represents minor adjustments to the original HVDC alternative route, and it would not cross any additional designated recreation areas or remove crossing locations from those described for the original HVDC alternative route.

3.12.6.3.2.1.2.2 Alternative Route 3-B

HVDC Alternative Route 3-B could potentially impact 22 acres of the OSU-owned and -managed Lake Carl Blackwell if the Project is routed on the representative centerline. The tensioning areas associated with HVDC Alternative Route 3-B could potentially impact 0.2 acre of Lake Carl Blackwell and would have similar construction impacts as described for the HVDC Alternative Route 3-A. The corresponding Applicant Proposed Route Links 1, 2, and 3 have no impacts to recreation resources because no recreation resources are located in the representative ROW.

Hunting opportunities could be temporarily impacted by HVDC Alternative Route 3-B if wildlife species are displaced from areas near construction activities to suitable habitats adjacent to, but beyond the extent of, construction disturbances as described in Section 3.12.6.2.3. These impacts would be limited to the immediate area of construction activity and would be short term in nature and, in some areas, may be mitigated by vegetation that is outside the ROW and not subject to clearing.

3.12.6.3.2.1.2.3 Alternative Route 3-C

HVDC Alternative Route 3-C could potentially impact 1 acre of the Webbers Falls Lock and Dam Reservoir land, while corresponding Applicant Proposed Route Links 3, 4, 5, and 6 would impact 4 acres of Webbers Falls Lock and Dam. No tensioning areas are associated with HVDC Alternative Route 3-C. Short term impacts during construction may include noise and visual disturbance which could diminish the quality of a recreational visit.

3.12.6.3.2.1.2.4 Alternative Route 3-D

HVDC Alternative Route 3-D could potentially impact 1 acre of the Webbers Falls Lock and Dam Reservoir land if the Project is routed on the representative centerline, while corresponding Applicant Proposed Route Links 5 and 6 would affect 4 acres of Webbers Falls Lock and Dam. No tensioning areas are associated with the HVDC Alternative Route 3-D. Short term impacts during construction may include noise and visual disturbance which could diminish the quality of a recreational visit.

The Webbers Falls Lock and Dam Reservoir is crossed by Alternative Route 3-D in Region 3 and is also crossed by several existing transmission lines:

- Gore to Weleetka 161kV
- Gore to Webbers Falls 115kV
- Eufaula to Gore 138kV
- Muskogee to Pittsburg 345kV

3.12.6.3.2.1.2.5 Alternative Route 3-E

HVDC Alternative Route 3-E could potentially impact 1 acre of the Webbers Falls Lock and Dam Reservoir land if the Project is routed on the representative centerline, while corresponding Applicant Proposed Route Links 5 and 6 would affect 4 acres of Webbers Falls Lock and Dam. No tensioning areas are associated with HVDC Alternative Route 3-E; tensioning areas associated with Applicant Proposed Route Links 5 and 6 would affect 1 acre of Webbers Falls Lock and Dam. Short term impacts during construction may include noise and visual disturbance which could diminish the quality of a recreational visit.

3.12.6.3.2.1.3 Region 4

3.12.6.3.2.1.3.1 Alternative Route 4-A

HVDC Alternative Route 4-A would cross a section of the Mulberry River designated as Arkansas Natural and Scenic Rivers System by crossing the river near Clarksville, Arkansas. HVDC Alternative Route 4-A would cross a section of the Little Lee Creek designated as an Arkansas Natural and Scenic Rivers System by crossing the river near the Arkansas and Oklahoma state line. HVDC Alternative Route 4-A would cross a section of the Lee Creek designated on the NRI. The rivers would likely be spanned and structures would not be placed within the riparian zones.

HVDC Alternative Route 4-A would cross the Trail of Tears National Historic Trail in two places. HVDC Alternative Route 4-A would cross State Scenic Highway 220 and State Scenic Byway 540 (Boston Mountains Scenic Loop).

Corresponding Applicant Proposed Route Links 3, 4, 5, and 6 would affect 2 acres of the Ozark Lake WMA and 4 acres of the Frog Bayou WMA. Tensioning areas associated with Applicant Proposed Route Links 3, 4, 5, and 6 would affect 4 acres of the Frog Bayou WMA and cross the NRI segment of Lee Creek. Short term impacts during construction may include noise and visual disturbance which could diminish the quality of a recreational visit.

3.12.6.3.2.1.3.2 Alternative Route 4-B

HVDC Alternative Route 4-B could potentially impact 230 acres of the Ozark National Forest and Ozark National Forest WMA if HVDC Alternative Route 4-B is routed on the representative centerline. Within the Ozark National Forest, approximately 102 acres are federal (public) land and approximately 157 acres are private inholdings. Recreation is most likely to occur on the federal portion of the Ozark National Forest; however, private landowners may allow hunting or other recreation within their lands.

HVDC Alternative Route 4-B would cross a section of the Mulberry River designated as Arkansas Natural and Scenic Rivers System by crossing the river near Clarksville, Arkansas. HVDC Alternative Route 4-B could potentially impact the sections of the Little Lee Creek designated as Arkansas Natural and Scenic Rivers System by crossing the river near the Arkansas and Oklahoma state line. HVDC Alternative Route 4-B would cross three sections of the Lee Creek that are designated on the NRI. The rivers would be spanned and structures would not be placed within the riparian zones. Tensioning areas would be located adjacent to the Mulberry River crossing location for HVDC Alternative Route 4-B.

HVDC Alternative Route 4-B would cross the Trail of Tears National Historic Trail in two places. HVDC Alternative Route 4-B would cross State Scenic Highway 220, and State Scenic Byway 23 (Pig Trail Scenic Byway). The Trail of Tears locations mapped by the NPS are representative of the historic location of the trail and the extent of the trail at each crossing location is not known.

Short term impacts during construction may include noise and visual disturbance which could diminish the quality of a recreational visit.

Corresponding Applicant Proposed Route Links 2, 3, 4, 5, 6, 7 and 8 would affect 2 acres of the Ozark Lake WMA and 4 acres of the Frog Bayou WMA and would cross Lee Creek. Tensioning areas associated with Applicant Proposed Route Links 2, 3, 4, 5, 6, 7, and 8 would affect 4 acres of the Frog Bayou WMA. There are no specific recreation areas, such as boat launches, campgrounds, or shooting ranges, that are located in HVDC Alternative Route 4-B.

3.12.6.3.2.1.3.3 Alternative Route 4-C

HVDC Alternative Route 4-C would cross the Trail of Tears and would span the trail. The Trail of Tears locations mapped by the NPS are representative of the historic location of the trail and the extent of the trail at each crossing location is not known. Alternative Route 4-C would cross State Scenic Highway 59. Short term impacts during construction may include noise and visual disturbance which could diminish the quality of a recreational visit. No impacts to recreational lands or uses are anticipated from construction of corresponding Applicant Proposed Route Link 5 because no recreation resources are located within the representative ROW.

3.12.6.3.2.1.3.4 Alternative Route 4-D

HVDC Alternative Route 4-D could potentially impact the sections of the Mulberry River designated as Arkansas Natural and Scenic Rivers System by crossing the river near Clarksville, Arkansas. The river would likely be spanned and structures would not be placed within the riparian zones. HVDC Alternative Route 4-D would cross the Trail of Tears in two places and would span the trail. The Trail of Tears locations mapped by the NPS are representative of the historic location of the trail and the extent of the trail at each crossing location is not known. HVDC Alternative Route 4-D would cross State Scenic Highway 59 and State Scenic Highway U.S. Highway 71. Short term impacts during construction may include noise and visual disturbance which could diminish the quality of a recreational visit. The construction of corresponding Applicant Proposed Route Links 4, 5, and 6 would affect 2 acres of the Ozark Lake WMA and 4 acres of the Frog Bayou WMA, and tensioning areas associated with these same links would affect 4 acres of the Frog Bayou WMA.

3.12.6.3.2.1.3.5 Alternative Route 4-E

HVDC Alternative Route 4-E could potentially impact the Big Piney Creek listed on the NRI by crossing the river near Clarksville, Arkansas. The river would likely be spanned and structures would not be placed within the riparian zones. HVDC Alternative Route 4-E would cross the Trail of Tears and would span the trail. Tensioning areas associated with HVDC Alternative Route 4-E would be adjacent to the Trail of Tears crossing and construction equipment may be located adjacent to the trail. The Trail of Tears locations mapped by the NPS are representative of the historic location of the trail and the extent of the trail at each crossing location is not known.

HVDC Alternative Route 4-E would cross State Scenic Highway Interstate-40 and State Scenic Byway 21 (Ozark Highlands Scenic Byway). Short term impacts during construction may include noise and visual disturbance which could diminish the quality of a recreational visit. No impacts to recreational lands or uses are anticipated from construction of corresponding Applicant Proposed Route Link 5 because no recreation resources are located within the representative ROW.

3.12.6.3.2.1.4 Region 5

3.12.6.3.2.1.4.1 Alternative Route 5-A

HVDC Alternative Route 5-A and tensioning areas associated with HVDC Alternative Route 5-A would cross the Arkansas Scenic 7 Byway. HVDC Alternative 5-A would cross State Scenic Byway 7 (Arkansas Scenic 7 Byway) and State Scenic Highway 27. Short term impacts during construction may include noise and visual disturbance which could diminish the quality of a recreational visit. No impacts to recreational lands or uses are anticipated from construction of corresponding Applicant Proposed Route Link 1 because no recreation resources are located within the representative ROW.

3.12.6.3.2.1.4.2 Alternative Route 5-B

HVDC Alternative Route 5-B would cross two sections of the Cadron Creek listed on the NRI. HVDC Alternative Route 5-B would cross the following Arkansas State Scenic Highways: State Highway 9, U.S. Highway 65, State Highway 5 and State Highway 16. Short term impacts during construction may include noise and visual disturbance which could diminish the quality of a recreational visit. All features are expected to be spanned. No impacts to recreational lands or uses are anticipated from construction of corresponding Applicant Proposed Route Links 3, 4, 5, and 6 because no recreation resources are located within the representative ROWs.

As described in Appendix M and summarized in Section 2.4.2.4, a route adjustment was developed for HVDC Alternative Route 5-B to maintain an end-to-end route with Applicant Proposed Route Links 2 and 3, Variation 1. In general, these variations represent minor adjustments to the HVDC Alternative Route, and they would not cross any additional designated recreation areas or remove crossing locations from those described for the original HVDC alternative route. The only exception is Applicant Proposed Route Links 2 and 3, Variation 1, which would cross Cadron Creek at a new location. The potential impacts for this variation are expected to be the same as those described for the original HVDC alternative route.

3.12.6.3.2.1.4.3 Alternative Route 5-C

HVDC Alternative Route 5-C would cross State Scenic Highway 16 and would span the road. Short term impacts during construction may include noise and visual disturbance which could diminish the quality of a recreational visit. No impacts to recreational lands or uses are anticipated from construction of corresponding Applicant Proposed Route Links 6 and 7 because no recreation resources are located within the representative ROWs.

3.12.6.3.2.1.4.4 Alternative Route 5-D

No impacts to recreational lands or uses are anticipated from construction of HVDC Alternative Route 5-D because no recreational resources are located within the representative ROW. Likewise, no impacts to recreational lands or uses are anticipated from construction of corresponding Applicant Proposed Route Link 9 because no recreation resources are located within the representative ROW.

3.12.6.3.2.1.4.5 Alternative Route 5-E

HVDC Alternative Route 5-E would cross two sections of the Cadron Creek listed on the NRI, and State Scenic Highway 25, all are expected to be spanned. No impacts to recreational lands or uses are anticipated from construction of corresponding Applicant Proposed Route Links 4, 5, and 6 because no recreation resources are located within the representative ROWs.

As described in Appendix M and summarized in Section 2.4.2.5, a route adjustment was developed for HVDC Alternative Route 5-E in response to public comments on the Draft EIS to maintain continuity with Applicant Proposed Route Links 3 and 4, Variation 2. In general, these variations represent minor adjustments to the HVDC alternative route, and they would not cross any additional designated recreation areas or remove crossing locations from those described for the original HVDC alternative route. The only exception is Applicant Proposed Route Links 3 and 4, Variation 2, which would cross Cadron Creek at a new location. The potential impacts for this variation are expected to be the same as those described for the original HVDC alternative Route.

3.12.6.3.2.1.4.6 Alternative Route 5-F

HVDC Alternative Route 5-F would cross a section of the Cadron Creek listed on the NRI, and is expected to be spanned. Short term impacts during construction may include noise and visual disturbance which could diminish the quality of a recreational visit. No impacts to recreational lands or uses are anticipated from construction of corresponding Applicant Proposed Route Links 5 and 6 because no recreation resources are located within the representative ROWs.

3.12.6.3.2.1.5 Region 6

3.12.6.3.2.1.5.1 Alternative Route 6-A

No impacts to recreational lands or uses are anticipated from construction of HVDC Alternative Route 6-A because no recreation resources are located within the representative ROW. Likewise, no impacts to recreational lands or uses are anticipated from construction of corresponding Applicant Proposed Route Links 2, 3, and 4 because no recreation resources are located within the representative ROWs.

As described in Appendix M and summarized in Section 2.4.2.6, a route adjustment was developed for HVDC Alternative Route 6-A to maintain an end-to-end route with Applicant Proposed Route Link 2, Variation 1. The route adjustment would not cross any additional designated recreation areas, nor would it remove crossing locations from what is described for the original HVDC alternative route. The route adjustment is illustrated in Exhibit 1 of Appendix M.

3.12.6.3.2.1.5.2 Alternative Route 6-B

HVDC Alternative Route 6-B would cross Arkansas Scenic Highway 14 and is expected to span the road. Short-term impacts during construction may include noise and visual disturbance which could diminish the quality of a recreational visit. No impacts to recreational lands or uses are anticipated from construction of corresponding Applicant Proposed Route Link 3 because no recreation resources are located within the representative ROW.

3.12.6.3.2.1.5.3 Alternative Route 6-C

HVDC Alternative Route 6-C would cross the Crowley's Ridge Parkway National Scenic Byway and is expected to span the road. Short term impacts during construction may include noise and visual disturbance which could diminish the quality of a recreational visit. Corresponding Applicant Proposed Route Links 6 and 7 would affect 1 acre of the Singer Forest Natural Area/St. Francis Sunken

3.12.6.3.2.1.5.4 Alternative Route 6-D

No impacts to recreational lands or uses are anticipated from construction of HVDC Alternative Route 6-D because no recreational resources are located within the representative ROW. Likewise, no impacts to recreational lands or uses are anticipated from construction of corresponding Applicant Proposed Route Link 7 because no recreation resources are located within the representative ROW.

3.12.6.3.2.1.6 Region 7

3.12.6.3.2.1.6.1 Alternative Route 7-A

HVDC Alternative Route 7-A would cross State Scenic Highway 63 and Great River Road National Scenic Byway. Short term impacts during construction may include noise and visual disturbance which could diminish the quality of a recreational visit. No impacts to recreational lands or uses are anticipated from construction of corresponding Applicant Proposed Route Link 1 because no recreation resources are located within the representative ROW.

3.12.6.3.2.1.6.2 Alternative Route 7-B, 7-C, and 7-D

No impacts to recreational lands or uses are anticipated from construction of HVDC Alternative Routes 7-B, 7-C, and 7-D because no recreational resources are located within the representative ROW. Likewise, no impacts to recreational lands or uses are anticipated from construction of corresponding Applicant Proposed Route Links 3 and 4 (which correspond to Route 7-B) because no recreation resources are located within the representative ROWs. No impacts to recreational lands or uses are anticipated from construction of corresponding Applicant Proposed Route Links 3, 4, and 5 (which correspond to Route 7-C) because no recreation resources are located within the representative ROWs. No impacts to recreational lands or uses are anticipated from construction of corresponding Applicant Proposed Route Links 4 and 5 (which correspond to HVDC Alternative Route 7-D) because no recreation resources are located within the representative ROW.

3.12.6.3.2.2 Operations and Maintenance Impacts

Operation and maintenance impacts from the HVDC alternative routes are similar to those for construction; however, they would be shorter in duration and at a smaller scale as discussed in Section 3.12.6.2.3.

3.12.6.3.2.3 Decommissioning Impacts

Decommissioning of HVDC transmission lines, as with any of the HVDC alternative routes, would be expected to have impacts similar to those described in Section 3.12.6.1 for common construction activities.

3.12.6.4 Best Management Practices

The Applicant has developed a comprehensive list of EPMs as part of the Project to minimize impacts to recreation resources. No other BMPs are recommended; however, some of the impacts discussed in this section are unavoidable. A complete list of EPMs for the Project is provided in Appendix F; those EPMs that would specifically minimize the potential for impacts on recreation resources are summarized in Section 3.12.6.1.

3.12.6.5 Unavoidable Adverse Impacts

Unavoidable impacts include the potential loss or alteration of recreational land and recreational uses of public or private lands that are located within the transmission line ROW due to restriction of public access from structure locations. Following the completion of construction, access to the HVDC transmission line ROWs would resume consistent with access prior to construction; in some cases opening new areas within the ROW to recreational activities (e.g., hiking trails, hunting). Impacts to the setting of public recreational lands would be minimized by the EPMs, would be unavoidable and long-term, but would not be permanent in recreational areas that the Project crosses.

3.12.6.6 Irreversible and Irretrievable Commitment of Resources

All impacts related to recreational resources would cease with the end of the Project and would not be considered an irreversible or irretrievable commitment of resources.

3.12.6.7 Relationship between Local Short-term Uses and Long-term Productivity

Some direct short-term impacts to resources such as noise or visual disturbance, or restricted access to the recreation area during construction, would likely diminish the quality of a recreational visit. Long-term productivity of recreational areas could potentially decrease in recreational areas that were crossed by the Project.

3.12.6.8 Impacts from Connected Actions

3.12.6.8.1 Wind Energy Generation

The recreational lands within the WDZs may be affected by construction, operations and maintenance, and decommissioning of the Project. Indirect impacts to the visual setting would likely occur from construction, operations and maintenance, and decommissioning of wind facilities that would interconnect into the Project.

Recreational lands within the WDZs may experience short-term direct impacts during construction of wind projects. Noise, dust, and human activity, as well as vegetation clearing and turbine erection would cause short-term direct and indirect impacts to recreation. The quality of recreational activities such as sightseeing, fishing, hiking, bird watching, and wildlife viewing could be temporarily diminished due to construction noise and activity in the area and vegetation clearing. Recreation areas may also have long-term indirect visual impact from vegetation clearing (as needed) and the presence of turbines. The landscape in this region is flat with very few trees, which would make views of the wind turbines visible for a long distance.

Short-term direct impacts from construction-related noise and activity could be caused by the Project if wildlife species are displaced from areas near construction activities to suitable habitats adjacent to, but beyond the extent of, construction disturbances. Alternately, some wildlife may be temporarily attracted to cleared areas due to an increased availability of food. In such areas, food resources, such as nuts and seeds, left on the ground can be easily found by wildlife. Such displacement could improve hunting and wildlife viewing opportunities in some areas for a short period of time following clearing activities. After construction, operation of a wind project would not preclude hunting within the existing hunting boundaries or the wind farm boundary. Hunting is typically allowed on wind farms and public access is maintained. Access to hunting areas would likely not change as a result of developing a wind project; however, closures are possible during construction or maintenance for safety reasons. Noise and human activity could displace wildlife species from areas near construction activities to suitable habitats adjacent to, but beyond the extent of, construction disturbances. Such displacement could improve hunting and wildlife viewing opportunities in some areas while reducing or temporarily eliminating opportunities in other areas.

Local parks located in WDZ-A lie within municipal boundaries and are unlikely to experience impacts from wind development. Wind farms may be visible from local parks, causing long-term visual disturbance until after decommissioning of the wind farm.

Palo Duro Reservoir is popular for fishing, sight-seeing, and water sports and is located in WDZ-B. Direct impacts from construction, such as noise and activity, are unlikely to affect the Palo Duro Reservoir because wind facilities are typically located away from open water. The components of the wind farm could have long-term impacts on the quality of recreational visits to Palo Duro Reservoir by adding unnatural components to scenic landscapes. The extent of these impacts would, however, depend on existing visual conditions in the affected areas, with impacts lower in those areas where other types of development are already present. Impacts would also vary based on the distance of the recreation area from the components. The reservoir is used for camping, and it may experience an influx of construction workers to the area who would reside in campers or RVs for the duration of construction. Only a small permanent workforce would be required for operation of the wind facilities. If workers are expected to stay in campers or RVs near the wind facility site, the developer would notify local RV park and camp site owners.

Millers Lake and County Road 18 hunting areas are located in Hansford County, Texas, in WDZ-B. Hunting opportunities could be temporarily impacted by the wind farm if wildlife species are displaced from areas near construction activities to suitable habitats adjacent to, but beyond the extent of, construction disturbances.

No recreational areas are present in WDZ-C and WDZ-E through WDZ-K, so no impacts are expected.

Schultz WMA and Optima WMA are located in WDZ-D and are used primarily for hunting. Hunting opportunities could be temporarily impacted by the wind farm if wildlife species are displaced from areas near construction activities to suitable habitats adjacent to, but beyond the extent of, construction disturbances

Local parks located in WDZ-L lie within municipal boundaries and are unlikely to experience impacts from wind development because parks are unlikely to be targeted for development. Additionally, the wind industry has an established practice of avoiding local parks. It is assumed that wind energy developers would likely site wind farms to avoid direct impacts to parks and municipalities. Wind farms may be visible from local parks, causing long-term disturbance from potential views of the structures from these recreational resources until after decommissioning of the wind farm.

3.12.6.8.2 Optima Substation

No impacts to recreational lands or uses are anticipated from the future Optima Substation because no recreation resources are located within the substation siting area.

3.12.6.8.3 TVA Upgrades

The ROI for the direct assignment facilities cannot be fully determined at this time as described in Section 3.12.5.8.3.

Potential recreation impacts associated with the upgrades could include disruption of recreational activities from temporary closures of recreation lands or access needed for construction activities for new or upgraded facilities. Long-term impacts are not likely for the required upgrades to existing facilities. The new 37-mile-long transmission line could affect views from recreational areas, both from the structures and from the changes in vegetation within and adjacent to the ROW. Recreational activities could be interrupted periodically by maintenance activities. Recreational users could be affected by the new 37-mile-long transmission line if they opted for similar recreation areas without transmission lines or associated facilities, leading to increased visitation at other recreational sites in the area. Depending on its location, the new 37-mile-long transmission line could interfere with access to existing recreation areas.

3.12.6.9 Impacts Associated with the No Action Alternative

Under the No Action Alternative, DOE assumes for analytical purposes that the Project would not be constructed. No disturbances would occur due to the Project, including disturbances to recreation resources. No disturbances due to construction vehicles, equipment, or access roads would affect recreation resources.

Impacts to recreation resources would be consistent with present levels of disturbance already occurring locally.

Contents

Tables

Figures Presented in Text*

*Other EIS figures presented in Appendix A.

3.13 Socioeconomics

3.13.1 Regulatory Background

Socioeconomic conditions and impacts are among “the effects on the human environment” to be discussed in an EIS. They are also commonly recognized and addressed as a concern under various federal, state, and local planning and management processes.

3.13.2 Data Sources

The socioeconomic analysis relies primarily on published information compiled by federal and state government agencies, supplemented by information from academic and private sources, as well as Project-specific data and information. Key federal and state data sources include the following:

- Federal agencies: U.S. Census Bureau, U.S. Bureau of Economic Analysis, U.S. Bureau of Labor Statistics, and USDA
- State agencies: economic, demographic, labor, and revenue/taxation departments

3.13.3 Region of Influence

3.13.3.1 Region of Influence for the Project

The ROI for the socioeconomic analysis consists of the 33 counties that could potentially be directly affected by the Project components. The ROI is divided into seven regions for the purposes of analysis (Table 3.13-1; Figure 2.1-2 in Appendix A). The counties crossed by the AC collection system that are not crossed by the HVDC transmission line—Hansford, Ochiltree, and Sherman counties, Texas, and Cimarron County, Oklahoma—are not identified in Table 3.13-1, but are included as part of Region 1. Faulkner County, Arkansas, is not crossed by the Applicant Proposed Route and is therefore not identified in Table 3.13-1, but is included as part of Region 5.

Table 3.13-1:
States and Counties Crossed by the Applicant Proposed HVDC Transmission Line by Region

Region	State	County[1]	Miles
1	Oklahoma[2]	Texas, Beaver, Harper	115.5
2	Oklahoma	Woodward, Major, Garfield[3]	106.0
3	Oklahoma	Garfield[3], Kingfisher, Logan, Payne, Lincoln, Creek, Okmulgee, Muskogee[3]	161.7
4	Oklahoma	Muskogee[3], Sequoyah	43.5
	Arkansas	Crawford, Franklin, Johnson, Pope[3]	82.8
5	Arkansas[4]	Pope, Conway, Van Buren, Cleburne, White, Jackson[3]	112.8
6	Arkansas	Jackson[3], Poinsett[3], Cross	54.3
7	Arkansas	Poinsett[3], Mississippi	26.4
	Tennessee	Tipton, Shelby	16.4
		Total	719.4

1 Counties are generally listed from west to east by region.
2 Region 1 also includes the following counties that would be potentially crossed by the AC collection system routes: Hansford, Ochiltree, and Sherman counties, Texas, and Texas and Cimarron counties, Oklahoma.
3 Counties located in more than one region.
4 Region 5 also includes Faulkner County because it would be crossed by HVDC Alternative Routes 5-B and 5-D.

Where possible, the socioeconomic assessment references the seven regions, but the available socioeconomic data are typically based on geopolitical boundaries, usually counties, that do not directly correspond with the regions. As indicated in Table 3.13-1, the regions typically break mid-county, which results in several counties being located in more than one region. In addition, the proposed HVDC transmission line, as currently proposed, would be constructed in five approximately 140-mile-long segments that do not directly coincide geographically with the seven regions.

The following counties are located in more than one region: Garfield and Muskogee counties, Oklahoma, and Pope, Jackson, and Poinsett counties, Arkansas. Counties are assigned to one region for the purposes of analysis. Garfield, Muskogee, and Pope counties are assigned to the region that includes the majority of the HVDC transmission line located in that county: Regions 2, 3, and 5, respectively. The length of transmission line in Jackson and Poinsett counties is fairly evenly divided between two regions. These counties are included in the easternmost area of the two regions, Regions 5 and 6, respectively.

The length of the HVDC transmission line ranges from 3.4 miles in Kingfisher County, Oklahoma, to 56 miles in Beaver County, Oklahoma (Table 3.13-2).

Table 3.13-2:
Miles Crossed by the Applicant Proposed HVDC Transmission Line by County and State

State/County[1]	Miles	State/County[1]	Miles	State/County[1]	Miles
Oklahoma		Arkansas		Tennessee	
Texas	23.8	Crawford	28.4	Shelby	5.0
Beaver	56.0	Franklin	19.8	Tipton	11.4
Harper	35.6	Johnson	27.8	Total	16.4
Woodward	32.4	Pope	27.1		
Major	52.2	Conway	21.6		
Garfield	22.2	Van Buren	13.2		
Kingfisher	3.4	Cleburne	23.5		
Logan	20.8	White	17.2		
Payne	35.7	Jackson	33.7		
Lincoln	10.0	Poinsett	31.5		
Creek	27.4	Cross	16.1		
Okmulgee	27.7	Mississippi	16.3		
Muskogee	39.5	Total	276.2		
Sequoyah	39.9				
Total	426.6				

1 Counties are generally listed from west to east by state.

Several route variations to the Applicant Proposed Route in Regions 2–7 were developed in response to public comments on the Draft EIS and are described in Appendix M and summarized in Sections 2.4.2.1–2.4.2.7. Assessments of the impacts related to the route variations by Project region, including accompanying HVDC alternative route adjustments, are noted below. The variations are presented graphically in Exhibit 1 of Appendix M.

Viewed at a county level, these variations would change the total length by county by less than 1 mile in all cases and would result in minor changes to the impact analyses presented in Section 3.13.6.

Potential socioeconomic impacts would occur in the counties where the proposed facilities would be located and these counties form the ROI for the following analysis. Some impacts would also likely occur outside these counties. This is especially likely to be the case where larger communities are located in adjacent or nearby counties. These communities are likely to provide some local workers and also provide temporary housing for workers temporarily relocating to the area. Larger communities where these types of impact may occur include Metropolitan Statistical Areas (MSAs) are part of or adjacent to the ROI. MSAs have at least one urbanized area with 50,000 or more residents, plus adjacent territory that has a high degree of social and economic integration with the core as measured by commuting ties (OMB 2013). These areas represent larger communities that form regional markets for labor, goods and services, and information. MSAs typically include an urbanized node and economically related surrounding counties. The potentially affected MSAs are identified in Table 3.13-3.

Table 3.13-3:
MSAs that are Part of or Adjacent to the ROI

Region[1]	MSA	Principal City	Counties
3	Oklahoma City, OK	Oklahoma City, OK	Canadian, OK; Cleveland, OK; Grady, OK; Lincoln, OK[2]; Logan, OK[2]; McClain, OK; Oklahoma, OK
3	Tulsa, OK	Tulsa, OK	Creek, OK[2]; Okmulgee, OK[2]; Osage, OK; Pawnee, OK; Rogers, OK; Tulsa, OK; Wagoner, OK
4	Fort Smith, AR-OK	Fort Smith, AR	Crawford, AR[2]; Sebastian, AR; Le Flore, OK; Sequoyah, OK[2]
5	Little Rock-North Little Rock-Conway, AR	Little Rock, North Little Rock, Conway	Faulkner, AR[2]; Grant, AR; Lonoke, AR; Perry, AR; Pulaski, AR; Saline, AR
6	Jonesboro, AR	Jonesboro, AR	Craighead, AR; Poinsett, AR[2]
7	Memphis, TN-MS-AR	Memphis, TN	Crittenden, AR; Benton, MS; DeSoto, MS; Marshall, MS; Tate, MS; Tunica, MS; Fayette, TN; Shelby, TN[2]; Tipton, TN[2]

1 Identifies the region that includes counties that are part of the identified MSA.
2 County included in the ROI.

3.13.3.2 Region of Influence for Connected Actions

The ROI for wind energy generation, the future Optima Substation, and TVA upgrades is described in Section 3.1.1.

3.13.4 Affected Environment

3.13.4.1 Population

The 33 counties in the ROI had a total combined population of slightly more than 2 million people (2,055,103) in 2012, with almost half this total (934,654) concentrated in Shelby County, Tennessee. This county, located at the eastern end of the ROI includes the city of Memphis, which had an estimated 2012 population of 655,155 (USCB 2014a). As a result, slightly more than half the total population of the counties in the ROI is concentrated in Region 7. Total population in the remaining six regions in 2012 ranged from 51,652 in Region 1 (2.5 percent of the ROI total) to 348,517 in Region 3 (17.0 percent of the ROI total), closely followed by Region 5 with 334,750 (16.3 percent of the ROI total) (Table 3.13-4).

The western portion of the ROI is sparsely populated. The seven counties that compose Region 1 had an average population density of 5.4 people per square mile in 2012 (compared to a national average of 88.9). The city of Guymon, the county seat of Texas County, Oklahoma, is the largest community in Region 1, with an estimated population of just 11,930 in 2012 (USCB 2014a). Woodward and Major counties in Oklahoma (Region 2) are also relatively sparsely populated with 2012 population densities of 16.3 and 7.9 people/square mile, respectively. Average population densities in the other regions ranged from 30.8 people/square mile in Region 6 to 491.2 people/square mile in Region 7 (Table 3.13-4). MSAs adjacent to the ROI are identified by region in Table 3.13-3. There are no larger communities or MSAs within commuting distance of Region 1.

Population increased from 1990 to 2000 in all four states that are crossed by the ROI, with increases ranging from 10 percent (Oklahoma) to 23 percent (Texas), compared to a nationwide increase of 13 percent (Table 3.13-5). As detailed in Table 3.13.4, viewed by region, changes in population in the ROI from 1990 to 2000 ranged from no change in Region 2 to 24 percent in Region 5. Population in Region 1 increased by 5 percent over this period, but this was mainly due to a 22 percent increase in Texas County, Oklahoma, the most populated of the seven Region 1 counties. Five of the remaining six counties actually lost population in the 1990s.

Population also increased from 2000 to 2012 in all four states, with increases ranging from 10 percent (Oklahoma and Arkansas) to 25 percent (Texas), compared to a nationwide increase of 11 percent (Table 3.13-5). Viewed by region, changes over this period ranged from a net decrease of 6 percent in Region 6 to a 17 percent increase in Region 5 (Table 3.13-4).

Population is projected to increase nationwide and in all four states from 2012 to 2020 and from 2020 to 2030. In all cases, projected increases are expected to be smaller than those experienced over the past two decades (Table 3.13-5). Population projections for 2012 to 2020 vary substantially by region, ranging from a 6 percent decrease in Region 6 to a 20 percent increase in Region 5. Most counties are anticipated to see increases in population from 2020 to 2030 in all regions (Table 3.13-4).

Table 3.13-4:
Population by County and Region

Region	County[1]	2012 Population	2012 Population Density (people/square mile)	Population Change (Percent)		Projected Population Change[2] (Percent)	
				1990 to 2000	2000 to 2012	2012 to 2020	2020 to 2030
1	Hansford, TX	5,521	6.0	-8	3	11	11
	Ochiltree, TX	10,728	11.7	-1	19	7	13
	Sherman, TX	3,073	3.3	11	-4	7	9
	Cimarron, OK	2,451	1.3	-5	-22	-6	-7
	Texas, OK	20,620	10.1	22	3	7	5
	Beaver, OK	5,587	3.1	-3	-5	-6	-5
	Harper, OK	3,672	3.5	-12	3	-8	-7
	Region 1 Total	51,652	5.4	5	3	4	5
2	Woodward, OK	20,232	16.3	-3	9	3	5
	Major, OK	7,563	7.9	-6	0	0	-2
	Garfield, OK[1]	60,272	56.9	2	4	0	1
	Region 2 Total	88,067	27.0	0	5	0	1

Table 3.13-4:
Population by County and Region

Region	County[1]	2012 Population	2012 Population Density (people/square mile)	Population Change (Percent)		Projected Population Change[2] (Percent)	
				1990 to 2000	2000 to 2012	2012 to 2020	2020 to 2030
3	Kingfisher, OK	14,965	16.7	5	7	3	3
	Logan, OK	41,982	56.4	17	24	10	9
	Payne, OK	77,125	112.6	11	13	9	8
	Lincoln, OK	34,106	35.8	10	6	9	9
	Creek, OK	69,934	73.6	11	4	8	8
	Okmulgee, OK	39,770	57.0	9	0	2	2
	Muskogee, OK[1]	70,635	87.2	2	2	6	3
	Region 3 Total	348,517	60.7	9	7	7	6
4	Sequoyah, OK	41,945	62.3	15	8	10	10
	Crawford, AR	61,670	104.0	25	16	19	6
	Franklin, AR	18,110	29.7	19	2	2	9
	Johnson, AR	25,554	38.7	25	12	14	5
	Region 4 Total	147,279	58.1	21	11	14	7
5	Pope, AR[1]	61,853	76.1	19	14	15	-4
	Conway, AR	21,203	38.4	6	4	6	-8
	Van Buren, AR	17,223	24.3	16	6	8	7
	Cleburne, AR	25,849	46.7	24	7	10	15
	Faulkner, AR	113,730	175.5	43	32	36	4
	White, AR	77,007	74.4	23	15	17	0
	Jackson, AR[1]	17,885	28.2	-3	-3	-2	-25
	Region 5 Total	334,750	67.7	24	17	20	1
6	Poinsett, AR[1]	24,506	32.3	4	-4	-4	3
	Cross, AR	17,891	29.0	2	-8	-10	10
	Region 6 Total	42,397	30.8	3	-6	-6	6
7	Mississippi, AR	46,388	51.5	-10	-11	-12	-9
	Shelby, TN	934,654	1224.7	9	4	2	1
	Tipton, TN	61,399	134.0	36	20	12	12
	Region 7 Total	1,042,441	491.2	9	4	2	1

1 Counties located in more than one region are assigned to one region for the purposes of analysis. Garfield and Muskogee counties, Oklahoma, and Pope County, Arkansas, are assigned to the region that includes the majority of the HVDC transmission line located in that county. Garfield County is assigned to Region 2, Muskogee County to Region 3, and Pope County to Region 5. The length of transmission line in Jackson and Poinsett counties, Arkansas, is fairly evenly divided between two regions. These counties are included in the first region from east to west. Jackson County is assigned to Region 5 and Poinsett County to Region 6. This distribution of counties by region is used throughout the following analysis.

2 Population projections for Texas, Oklahoma, and Tennessee counties are based on 2010 Census data. Projections for Arkansas for 2020 are based on 2010 Census data; 2030 Arkansas projections are based on 2000 Census data.

Sources: Oklahoma DOC (2012), Texas State Data Center (2012), USCB (2002, 2010, 2014a), Institute for Economic Advancement (2010, 2012), CBER (2013)

Table 3.13-5:
Population by State

State	2012 Population	2012 Population Density (people /square mile)	Population Change (Percent)		Projected Population Change (Percent)	
			1990 to 2000	2000 to 2012	2012 to 2020	2020 to 2030
Texas	26,060,796	99.8	23	25	5	7
Oklahoma	3,786,152	55.2	10	10	6	7
Arkansas	2,936,822	56.4	14	10	12	3
Tennessee	6,404,240	155.3	17	13	8	8
United States	313,914,040	88.9	13	11	6	7

Sources: Oklahoma DOC (2012), Texas State Data Center (2012), USCB (2002, 2010, 2014a), Institute for Economic Advancement (2010, 2012), CBER (2013)

3.13.4.2 Economic Conditions

The USDA Economic Research Service (ERS) developed a set of county typology codes designed to capture differences in economic and social characteristics at the county level (USDA ERS 2008). These codes consist of six non-overlapping categories of economic dependence (farming, mining, manufacturing, federal/state government, services, and non-specialized) and seven overlapping categories of policy-relevant themes, including non-metropolitan recreation area and retirement destination. The economic dependence categories are assigned based on the share of average annual labor and proprietors' income and/or the share of total employment associated with the identified categories. The ERS assigned all counties to one of the economic dependence categories based on data from 1998 to 2000 (Table 3.13-6).

The ERS typology identified all seven counties in Region 1 as farming-dependent. The majority of the other counties were identified as non-specialized, with six counties identified as manufacturing-dependent, two counties identified as federal/state government-dependent, two counties identified as services-dependent, and one identified as mining-dependent (Table 3.13-6). In addition, three counties, all located in Region 5, were identified as retirement destination counties, and one other was identified as a non-metropolitan county.

Total employment increased from 2001 to 2011in all four states crossed by the ROI, as well as nationwide (Table 3.13-6). Viewed by region, changes in total employment from 2001 to 2011 ranged from a 7 percent decrease in Region 6 to a 14 percent increase in Region 1. Annual unemployment rates in 2012 by region ranged from 3.3 percent and 3.7 percent in Regions 2 and 1, respectively, to 9.1 percent in Region 7 (Table 3.13-6). The national unemployment rate in 2012 was 8.1 percent (Table 3.13-7). Average per capita income by region ranged from $28,698 (equivalent to 66 percent of the U.S. per capita income) in Region 4 to $44,558 in Region 1, which is slightly higher than the U.S. average per capita income (Table 3.13-6).

Table 3.13-6:
Economic Conditions by County and Region

Region	County	Economic Type	Employment[1]		Annual Unemployment Rate 2012	Per-Capita Income	
			2011	Percent Change 2001 to 2011		2012	Percent of U.S. Per Capita-Income
1	Hansford, TX	Farming	3,712	8	3.9	56,221	129%
	Ochiltree, TX	Farming	7,687	29	3.3	52,628	120%
	Sherman, TX	Farming	1,790	0	4.6	58,431	134%
	Cimarron, OK	Farming	2,059	-4	3.6	44,090	101%
	Texas, OK	Farming	14,051	16	4.7	36,504	83%
	Beaver, OK	Farming	4,156	16	2.5	44,876	103%
	Harper, OK	Farming	2,144	1	2.9	36,897	84%
	Region 1		35,599	14	3.7	44,558	102%
2	Woodward, OK	Non-specialized	11,883	-16	2.8	44,285	101%
	Major, OK	Mining	5,310	13	3.2	43,005	98%
	Garfield, OK	Federal/state government	38,682	16	3.5	43,705	100%
	Region 2		55,875	7	3.3	43,778	100%
3	Kingfisher, OK	Non-specialized	9,922	12	3.2	43,162	99%
	Logan, OK	Non-specialized	22,398	32	4.4	40,789	93%
	Payne, OK	Federal/state government	46,646	4	4.8	36,186	83%
	Lincoln, OK	Non-specialized	14,540	3	5.1	32,633	75%
	Creek, OK	Manufacturing	30,356	5	6.0	34,619	79%
	Okmulgee, OK	Non-specialized	15,329	4	7.7	30,674	70%
	Muskogee, OK	Non-specialized	38,706	-1	6.4	33,653	77%
	Region 3		177,897	6	5.6	35,236	81%
4	Sequoyah, OK	Non-specialized	14,629	6	8.5	29,010	66%
	Crawford, AR	Non-specialized	27,152	14	7.4	28,880	66%
	Franklin, AR	Non-specialized	7,001	-5	6.7	31,837	73%
	Johnson, AR	Manufacturing	11,866	6	6.8	25,520	58%
	Region 4		60,648	8	7.5	28,698	66%
5	Pope, AR	Non-specialized	34,057	7	7.1	29,929	68%
	Conway, AR	Non-specialized	11,160	8	7.6	34,140	78%
	Van Buren, AR	Non-specialized [3]	6,162	0	8.9	31,285	72%
	Cleburne, AR	Manufacturing[2]	12,889	8	7.2	36,510	83%
	Faulkner, AR	Non-specialized[2]	55,844	22	6.6	34,472	79%
	White, AR	Services[2]	36,823	10	8.0	31,059	71%
	Jackson, AR	Non-specialized	7,900	-9	9.6	33,022	76%
	Region 5		164,835	12	7.3	32,742	75%
6	Poinsett, AR	Manufacturing	8,125	-13	7.8	33,832	77%
	Cross, AR	Non-specialized	8,314	0	8.2	33,687	77%
	Region 6		16,439	-7	8.0	33,771	77%

Table 3.13-6:
Economic Conditions by County and Region

Region	County	Economic Type	Employment[1]		Annual Unemployment Rate 2012	Per-Capita Income	
			2011	Percent Change 2001 to 2011		2012	Percent of U.S. Per Capita-Income
7	Mississippi, AR	Manufacturing	24,179	-5	10.0	33,822	77%
	Shelby, TN	Services	624,006	1	9.1	42,409	97%
	Tipton, TN	Manufacturing[2]	15,794	3	8.9	36,825	84%
	Region 7		663,979	0	9.1	41,698	95%

1 Total employment includes self-employed individuals. Employment data are by place of work, not place of residence and, therefore, include people who work in the area but do not live there. Employment is measured as the average annual number of jobs, both full- and part-time, with each job that a person holds counted at full weight.
2 Retirement destination county
3 Non-metropolitan recreation county
Sources: BEA (2012, 2013a), BLS (2014a), USDA ERS (2008)

Table 3.13-7:
Economic Conditions by State

State/Country	Employment				Annual Unemployment Rate 2012	Per-Capita Income	
	2001	2011	Net Change 2001 to 2011	Percent Change 2001 to 2011		2012	Percent of U.S. Per-Capita Income
Texas	12,211,172	14,611,475	2,400,303	19.7	6.8	35,437	81%
Oklahoma	2,009,727	2,167,780	158,053	7.9	5.2	40,620	93%
Arkansas	1,482,678	1,552,597	69,919	4.7	7.3	38,752	89%
Tennessee	3,433,689	3,591,298	157,609	4.6	8.0	42,638	97%
United States	165,510,200	175,834,700	10,324,500	6.2	8.1	43,735	na

na = not applicable
Sources: BEA (2012, 2013a), BLS (2014b)

One organization commenting on the Draft EIS expressed concern that the importance of natural gas operations on the Fayetteville shale in Arkansas was not adequately captured. According to a recent report (CBER 2012) commissioned by the Arkansas State Chamber of Commerce/Associated Industries of Arkansas, from 2008 to 2011, a total of $12.7 billion was invested in natural gas operations on the Fayetteville shale that supported a total statewide economic activity of more than $18.5 billion and annual employment of more than 22,000 people in 2011. Natural gas production from 2008 to 2011 occurred in nine counties, eight of which—Cleburne, Conway, Faulkner, Franklin, Jackson, Pope, Van Buren, and White counties—could be crossed by the Project. Major producers in the area of the Fayetteville shale play directly employed 1,092 full-time employees in these nine counties, with 335 employed elsewhere in the state. Total employment in the eight Fayetteville shale counties that could be crossed by the Project was 171,836 in 2011 (Table 3.13-6). In addition, it was estimated that from 2008 to 2011, Fayetteville shale activities resulted in the collection of almost $2.0 billion in state and local taxes from permit fees and severance, property, income, sales, and other taxes (CBER 2012).

Acres of shale play and the number of existing oil and gas wells within the ROI are identified by region in Section 3.6. The counties where drilling occurred from 2008 to 2011 are located in Regions 4 (Franklin County) and 5 (Cleburne, Conway, Faulkner, Jackson, Pope, Van Buren, and White counties). The ROI for identifying oil and gas wells is a 4,000-foot-wide corridor along the HVDC transmission lines and a 1,500-foot-wide buffer around converter station siting areas.

3.13.4.3 Agriculture

Land in farms accounted for 78 percent of the total land area in Texas in 2012 and 78 percent of total land area in Oklahoma. In Arkansas and Tennessee land in farms accounted for about 42 percent of each state's total land area (Table 3.13-8). Average farm size ranged from 160 acres in Tennessee to 523 acres in Texas. Livestock, poultry, and their products accounted for the majority of agricultural products sold by market value in three of the four states, ranging from 51 percent of the total in Arkansas to 74 percent in Oklahoma (Table 3.13-8). Tennessee was the exception, with crops accounting for 58 percent of agricultural products sold by market value in 2012.

Table 3.13-8:
Summary of Agriculture by State

County	Number of Farms	Land in Farms (acres)	Percent of Total Land Area	Average Farm Size (acres)	Market Value of Agriculture Products Sold ($ million)	Total Market Value of Agricultural Products Sold	
						Crops (%)	Livestock, Poultry, and Products (%)
Arkansas	45,071	13,810,786	42%	306	9,776	49	51
Oklahoma	80,245	34,356,110	78%	428	7,130	26	74
Tennessee	68,050	10,867,812	42%	160	3,611	58	42
Texas	248,809	130,153,438	78%	523	25,376	29	71

Source: USDA (2014)

Viewed by region, land in farms ranged from 38 percent in Region 4 to 97 percent in Region 1. Land in farms also accounted for a large share (92 percent) of the total land area in Region 2 (Table 3.13-9). Average farm size by region ranged from 175 acres in Region 4 to 1,468 acres in Region 1. Average farm size by county ranged from 141 acres in Crawford County, Arkansas, to 2,155 acres in Hansford County, Texas. All seven counties in Region 1 had average farm sizes larger than 1,000 acres (Table 3.13-9).

Table 3.13-9:
Summary of Agriculture by County and Region

Region	County	Number of Farms	Land in Farms (acres)	Percent of Total Land Area	Average Farm Size (acres)	Market Value of Agriculture Products Sold ($ million)	Total Market Value of Agricultural Products Sold	
							Crops (%)	Livestock, Poultry, and Products (%)
1	Hansford, TX	263	566,770	96%	2,155	783	14	86
	Ochiltree, TX	348	544,623	93%	1,565	425	15	85
	Sherman, TX	313	583,168	99%	1,863	590	22	78
	Cimarron, OK	554	1,157,186	99%	2,089	377	17	83
	Texas, OK	1,024	1,286,834	99%	1,257	1,014	15	85
	Beaver, OK	965	1,115,852	96%	1,156	187	18	82
	Harper, OK	532	617,812	93%	1,161	149	9	91
	Region 1	3,999	5,872,245	97%	1,468	3,524	16	84

Table 3.13-9:
Summary of Agriculture by County and Region

Region	County	Number of Farms	Land in Farms (acres)	Percent of Total Land Area	Average Farm Size (acres)	Market Value of Agriculture Products Sold ($ million)	Total Market Value of Agricultural Products Sold	
							Crops (%)	Livestock, Poultry, and Products (%)
2	Woodward, OK	882	714,706	90%	810	116	13	87
	Major, OK	901	537,111	88	596	105	39	61
	Garfield, OK	1,098	666,373	98	607	152	62	38
	Region 2	2,881	1,918,190	92	666	374	40	60
3	Kingfisher, OK	1,021	567,621	99	556	162	39	61
	Logan, OK	1,203	367,361	77	305	44	47	53
	Payne, OK	1,466	349,732	80	239	34	26	74
	Lincoln, OK	2,121	454,252	75	214	39	27	73
	Creek, OK	1,777	347,003	57	195	24	19	81
	Okmulgee, OK	1,329	300,165	67	226	27	28	72
	Muskogee, OK	1,735	350,119	68	202	51	42	58
	Region 3	10,652	2,736,253	75	257	380	36	64
4	Sequoyah, OK	1,204	215,116	50%	179	55	23	77
	Crawford, AR	886	125,292	33%	141	67	33	67
	Franklin, AR	829	159,864	41%	193	158	3	97
	Johnson, AR	624	118,391	28%	190	141	3	97
	Region 4	3,543	618,663	38%	175	422	10	90
5	Pope, AR	977	153,782	30%	157	150	7	93
	Conway, AR	816	179,318	51%	220	162	10	90
	Van Buren, AR	587	122,875	27%	209	20	5	95
	Cleburne, AR	797	157,449	44%	198	48	2	98
	Faulkner, AR	1,288	184,958	45%	144	26	38	62
	White, AR	1,836	355,669	54%	194	100	39	61
	Jackson, AR	437	307,098	76%	703	187	98	2
	Region 5	6,738	1,461,149	46%	217	693	38	62
6	Poinsett, AR	397	385,236	79%	970	287	100	0
	Cross, AR	325	278,915	71%	858	189	100	0
	Region 6	722	664,151	75%	920	476	100	0
7	Mississippi, AR	347	475,699	83%	1,371	315	100	0
	Shelby, TN	411	81,860	17%	199	32	94	6
	Tipton, TN	520	155,449	53%	299	68	97	3
	Region 7	1,278	713,008	52%	558	414	99	1

(D) Data suppressed by the Census to prevent disclosure of an individual respondent's data.
Source: USDA (2014)

The market value of agricultural products sold in 2012 ranged from $374 million in Region 2 to $3,524 million in Region 1. Viewed by county, total market value in 2012 ranged from $20 million in Van Buren County, Arkansas, to $1,014 million in Texas County, Oklahoma (Table 3.13-9). Total market value and the relative distribution between crops and livestock, poultry, and their products are shown graphically by county in Figure 3.13-1. Livestock, poultry, and their products accounted for the majority of agricultural products sold by market value in the counties that compose Regions 1 through 4, and some of the counties in Region 5. Crops accounted for the vast majority of the value of agricultural products sold in the counties in Regions 6 and 7, as well as Jackson County in Region 5 (Figure 3.13-1).

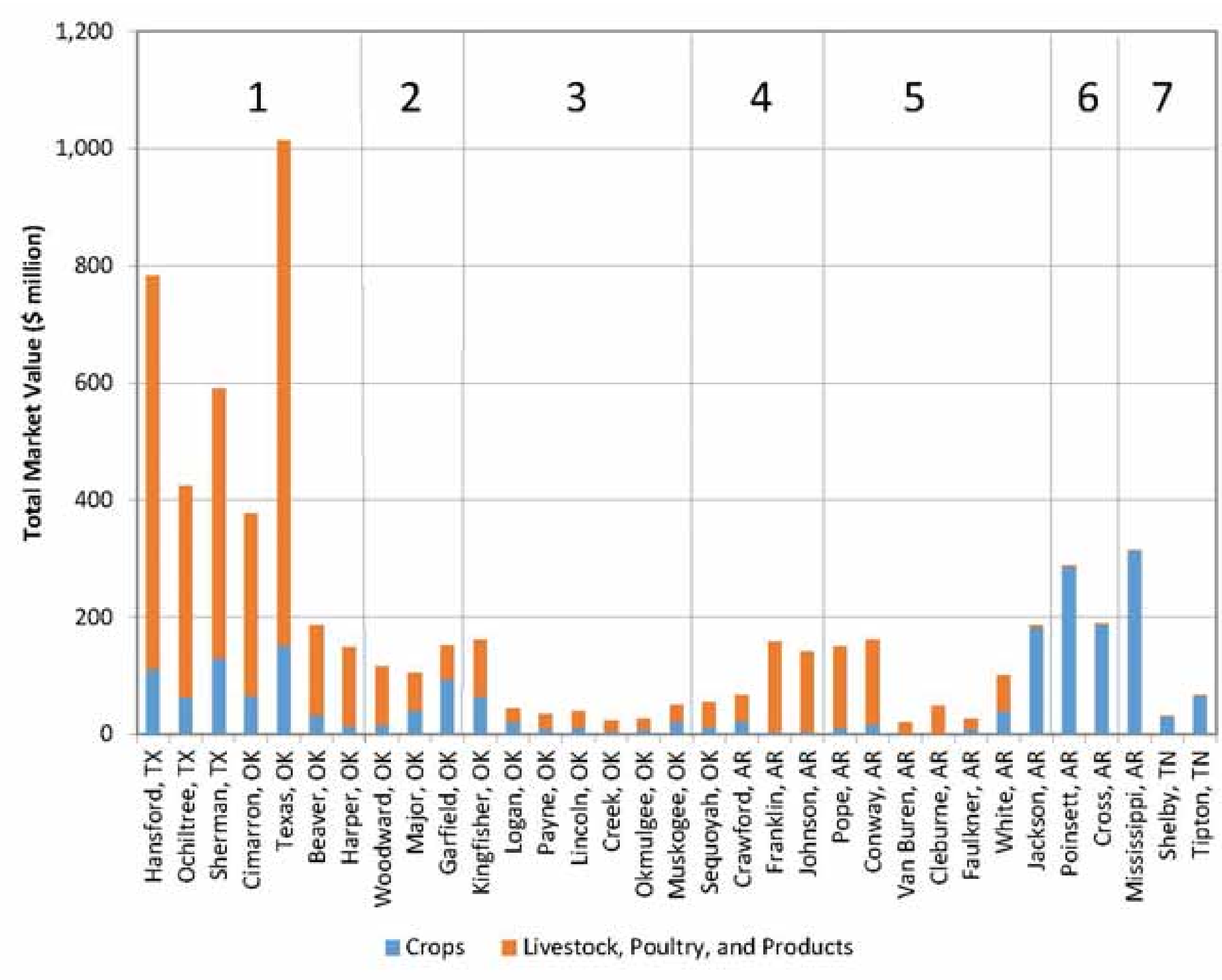


Figure 3.13-1: Total Market Value of Agricultural Products Sold, 2012

Source: USDA (2014)
The numbers (1 through 7) across the top of this figure represent the seven regions that compose the ROI.

Several people commenting on the Draft EIS stated that farmers and other rural landowners are unique in their ties to the land, with farms and land holdings often passed down through generations. Commenters also felt that rural landowners are unique because much of their income may be invested in their land and farming operations rather than banks. As shown in Table 3.13-9, land held as farms accounts for a large share of total land in many of the counties that would be crossed by the Project, especially those in Regions 1, 2, and 6, and all seven counties in Region 1 were identified by the ERS as farming-dependent (Table 3.13-8).

3.13.4.4 Housing

Construction of the HVDC transmission line is expected to draw local and workers from outside the region (import workers). The majority of import workers would likely temporarily relocate to the ROI and adjacent communities, especially the larger metropolitan areas that offer quality of life amenities and are within commuting distance to portions of the Project.

Housing resources are summarized for the ROI by county and region in Table 3.13-10. Data on housing units are estimates for 2012 prepared by the USCB (2014b). The Census Bureau defines a housing unit as a house, an apartment, a mobile home or trailer, a group of rooms, or a single room occupied or intended to be occupied as separate living quarters. Viewed by region, these estimates suggest that limited rental housing is available in Region 1, with less than 100 units available in six of the seven counties that compose the region for a combined estimated total of 370 units (Table 3.13-10). Rental housing is also relatively limited in Regions 2 and 6, with 862 and 908 units available, respectively. The relatively low number of units available in Region 6 is largely due to the small size of the region, which consists of just two counties.

Table 3.13-10:
Housing Resources by County and Region

County	Housing Units 2012[1]			Hotel and Motel Rooms[2]	RV Spaces[3]
	Total	Rental Vacancy Rate	Units Available for Rent		
Hansford, TX	2,338	5.9	25	29	37
Ochiltree, TX	4,048	0.0	0	252	124
Sherman, TX	1,188	5.1	13	22	N/A
Cimarron, OK	1,583	8.3	30	44	17
Texas, OK	8,221	6.0	174	697	24
Beaver, OK	2,674	11.1	75	36	7
Harper, OK	1,907	15.0	53	13	26
Region 1	21,959	6.1	370	1,093	235
Woodward, OK	8,827	17.0	437	775	25
Major, OK	3,673	3.0	22	35	9
Garfield, OK	26,809	4.7	403	794	60
Region 2	39,309	7.2	862	1,604	94
Kingfisher, OK	6,404	5.9	89	54	N/A
Logan, OK	17,037	7.9	280	315	63
Payne, OK	33,912	7.0	1,108	1,008	292
Lincoln, OK	15,168	6.9	216	183	13
Creek, OK	29,755	6.9	478	164	142
Okmulgee, OK	17,898	7.2	352	316	154
Muskogee, OK	30,937	6.9	670	832	15

Table 3.13-10:
Housing Resources by County and Region

County	Housing Units 2012[1]			Hotel and Motel Rooms[2]	RV Spaces[3]
	Total	Rental Vacancy Rate	Units Available for Rent		
Region 3	151,111	7.0	3,193	2,872	679
Sequoyah, OK	18,662	7.0	341	656	193
Crawford, AR	25,985	8.5	598	690	53
Franklin, AR	8,022	8.6	159	114	194
Johnson, AR	11,265	7.1	237	408	N/A
Region 4	63,934	7.8	1,335	1,868	440
Pope, AR	25,555	11.2	878	1,075	177
Conway, AR	9,703	16.8	436	243	142
Van Buren, AR	10,315	1.0	16	105	49
Cleburne, AR	15,765	8.6	228	501	94
Faulkner, AR	46,571	9.9	1,668	1,459	83
White, AR	32,356	7.1	708	995	68
Jackson, AR	7,624	12.2	273	171	20
Region 5	147,889	9.6	4,207	4,549	633
Poinsett, AR	10,957	11.9	464	96	27
Cross, AR	7,876	16.6	444	142	24
Region 6	18,833	13.8	908	238	51
Mississippi, AR	20,559	10.4	842	714	18
Shelby, TN	398,847	13.8	22,003	11,043	375
Tipton, TN	23,189	8.3	513	70	N/A
Region 7	442,595	13.4	23,358	11,827	393

N/A —Number of units not available

1 Data on housing units were compiled from USCB (2014b).

2 Data for hotel and motel rooms were compiled by Clean Line (2013) from the following sources:
Texas—Source Strategies, Inc.
Oklahoma—Oklahoma Tourism and Recreation Department
Arkansas—Arkansas Department of Parks and Tourism
Tennessee—Memphis Convention and Visitors Bureau

3 Data for RV spaces were compiled by Clean Line (2013) from the following sources:
Texas—Texas Office of Economic Development and Tourism
Oklahoma—Oklahoma Tourism and Recreation Department
Arkansas—Arkansas Department of Parks and Tourism
Tennessee—Memphis Convention and Visitors Bureau

Data on hotel and motel rooms and recreational vehicle (RV) spaces were compiled by Clean Line (2013) from various state resources (identified in Table 3.13-10). These data are partial estimates and likely underestimate the number of hotel and motel rooms and RV spaces present. Numbers of hotel and motel rooms estimated by Clean Line range from 238 in Region 5 to 11,827 in Region 7. Other regions with relatively low estimates of hotel and motel rooms include Region 1 (1,093 rooms), Region 2 (1,604 rooms), and Region 4 (1,868 rooms).

Comprehensive data on hotel and motel rooms are available for the three Texas counties in Region 1. These data indicate that the supply of rooms is extremely limited in these counties. Number of rooms varied from just 22 and 29 rooms located in Hansford and Sherman counties, respectively, and 252 rooms located in Ochiltree County while occupancy rates varied by season in 2013, with rates generally higher in the third quarter than in the earlier part of the year (Source Strategies 2013b). Occupancy rates in the third quarter (July, August, and September) were 75.0 percent, 74.1 percent, and 49.4 percent in Hansford, Ochiltree, and Sherman counties, respectively (Source Strategies 2013a, 2013b).

Estimates of RV spaces range from 51 in Region 6 to 679 in Region 3 (Table 3.13-10). Comprehensive data are not available on these types of resources, and the estimates presented in Table 3.13-10, while representing the best available information, likely understate the number of RV spaces in many cases. However, information from various state resources suggests that RV facilities are more likely to be available in the vicinity of the more populated parts of the ROI and adjacent communities.

The data presented in Table 3.13-10 are for those counties within the ROI only. Additional housing resources within daily commuting distance are available in adjacent larger communities along parts of the ROI. This is the case for Regions 3 through 7 where communities within commuting distance generally include Oklahoma City and Tulsa in Oklahoma, Fort Smith, Little Rock, and Jonesboro in Arkansas, and Memphis in Tennessee. Located in Shelby County, Memphis is part of Region 7, but is also within daily commuting distance of parts of Region 6.

3.13.4.5 Community Services

3.13.4.5.1 Police and Fire Services

Summary data for law enforcement and fire departments are presented by county and region in Table 3.13-11. These data compiled by Clean Line (2013) provide a partial overview of resources available in each county. In general, the number of police and fire departments is directly related to the overall size and population of the county, as well as the number of communities. Multiple law enforcement agencies and providers exist in the potentially affected counties, including state patrol, county sheriffs, and local police departments. In many cases, mutual aid agreements allow agencies to support one another in emergency situations. Multiple fire departments and districts also provide fire protection and suppression services in the ROI. Many of these fire departments and districts are at least partially staffed by volunteers and tend to be housed in stations and fire houses in the larger communities.

Table 3.13-11:
Summary of Law Enforcement and Fire Departments by County and Region

Region	County	Police Departments	Fire Departments
1	Hansford, TX	3	1
	Ochiltree, TX	3	1
	Sherman, TX	3	1
	Cimarron, OK	3	2
	Texas, OK	6	4
	Beaver, OK	1	4
	Harper, OK	3	3
	Region 1	22	16

Table 3.13-11:
Summary of Law Enforcement and Fire Departments by County and Region

Region	County	Police Departments	Fire Departments
2	Woodward, OK	3	3
	Major, OK	3	4
	Garfield, OK	6	4
	Region 2	12	11
3	Kingfisher, OK	5	4
	Logan, OK	5	6
	Payne, OK	7	5
	Lincoln, OK	9	6
	Creek, OK	10	10
	Okmulgee, OK	7	10
	Muskogee, OK	9	12
	Region 3	52	53
4	Sequoyah, OK	8	17
	Crawford, AR	5	7
	Franklin, AR	3	6
	Johnson, AR	2	4
	Region 4	18	34
5	Pope, AR	5	10
	Conway, AR	2	9
	Van Buren, AR	1	6
	Cleburne, AR	3	7
	Faulkner, AR	5	14
	White, AR	8	19
	Jackson, AR	5	7
	Region 5	29	72
6	Poinsett, AR	7	9
	Cross, AR	3	5
	Region 6	10	14
7	Mississippi, AR	8	10
	Shelby, TN	9	10
	Tipton, TN	4	7
	Region 7	21	27

Source: Clean Line (2013)

3.13.4.5.2 Medical Facilities

Medical facilities in the ROI are identified in Table 3.13-12. Minor Project-related injuries would be treated at local medical facilities or emergency rooms. Workers with more serious injuries would be taken to one of the major hospitals in the general vicinity.

Table 3.13-12:
Medical Facilities by County and Region

Region	Hospital	County[1]	Beds	Services
1	Hansford County Hospital	Hansford	4	Emergency Services
	Ochiltree General Hospital	Ochiltree, TX	25	Emergency Services
	Stratford Hospital District	Sherman	42	Emergency Services
	Cimarron Memorial Hospital	Cimarron	25	Emergency Room Services
	Memorial Hospital of Texas County	Texas	47	Emergency Room Services
	Beaver County Memorial Hospital	Beaver	24	Emergency Room Services
	Harper County Community Hospital	Harper	25	Emergency Room Services
2	Woodward Regional Hospital	Woodward	73	Emergency Room Services
	Okeene Municipal Hospital[2]	Blaine	17	Emergency Room Services
	Integtis Bass Baptist Health Center	Garfield	162	Emergency Room Services, Medical Helicopter Pad
	St. Mary's Regional Medical Center	Garfield	263	Emergency Room Services
3	Kingfisher Regional Hospital	Kingfisher	25	Emergency Room Services
	Mercy Hospital Logan County	Logan	25	Emergency Room Services
	Hillcrest Hospital Cushing	Payne	99	Emergency Room Services
	Stillwater Medical Center	Payne	120	Emergency Room Services, Medical Helicopter Pad
	Prague Community Hospital	Lincoln	25	Emergency Room Services
	Stroud Regional Medical Center	Lincoln	25	Emergency Room Services
	Bristow Medical Center	Creek	30	Emergency Room Services
	Drumright Regional Hospital	Creek	15	Emergency Room Services
	St John Sapulpa	Creek	25	Emergency Room Services
	Okmulgee Memorial Hospital	Okmulgee	66	Emergency Room Services
	Eastar Health System	Muskogee	320	Emergency Room Services, Medical Helicopter Pad
	Intensiva Hospital of Eastern Oklahoma	Muskogee	30	Emergency Room Services
	Solara Hospital Muskogee	Muskogee	41	Emergency Room Services
4	Sequoyah Memorial Hospital	Sequoyah	41	Emergency Room Services
	Summit Medical Center	Crawford	103	Emergency Room Services
	Mercy Hospital Turner Memorial	Franklin	25	Emergency Room Services
	Johnson Regional Medical Center	Johnson	80	Emergency Room Services
5	St Mary's Regional Medical Center	Pope	170	Emergency Room Services, Medical Helicopter Pad
	River Valley Medical Center[3]	Yell	25	Emergency Room Services
	St Vincent Morrilton	Conway	35	Emergency Room Services
	Ozark Health	Van Buren	25	Emergency Room Services
	Baptist Health Medical Center Heber Springs	Cleburne	25	Emergency Room Services
	Conway Regional Medical Center	Faulkner	149	Emergency Room Services, Medical Helicopter Pad
	White County Medical Center	White	193	Emergency Room Services, Medical Helicopter Pad
	Harris Hospital	Jackson	133	Emergency Room Services
6	Crossridge Community Hospital	Cross	15	Emergency Room Services

Table 3.13-12:
Medical Facilities by County and Region

Region	Hospital	County[1]	Beds	Services
7	South Mississippi County Regional Medical Center	Mississippi	25	Emergency Room Services
	Baptist Memorial Hospital	Shelby	706	Emergency Room Services, Medical Helicopter Pad
	Delta Medical Center	Shelby	243	Emergency Room Services
	Methodist Healthcare Memphis Hospital	Shelby	1,537	Emergency Room Services
	Saint Francis Bartlett Medical Center	Shelby	100	Emergency Room Services
	Select Specialty Hospital Memphis	Shelby	30	Emergency Room Services
	St Francis Hospital	Shelby	519	Emergency Room Services
	Baptist Memorial Hospital Tipton	Tipton	100	Emergency Room Services

N/A—not applicable
1 No hospitals were identified in Major County, Oklahoma, or Poinsett County, Arkansas.
2 Okeene Municipal Hospital is located in Blaine County, Oklahoma, approximately 7 miles south of Major County.
3 River Valley Medical Center is located in Yell County, Arkansas, across the Arkansas River from Pope County.
Source: Clean Line (2013)

Medical facilities are limited in the Texas counties located in Region 1. The Ochiltree General Hospital, a Level IV trauma center, provides emergency services in Ochiltree County. Emergency medical services are provided in Sherman County by the Stratford EMS, which is part of the Stratford Hospital District. Additional hospitals are located in neighboring counties, including the Moore County Hospital, south of Sherman County, which provides 24-hour emergency services.

Most counties in Oklahoma within the ROI have at least one hospital that provides emergency services. Major County is the one exception. Emergency room services are, however, available at the Okeene Municipal Hospital in neighboring Blaine County, about 7 miles south of the county line. All but one of the counties in Arkansas has at least one hospital with emergency services. Poinsett County is the exception. Medical services are available in nearby counties. At least six hospitals serve the Memphis area in Tennessee and provide emergency services and a substantial number of beds (Table 3.13-12).

3.13.4.5.3 Education

The total number of school districts, schools, students, and teachers are summarized by county in Table 3.13-13. Student/teacher ratios are also summarized by county and region. Student/teacher ratios, calculated by dividing the total number of students by the total number of full-time equivalent teachers, are a common measure used to assess the overall quality of a school. The national average student teacher ratio for the 2011 school year (the most recent available data) was 16.0. The statewide average ratios in Texas, Oklahoma, Arkansas, and Tennessee were 15.4, 16.1, 15.1, and 14.8, respectively (NEA 2012).

All three Texas counties in Region 1 had student/teacher ratios below the state and national average (fewer students per teacher). This was also the case with Oklahoma counties in Regions 1 through 4, all of which had student/teacher ratios below the corresponding state and national averages, ranging from 6.9 in Beaver County (Region 1) to 11.8 in Logan and Payne counties (Region 3). Average student/teacher ratios in the Arkansas counties in the ROI range from 9.7 in Van Buren County to 15.0 in Faulkner County (both in Region 5), below the corresponding and state averages. Student/teacher ratios in the two Tennessee counties (Region 7) were higher than the statewide and national averages (Table 3.13-13). The numbers, presented here by county and region, are averages. Student/teacher ratios vary by school district and by school in each county, as well as by grade within each school.

Table 3.13-13:
Schools by County and Region

Region	County	Number of School Districts	Total Number of Schools	Total Number of Students	Total Number of Teachers	Student/Teacher Ratio (Average)[1]
1	Hansford, TX	3	7	1,341	136	9.9
	Ochiltree, TX	2	8	2,646	213	12.4
	Sherman, TX	3	7	1,498	130	11.5
	Cimarron, OK	3	9	864	119	7.3
	Texas, OK	9	23	4,475	460	9.7
	Beaver, OK	4	8	1,111	160	6.9
	Harper, OK	2	4	766	94	8.1
	Region 1	26	66	12,701	1,312	9.7
2	Woodward, OK	4	12	3,809	343	11.1
	Major, OK	4	9	1,539	186	8.3
	Garfield, OK	8	31	10,664	926	11.5
	Region 2	16	52	16,012	1,455	11.0
3	Kingfisher, OK	6	16	3,428	397	8.6
	Logan, OK	4	13	4,647	395	11.8
	Payne, OK	7	28	10,757	914	11.8
	Lincoln, OK	9	23	5,736	584	9.8
	Creek, OK	15	39	13,047	1,209	10.8
	Okmulgee, OK	9	23	6,890	621	11.1
	Muskogee, OK	10	35	13,488	1,174	11.5
	Region 3	60	177	57,993	5,294	11.0
4	Sequoyah, OK	12	26	8,616	796	10.8
	Crawford, AR	5	23	11,232	757	14.8
	Franklin, AR	4	9	3,225	238	13.6
	Johnson, AR	3	10	4,383	321	13.7
	Region 4	24	68	27,456	2,112	13.0
5	Pope, AR	5	22	9,665	756	12.8
	Conway, AR	4	10	3,121	265	11.8
	Van Buren, AR	3	8	2,231	229	9.7
	Cleburne, AR	4	9	3,355	280	12.0
	Faulkner, AR	6	36	18,157	1,211	15.0
	White, AR	9	28	12,764	946	13.5
	Jackson, AR	2	6	2,162	188	11.5
	Region 5	33	119	51,455	3,875	13.3
6	Poinsett, AR	5	15	4,227	361	11.7
	Cross, AR	2	6	3,446	250	13.8
	Region 6	7	21	7,673	611	12.6

Table 3.13-13:
Schools by County and Region

Region	County	Number of School Districts	Total Number of Schools	Total Number of Students	Total Number of Teachers	Student/Teacher Ratio (Average)[1]
7	Mississippi, AR	6	21	8,035	631	12.7
	Shelby, TN	4	52	45,705	2,742	16.7
	Tipton, TN	2	14	11,437	744	15.4
	Region 7	12	87	65,177	4,117	15.8

1 Data are average student/teacher rations per county. Rates vary within each county by school district and school.
Source: Clean Line (2013)

3.13.4.6 Tax Revenues

3.13.4.6.1 Sales, Use, and Lodging Taxes

The state of Texas levies a 6.25 percent sales and use tax on all retail and rental sales. In addition, counties and cities have the option to levy additional combined sales and use taxes of up to 2 percent within their jurisdictions. Most counties in the state of Texas levy an additional 0.5 percent sales and use tax. None of the counties in the ROI currently levies a sales and use tax, and no sales tax receipts were received in these counties in July 2013 (Table 3.13-14).

Table 3.13-14:
Sales and Use Tax by Texas County, 2013

Region	State/County	Sales Tax (Percent)	Monthly Sales Tax Receipts (July 2013)
	Texas	6.25	N/A
1	Hansford	0.00	$0
	Ochiltree	0.00	$0
	Sherman	0.00	$0

Source: Texas Comptroller of Public Accounts (2013a)

The state of Oklahoma levies a sales, use, and lodging tax of 4.5 percent. Sales tax is levied on goods and services purchased within the state. Use tax is imposed on goods purchased tax-free outside Oklahoma for use in Oklahoma (see Oklahoma Administrative Code Title 710, Chapter 65). County and other local jurisdictions are allowed to levy additional sales, use, and lodging taxes within their jurisdictions. Additional sales, use, and lodging taxes levied by counties in Oklahoma in the ROI range from 0.25 percent in Major County (Region 2) to 2 percent in Beaver and Harper counties (Region 1) (Table 3.13-15).

Table 3.13-15:
Sales and Use Tax by Oklahoma County, 2013

Region	State/County	Sales, Use, and Lodging Tax Rates (Percent) (July 2013)	Monthly Sales Tax and Use Tax Receipts (July 2013)
	Oklahoma	4.50	N/A
1	Cimarron	2.00	40,541
	Texas	1.00	372,896
	Beaver	2.00	399,427
	Harper	2.00	136,669

Table 3.13-15:
Sales and Use Tax by Oklahoma County, 2013

Region	State/County	Sales, Use, and Lodging Tax Rates (Percent) (July 2013)	Monthly Sales Tax and Use Tax Receipts (July 2013)
2	Woodward	1.33	357,400
	Major	0.25	22,890
	Garfield	0.35	334,300
3	Kingfisher	0.75	202,916
	Logan	1.00	502,660
	Payne	0.81	1,369,669
	Lincoln	1.00	283,726
	Creek	1.00	482,373
	Okmulgee	1.25	273,060
	Muskogee	0.65	427,365
4	Sequoyah	1.42	311,253

Source: Oklahoma Tax Commission (2013a, 2013b)

The state of Arkansas levies a sales and use tax of 6.5 percent. Counties and other local jurisdictions are also able to levy additional sales and use taxes within their jurisdictions. Current county rates range from 0.5 percent in Faulkner County (Region 5) to 2.25 percent in Jackson County (Region 5) (Table 3.13-16).

Table 3.13-16:
Sales and Use Tax by Arkansas County, 2013

Region	State/County	Sales and Use Tax Rate (Percent)	Monthly Sales and Use Tax Receipts (July 2013)
	Arkansas	6.50	N/A
4	Crawford, AR	1.00	$516,053
	Franklin, AR	1.50	$208,843
	Johnson, AR	1.00	$236,443
5	Pope, AR	1.00	$830,995
	Conway, AR	1.75	$530,926
	Van Buren, AR	2.00	$316,123
	Cleburne, AR	1.63	$588,197
	Faulkner, AR	0.50	$1,808,224
	White, AR	1.50	$1,472,778
	Jackson, AR	2.25	$380,013
6	Poinsett, AR	1.25	$241,922
	Cross, AR	2.00	$372,256
7	Mississippi, AR	2.00	$1,044,722

Source: Arkansas Department of Finance and Administration (2013a, 2013b)

The state of Tennessee levies a 7.00 percent sales and use tax. Shelby and Tipton counties both levy an additional 2.25 percent sales and use tax (Table 3.13-17).

Table 3.13-17:
Sales and Use Tax by Tennessee County, 2014

Region	State/County	Sales Tax Rate	Monthly Sales Tax Receipts (January 2014)
	Tennessee	7.00	N/A
7	Shelby	2.25	$28,059,228
	Tipton	2.25	$856,828

Source: Tennessee Department of Revenue (2014a, 2014b)

3.13.4.6.2 Property and Ad Valorem Taxes

Texas has no state property tax. Property taxes are local taxes levied by local governments and used to pay for schools, streets, police, fire protection, and other services. Counties, cities, school districts, and various special districts collect and spend property taxes. The governing body of each of these local governments determines the amount of property taxes it wants to raise and sets its own tax rate. Most local governments contract with their county's tax assessor-collector to collect the tax on their behalf (Texas Comptroller of Public Accounts 2014). Utility property in Texas is assessed by each county using a unitary method that can include one or more of the cost, income, or market approach to valuation. These approaches are briefly summarized below.

Each county is served by an appraisal district responsible for determining the value of the county's taxable property. Property taxes are calculated by applying a millage rate to the assessed value of the property. One mill equals one-thousandth of a dollar. If the assessed value of a property is $1,000 and the millage rate is 1.00, then the tax on that property is $1.00. Millage rates for the three Texas counties in Region 1 are shown in Table 3.13-18.

Table 3.13-18:
Millage Tax Rate by Texas County, 2012

Region	County	Millage Rate[1]
1	Hansford	4.131
	Ochiltree	4.200
	Sherman	4.392

1. Property tax rates are presented per $100 of assessed value in Texas. The applicable rates have been adjusted here so they are per $1,000 of assessed value.

Source: Texas Comptroller of Public Accounts (2013b)

Property or ad valorem taxes in Oklahoma are local taxes. County officials typically value property, set tax rates, and collect tax revenues. Oklahoma uses a fractional assessment system, which means the assessed value is less than 100 percent of the property's fair cash value. Once an assessed value has been determined, the various taxing entities apply their tax rate or millage rate to this assessed value to determine the total amount of ad valorem tax.

Special rules apply to the valuation of public service corporations in Oklahoma. Public service corporations, which include electric companies, are valued at the state level by the Oklahoma Tax Division. Fair cash value of public service corporation property may be determined by any combination of three possible approaches: an income approach, which converts projected future income or cash flow into an estimate of present value; the stock and debt or market approach, which estimates the price obtainable from the sale of all outstanding capital stock and funded debt; or the cost approach, which uses either the original cost or historical cost less depreciation. Assessed values are determined for public service corporation property by applying an assessment rate of 22.85 percent to the fair cash value (Oklahoma SBE 2006).

Property taxes are then calculated by applying a millage rate to the assessed value of the property. Millage rates vary within a county based on location and the corresponding jurisdictions levying a property tax. Table 3.13-19 presents a range of potential millage rates for each of the Oklahoma counties within the ROI.

Table 3.13-19:
Millage Tax Rates by Oklahoma County, 2012

Region	State/County	Low Millage[1]	High Millage[1]
1	Cimarron	61.74	67.29
	Texas	55.60	80.73
	Beaver	52.19	67.94
	Harper	57.00	86.36
2	Woodward	63.64	93.10
	Major	78.89	100.12
	Garfield	80.29	103.61
3	Kingfisher	77.99	105.94
	Logan	76.29	119.76
	Payne	73.67	102.61
	Lincoln	73.75	99.11
	Creek	73.98	120.55
	Okmulgee	80.68	97.29
	Muskogee	74.96	100.40
4	Sequoyah	68.50	84.33

1. Millage rates are presented as a range. Actual rates vary by district.
Source: OK Assessor (2012)

In Arkansas, local government entities, such as county and city governments, school districts, fire and emergency medical districts, sewer districts, and other special taxing districts, are allowed to levy *ad valorem* property taxes on real and personal property within their jurisdictions. The Arkansas Public Service Commission's Tax Division determines ad valorem assessments for transmission lines throughout the state. The Division uses a unitary appraisal method that considers the value of the company as a whole to determine assessed values (APSC 2010). An assessment rate of 20 percent is applied to the fair cash value to determine the total assessed value of the property (Arkansas Assessment Coordination Department 2012).

The average overall millage rates for Arkansas counties within the ROI are presented in Table 3.13-20. These rates consist of the combined total of the average school district, average city, and average county millage rate for each county. The combined rate for Cleburne County (41.94), for example, consists of an average school district millage of 34.86 plus the average city millage of 1.98 plus the average county millage of 5.10 (Arkansas Assessment Coordination Department 2013).

Table 3.13-20:
Millage Tax Rates by Arkansas County, 2012

Region	State/County	Millage Rate
4	Crawford, AR	49.11
	Franklin, AR	46.79
5	Johnson, AR	47.96
	Pope, AR	45.98
	Conway, AR	46.53
	Van Buren, AR	43.90
	Cleburne, AR	41.94
	Faulkner, AR	48.70
	White, AR	43.01
	Jackson, AR	46.65
6	Poinsett, AR	44.47
	Cross, AR	49.89
7	Mississippi, AR	49.70

Source: Arkansas Assessment Coordination Department (2013)

The Tennessee Comptroller of the Treasury is responsible for assessing public utility property throughout the state for property tax purposes, employing a unitary method to assess the value of the company as a whole. Utility property is assessed at 55 percent of fair market value with an appraisal ratio applied for each county to equalize values throughout the state (Tennessee SBE 2013, 2014). Average millage rates in Shelby and Tipton counties in Tennessee in 2012 were 4.06 and 2.34, respectively (Tennessee Comptroller of the Treasury 2013). These tax rates are expressed as an amount per $100 of assessed value and set by the governing body of the county (Tennessee SBE 2013). Adjusted to be per $1,000 of assessed value, the average millage rates in Shelby and Tipton counties in Tennessee in 2012 were 40.6 and 23.4, respectively.

3.13.5 Connected Actions

3.13.5.1 Wind Energy Generation

The Applicant has identified a total of 12 WDZs within a 40 mile radius of the Oklahoma Converter Station Siting Area spread over six counties, three in Oklahoma (Beaver, Cimarron, and Texas) and three in Texas (Hansford, Ochiltree, and Sherman (Table 3.13-21). These counties are the ROI for Region 1 and baseline information is presented for each of these counties in Section 3.13.4.

Table 3.13-21:
Total WDZ Acres by State and County

Wind Development Zone	Oklahoma[1]			Texas[1]			Total[2]
	Beaver	Cimarron	Texas	Hansford	Ochiltree	Sherman	
A				14	95		109
B				125			125
C				52		109	161
D			69				69
E			47				47

Table 3.13-21:
Total WDZ Acres by State and County

Wind Development Zone	Oklahoma[1]			Texas[1]			Total[2]
	Beaver	Cimarron	Texas	Hansford	Ochiltree	Sherman	
F			110			2	112
G		125	62				187
H			116				116
I			105				105
J	70		22				92
K	92				1		93
L				39	127		166
Total	162	125	531	230	223	111	1,382

1 WDZ areas are summarized in thousands of acres.
2 Totals may not sum due to rounding.

3.13.5.2 Optima Substation

The ROI for the future Optima Substation for socioeconomics is Texas County, Oklahoma. This county is part of the ROI for Region 1; baseline information is presented for this county in Section 3.13.4.

3.13.5.3 TVA Upgrades

The ROI for the direct assignment facilities (which are included in the Applicant Proposed Project) would occur within the Tennessee Converter Station Siting Area and more specifically within the Shelby Substation. The ROI for the network upgrades, and in particular TVA's future 500kV transmission line, cannot be fully determined at this time. The new 500kV line would be constructed in western Tennessee. The upgrades to existing facilities would mostly be in western and central Tennessee. Upgrades to existing infrastructure would include upgrading terminal equipment at three existing 500kV substations and six existing 161kV substations, making appropriate upgrades to increase heights on 16 existing 161kV transmission lines to increase line ratings, and replacing the conductors on eight existing 161kV transmission lines. Where possible, general impacts associated with the required TVA upgrades are discussed in the impact sections that follow.

3.13.6 Socioeconomic Impacts

3.13.6.1 Methodology

The socioeconomic analysis is based primarily on secondary data compiled from federal, state, and local government agencies. Key sources of data include the U.S. Census Bureau, the U.S. Bureau of Economic Analysis, the U.S. Bureau of Labor Statistics, USDA, and various state agencies.

The potential effects of the converter stations, AC collection system, Applicant Proposed Route, and the DOE Alternatives, including the Arkansas Converter Station Alternative and DOE alternative routes, were evaluated with respect to the key aspects of the socioeconomic environment, including demographic characteristics, economic conditions, housing, property values, community services, and tax revenues. These evaluations employ different resource-specific analysis methods that are described in their respective sections.

Key Project-related variables used in the socioeconomic analysis include projected construction employment and expenditures. Operations-related employment and expenditures are also used. Construction employment and spending estimates are disaggregated by county where appropriate, primarily based on the share of overall construction that would occur in that county. Information is primarily presented by region (Figure 2.1-2 in Appendix A) consistent with other resources and with consideration given to an ROI more consistent with socioeconomic analysis of linear facilities. These estimates represent the best available information and a reasonable approximation of the likely distribution of potential impacts, but should not be considered precise forecasts. In most cases, estimated impacts may be compared with the existing conditions data presented in the preceding part of this section.

Total regional economic impacts are estimated at the state level using direct-effect multipliers for earnings and for employment from the U.S. Bureau of Economic Analysis' RIMS II regional modeling system (BEA 2013b). The multipliers from this model are based on regional information derived from databases analyzing commercial, industrial, and household spending patterns and relationships. Multipliers are provided for different sectors of the economy. Multipliers for the construction and utilities sectors are used in this analysis. Total economic impacts consist of direct, indirect, and induced impacts.

Direct impacts represent the change in economic activity resulting from the initial round of inputs purchased by the project. In this case, direct impacts consist of the employment and related earnings directly associated with construction, operations and maintenance, and decommissioning phases of the Project. These direct impacts generate economic activity elsewhere in the local economy through the multiplier effect, as initial changes in demand "ripple" through the economy and generate indirect and induced impacts. *Indirect* impacts are generated by the expenditures by suppliers who provide goods and services to the construction project or for project operations. *Induced* impacts are generated by the spending of households benefiting from the additional wages and business income earned through related direct or indirect activities.

Economic impacts to agriculture in eastern Arkansas are assessed using information from the Arkansas Delta Agricultural Economic Impact Study prepared for this project. This agricultural economic impact study, which focuses on four counties in eastern Arkansas: Jackson (Regions 5 and 6), Cross (Region 6), Poinsett (Regions 6 and 7), and Mississippi (Region 7), is included as Appendix J to this EIS.

Clean Line will implement the EPMs listed in Appendix F to avoid or minimize potential impacts from construction of the Project. Those EPMs that would help avoid or minimize potential socioeconomic impacts include the following:

- GE-6: Clean Line will restrict vehicular travel to the ROW and other established areas within the construction, access, or maintenance easement(s).
- GE-8: Access controls (e.g., cattle guards, fences, gates) will be installed, maintained, repaired, replaced, or restored as required by regulation, road authority, or as agreed to by landowner.
- GE-11: Clean Line will conduct construction, operation, and maintenance activities to minimize the creation of dust. This may include measures such as limitations on equipment, speed, and/or travel routes utilized. Water, dust palliative, gravel, combinations of these, or similar control measures may be used. The Applicant will implement measures to minimize the transfer of mud onto public roads.
- GE-12: Clean Line will avoid remedial structures (e.g., capped areas, monitoring equipment, or treatment wells) on contaminated sites, Superfund sites, CERCLA remediation areas, and other similar areas. Workers will use

appropriate protective equipment and appropriate safe working techniques when working at or near contaminated sites.

- GE-15: Waste generated during construction or maintenance, including solid waste, petroleum waste, and any potentially hazardous materials will be removed and taken to an authorized disposal facility.
- GE-20: Clean Line will conduct construction and scheduled maintenance activities on the facilities during daylight hours, except in rare circumstances that may include, for example, to address emergency or unsafe situations, to avoid adverse environmental effects, to minimize traffic disruptions, or to comply with regulatory or permit requirements.
- GE-21: Clean Line will maintain construction equipment in good working order. Equipment and vehicles that show excessive emissions of exhaust gasses and particulates due to poor engine adjustments or other inefficient operating conditions will be repaired or adjusted.
- GE-22: Clean Line will impose speed limits during construction for access roads (e.g., to reduce dust emissions, for safety reasons, and for protection of wildlife).
- GE-23: Clean Line will maximize the distance between stationary equipment and sensitive noise receptors consistent with engineering design criteria.
- GE-24: Clean Line will minimize the number and distance of travel routes for construction equipment near sensitive noise receptors.
- GE-25: Clean Line will turn off idling equipment when not in use.
- GE-27: Clean Line will minimize compaction of soils and rutting through appropriate use of construction equipment (e.g., low ground pressure equipment and temporary equipment mats).
- GE-28: Hazardous materials and chemicals will be transported, stored, and disposed of according to federal, state, or local regulations or permit requirements.
- AG-1: Clean Line will avoid or minimize adverse effects to surface and subsurface irrigation and drainage systems (e.g., tiles). The Applicant will work with landowners to minimize the placement of structures in locations that would interfere with the operation of irrigation systems.
- AG-2: Agricultural soils temporarily impacted by construction, operation, or maintenance activities will be restored to pre-activity conditions. For example, soil remediation efforts may include decompaction, recontouring, liming, tillage, fertilization, or use of other soil amendments.
- AG-4: Clean Line will work with landowners and/or tenants to identify specialty agricultural crops or lands (e.g., certified organic crops or products that require special practices, techniques, or standards) that may require protection during construction, operation, or maintenance. The Applicant will avoid and/or minimize impacts that could jeopardize standards or certifications that support specialty croplands or farms.
- AG-5: Clean Line will work with landowners and/or tenants to consider potential impacts to current aerial spraying or application (i.e., crop dusting) of herbicides, fungicides, pesticides, and fertilizers within or near the transmission ROW. The Applicant will avoid or minimize impacts to aerial spraying practices when routing and siting the transmission line and related infrastructure.
- AG-6: Clean Line will work with landowners to develop compensation for lost crop value caused by construction and/or maintenance.
- LU-1: Clean Line will work with landowners and operators to ensure that access is maintained as needed to existing operations (e.g., to oil/gas wells, private lands, agricultural areas, pastures, hunting leases).
- LU-2: Clean Line will minimize the frequency and duration of road closures.
- LU-3: Clean Line will work with landowners to avoid and minimize impacts to residential landscaping.

- LU-4: Clean Line will coordinate with landowners to site access roads and temporary work areas to avoid and/or minimize impacts to existing operations and structures.
- W-15: Clean Line will seek to procure water from municipal water systems where such water supplies are within a reasonable haul distance; any other water required will be obtained through permitted sources or through supply agreements with landowners.

Additionally, Clean Line proposes to implement the following plans that would help minimize other potential socioeconomic impacts:

- Transportation and Traffic Management Plan. This plan will describe measures designed to avoid and/or minimize adverse effects associated with the existing transportation system.
- Spill Prevention, Control and Countermeasures Plan. This plan will describe the measures designed to prevent, control, and clean up spills of hazardous materials.
- Construction Security Plan. This plan will describe measures designed to avoid and/or minimize adverse effects associated with breaches in Project security during construction including terrorism, sabotage, vandalism, and theft. The plan will include provisions describing how the Project construction team will coordinate with state and local law enforcement agencies during construction to improve Project security and facilitate security incident response, if required.
- Communications Plan. This plan will incorporate all forms of communication with the public, with elements implemented as appropriate during different phases of the Project. Elements of this plan are described in Section 3.1.2.

3.13.6.2 Impacts Associated with the Applicant Proposed Project

3.13.6.2.1 Population

3.13.6.2.1.1 Converter Stations and AC Interconnection Siting Areas

3.13.6.2.1.1.1 Construction Impacts

The Applicant proposes to locate new AC/DC converter stations in Texas County, Oklahoma, and Shelby County, Tennessee. The Oklahoma converter station would be located in Region 1. The Tennessee converter station would be located in Region 7.

Employment during construction of each converter station is expected to follow a bell-shaped pattern, with an average of 138 workers over a 32-month construction period and a peak of 232 to 242 workers from months 12 to 17 (Figure 3.13-2). An estimated 26 percent of the workers who would be employed on the Project are expected to be hired locally (i.e., workers who normally reside within daily commuting distance of the applicable converter station site). Daily commuting distance is assumed to be up to a 2-hour drive each way for the purposes of this analysis (Clean Line 2014a). Some workers would be employed for the full duration of construction, but many workers would be employed for shorter periods based on their trades. Local hires would include surveyors and workers employed in site development, fence installation, and traffic control. Local hires would compose a smaller share of the workforce for more specialized tasks, such as equipment footings and cable trenching, conduits, and grounding and steel structure erection and electrical equipment installation. The proportion of non-local workers on site at any one time would vary over the construction period as the mix of labor categories and skills varies.

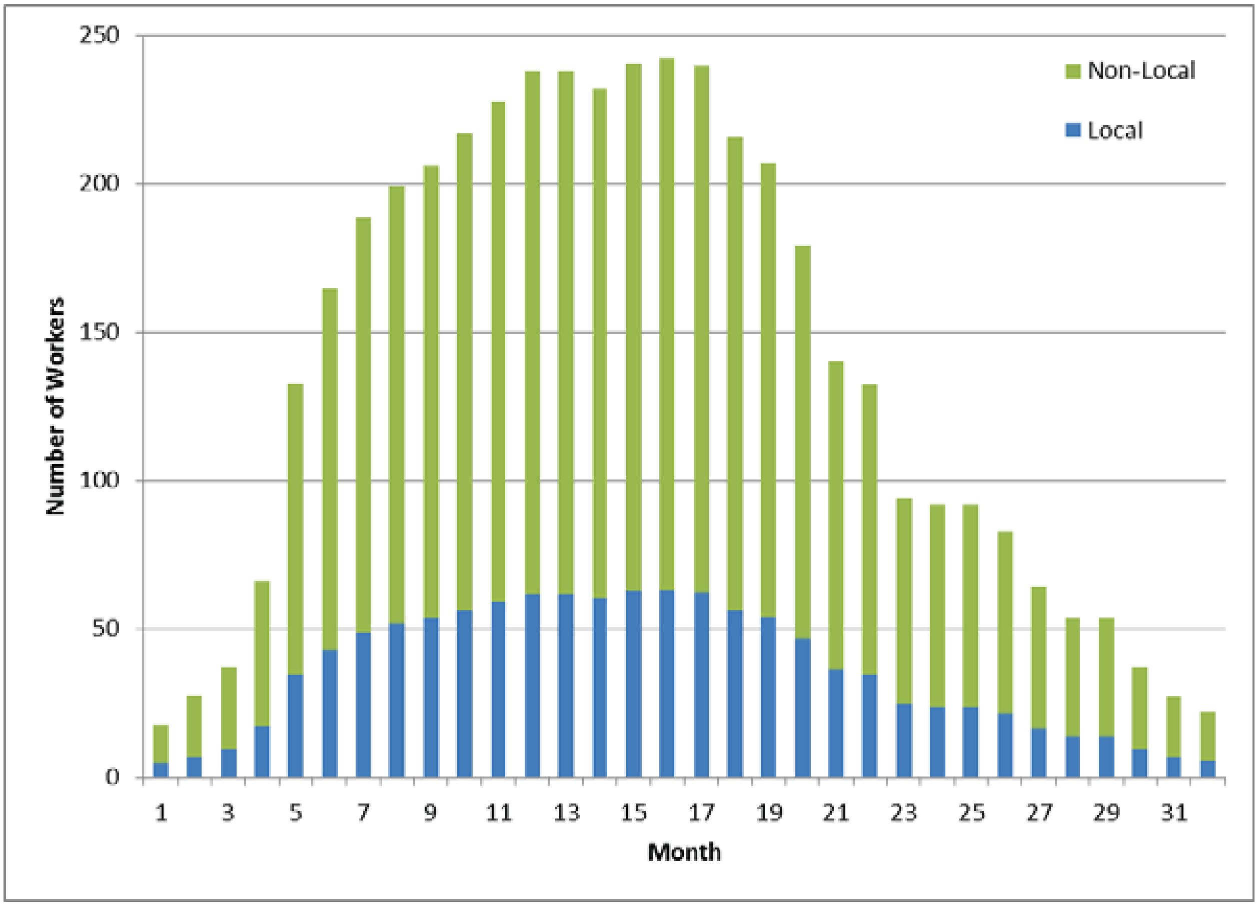


Figure 3.13-2: Estimated Construction Workforce per Converter Station by Month and Local/Non-Local Workers

Source: Clean Line (2014a)

For the purposes of analysis, the share of non-local workers is assumed to be 74 percent for the full duration of convertor station construction, resulting in an average of 102 non-local workers employed over the 32-month construction period, with an estimated peak of 171 to 179 non-local workers employed during months 12 to 17. In addition, 10 percent of non-local workers temporarily relocating to the Project sites are assumed to be accompanied by family members; the average size of a family that is relocating is assumed to be two adults and one school-age child (Clean Line 2013).

Based on these assumptions, an estimated average of 123 people would be expected to temporarily relocate to the vicinity of each converter station for the full duration of the 32-month construction period, with the number of people who would relocate increasing to 215 during the peak construction period (months 12 to 17). The average increase would be equivalent to approximately 0.6 percent and less than 0.1 percent of the existing (2012) population in Texas and Shelby counties, respectively. The peak increase would be equivalent to approximately 1 percent and less than 0.1 percent of the respective existing (2012) populations in Texas and Shelby counties. Very few, if any, of the non-local workers employed during the construction phase of the converter stations would be expected to permanently relocate to the affected areas, so it is unlikely that construction of the converter stations would result in any long-term changes in population.

3.13.6.2.1.1.2 Operations and Maintenance Impacts

Operations and maintenance of each of the converter stations is expected to employ up to 15 workers. These estimated staffing levels would have no noticeable impact on existing population levels in the potentially affected counties.

3.13.6.2.1.1.3 Decommissioning Impacts

The labor force required to decommission each converter station would be similar to that required for construction. Impacts to population from decommissioning are, therefore, expected to be similar to those from construction.

3.13.6.2.1.2 AC Collection System

3.13.6.2.1.2.1 Construction Impacts

The counties crossed by the AC collection system routes and mileage of each route within each county are provided in Table 2.1-5. The AC collection system routes are all located in Region 1 (Figure 2.1-2 in Appendix A).

Assuming that workforce requirements are similar to those estimated for the HVDC transmission line on a per-mile basis, the average length of an AC collection system route, 34.4 miles, would require an average of 51 workers over a 24-month construction period, with an estimated peak of 71 workers. Adjusted to reflect the length of each alternative, the respective average and peak number of workers would range from 20 and 28 for AC Collection System Routes SE-2 and SW-1 (13.4 miles) to 83 and 116 for AC Collection System Route NW-2 (56.0 miles).

Estimated temporary increases in population are shown by alternative and county in Table 3.13-22. These estimates assume that 74 percent of the workforce would be non-local for the duration of the Project. In addition, approximately 10 percent of non-local workers are assumed to be accompanied by family members; the average size of a family that is relocating is assumed to be three, two adults and one school-age child. Population is distributed for the purposes of analysis based on the length of the line in each county.

Table 3.13-22:
Estimated Temporary Change in Population During Construction by AC Collection System Routes and County

County/Route	E-1	E-2	E-3	NE-1	NE-2	NW-1	NW-2	SE-1	SE-2	SE-3	SW-1	SW-2	W-1
Temporary Change in Population Based on Average Employment Forecast[1]													
Beaver, OK	5	20	21	0	0	0	0	0	0	4	0	0	0
Texas, OK	33	32	31	39	35	66	71	25	5	32	5	20	27
Cimarron, OK	0	0	0	0	0	2	3	0	0	0	0	0	0
Hansford, TX	0	0	0	0	0	0	0	3	13	0	13	4	0
Ochiltree, TX	0	0	0	0	0	0	0	26	0	28	0	0	0
Sherman, TX	0	0	0	0	0	0	0	0	0	0	0	25	0
Total	38	52	52	39	35	68	74	53	18	64	18	49	27

Table 3.13-22:
Estimated Temporary Change in Population During Construction by AC Collection System Routes and County

County/Route	E-1	E-2	E-3	NE-1	NE-2	NW-1	NW-2	SE-1	SE-2	SE-3	SW-1	SW-2	W-1
Temporary Change in Population Based on Peak Employment Forecast[1]													
Beaver, OK	7	28	30	0	0	0	0	0	0	6	0	0	0
Texas, OK	46	45	44	55	48	93	99	34	7	45	7	28	38
Cimarron, OK	0	0	0	0	0	3	4	0	0	0	0	0	0
Hansford, TX	0	0	0	0	0	0	0	4	18	0	18	6	0
Ochiltree, TX	0	0	0	0	0	0	0	36	0	40	0	0	0
Sherman, TX	0	0	0	0	0	0	0	0	0	0	0	35	0
Total	53	73	73	55	48	95	103	74	25	90	25	68	38

1 Totals may not sum due to rounding.

Viewed by AC collection system route, projected changes in population during peak construction would range from about 25 (AC Collection System Routes SE-2 and SW-1) to about 103 (AC Collection System Route NW-1) (Table 3.13-22). The largest expected temporary increase (103) is equivalent to about 0.2 percent of the total existing (2012) population in Region 1 (51,652) (Table 3.13-4). The largest expected gain for an individual county would be a temporary increase of 99 in Texas County, Oklahoma, under AC Collection System Route NW-2. This estimated increase of 99 people is equivalent to about 0.5 percent of Texas County's total 2012 population (20,620) (Table 3.13-4).

Four to six AC transmission lines are expected to be built. Assuming that six alternatives with an average length of 34.4 miles are constructed, average and peak population increases of about 271 and 379 people, respectively, approximately 0.5 percent and 0.7 percent of the total 2012 population in Region 1, would result.

Very few, if any, of the non-local workers employed during the construction phase of the AC collection system routes would be expected to permanently relocate to the affected areas, so it is unlikely that construction of the AC collection system would result in any long-term changes in population.

3.13.6.2.1.2.2 Operations and Maintenance Impacts

Combined operation of the HVDC and AC transmission lines in Region 1 is expected to employ 15 workers based in Guymon, Oklahoma (Texas County). This number is not expected to vary based on which AC collection system routes are selected. This estimated staffing level would have no noticeable impact on existing population levels in Texas County, which had a total estimated population of 20,620 in 2012 (Table 3.13-4).

3.13.6.2.1.2.3 Decommissioning Impacts

Decommissioning of the AC transmission lines would require a labor force approximately equal to that needed for its construction. Impacts to population from decommissioning are, therefore, expected to be similar to those from construction.

3.13.6.2.1.3 HVDC Applicant Proposed Route

3.13.6.2.1.3.1 Construction Impacts

Overall construction of the 720-mile-long HVDC transmission line is expected to take 36 months. Total employment by month is expected to range from 83 in month 1 to a peak of 1,277 in month 16, with an average monthly employment of 690 (Appendix F). The transmission line would be constructed in five 140-mile-long segments, each taking 24 months to complete. The estimated workforce is shown by month and task for a representative 140-mile segment in Figure 3.13-3. Total employment by month for each 140-mile segment is expected to range from 55 workers in month 24 to a peak of 290 workers in months 4, 5, and 6, with an average monthly employment of 207.

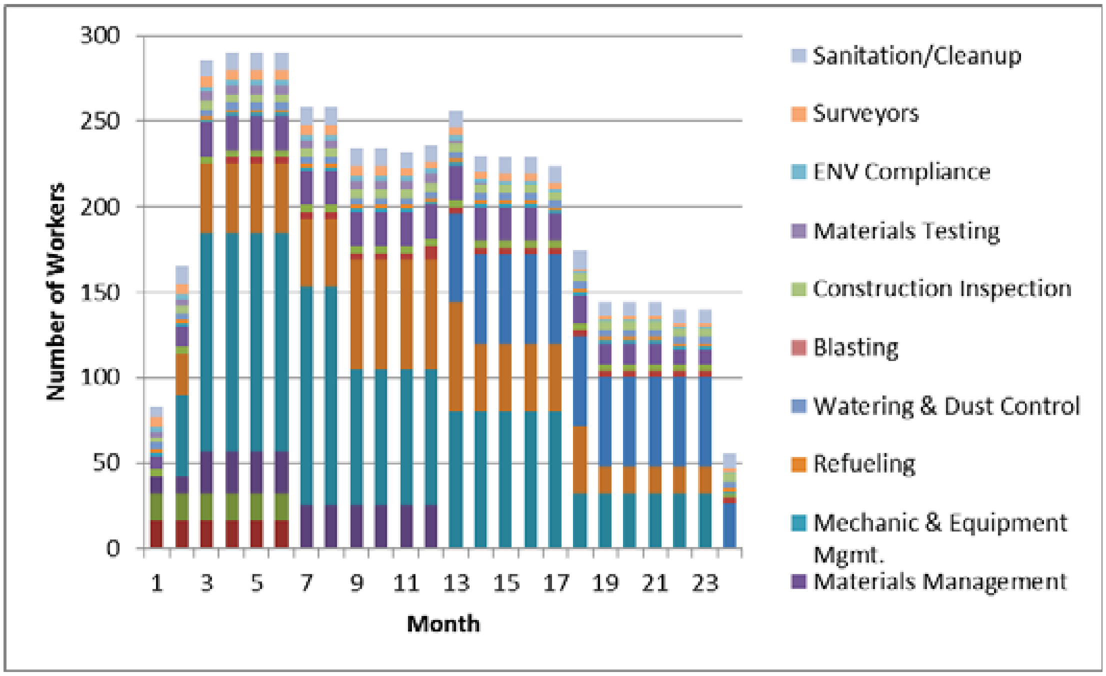


Figure 3.13-3: Estimated Construction Workforce per 140-mile Segment of HVDC Transmission Line by Month and Task

Source: Clean Line (2013)

Figure 3.13-4 identifies the expected local/non-local breakdown for an average 140-mile segment by month. Local workers are those who normally reside within commuting distance of the work sites. Non-local workers would temporarily relocate to the ROI or immediate vicinity for the duration of their employment; some workers would possibly commute home on weekends, depending on the location of their primary residence. Individual non-local workers may also relocate along the ROI and between segments depending on their assignment.

Tasks expected to mainly employ local workers include ROW clearing, access road and pad construction, foundation construction, restoration, and materials management. Tasks expected to be dominated by non-local workers are related to specialty trades and include tower lacing (assembly), tower setting (erection), wire stringing, supervision, blasting, and construction inspection. The distribution of local/non-local workers shown in Figure 3.13-4 assumes that non-local workers would account for 74 percent of the total workforce for the duration of the Project. Local employment by month for each 140-mile segment is expected to range from 14 workers per month in month 24 to 75 workers per month in months 4, 5, and 6, with an average monthly employment of 54.

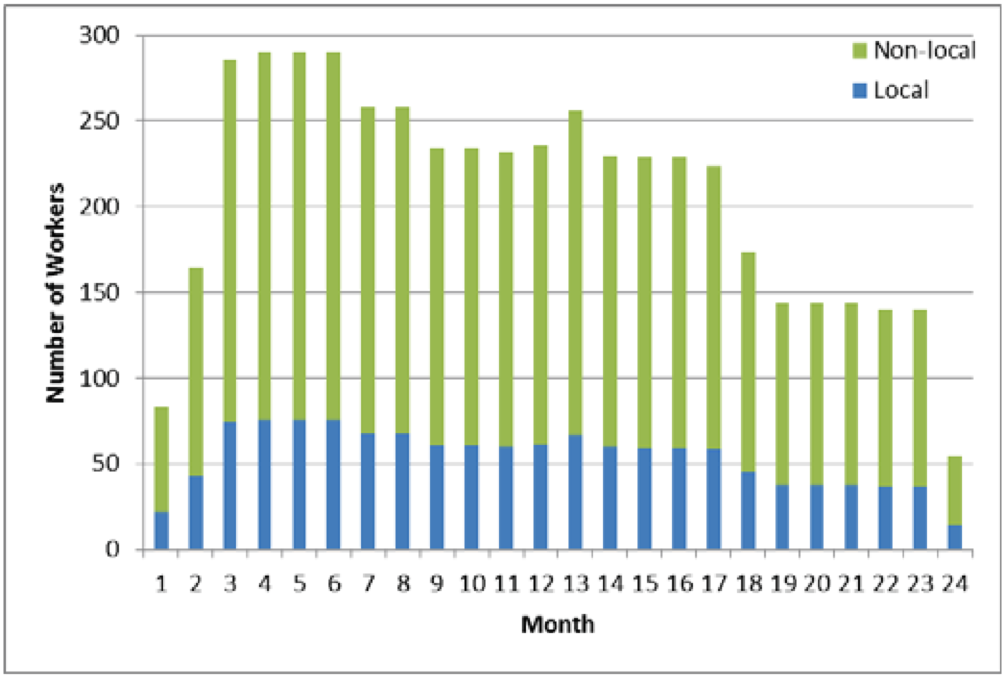


Figure 3.13-4: Estimated Construction Workforce per 140-mile Segment of HVDC Transmission Line by Month and Local/Non-Local Workers

Source: Clean Line (2013, 2014a)

Non-local employment is expected to range from 41 workers per month in month 24 to 215 workers per month in months 4 to 6, with an average monthly employment of 153 (Figure 3.13-4). Very few, if any, of the non-local workers employed during the construction phase of each segment would be expected to permanently relocate to the affected areas. For the purposes of analysis, 10 percent of non-local workers temporarily relocating to the Project sites are assumed to be accompanied by family members; the average size of a family that is relocating is assumed to be three, two adults and one school-age child (Clean Line 2013).

Table 3.13-23 compares the projected average and peak numbers of people relocating by region with the corresponding 2012 population totals. Estimates of people by region are based on the estimated workforce per 140-mile segment, adjusted to account for the miles of HVDC transmission line that would be located in each region. Projected temporary peak increases in population range from less than 0.1 percent of total existing (2012) population in Region 7 to 0.4 percent in Region 1.

Table 3.13-23:
Projected Temporary Change in Population During Construction of the Applicant Proposed Route by Region

Region	2012 Population[1]	Average Employment Forecast		Peak Employment Forecast	
		Number of People Temporarily Relocating[2, 3]	Percent of 2012 Population	Number of People Temporarily Relocating[2, 3]	Percent of 2012 Population
1	51,652	151	0.3	212	0.4
2	88,067	139	0.2	195	0.2
3	348,517	212	0.1	297	0.1
4	147,279	166	0.1	232	0.2
5	334,750	148	0.0	207	0.1
6	42,397	71	0.2	100	0.2
7	1,042,441	56	0.0	79	0.0

1 Existing population data are estimates prepared by the USCB (2014a). These estimates are presented by county in Table 3.13-4.
2 The estimated numbers of people temporarily relocating are based on the projected workforce requirements shown in Figure 3.13-4. An estimated 10 percent of workers temporarily relocating are assumed to be accompanied by their families; the average size of a family that is relocating is assumed to be three, two adults and one school-age child. Workers and their families are allocated by region based on the total miles of transmission line proposed for each region.
3 The values in this table would not change as a result of the minor route variations and adjustments to the HVDC Applicant Proposed Route.

Construction of the HVDC transmission line, converters stations, and AC collection system routes could potentially occur at the same time, with associated temporary population increases also taking place at the same time. If this were to occur, the largest overall temporary population increases would occur in Region 1, with the concurrent construction of the HVDC transmission line, Oklahoma converter station, and four to six AC transmission lines. The combined peak increase in population in Region 1 would be equivalent to 1.6 percent of the 2012 population total. In Region 7, the combined peak (HVDC transmission line plus the Tennessee converter station) would be equivalent to 0.03 percent of the 2012 population (Table 3.13-24).

Table 3.13-24:
Projected Temporary Change in Population During Construction of the Applicant Proposed Route, Converter Stations, and AC Collection System Routes by Region

Region[1]	2012 Population	Average Employment Forecast[1, 2]		Peak Employment Forecast[1, 2]	
		Number of People Temporarily Relocating	Percent of 2012 Population	Number of People Temporarily Relocating	Percent of 2012 Population
1	51,652	545	1.1	807	1.6
7	1,042,441	179	0.0	294	0.0

1 Average and peak employment forecasts by region include the following Project components:
Region 1: 115.5 miles of HVDC transmission line, the Oklahoma converter station, and six AC collection system routes with an average length of 34.4 miles (total length 206 miles)
Region 7: 42.8 miles HVDC transmission line and the Tennessee converter station
2 The values in this table would not change as a result of the minor route variations and adjustments to the HVDC Applicant Proposed Route.

3.13.6.2.1.3.2 Operations and Maintenance Impacts

Operations and maintenance of the HVDC and AC transmission lines would employ 32 workers in Oklahoma, including 15 in Guymon, Oklahoma (Texas County) (Region 1), seven in Woodward, Oklahoma (Region 2), and 10 in Muskogee, Oklahoma (Region 3). An additional 10 workers would be employed in Newport, Arkansas (Jackson County) (Region 6). These workers would be responsible for operations and maintenance of all of the HVDC and AC transmission lines, including those located in Regions 4, 5, and 7. These estimated staffing levels would have no noticeable impact on existing population levels in the potentially affected counties or regions.

Operations and maintenance of the Oklahoma converter station would employ up to 15 workers. If these workers and those required to operate and maintain the HVDC and AC transmission lines in Texas County all permanently relocated to the area from elsewhere, these combined staffing levels (30 workers) would not be expected to have a noticeable impact on existing population levels. Assuming an average family size of three people, a permanent increase in population of 90 people, about 0.4 percent of the estimated 2012 total of 20,620 would result (Table 3.13-4). The operations and maintenance employees associated with the Tennessee converter station would not be expected to reside in the same counties as the HVDC transmission line staff.

3.13.6.2.1.3.3 Decommissioning Impacts

Decommissioning of the HVDC transmission line would require a labor force approximately equal to that needed for its construction. Impacts to population from decommissioning are, therefore, expected to be similar to those from construction.

3.13.6.2.2 Economic Conditions

3.13.6.2.2.1 Converter Stations and AC Interconnection Siting Areas

3.13.6.2.2.1.1 Construction Impacts

Construction of the Oklahoma and Tennessee converter stations would each result in a temporary increase in employment and income in the surrounding area. Construction of each converter station is expected to cost approximately $250 million and employ an average of 138 workers over a 32-month construction period, resulting in estimated total employee earnings of $16.2 million.

Viewed in terms of annualized jobs, each converter station would provide approximately 367 years of employment, with 143 of these job-years in the first 12 months (Year 1), 188 job-years in Year 2, and 36 job-years in Year 3 (Table 3.13-25). Annualized jobs are employment estimates adjusted to be based on 12 months of employment. These estimates do not directly translate into numbers of individual workers, who may be employed for shorter periods. Construction of the Oklahoma converter station would support an estimated total (direct, indirect, and induced) of 266 jobs in Year 1, 348 jobs in Year 2, and 67 jobs in Year 3 (Table 3.13-25). Construction of the Project would also support an estimated total (direct, indirect, and induced) earnings of about $11.3 million in Year 1, $14.8 million in Year 2, and $2.8 million in Year 3 (Table 3.13-26).

Construction of the Tennessee converter station would support an estimated total (direct, indirect, and induced) of 285 jobs in Year 1, 373 jobs in Year 2, and 72 jobs in Year 3 (Table 3.13-25). Construction of the Project would also support an estimated total (direct, indirect, and induced) earnings of about $12.2 million in Year 1, $16.0 million in Year 2, and $3.1 million in Year 3 (Table 3.13-26).

Table 3.13-25:
Estimated Total Employment Associated with Construction of the Converter Stations, AC Collection System Routes, and Applicant Proposed Route by Region and Year

Region	Year 1[1]			Year 2[1]			Year 3[1]		
	Direct Employment	Indirect and Induced Employment[2]	Total Employment[3]	Direct Employment	Indirect and Induced Employment[2]	Total Employment[3]	Direct Employment	Indirect and Induced Employment[2]	Total Employment[3]
Converter Stations[4 5]									
1	143	123	266	188	160	348	36	31	67
7	143	142	285	188	185	373	36	36	72
AC Collection System[6]									
1				305	284	589	305	284	589
Applicant Proposed Route[7]									
1	196	168	364	145	124	269			
2	180	154	334	133	114	247			
3	275	235	510	203	174	377			
4	215	183	398	159	136	294			
5	192	164	355	142	121	263			
6	92	79	171	68	58	127			
7	73	66	139	54	46	100			
Converter Stations, AC Collection System, and Applicant Proposed Route[8]									
1	340	290	630	638	568	1,206	341	314	655
7	216	207	424	242	231	473	36	36	72

1 The direct, indirect, and induced employment estimates presented here by year are slightly different than those in the corresponding table in the Draft EIS because the Applicant adjusted the proposed scheduling of some of the Project components between the Draft and Final EIS. There were no changes to projected employment per component.

2 Indirect and induced effects are estimated using the applicable state multipliers for the construction sector. Regions 4 and 7 include counties from more than one state (see Table 3.13-1). For these regions, the projected construction workforce is divided by state with the appropriate state multipliers used to estimate indirect and induced effects.

2 Total employment consists of direct, indirect, and induced employment.

3 Construction of each converter station is expected to take place over a 32-month period (Figure 3.13-2).

4 The Oklahoma converter station would be located in Region 1; the Tennessee converter station would be located in Region 7.

5 The AC collection system routes assume that six routes with an average length of 34.4 miles would be built. Construction of all six average routes would take place over a 24-month construction period with the workforce assumed to be divided equally between Year 2 and Year 3 for the purposes of analysis.

6 The Applicant Proposed Route would be constructed in five 140-mile-long segments, each taking 24 months to complete. These segments are assumed to be constructed concurrently for the purposes of analysis. The values in this table would not change as a result of the minor route variations and adjustments to the HVDC Applicant Proposed Route.

7 Data are presented for those regions with two or more Project components only. Region 1 includes the proposed Oklahoma converter station, approximately 206 miles of AC collection system routes, and 115.5 miles of HVDC transmission line. Region 7 includes the proposed Tennessee converter station and approximately 42.8 miles of HVDC transmission line.

This page intentionally left blank.

Table 3.13-26:
Estimated Total Earnings Associated with Construction of the Converter Stations, AC Collection System Routes, and Applicant Proposed Route by Region and Year ($ million)

Region	Year 1[1]			Year 2[1]			Year 3[1]		
	Direct Earnings[2]	Indirect and Induced Earnings[2 3]	Total Earnings[2 4]	Direct Earnings[2]	Indirect and Induced Earnings[2 3]	Total Earnings[2 4]	Direct Earnings[2]	Indirect and Induced Earnings[2 3]	Total Earnings[2 4]
Converter Stations[5 6]									
1	$6.3	$5.0	$11.3	$8.3	$6.5	$14.8	$1.6	$1.3	$2.8
7	$6.3	$5.9	$12.2	$8.3	$7.7	$16.0	$1.6	$1.5	$3.1
AC Collection System[7]									
1				$13.4	$11.2	$24.6	$13.4	$11.2	$24.6
Applicant Proposed Route[8]									
1	$8.6	$6.8	$15.5	$6.4	$5.0	$11.4			
2	$7.9	$6.3	$14.2	$5.9	$4.6	$10.5			
3	$12.1	$9.5	$21.6	$9.0	$7.1	$16.0			
4	$9.5	$6.7	$16.2	$7.0	$5.0	$12.0			
5	$8.4	$5.7	$14.1	$6.2	$4.2	$10.5			
6	$4.1	$2.7	$6.8	$3.0	$2.0	$5.0			
7	$3.2	$2.5	$5.7	$2.4	$1.8	$4.2			
Converter Stations, AC Collection System, and Applicant Proposed Route[9]									
1	$15.0	$11.8	$26.8	$28.1	$22.8	$50.9	$15.0	$12.5	$27.5
7	$9.5	$8.4	$17.9	$10.6	$9.5	$20.2	$1.6	$1.5	$3.1

1 The direct, indirect, and induced earnings estimates presented here by year are slightly different than those in the corresponding table in the Draft EIS because the Applicant adjusted the proposed scheduling of some of the Project components between the Draft and Final EIS. There were no changes to projected employment or earnings per component.
2 Direct earnings estimates are based on an average annual construction salary of $44,050 (BLS 2012). Earnings estimates are presented in millions of dollars ($ million).
3 Indirect and induced effects are estimated using the applicable state multipliers for the construction sector. Regions 4 and 7 include counties from more than one state (see Table 3.13-1). Indirect and induced earnings are estimated based on the share of construction in each state.
4 Total earnings consist of direct, indirect, and induced earnings.
5 Construction of each converter station is expected to take place over a 32-month period (Figure 3.13-2).
6 The Oklahoma converter station would be located in Region 1; the Tennessee converter station would be located in Region 7.
7 The AC collection system routes assume that six routes with an average length of 34.4 miles would be built. Construction of all six average routes would take place over a 24-month construction period with the workforce assumed to be divided equally between Year 2 and Year 3 for the purposes of analysis.
8 The Applicant Proposed Route would be constructed in five 140-mile-long segments, each taking 24 months to complete. These segments are assumed to be constructed concurrently for the purposes of analysis. The values in this table would not change as a result of the minor route variations and adjustments to the HVDC Applicant Proposed Route.
9 Data are presented for those regions with two or more Project components only. Region 1 includes the proposed Oklahoma converter station, approximately 206 miles of AC collection system routes, and 115.5 miles of HVDC transmission line. Region 7 includes the proposed Tennessee converter station and approximately 42.8 miles of HVDC transmission line.

This page intentionally left blank.

Total regional economic impacts are estimated at the state level using direct-effect multipliers for earnings and for employment from the U.S. Bureau of Economic Analysis' RIMS II regional modeling system (BEA 2013b). The multipliers for the construction sector in Tennessee are slightly higher than those for the corresponding sector in Oklahoma and, as a result, *total* estimates for the Tennessee converter station are higher than those for the Oklahoma converter station.

3.13.6.2.2.1.2 Operations and Maintenance Impacts

Operations and maintenance of each of the converter stations is expected to support up to 15 workers, with total estimated annual earnings of approximately $1 million. Operations and maintenance activities associated with the Oklahoma converter station would support an estimated total (direct, indirect, and induced) of 54 jobs and $2.1 million in annual earnings (Table 3.13-27). Statewide multipliers for the utilities sector are lower in Tennessee than in Oklahoma. The corresponding total annual impacts for the Tennessee converter station are estimated to be 39 jobs and $1.74 million in total annual earnings (Table 3.13-28).

Table 3.13-27:
Total Annual Economic Impacts from Operations and Maintenance of the Oklahoma Converter Station

Impacts	Employment (Jobs)	Annual Earnings ($ million)[1]
Direct Impact	15	$1.02
Indirect and Induced Impacts[2]	39	$1.11
Total Impact	54	$2.13

1 Total earnings were estimated based on the 2012 estimate of $67,950 for the annual average wage across the United States for all occupations in the electric power generation, transmission, and distribution industry (BLS 2012).
2 Indirect and induced impacts are estimated using the U.S. Bureau of Economic Analysis RIMS II direct-effect multipliers for the state of Oklahoma (BEA 2013b).

Table 3.13-28:
Total Annual Economic Impacts from Operations and Maintenance of the Tennessee Converter Station

Impacts	Employment (Jobs)	Annual Earnings ($ million)[1]
Direct Impact	15	$1.02
Indirect and Induced Impacts[2]	24	$0.72
Total Impact	39	$1.74

1 Total earnings were estimated based on the 2012 estimate of $67,950 for the annual average wage across the United States for all occupations in the electric power generation, transmission, and distribution industry (BLS 2012).
2 Indirect and induced impacts are estimated using the U.S. Bureau of Economic Analysis RIMS II direct-effect multipliers for the state of Tennessee (BEA 2013b).

3.13.6.2.2.1.3 Decommissioning Impacts

Decommissioning of the each converter station would require a labor force approximately equal to that needed for its construction. Local expenditures on materials and supplies and payments to workers would likely be similar, resulting in broadly similar economic impacts to those from construction.

3.13.6.2.2.2 AC Collection System

3.13.6.2.2.2.1 Construction Impacts

Estimates of direct employment and earnings are presented by alternative in Table 3.13-29. These estimates assume similar workforce requirements to those estimated for the HVDC transmission line, with direct earnings estimates based on an average annual construction worker salary of $44,050 (BLS 2012). Total (direct, indirect, and induced) employment and earnings are estimated using the applicable multipliers for Oklahoma and Texas. The resulting annual total employment estimates range from 43 for AC Collection System Route SW-1 to 154 for AC Collection System Route NW-2; respective total earnings are estimated to be $1.7 million and $6.5 million.

Table 3.13-29:
Total Economic Impacts from Construction by AC Collection System Route

Route[1]	Direct Employment	Indirect and Induced Employment[2]	Total Employment	Direct Earnings ($ million)	Indirect and Induced Earnings ($ million)	Total Earnings ($ million)
E-1	43	37	80	$1.9	$1.5	$3.4
E-2	59	50	109	$2.6	$2.0	$4.6
E-3	59	50	109	$2.6	$2.0	$4.6
NE-1	44	38	82	$2.0	$1.5	$3.5
NE-2	39	33	72	$1.7	$1.3	$3.0
NW-1	77	65	142	$3.4	$2.7	$6.1
NW-2	83	71	154	$3.6	$2.9	$6.5
SE-1	60	64	124	$2.6	$2.4	$5.0
SE-2	20	23	43	$0.9	$0.8	$1.7
SE-3	73	75	148	$3.2	$2.9	$6.1
SW-1	20	23	43	$0.9	$0.8	$1.7
SW-2	55	60	115	$2.4	$2.3	$4.7
W-1	31	26	57	$1.4	$1.1	$2.5
Average	51	47	98	$2.2	$1.9	$4.1

1 Construction is expected to take place over a 24-month period.
2 Indirect and induced impacts are estimated using the BEA RIMS II direct effect multipliers for the states of Oklahoma and Texas (BEA 2013b).

Assuming that six routes with an average length of 34.4 miles are constructed would result in direct annual employment of 305, with total (direct, indirect, and induced) employment of about 589 jobs (Table 3.13-25). Direct employment would support $13.4 million in employee earnings, with total employment supporting $24.6 million. These direct and total employment estimates are equivalent to approximately 0.9 percent and 1.7 percent of total employment in Region 1 (35,599) in 2011, respectively (Table 3.13-6).

3.13.6.2.2.2.2 Operations and Maintenance Impacts

Operations and maintenance of the HVDC and AC transmission lines would employ 32 workers in Oklahoma, including 15 in Guymon, Oklahoma (Texas County) (Region 1). The potential economic impacts of this employment are discussed below in the Applicant Proposed Route section.

3.13.6.2.2.2.3 Decommissioning Impacts

Decommissioning of the AC transmission lines would require a labor force approximately equal to that needed for its construction. Local expenditures on materials and supplies and payments to workers would likely be similar, resulting in broadly similar economic impacts to those from construction.

3.13.6.2.2.3 HVDC Applicant Proposed Route

3.13.6.2.2.3.1 Construction Impacts

The transmission line would be constructed in five 140-mile-long segments, each taking 24 months to complete. The estimated workforce is shown by month for a representative 140-mile segment in Figures 3.13-3 and 3.13-4. Total employment by month is expected to range from 55 workers in month 24 to a peak of 290 workers in months 4, 5, and 6, with an average monthly employment of 207. Viewed in terms of annualized jobs, each 140-mile segment would provide approximately 414 years of employment, with approximately 58 percent or 238 of these job-years in the first 12 months (Year 1) and the remaining 176 job-years in Year 2.

Table 3.13-30 compares the projected number of job-years for each region with the corresponding 2011 employment totals. Projected job-years are presented by 12-month period (Year 1 and 2) based on the estimated workforce per 140-mile segment, adjusted to account for the miles of HVDC transmission line that would be located in each region. Viewed as a share of total employment in 2011, projected construction employment ranges from 0.01 percent in Region 7 (Years 1 and 2) to 0.6 percent in Region 1 (Year 1).

Table 3.13-30:
Estimated Direct Construction Employment for the Applicant Proposed Route by Region and Year

Region[2]	2011 Employment[3]	Year 1[1]		Year 2[1]	
		Direct Jobs	Percent of 2011 Employment	Direct Jobs	Percent of 2011 Employment
1	35,599	196	0.6	145	0.4
2	55,875	180	0.3	133	0.2
3	177,897	275	0.2	203	0.1
4	60,648	215	0.4	159	0.3
5	164,835	192	0.1	142	0.1
6	16,439	92	0.6	68	0.3
7	663,979	73	0.01	54	0.01

1 The Applicant Proposed Route would be constructed in five 140-mile-long segments, each taking 24 months to complete. These segments are assumed to be constructed concurrently for the purposes of analysis.
2 Estimated employment by region is based on the projected workforce requirements shown in Figure 3.13-4. Workers are allocated by region based on the total miles of transmission line proposed for each region. The values in this table would not change as a result of the minor route variations and adjustments to the HVDC Applicant Proposed Route.
3 Existing employment data are from the BEA (2013b) and presented by county in Table 3.13-6.

Total (direct, indirect, and induced) employment and earnings estimates for the construction phase of the Project are presented by region and year in Tables 3.13-25 and 3.13-26, respectively. These estimates were developed using an average annual construction worker salary of $44,050 and direct-effect multipliers for the corresponding states. Total employment divided into direct and indirect/induced components is shown graphically for Years 1 and 2 in Figures 3.13-5 and 3.13-6, respectively.

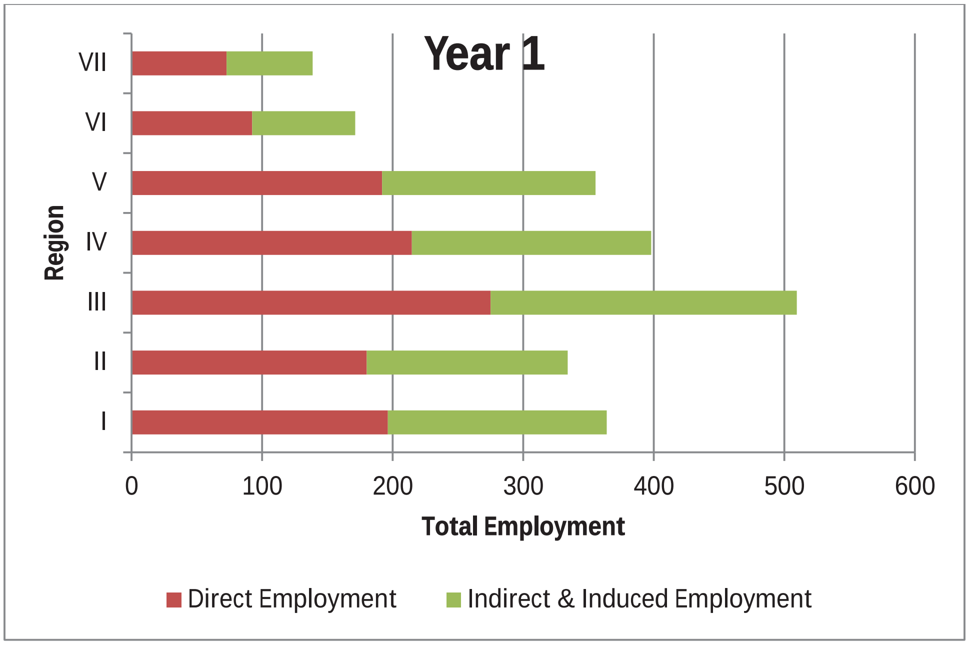


Figure 3.13-5: Total Projected HVDC Construction-Associated Employment by Region, Year 1

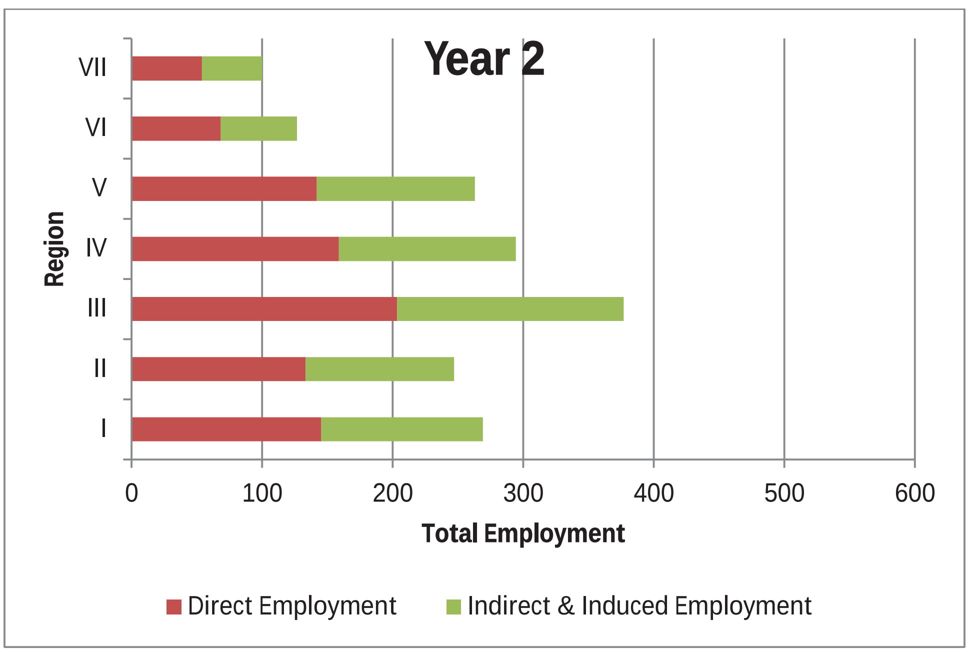


Figure 3.13-6: Total Projected HVDC Construction-Associated Employment by Region, Year 2

As noted above, an estimated 57 percent of the total construction employment (viewed in terms of job-years) would occur in Year 1 (as shown in Figures 3.13-3 and 3.13-4). Viewed by region, total HVDC construction-related employment in Year 1 would range from 139 jobs in Region 7 to 510 jobs in Region 3, reflecting the relative length of transmission line proposed for each region (Table 3.13-25). Viewed as a share of total employment in 2011, total projected construction employment in Year 1 would range from less than 0.1 percent of total employment in Region 7 to 1.0 percent in Regions 1 and 6. Estimated direct earnings for construction activities in Year 1 would range from $3.2 million in Region 7 to $12.1 million in Region 3. Estimated total (direct, indirect, and induced) earnings in Year 1 range from about $5.7 million in Region 7 to $21.6 million in Region 3 (Table 3.13-26).

Table 3.13-25 also summarizes the direct and total (direct, indirect, and induced) employment that would be supported if construction of the converter stations, AC collection system routes, and Applicant Proposed Route were to occur at the same time. Data are presented by year and region. The largest combined employment totals would occur in Region 1, with the concurrent construction of about 116 miles of HVDC transmission line, the Oklahoma converter station, and an estimated 206 miles of AC collection system transmission line. The estimated miles for the AC collection system routes assume that six routes with an average length of 34.4 miles would be built in Years 2 and 3. The combined estimated total employment in Region 1 would be 630 jobs in Year 1, and 1,206 jobs and 655 jobs in Years 2 and 3, respectively, equivalent to about 1.8 percent, 3.4 percent, and 1.8 percent of total employment in the region in 2011, respectively. Combined total employment in Region 7 would be approximately 424 jobs in Year 1, and 473 jobs and 72 jobs in Years 2 and 3, respectively, equivalent to about 0.1 percent and less of total employment in the region in 2011 (Table 3.13-25).

Total combined employment in Region 1 would support an estimated $26.8 million in earnings in Year 1 and $50.9 million and $27.5 million in Years 2 and 3, respectively (Table 3.13-26). In Region 7, combined converter station- and transmission line-related construction employment would support estimated total (direct, indirect, and induced) earnings of $17.9 million in Year 1 and $20.2 million and $3.1 million in Years 2 and 3, respectively (Table 3.13-26).

3.13.6.2.2.3.1.1 *Fayetteville Shale*

One organization commenting on the Draft EIS expressed concern that the potential economic impact of the Project on the development of the Fayetteville shale in Arkansas was not adequately captured. Potential impacts identified by the commenter were possible difficulties siting new well pads, accessing existing well pads, developing gathering pipelines, and using related electronic equipment. Viewed in the context of the overall Fayetteville shale play, the representative ROW that would be occupied by the Project constitutes a small share of the area and is not expected to result in overall reductions to future shale play development.

Potential adverse impacts to mineral resources and supporting infrastructure would be minimized through the implementation of EPMs GE-29, LU-1, and LU-4. These measures state that Clean Line will work with landowners and operators of active oil and gas wells, utilities, and other infrastructure to identify and verity the location of facilities and to minimize adverse impacts (GE-29); the Project would be designed to avoid crossing existing operations (such as the well pads of any active oil and gas wells or impeding access to these resources) (LU-1); and that Clean Line will work with landowners and operators to ensure that access is maintained as needed to existing operations (e.g., to oil/gas wells, private land, agricultural areas, pasture, hunting leases) (LU-4). Micrositing of the lines and towers can be employed when necessary to allow adequate access to existing infrastructure.

3.13.6.2.2.3.2 Operations and Maintenance Impacts

Operations and maintenance of the HVDC and AC transmission lines would employ 32 workers in Oklahoma: 15 in Guymon, Oklahoma (Texas County) (Region 1), seven in Woodward, Oklahoma (Region 2), and 10 in Muskogee, Oklahoma (Region 3). An additional 10 workers would be employed in Newport, Arkansas (Jackson County) (Region 6). Using the annual average wage for installation, maintenance, and repair occupations in the electric power generation, transmission, and distribution industry ($67,950), these jobs would support an estimated direct total of $2.07 million in salary and wages in Oklahoma and $0.65 million in Arkansas. Total (direct, indirect, and induced) estimated employment and earnings are presented by affected region in Table 3.13-31.

Table 3.13-31:
Estimated Total Employment Associated with Operations and Maintenance of the Applicant Proposed Route by Region and Year

Region[2]	Employment[1]		Earnings[1]	
	Direct	Total (Direct, Indirect, and Induced)[3]	Direct[4] ($ million)	Total (Direct, Indirect, and Induced)[3] ($ million)
1	15	54	$1.0	$2.1
2	7	25	$0.5	$1.0
3	10	36	$0.7	$1.4
6	10	25	$0.7	$1.1

1 The values in this table would not change as a result of the minor route variations and adjustments to the HVDC Applicant Proposed Route.
2 Data are presented for the regions where operations and maintenance staff would be based. No operations and maintenance staff are proposed for locations in Regions 4, 5, or 7.
3 Total impacts (employment and earnings) are estimated using statewide multipliers for the utilities sector for Oklahoma (Regions 1, 2, and 3) and Arkansas (6) from the BEA (2013b).
4 Total direct earnings are estimated using an annual average wage of $67,950 (BLS 2012)

Operations and maintenance of the Oklahoma converter station is expected to support up to 15 workers, with estimated annual earnings of approximately $1 million. This employment would support approximately 54 total (direct, indirect, and induced) jobs and $2.1 million in annual earnings (Table 3.13-27). Operations and maintenance of this converter station and HVDC and AC transmission line operations and maintenance in Region 1 would support a combined annual total of 108 jobs and $4.3 million in earnings. The operation and maintenance employees associated with the Tennessee converter station would not be expected to reside in the same counties as the HVDC transmission line staff.

3.13.6.2.2.3.3 Decommissioning Impacts

Decommissioning of the HVDC transmission line would require a labor force approximately equal to that needed for its construction. Local expenditures on materials and supplies and payments to workers would likely be similar, resulting in broadly similar economic impacts to those from construction.

3.13.6.2.3 Agriculture

3.13.6.2.3.1 Converter Stations and AC Interconnection Siting Areas

3.13.6.2.3.1.1 Construction and Operations and Maintenance

Both of the converter stations would affect agricultural land use. The Oklahoma converter station is located on rangeland and would involve the conversion of 45 to 60 acres to industrial use. Construction of the Tennessee converter station would involve the conversion of approximately 45 to 60 acres of land to industrial land use. Potentially affected land uses would likely include cultivated crops and pasture/hay. Construction of both converter stations would also temporarily disturb an additional 5 to 10 acres. Other related short- and long-term land use impacts are described in Section 3.2.6.2.1. These land use conversions would affect a very small share of the total agricultural land use in the Texas County, Oklahoma, and Shelby County, Tennessee, which included about 1.3 million and 81,860 acres in 2012, respectively (see Table 3.13-9).

3.13.6.2.3.1.2 Decommissioning Impacts

Decommissioning of the converter stations would involve restoring the affected sites to their preconstruction condition to the extent possible and a return to their preconstruction use. Some of the affected areas could be used for agriculture again at some point in the future.

3.13.6.2.3.2 AC Collection System and HVDC Applicant Proposed Route

3.13.6.2.3.2.1 Construction and Operations and Maintenance

The majority of the land in the ROI used to assess land use impacts is used for agriculture, with cultivated crops, grassland/herbaceous, and pasture/hay land covers together ranging from 38 percent of the land use ROI in Region 5 to 90 percent in Region 1 (see Tables 3.10-3 through 3.10-11). Livestock dominates the agricultural sectors in Regions 1 through 4 in terms of total market value of agricultural products sold (Table 3.13-9; Figure 3.13-1). Cultivated crops make up a large share of the land use in the land use ROI for Regions 6 and 7, accounting for 78 percent and 69 percent of their respective totals. Crops also account for the vast majority of the value of agricultural products sold in these regions (Table 3.13-9; Figure 3.13-1).

Several people commenting on the Draft EIS stated that farmers and other rural landowners are unique in their ties to the land, with farms and land holdings often passed down through generations, and that if displaced, these landowners would have difficulty finding another property with similar attributes. Commenters also felt that rural landowners are unique because much of their income may be invested in their land and farming operations rather than banks. No farmers and rural landowners are expected to be displaced as a result of the Project.

The introduction of a new transmission line can have an impact on agricultural production by reducing the acreage available for cultivation and, in some cases, disrupting existing harvest patterns, with new transmission line structures affecting the farmer’s ability to maneuver equipment in the vicinity of the immediately affected area. A new transmission line also has the potential to negatively affect farm operations that employ pivot irrigation systems by potentially disrupting the “sweep area.” Potential impacts to agricultural land are discussed in Section 3.2 and include the potential impacts to livestock grazing, crop production, irrigation, global navigation satellite systems (GNSS), and aerial spraying. Impacts addressed include those associated with construction, operations and maintenance, and decommissioning of the Project.

Viewed in terms of agricultural operations in the socioeconomic ROI, total estimated disturbance based on the land use ROI represents a very small share of the 14 million acres of land in farms in the 33 potentially affected counties and is unlikely to noticeably affect overall agricultural production and employment in any of the affected counties. Impacts could, however, be potentially significant to the individual operations affected.

3.13.6.2.3.2.1.1 *Livestock*

Construction and operations and maintenance of the transmission lines could affect the economic value of livestock production in the ROI by increasing ranchers’ costs and decreasing available forage. Potential impacts during construction could result from road construction providing increased access and related disturbance to livestock grazing patterns, temporary reductions in available forage, and reductions in the palatability of forage due to construction-related dust.

The Project could affect net earnings from livestock production in the following ways:

- Decreased forage from land taken out of production.
- Increased management costs associated with controlling additional noxious and invasive vegetation species introduced by Project construction equipment.
- Increased management costs associated with moving livestock around Project-related structures and easements.

Total construction- and operations and maintenance-related disturbance to rangeland and pasture is discussed by Region in Section 3.2. This analysis evaluates impacts in terms of acres of forage that would be temporarily (construction) or permanently (operations) unavailable for use.

The value of the grazing land that would be affected can be approximated using data compiled by the USDA. The average land value for pasture in the affected states ranged from $1,330 per acre in Oklahoma to $3,600 per acre in Tennessee (Table 3.13-32). Average cash rents for pasture ranged from $6.5 per acre in Texas to $20 per acre in Tennessee (Table 3.13-33).

Table 3.13-32:
Average Agricultural Land Value per acre by State, 2013

State	Pasture	Cropland		
		Irrigated[1]	Non-Irrigated[1]	Overall Average[1, 2]
Texas	1,560	1,830	1,610	1,640
Oklahoma	1,330	N/A	1,500	1,520
Arkansas	2,400	3,100	1,950	2,560
Tennessee	3,600	N/A	N/A	3,550
U.S. Total	1,200	N/A	N/A	4,000

N/A = Not available; separate irrigated and non-irrigated values are only provided for states with significant irrigated acreage
1 Values are expressed in dollars per acre.
2 This represents the average land value per acre for all cropland (irrigated and non-irrigated).
Source: USDA (2013b)

Table 3.13-33:
Average Agricultural Cash Rent per Acre by State, 2013

State	Pasture[1]	Cropland		
		Irrigated[1]	Non-Irrigated[1]	Overall Average[1, 2]
Texas	6.5	82	24	35.5
Oklahoma	12	70	32	33.5
Arkansas	18	122	50	95.5
Tennessee	20	160	89	92
U.S. Total	12	202	125	136

1 Values are expressed in dollars per acre.
2 This represents the average land value per acre for all cropland (irrigated and non-irrigated).
Source: USDA (2013a)

3.13.6.2.3.2.1.2 *Cropland*

Construction of the transmission lines could affect net earnings from cropland in the following ways:

- Reduce acreage available for cultivation and use due to the placement of transmission structures, access roads, and other proposed Project uses.
- Increase irrigation costs due to limitations placed with respect to pivot irrigation systems.
- Increase costs due to the need to maneuver farming equipment around transmission structures.
- Increase management costs associated with controlling additional noxious and invasive vegetation species introduced by Project construction equipment.
- Reduce productivity as a result of construction-related soil compaction and erosion and damage to drainage tiles.

Potential impacts to cropland would vary based on the design and location of the transmission line structures and access roads relative to existing agricultural operations.

The value of the cropland that would be affected can be approximated using average land value and cash rent data compiled by the USDA (2013a, 2013b). The average land value for cropland in the affected states ranged from $1,520 per acre in Oklahoma to $3,550 per acre in Tennessee (Table 3.13-32). Average land values for irrigated and non-irrigated cropland are only available for those states with substantial irrigated acreage. Values are typically higher for irrigated land as illustrated in Table 3.13-32. Average cash rents for cropland ranged from $33.5 per acre in Oklahoma to $95.5 per acre in Arkansas (Table 3.13-33). Average cash rents were higher for irrigated than non-irrigated cropland, with average cash rents for irrigated cropland ranging from $70 per acre in Oklahoma to $160 per acre in Tennessee.

The Arkansas Delta Agricultural Economic Impact Study (Arkansas Delta study) commissioned by the Applicant assesses the potential economic impact of the Project on agricultural resources in Jackson, Poinsett, Cross, and Mississippi counties, Arkansas (see Appendix J). These counties are spread over two regions, Regions 6 and 7 (Table 3.13-1). Much of the cropland in these counties has a higher land value than the Arkansas average of $2,560 per acre in 2013 (Table 3.13-32), with prices ranging up to $5,000 per acre. These high values reflect local conditions (soil and topography) that allow farmers to precision level their fields and the ready availability of irrigation water from shallow aquifers.

The Arkansas Delta study estimated the following potential Project-related monetary impacts: one-time impacts expected to occur during construction and operation and annual impacts expected to occur for the life of the project.

3.13.6.2.3.2.1.2.1 One-Time Impacts

Using a “with and without Project” framework, the Arkansas Delta study estimated one-time impacts to agricultural production using data from the University of Arkansas crop budgets and a weighted average of net returns for six crops (corn, soybeans, rice, cotton, wheat, and sorghum). Net returns are estimated by subtracting production and capital costs from gross revenues (average yield per crop × price per unit). Values for the six major crops were weighted based on their share of total cropland in the four study-area counties resulting in a “without Project” average net return of $331 per acre based on a full year of costs and returns (Table 3.13-34).

Net returns estimated for the same average or “composite” acre “with Project” assume no revenues and vary depending on the time year that Project construction begins and the production costs that have been incurred up to that point. If construction begins in March, estimated cumulative production costs per disturbed composite acre would be $60, increasing as the season progresses and peaking at $407 per acre in August. Capital recovery costs are assumed to be constant at $47 per composite acre. Table 3.13-34 shows estimated with Project net returns per composite acre by month.

Table 3.13-34:
Estimated Monetary Impact per Composite Acre by Month

Month	Value per Composite Acre[1]					
	Net Return Without Project	Gross Revenues With Project	Cumulative Production Cost With Project[2]	Capital Cost With Project	Net Return With Project[3]	Estimated Monetary Impact[4]
March	$331	$0	$60	$47	-$107	-$438
April	$331	$0	$161	$47	-$208	-$539
May	$331	$0	$289	$47	-$336	-$667
June	$331	$0	$344	$47	-$391	-$722
July	$331	$0	$369	$47	-$416	-$747
August	$331	$0	$407	$47	-$454	-$785
September	$331	$0	$264	$47	-$311	-$642

1 Values for an average or composite acre were estimated using data from University of Arkansas crop budgets, with values for six major crops (corn, soybeans, rice, cotton, wheat, and sorghum) weighted based on their share of total cropland in the four study area counties. Corresponding estimates of net returns are presented by crop in Appendix 7.7 to the Arkansas Delta study (see Appendix J to this EIS).
2 Production costs consist of operating and post-harvest costs. Operating costs were estimated based on seasonal investments in crop production, which increase as the season progresses up until harvest. For summer crops, production expenditures are lowest from October through February when investments mainly consist of field work completed in fall in preparation for the next crop. Field expenses start to increase in March as farmers till, fertilize, and implement weed control measures in advance of planting, and they continue to increase until the crop is harvested in the fall.
3 The net return with Project equals gross revenues with Project minus cumulative production and capital costs.
4 Estimated monetary impacts per composite acre consist of the net return with Project minus the net return without Project.
Source: Appendix J

3.13.6.2.3.2.1.2.2 Annual Impacts

The Arkansas Delta study (Appendix J of this EIS) considered potential annual impacts to agricultural water management systems, aerial application (crop dusting), crop production logistics, and crop insurance and commodity programs.

Agricultural Water Management Systems

According to Arkansas Delta study, the proposed transmission line structures could potentially affect both center-pivot and furrow irrigation systems. Where sprinkler (center-pivot) irrigation is used, depending on its location, the presence of a new transmission line structure could prevent the pivot from being able to traverse the entire circle, with the area affected increasing the closer the structure is located to the pivot point. For fields with furrow irrigation systems, placement of a new transmission line structure could block the flow of water downstream of the structure, with the area affected increasing the closer the structure is to the upper end of the furrow.

The Arkansas Delta study estimated potential monetary impacts based on the net return for a composite acre that is a weighted average of net returns for irrigated corn, soybean, cotton, and sorghum. Impacts may be estimated by assuming that land that is no longer irrigated will be converted to dryland production, with a commensurate reduction in yield per acre and net returns. The estimated change in net return would involve a reduction from $276 per composite acre to $104 per acre, a 62 percent reduction in net returns. Annual impacts may subsequently be estimated by adjusting estimated net returns based on the number of acres expected to be converted from irrigated to dryland farming.

Aerial Applications (Aerial Spraying)

The Arkansas Delta study assumes that the presence of a transmission line would impede the ability of applicators to apply fertilizers and chemicals resulting in a reduction in yields, which the study authors assumed would be equivalent to 50 percent of the without Project yield. Reducing yields by 50 percent would reduce net returns per composite acre from $331 to -$19 per acre. Impacts may subsequently be estimated by adjusted based on the number of acres where aerial application would be affected.

Crop Production Logistics

The placement of transmission line structures could potentially affect crop production logistics by requiring a farmer to spend additional time maneuvering around the structures. The Arkansas Delta study did not quantify these potential impacts, but it should be noted that with large equipment, the additional time required to maneuver could add to crop production costs in affected areas, especially when combined with associated damage to crops.

Crop Insurance and Commodity Programs

The Arkansas Delta study discusses potential impacts to crop insurance and commodity payment programs in qualitative terms. The crop insurance program uses a 10-year crop yield history to determine losses and payments. Any potential reduction in yield, therefore, has the potential to affect crop insurance damage assessments and payments should a crop be damaged from a storm. Further, changes in yield over time could potentially affect payments a farmer might receive from the new Agricultural Risk Coverage (Individual option) program in the 2014 Farm Bill.

3.13.6.2.3.2.2 Decommissioning Impacts

Potential impacts to agriculture during decommissioning would be similar to those experienced during construction. Decommissioning could involve restoring the affected sites to their preconstruction condition to the extent possible and a return to their preconstruction use. Some of the affected areas could be used for agriculture again at some point in the future.

3.13.6.2.4 Housing

An estimated 26 percent of the construction workforce would be hired and/or contracted locally (i.e., within commuting distance) and would likely commute to and from their homes to work each day. The remaining 74 percent of the construction workforce is assumed to permanently reside further than commuting distance from the Project sites and would be expected to temporarily relocate to the ROI or immediate vicinity for the duration of their employment, possibly commuting home on weekends, depending on the location of their primary residence (Clean Line 2014a). Approximately 10 percent of workers temporarily relocating are assumed for the purposes of analysis to be accompanied by their families (see Section 3.13.9.3).

Almost half (45 percent) of the workers temporarily relocating are expected to require motel or hotel rooms, with the remaining non-local workers expected to require rental housing (apartments, houses, or mobile homes) (20 percent), or provide their own housing in the form of RVs or pop-up trailers (35 percent). Construction workers, particularly those working in less populated areas, often commute relatively long distances to job sites depending on cost and availability of housing and community amenities/services within the vicinity. The Applicant estimates that workers could commute up to 2 hours or approximately 100 miles each way.

Housing availability within the vicinity of the Project would be influenced by a number of factors outside Project demand. Other sources of temporary housing demand could include other construction projects, community-sponsored events, and hunting and other recreational activities.

3.13.6.2.4.1 Converter Stations and AC Interconnection Siting Areas

3.13.6.2.4.1.1 Construction Impacts

Construction of each of the converter stations is expected to employ an average of 138 workers over a 32-month construction period. The share of non-local workers is assumed to be 74 percent for the full duration of construction for each converter station, resulting in an average of 102 non-local workers employed over the 32-month construction period, with an estimated peak of 179 non-local workers employed during months 12 to 17 (Figure 3.13-2). The Oklahoma converter station would be located in Region 1; the Tennessee converter station would be located in Region 7.

Table 3.13-35 compares projected peak housing demand with estimated supply in the two affected regions. These data suggest that adequate temporary housing resources likely exist within each of the affected regions, a situation that is especially likely to be the case for the Tennessee converter station, which is located within commuting distance of the city of Memphis. Existing housing resources are substantially more limited in Region 1, within the counties that make up the region and also elsewhere within a commuting distance of up to 2 hours. Unlike Regions 3 through 7, there are no large communities within 2 hours commuting distance of Region 1. Economic development organizations in the Oklahoma Panhandle region have identified a potential shortage in permanent housing in and around the city of Guymon in Texas County, with these problems expected to be further exacerbated by future wind energy development (Fleming 2013).

3.13.6.2.4.1.2 Operations and Maintenance Impacts

Operations and maintenance of each of the converter stations is expected to employ up to 15 workers. These estimated staffing levels would have a minor impact on existing demand for housing in the potentially affected areas.

3.13.6.2.4.1.3 Decommissioning Impacts

Decommissioning each of the converter stations would require a labor force approximately equal to that needed for its construction. Impacts to housing from decommissioning are, therefore, expected to be similar to those from construction.

3.13.6.2.4.2 AC Collection System

3.13.6.2.4.2.1 Construction Impacts

Assuming six routes with an average length of 34.4 miles are constructed at the same time would result in a combined average of 226 non-local workers and an estimated combined peak of 316 non-local workers temporarily relocating to Region 1. A comparison of expected peak housing demand with existing temporary housing resources suggests that this demand would be equivalent to 52 percent of the hotel and motel rooms assumed to be available and 47 percent of all identified RV spaces (Table 3.13-35).

Table 3.13-35:
Estimated Construction-Related Housing Demand by Project Component, Housing Type, and Region

Region	Projected Non-Local Employment[1]		Projected Peak Housing Demand[2]			Estimated Available Housing Units[3]			Projected Demand as a Share of Existing Resources		
	Average Employment (Jobs/Week)	Peak Employment (Jobs/Week)	Rental Housing	Hotel and Motel Rooms	RV Spaces	Rental Housing[4]	Hotel and Motel Rooms[5]	RV Spaces	Rental Housing	Hotel and Motel Rooms	RV Spaces
Converter Stations											
1	102	179	36	81	63	370	273	235	10	29	27
7	102	179	36	81	63	23,358	2,957	393	0	3	16
AC Collection System[6]											
1	226	316	63	142	111	370	273	235	17	52	47
Applicant Proposed Route[7]											
1	119	168	34	76	59	370	273	235	9	28	25
2	112	158	32	71	55	862	401	94	4	18	59
3	182	255	51	115	89	3,193	718	679	2	16	13
4	130	182	36	82	64	1,335	467	440	3	18	14
5	142	200	40	90	70	4,207	1,137	633	1	8	11
6	47	66	13	30	23	908	60	51	1	50	45
7	32	46	9	20	16	23,358	2,957	393	0	1	4
Converter Stations, AC Collection System Routes, and Applicant Proposed Route											
1	447	663	133	298	232	370	273	235	36	109	99
7	134	225	45	101	79	23,358	2,957	393	0	3	20

1 An estimated 74 percent of the total construction workforce is assumed to be non-local for the duration of the Project.
2 Projected housing demand is assumed to be divided as follows: rental housing (apartments, houses, or mobile homes) (20 percent), hotel and motel rooms (45 percent), and RV spaces (35 percent) (Clean Line 2013).
3 Estimated available housing units are presented by county in Table 3.13-10. Data are presented for those counties within the ROI only.
4 Many of these available units include more than one bedroom and, if rented, could be occupied by more than one worker. A large number of in-migrating workers on similar projects typically rent a room in a house or live five in a rented house (BLM 2013).
5 Assumes an average occupancy rate of 75 percent for the purposes of analysis, with 25 percent of total units assumed to be potentially available.
6 Assumes six AC collection system routes with an average length of 34.4 miles.
7 The values in this table would not change as a result of the minor route variations and adjustments to the HVDC Applicant Proposed Route.

This page intentionally left blank.

3.13.6.2.4.2.2 Operations and Maintenance Impacts

Combined operation of the HVDC and AC transmission lines in Region 1 is expected to employ 15 workers based in Guymon, Oklahoma (Texas County). This number is not expected to vary based on the selected AC collection system routes or affect existing trends in housing demand in Texas County.

3.13.6.2.4.2.3 Decommissioning Impacts

Decommissioning of the AC transmission lines would require a labor force approximately equal to that needed during construction. Impacts to housing from decommissioning are, therefore, expected to be similar to those from construction.

3.13.6.2.4.3 HVDC Applicant Proposed Route

3.13.6.2.4.3.1 Construction Impacts

The HVDC transmission line would be constructed in five 140-mile-long segments, each taking 24 months to complete. Total employment by month is expected to range from 55 workers in month 24 to a peak of 290 workers in months 4, 5, and 6, with an average monthly employment of 207. The share of non-local workers is assumed to be 74 percent for the full duration of the Project. Non-local employment is expected to range from 41 workers per month in month 24 to 215 workers per month in months 4 to 6, with an average monthly employment of 153 (Figure 3.13-4).

Projected peak housing demand is compared with estimated supply by region in Table 3.13-35. The distribution of non-local workers is based on the miles of transmission line for each region and an average 140-mile-long segment. Demand for rental housing would range from less than 0.1 percent of the estimated available units in Region 7 to 9 percent in Region 1. Estimated peak demand for hotel and motel rooms as a share of existing available units would range from 1 percent in Region 7 to 50 percent in Region 6. Demand as a share of available hotel and motel rooms would also be relatively high in Region 1, accounting for about 28 percent of the available supply (Table 3.13-35).

Estimated peak demand for RV spaces as a share of total identified spaces would range from 4 percent in Region 7 to 59 percent in Region 2. Demand as a share of identified spaces would also be relatively high in Region 6, accounting for about 45 percent of the identified spaces (Table 3.13-35).

Table 3.13-35 also summarizes the estimated demand for housing if construction of the converter stations, AC collection system routes, and Applicant Proposed Route were to all peak at the same time. If construction of the Oklahoma converter station, six AC collection system routes, and the portion of the HVDC transmission line for Region 1 all occurred at the same time, demand for hotel and motel rooms would exceed the estimated available supply by 7 percent and demand for RV spaces would almost be equal to the total number of identified spaces (Table 3.13-35).

If the Tennessee converter station and the portion of the HVDC transmission line for Region 7 were built at the same time, demand for rental housing would be less than 1 percent of the estimated available properties, demand for hotel and motel rooms would be equivalent to 3 percent of the available supply, and demand for RV spaces would be equal to 20 percent of the total identified spaces (Table 3.13-35).

3.13.6.2.4.3.2 Operations and Maintenance Impacts

Operations and maintenance of the HVDC and AC transmission lines would employ 32 workers in Oklahoma: 15 in Guymon, Oklahoma (Texas County) (Region 1), seven in Woodward, Oklahoma (Region 2), and 10 in Muskogee, Oklahoma (Region 2). An additional 10 workers would be employed in Newport, Arkansas (Jackson County) (Region 6). These estimated staffing levels would not be expected to affect existing trends in housing demand in the potentially affected counties or regions.

Operations and maintenance of the converter station in Texas County, Oklahoma, would employ up to 15 workers. If these workers and those required to operate and maintain the HVDC and AC transmission lines in Texas County all permanently relocated to the area from elsewhere, these combined staffing levels would still not be expected to have more than a minor impact on existing housing demand. The operations and maintenance employees associated with Tennessee converter station would not be expected to reside in the same counties as the HVDC transmission line staff.

3.13.6.2.4.3.3 Decommissioning Impacts

Decommissioning of the HVDC transmission line would require a labor force approximately equal to that needed for its construction. Impacts to housing from decommissioning are, therefore, expected to be similar to those from construction.

3.13.6.2.5 Property Values

The HVDC transmission line would require a new ROW. The effect that a transmission line may have on property value is a damage-related issue that would be part of the negotiation between the Applicant and the affected landowner during the easement acquisition process. In theory, the value of each easement should be equal to the difference in value of the affected property before and after easement acquisition and construction of the facilities.

Changes in land use often raise concerns about the potential effect these changes may have on nearby property values. Research into the relationship between electric transmission facilities and local property values has tended to focus on residential properties, employing research methods that can, for the most part, be divided into surveys and opinion-based studies on one hand and quantitative studies largely based on comparisons of market data on the other.

Research conducted since the 1980s has tended to support the idea that proximity to transmission lines may affect the desirability and, therefore, the value of residential property (Bottemiller et al. 2000; Colwell 1990; Cowger et al. 1996; Delaney and Timmons 1992; Des Rosiers 2002; Hamilton and Schwann 1995). Some observers linked this general finding to increased concerns regarding potential EMF-related health effects, but a nationwide survey of real estate appraisers suggests that, for the most part, potential negative effects on property values tend to be related to the visual impact of transmission line facilities (Delaney and Timmons 1992).

The results of the studies cited above suggest that proximity to electric transmission lines can have negative effects on residential property values, with average impacts ranging from less than 1 percent to about 10 percent. The findings of these studies also suggest that this impact decreases with distance and tends to decline over time. A detailed literature review conducted by Chalmers and Voorvaart (2009) supported these conclusions, finding that in studies where depreciation was found, the typical change ranged from 3 percent to 6 percent within a few hundred feet and tended to decrease with distance and over time.

Studies of property-value impacts during periods of physical change, such as new transmission line construction or structural rebuilds, have generally revealed greater short-term impacts than long-term effects. Most studies have concluded that other factors, such as the general location, the size of property, improvements, conditions, amenities, and supply and demand factors in a specific market area are more important criteria than the presence or absence of transmission lines in determining the value of residential real estate.

Some short-term adverse impacts on residential property values (and marketability) might occur on an individual basis as a result of the Project. However, these impacts would be highly variable, individualized, and are difficult to predict. Unique Project characteristics that need to be taken into consideration when assessing the potential effects of transmission line structures on residential property values include the type and height of the structures, the distance and view from the potentially affected property, intervening topography and vegetation, and the property market and type of landscape involved. Chalmers (2012) evaluated the impacts of a 500kV transmission line on rural residential subdivisions in Montana using a case-study approach and a limited number of sales. Finding some evidence of impacts to sales price and the time it took for a property to sell, Chalmers notes that effects vary depending on the characteristics of the affected property and placement of the transmission line.

Few studies have addressed the impacts of transmission lines on the value of commercial and industrial properties. Those that have done so generally find the impacts are less than the impacts on residential properties. In interviews with appraisers, real-estate brokers, and owners and managers of commercial and industrial parks, Chapman (2005) found that, for the most part, the presence of a transmission line had little effect on market prices for commercial and industrial properties.

A review of studies of the impacts on agricultural land found that overhead transmission lines have the potential to reduce the sales price and the effect can vary widely, ranging from no effect to a decrease of 20 percent or more depending on the productivity of the land and the amount of disruption to farm operations (Kroll and Priestly 1992). Priestley (2015) noted that the cited decrease of 20 percent was based on a single appraiser study and was not consistent with the findings of other research on the effects of transmission lines on agricultural properties. More recently, Jackson (2010) assessed the impact of transmission lines on rural land used for agricultural or recreational purposes in Wisconsin. Using multivariate statistical analysis, Jackson found that prices for properties sold with a transmission line easement were 1.1 percent to 2.4 percent less than otherwise comparable properties sold at least 0.25 mile from a transmission line. These differences were not statistically significant (Jackson 2010). Chalmers (2012) evaluated the impacts of a 500kV transmission line on rural property values in Montana. Using a case-study approach and a range of techniques, including paired sales comparison and interviews, Chalmers considered the impacts to a range of rural land uses, broadly comparable to those that would be affected by the Project. Evaluating transactions for production agricultural lands, agricultural lands with recreational influence, and agricultural lands with high amenity recreation and natural features, Chalmers found no evidence that the presence of a transmission line affected sales price.

3.13.6.2.6 Community Services

3.13.6.2.6.1 Converter Stations and AC Interconnection Siting Areas

3.13.6.2.6.1.1 Construction Impacts

Projected peak employment and the number of workers and family members expected to temporarily relocate during construction of the converter stations is discussed in Section 3.13.9.3. The peak increase for each station, estimated to be about 213 people during months 12 to 17, would be equivalent to approximately 1 percent and less than 0.1 percent of the respective existing (2012) populations in Texas County, Oklahoma, and Shelby County, Tennessee.

The temporary addition of these workers to local communities is not expected to affect the levels of service provided by existing law and fire protection personnel. The number of law enforcement and fire departments per county are identified in Table 3.13-11. Increased demands for local services that could occur from construction workers and family members temporarily relocating to the affected areas would be short term. It is anticipated that community commercial and retail services would experience an economic benefit from additional spending from relocating workers and their families.

The closest major medical facility to the Oklahoma converter station is the Memorial Hospital of Texas County, located 10.3 miles northwest of the site in Guymon, Oklahoma. This 47-certified-bed facility has a staff that includes 17 licensed practical nurses, 45 registered practical nurses, and two full-time physicians. This hospital provides emergency room services and would be capable of treating most construction-related injuries. At least six hospitals serve the Memphis area in Tennessee and would be capable of treating construction-related injuries were they to occur (Table 3.3-12). The temporary relocation of workers and family members to the affected areas is not expected to affect existing levels of health care and medical services. Minor increases in demands for local services that could occur from workers and family members temporarily relocating to the area would be short term.

An average and peak of 10 and 18 school-age children are expected to temporarily relocate to the affected counties during construction of each converter station. This potential increase in the number of students would not be expected to affect existing average student/teacher ratios in either affected area (Table 3.13-13).

3.13.6.2.6.1.2 Operations and Maintenance Impacts

Operations and maintenance of each of the converter stations is expected to employ up to 15 workers. If these workers and their families were to relocate from elsewhere, the resulting very small increase in population would not be expected to noticeably affect the provision of community services.

3.13.6.2.6.1.3 Decommissioning Impacts

Decommissioning of each converter stations would require a labor force approximately equal to that needed for its construction. Impacts to community services from decommissioning are, therefore, expected to be similar to those from construction.

3.13.6.2.6.2 AC Collection System

3.13.6.2.6.2.1 Construction Impacts

Projected peak employment and the number of workers and family members expected to temporarily relocate during construction of the AC collection system routes are discussed in Section 3.13.9.3. Assuming that six routes with an average length of 34.4 miles are constructed would result in average and peak population increases of about 271 and 379 people, respectively, approximately 0.5 percent and 0.7 percent of the total 2012 population in Region 1. The temporary addition of these workers to local communities is not expected to affect the levels of service provided by existing law and fire protection personnel. The number of law enforcement and fire departments per county are identified in Table 3.13-11. Increased demands for local services that could occur from construction workers and family members temporarily relocating to the area would be short term. It is anticipated that community commercial and retail services would experience an economic benefit from additional spending from relocating workers and their families.

Construction of the AC collection system routes could result in increased demand for emergency services. Local police assistance would likely be required to facilitate traffic flows during construction at some road crossings and permits may be required for vehicle load and width limits for some of the vehicles delivering Project materials and supplies.

Medical facilities located in Region 1 are identified in Table 3.3-12. Medical facilities are limited in the Texas counties in the region. The Ochiltree General Hospital, a Level IV trauma center, provides emergency services in Ochiltree County. Emergency medical services are provided in Sherman County by the Stratford EMS. Additional hospitals are located in neighboring counties, including the Moore County Hospital, south of Sherman County, which provides 24-hour emergency services. The Oklahoma counties in Region 1—Cimarron, Texas, Beaver, and Harper counties—each have a hospital that provides 24-hour emergency services. These facilities would be capable of treating most construction-related injuries. The temporary relocation of workers and family members to the counties in the region is not expected to affect existing levels of health care and medical services. Minor increases in demands for local services that could occur from workers and family members temporarily relocating to the area would be short term.

The estimated number of children expected to temporarily relocate to Region 1 during peak construction ranges from about 2 (AC Collection System Routes SE-2 and SW-1) to 8 (AC Collection System Route Alternative NW-1). If six routes with an average length of 34.4 miles are constructed, an estimated peak increase of 38 school-age children would result. These children would likely be located in a number of different school districts throughout Region 1 and would not be expected to affect existing average student/teacher ratios (Table 3.13-13).

3.13.6.2.6.2.2 Operations and Maintenance Impacts

Combined operation of the HVDC and AC transmission lines in Region 1 is expected to employ 15 workers based in Guymon, Oklahoma (Texas County). This number is not expected to vary based on the selected AC collection system routes. If these workers and their families were to relocate from elsewhere, the resulting very small increase in population would not be expected to noticeably affect the provision of community services.

3.13.6.2.6.2.3 Decommissioning Impacts

Decommissioning of the transmission lines would require a labor force approximately equal to that needed for their construction. Impacts to community services from decommissioning are, therefore, expected to be similar to those from construction.

3.13.6.2.6.3 HVDC Applicant Proposed Route

3.13.6.2.6.3.1 Construction Impacts

Projected peak employment and the number of workers and family members expected to temporarily relocate during construction of the Applicant Proposed Route are identified by Region in Table 3.13-23, with peak increases in populations ranging from less than 0.1 percent (Region 7) to 0.4 percent (Region 1) of 2012 population totals. The temporary addition of these workers to local communities is not expected to affect the levels of service provided by existing law and fire protection personnel. Law enforcement and fire departments within each region are identified by county in Table 3.13-11. Increased demands for local services that could occur from construction workers and family members temporarily relocating to the affected Regions would be short term. It is anticipated community commercial and retail services would experience an economic benefit from additional spending from relocating workers and their families.

Construction of the HVDC transmission line could result in increased demand for emergency services. Local police assistance would likely be required to facilitate traffic flows during construction at some road crossings and permits may be required for vehicle load and width limits for some of the vehicles delivering Project materials and supplies.

Medical facilities located near the transmission line are identified by location in Table 3.13-12. Construction of the Applicant Proposed Route should not have significant adverse impacts on local and regional medical facilities and services. The temporary relocation of workers and family members to the counties in the ROI is not expected to affect existing levels of health care and medical services. Minor increases in demands for local services that could occur from workers and family members temporarily relocating to the area would be short term.

The numbers of workers expected to temporarily relocate with their families during construction of the Applicant Proposed Route are identified by Region in Table 3.13-36. Table 3.13-36 also identifies the projected peak and average number of school-age children expected to temporarily relocate to each Region, and compares the peak estimates with the existing number of students in each Region. The projected peak number of school children temporarily relocating to the area would be equivalent to approximately 0.01 percent (Region 7) to 0.14 percent (Region 1) of the existing enrollment in school districts in the regions and would have no noticeable effect on existing average student/teacher ratios (Table 3.13-36).

Table 3.13-36 also summarizes the estimated temporary increase in school-age children if construction of the converter stations, AC collection system routes, and Applicant Proposed Route were to all peak at the same time. This increase would affect Regions 1 and 7 and result in increases in school-age children equivalent to 0.58 percent and 0.04 percent of existing enrollment, respectively (Table 3.13-36). These increases would not be expected to affect existing average student/teacher ratios in these regions.

Table 3.13-36:
Projected Construction-Related Demand for Education Resources by Region

Region	1	2	3	4	5	6	7
Applicant Proposed Route[1]							
Projected Non-Local Employment[2]							
Average Employment (Jobs/Week)	126	116	177	138	123	59	47
Peak Employment (Jobs/Week)	177	162	248	194	173	83	66
Projected Number of School Age Children[3]							
Average	13	12	18	14	12	6	5
Peak	18	16	25	19	17	8	7
Estimated Education Resources							
Number of Schools	66	52	177	68	119	21	87
Number of Students	12,701	16,012	57,993	27,456	51,455	7,673	65,177
Number of Teachers	1,312	1,455	5,294	2,112	3,875	611	4,117
Student/Teacher Ratio (average)	9.7	11.0	11.0	13.0	13.3	12.6	15.8
Peak Comparison with Existing Student Numbers							
Percent of Existing Students	0.14	0.10	0.04	0.07	0.03	0.11	0.01

Table 3.13-36:
Projected Construction-Related Demand for Education Resources by Region

Region	1	2	3	4	5	6	7
Applicant Proposed Route, Converter Stations, and AC Collection System Routes[1]							
Projected Number of School Age Children[3]							
Peak	74	16	25	19	17	8	25
Peak Comparison with Existing Student Numbers							
Percent of Existing Students	0.58	0.10	0.04	0.07	0.03	0.11	0.04

1 The values in this table would not change as a result of the minor route variations and adjustments to the HVDC Applicant Proposed Route.
2 An estimated 74 percent of the total construction workforce is assumed to be non-local for the duration of the Project.
3 Projected numbers of school children are based on the assumptions that 10 percent of workers would be accompanied by their families; the average family household includes 1.0 child under the age of 18 years; and all children relocating to the area would be of school age.

3.13.6.2.6.3.2 Operations and Maintenance Impacts

Operations and maintenance of the HVDC and AC transmission lines would employ 32 workers in Oklahoma, including 15 in Guymon, Oklahoma (Texas County) (Region 1), seven in Woodward, Oklahoma (Region 2), and 10 in Muskogee, Oklahoma (Region 3). An additional 10 workers would be employed in Newport, Arkansas (Jackson County) (Region 6). Even if these workers were to relocate to the affected counties from outside the respective region, the associated increase in population would not be expected to noticeably affect the provision of community services.

Operations and maintenance of the converter station in Texas County, Oklahoma, would employ up to 15 workers. If these workers and those required to operate and maintain the HVDC and AC transmission lines in Texas County were all to relocate to the area permanently from elsewhere, these combined staffing levels would still not be expected to have a noticeable impact on community services. The operations and maintenance employees associated with Tennessee converter station would not be expected to reside in the same counties as the HVDC transmission line staff.

3.13.6.2.6.3.3 Decommissioning Impacts

Decommissioning the HVDC transmission line would require a labor force approximately equal to that needed for its construction. Impacts to community services from decommissioning are, therefore, expected to be similar to those from construction.

3.13.6.2.7 Tax Revenues

3.13.6.2.7.1 Converter Stations and AC Interconnection Siting Areas

3.13.6.2.7.1.1 Construction Impacts

Construction of the converter stations would generate sales, use, and lodging tax revenue during the construction period. According to the Applicant, approximately 90 percent of the total estimated construction costs of $250 million for each station would be for materials subject to sales and use tax in Oklahoma and Tennessee, respectively. Estimated sales and use tax revenues are summarized for the two converter stations in Table 3.13-37. Estimated state and county revenues are higher for the Tennessee converter station because the sales and use tax rates are higher in Tennessee and Shelby County (see Tables 3.13-14 and 3.13-17). These revenues would be generated over the 32-month construction period projected for each converter station. The Oklahoma and Tennessee converter stations would be located in Regions 1 and 7, respectively. Local spending by construction workers would also generate sales and lodging tax revenues, but the amount and distribution of this type of spending is difficult to accurately forecast. These potential revenues are not estimated here.

Table 3.13-37:
Estimated Sales and Use Tax Revenues from Converter Station Construction ($ million)

Converter Station	Total Estimated Cost[1]	Estimated State Revenues	Estimated County Revenues
Oklahoma	$250	$10.1	$2.3
Tennessee[1]	$250	$15.8	$5.1

1 Total estimated costs are from Clean Line (2013).

3.13.6.2.7.1.2 Operations and Maintenance Impacts

Operations of the converter stations would generate annual property or ad valorem tax revenues in the counties where they would be located. Using a simplified cost approach and an assumed value of $250 million (Clean Line 2013), annual ad valorem or property tax revenues generated by the Oklahoma converter station would range from $3.2 million to $4.6 million. These estimates are based on Oklahoma's assessment ratio (the share of assessed value subject to taxation) of 22.85 percent and the low and high millage rates identified for Texas County in 2012 (Table 3.13-19). These estimates are for payments that would be made in the first year of operation. Thereafter, ad valorem taxes would be paid annually based on an annual assessment by the responsible taxing agency.

Clean Line has entered into a payment in lieu of taxes (or "PILOT") arrangement with the Economic Development Growth Engine Industrial Development Board of City of Memphis and Shelby County, Tennessee ("EDGE"), with respect to the Tennessee converter station. Plains & Eastern was awarded a 41 percent 11-year PILOT incentive on the real and tangible personal property at the converter station. According to the terms of the agreement, after the construction of the Project, Shelby County would receive an estimated $3.19 million annually for the term of the PILOT and $5.4 million thereafter. Plains & Eastern would pay 59 percent of the assessed value for all real and tangible personal property during the term of the PILOT lease.

3.13.6.2.7.1.3 Decommissioning Impacts

Decommissioning the Project would involve local expenditures for supplies and services and would likely require the temporary influx of construction workers to remove the Project components. This spending would be expected to generate local sales and use tax. It is not possible to estimate approximate values, but adjusted for inflation, tax revenues would likely be generally equivalent to those estimated for construction, other conditions remaining equal. Removal of the Project would reduce the value of the affected property and result in a net reduction in ad valorem and property taxes, generally equivalent to the estimates developed for Project operations.

3.13.6.2.7.2 AC Collection System

3.13.6.2.7.2.1 Construction Impacts

The Applicant estimates that the AC transmission lines would cost $1 million to build per mile with 90 percent of this cost expected to be subject to sales and use tax in the affected states and counties (Clean Line 2014a). Estimated state sales and use tax revenues in Oklahoma range from $0.2 million for AC Collection System Routes SE-2 and SW-1 to $2.5 million for AC Collection System Route Alternative NW-2 (Table 3.13-38). Five of the alternatives are located in Texas counties. Estimated state sales and use tax for those alternatives ranges from $0.6 million (AC Collection System Routes SE-2 and SW-1) to $1.4 million (AC Collection System Routes SE-1 and SW-2). These revenues would be generated over the construction period for each alternative.

Table 3.13-38:
Estimated State Sales and Use Tax Revenues by AC Collection System Route ($ million)

County/ Alternative	Oklahoma[1]				Texas[1]			
	Beaver	Texas	Cimarron	Total	Hansford	Ochiltree	Sherman	Total
E-1	0.2	1.1		1.3				
E-2	0.7	1.1		1.8				
E-3	0.7	1.1		1.8				
NE-1		1.4		1.4				
NE-2		1.2		1.2				
NW-1		2.3	0.1	2.3				
NW-2		2.4	0.1	2.5				
SE-1		0.8		0.8	0.1	1.2		1.4
SE-2		0.2		0.2	0.6			0.6
SE-3	0.1	1.1		1.2		1.3		1.3
SW-1		0.2		0.2	0.6			0.6
SW-2		0.7		0.7	0.2		1.2	1.4
W-1		0.9		0.9				

1 Estimates in this table are for sales and use tax revenues that would be paid to the state. The affected counties in Oklahoma also levy additional sales, use, and lodging taxes (see Table 3.13-15). Estimated county sales and use revenues are not included in this table.

Counties and other local jurisdictions in Texas and Oklahoma are allowed to levy additional sales, use, and lodging taxes within their jurisdictions. Although most counties in Texas levy an additional 0.5 percent sales and use tax, none of the Texas counties in Region 1 currently levy a local sales and use tax (Table 3.13-14). As a result, the AC collection system routes that cross counties in Texas would not generate sales and use tax revenues for those counties.

Sales and use taxes levied by Oklahoma counties are identified in Table 3.13-15 and range from 1 percent to 2 percent in the Oklahoma counties in Region 1. Estimated sales and use tax revenues generated for Texas County would range from less than $0.1 million (AC Collection System Routes SE-2 and SW-1) to $0.5 million (AC Collection System Route NW-1). Four routes cross Beaver County. Sales and use tax revenues generated for that county would range from $0.1 million (AC Collection System Route SE-3) to about $0.7 million (AC Collection System Routes E-2 and E-3). Two routes cross Cimarron County (AC Collection System Routes NW-1 and NW-2) and would each generate less than $0.1 million in county sales and use tax revenues.

Local spending by construction workers would also generate sales and lodging tax revenues, but the amount of spending and distribution by county is difficult to accurately forecast, so these potential revenues are not estimated here.

3.13.6.2.7.2.2 Operations and Maintenance Impacts

Operations and maintenance of the AC collection transmission lines would generate annual property or ad valorem tax revenues in the counties where they would be located. Using a simplified cost approach and an assumed value of $1 million per mile (Clean Line 2014a), annual ad valorem or property tax revenues estimates are presented by alternative and county in Table 3.13-39. In all cases, these estimates are for payments that would be made in the first year of operation. Thereafter, ad valorem taxes would be paid annually based on an annual assessment by the responsible taxing agency.

Estimates for the affected Oklahoma counties (Beaver, Texas, and Cimarron counties) are based on the state assessment ratio (the share of assessed value subject to taxation) of 22.85 percent and the low and high millage rates identified for each county in 2012 (Table 3.13-19). Estimated low ad valorem tax revenues generated for Texas County range from less than $0.1 million (AC Collection System Routes SE-2 and SW-1) to $0.6 million (AC Collection System Route NW-1). Estimated high revenues would range from less than $0.1 million (AC Collection System Routes SE-2 and SW-1) to about $1 million (AC Collection System Route NW-2) (Table 3.13-39).

Low ad valorem tax revenues estimated for Beaver County range from less than $0.1 million (AC Collection System Routes E-1 and SE-3) to about $0.2 million (AC Collection System Routes E-2 and E-3). High estimates range from less than $0.1 million (AC Collection System Route E-1) to about $0.25 million (AC Collection System Route E-3). Two routes cross Cimarron County (AC Collection System Routes NW-1 and NW-2) and would each generate less than $0.1 million in ad valorem tax revenues under the low and high tax scenarios (Table 3.13-39).

Table 3.13-39:
Estimated Ad Valorem Tax Revenues by AC Collection System Route and County in Oklahoma ($ million)

County/Alternative	Low Ad Valorem Tax Estimate[1]			High Ad Valorem Tax Estimate[1]		
	Beaver	Texas	Cimarron	Beaver	Texas	Cimarron
E-1	0.05	0.32		0.06	0.46	
E-2	0.18	0.31		0.24	0.45	
E-3	0.19	0.30		0.25	0.44	
NE-1		0.38			0.55	
NE-2		0.33			0.48	
NW-1		0.64	0.02		0.93	0.02
NW-2		0.47	0.03		0.68	0.03
SE-1		0.24			0.35	
SE-2		0.05			0.07	
SE-3	0.04	0.31		0.05	0.45	
SW-1		0.05			0.07	
SW-2		0.19			0.28	
W-1		0.26			0.38	

1 Low and high ad valorem tax revenues are estimated based on an assumed value of $1 million per mile (Clean Line 2014a), the state assessment ratio, and county specific low and high millage rates.

Estimated ad valorem revenues for the potentially affected counties in Texas are presented in Table 3.13-40. Estimated values range from less than $0.1 million in Hansford and Ochiltree counties to $0.1 million in Ochiltree County (AC Collection System Route SE-3). Values are estimated using the average county millage rates for 2012 (see Table 3.13-18).

Table 3.13-40:
Estimated Ad Valorem Tax Revenues by AC Collection System Route and County in Texas ($ million)

County/Alternative	SE-1	SE-2	SE-3	SW-1	SW-2
Hansford, TX	0.01	0.04		0.04	0.01
Ochiltree, TX	0.08		0.09		
Sherman, TX					0.1

3.13.6.2.7.2.3 Decommissioning Impacts

The general tax implications of decommissioning the AC collection system routes would be similar to those discussed above with respect to the converter stations.

3.13.6.2.7.3 HVDC Applicant Proposed Route

3.13.6.2.7.3.1 Construction Impacts

Construction of the transmission line would generate sales and use tax during the construction period. The Applicant estimates that the transmission line would cost $2 million to build per mile with 90 percent of this cost expected to be subject to sales and use tax in the affected states and counties (Clean Line 2013). Estimated sales and tax revenues are presented by county in Table 3.13-41. These estimates are based on the miles of transmission line proposed for each county and the applicable state and county sales and use tax rates (see Tables 3.13-15, 3.13-16, and 3.13-17).

Total estimated state sales and use tax revenues range from $2.1 million in Tennessee to $34.6 million in Oklahoma; the estimated total for Arkansas would be $32.3 million. Estimated county sales and use tax revenues generated for the affected counties in Oklahoma range from $0.05 million in Kingfisher County to $2.0 million in Beaver County. In Arkansas, estimated sales and use tax revenues generated for the affected counties range from $0.5 million in several different counties to $1.4 million in Jackson County. The transmission line would generate an estimated $0.2 million in county sales and use tax revenues in Shelby County and $0.5 million in Tipton County (Table 3.13-41). These revenues would be generated over the construction period for each transmission line segment.

Table 3.13-41:
Estimated Sales and Use Tax Revenues from HVDC Transmission Line Construction ($ million)

County	Total Estimated Cost[1]	Estimated State Revenues[1]	Estimated County Revenues[1]
Region 1			
Texas, OK	$47.6	$1.9	$0.4
Beaver, OK	$112.0	$4.5	$2.0
Harper, OK	$71.3	$2.9	$1.3
Region 2			
Woodward, OK	$64.8	$2.6	$0.8
Major, OK	$104.3	$4.2	$0.2
Garfield, OK	$44.3	$1.8	$0.1
Region 3			
Kingfisher, OK	$6.7	$0.3	$0.0
Logan, OK	$41.6	$1.7	$0.4
Payne, OK	$71.5	$2.9	$0.5
Lincoln, OK	$19.9	$0.8	$0.2
Creek, OK	$54.9	$2.2	$0.5

Table 3.13-41:
Estimated Sales and Use Tax Revenues from HVDC Transmission Line Construction ($ million)

County	Total Estimated Cost[1]	Estimated State Revenues[1]	Estimated County Revenues[1]
Okmulgee, OK	$55.4	$2.2	$0.6
Muskogee, OK	$79.0	$3.2	$0.5
Region 4			
Sequoyah, OK	$79.9	$3.2	$1.0
Crawford, AR	$56.9	$3.3	$0.5
Franklin, AR	$39.7	$2.3	$0.5
Johnson, AR	$55.6	$3.3	$0.5
Region 5			
Pope, AR	$54.3	$3.2	$0.5
Conway, AR	$43.2	$2.5	$0.7
Van Buren, AR	$26.5	$1.5	$0.5
Cleburne, AR	$47.0	$2.7	$0.7
White, AR	$34.4	$2.0	$0.5
Jackson, AR	$67.3	$3.9	$1.4
Region 6			
Poinsett, AR	$63.0	$3.7	$0.7
Cross, AR	$32.2	$1.9	$0.6
Region 7			
Mississippi, AR	$32.7	$1.9	$0.6
Shelby, TN	$10.0	$0.6	$0.2
Tipton, TN	$22.8	$1.4	$0.5

1 The values in this table do not reflect the small changes that would result from application of the minor route variations and adjustments.

Local spending by construction workers would also generate sales and lodging tax revenues, but the amount of spending and distribution by county is difficult to accurately forecast, so these potential revenues are not estimated here. If construction of all three Project components—converter stations, AC transmission lines, and the HVDC transmission line—were to occur at the same time, combined sales and use totals in Beaver and Texas counties, Oklahoma, and Shelby County, Tennessee, would result. Combined sales and use tax revenue estimates are presented in Table 3.13-42. These estimates are based on a number of assumptions (see the table footnotes) and provide an illustration of the potential combined impacts.

Table 3.13-42:
Estimated Combined Sales and Use Tax Revenues from Converter Stations, AC Collection System, and HVDC Transmission Line Construction ($ million)

County	Estimated County Revenues[1]			
	Converter Stations	AC Collection System[2]	HVDC Transmission Line[3]	Total
Texas, OK	$2.3	$1.4	$0.4	$4.1
Beaver, OK		$0.8	$2.0	$2.8
Shelby, TN	$5.1		$0.2	$5.3

1 Data are combined estimates of the sales and use tax revenues that would accrue to each county and do not include sales and use tax that would be paid to the state (see the above tables).
2 The combined totals for Beaver and Texas counties would vary depending on the selected AC collection system routes. Estimates are based on six alternative AC transmission lines of average length, with four assumed to be partially located in Beaver County.
3 The values in this table do not reflect the small changes that would result from application of the minor route variations and adjustments.

3.13.6.2.7.3.2 Operations and Maintenance Impacts

Operations and maintenance of the HVDC transmission line would generate annual property or ad valorem tax revenues in the counties where it would be located. Using a simplified cost approach and an assumed value of $2 million per mile (Clean Line 2013), annual ad valorem or property tax revenues estimates are presented by county in Tables 3.13-43. In all cases, these estimates are for payments that would be made in the first year of operation. Thereafter, ad valorem taxes would be paid annually based on an annual assessment by the responsible taxing agency.

Estimates for the affected Oklahoma counties are based on the state assessment ratio (the share of assessed value subject to taxation) of 22.85 percent and the low and high millage rates identified for each county in 2012. The low estimates range from about $0.1 million in Kingfisher County (Region 3) to $1.9 million in Major County (Region 2). High estimates range from $0.2 million in Kingfisher County to $2.4 million in Major County (Table 3.13-43).

Table 3.13-43:
Estimated Ad Valorem Tax Revenues for the HVDC Transmission Line by County in Oklahoma ($ million)

Region/County	Total Estimated Cost	Low Millage (2012)	High Millage (2012)	Low Estimate[1]	High Estimate[1]
Region 1					
Texas, OK	$47.6	55.60	80.73	$0.6	$0.9
Beaver, OK	$112.0	52.19	67.94	$1.3	$1.7
Harper, OK	$71.3	57.00	86.36	$0.9	$1.4
Region 2					
Woodward, OK	$64.8	63.64	93.10	$0.9	$1.4
Major, OK	$104.3	78.89	100.12	$1.9	$2.4
Garfield, OK	$44.3	80.29	103.61	$0.8	$1.0
Region 3					
Kingfisher, OK	$6.7	77.99	105.94	$0.1	$0.2
Logan, OK	$41.6	76.29	119.76	$0.7	$1.1
Payne, OK	$71.5	73.67	102.61	$1.2	$1.7
Lincoln, OK	$19.9	73.75	99.11	$0.3	$0.5
Creek, OK	$54.9	73.98	120.55	$0.9	$1.5

Table 3.13-43:
Estimated Ad Valorem Tax Revenues for the HVDC Transmission Line by County in Oklahoma ($ million)

Region/County	Total Estimated Cost	Low Millage (2012)	High Millage (2012)	Low Estimate[1]	High Estimate[1]
Okmulgee, OK	$55.4	80.68	97.29	$1.0	$1.2
Muskogee, OK	$79.0	74.96	100.40	$1.4	$1.8
Region 4					
Sequoyah, OK	$79.9	68.50	84.33	$1.2	$1.5

1 The values in this table do not reflect the small changes that would result from application of the minor route variations and adjustments.
2 Low and high ad valorem tax revenues are estimated based on an assumed value of $2 million per mile (Clean Line 2014a), the state assessment ratio, and county-specific low and high millage rates.

Estimated annual ad valorem tax revenues are presented for the affected counties in Arkansas and Tennessee in Table 3.13-44. Estimates for Arkansas counties are based on the state assessment ratio (the share of assessed value subject to taxation) of 20 percent and the average millage rates identified for each county in 2012. Estimates range from $0.2 million in Van Buren County to about $0.6 million in Crawford, Jackson, and Poinsett counties (Table 3.13-44).

Table 3.13-44:
Estimated Ad Valorem Tax Revenues for the HVDC Transmission Line by County in Arkansas and Tennessee ($ million)

Region/County/State[1, 2, 3]	Total Estimated Cost	Average Millage Rates (2012)	Estimated Ad Valorem Tax Revenues
Region 4			
Crawford, AR	$56.9	49.11	$0.6
Franklin, AR	$39.7	46.79	$0.4
Johnson, AR	$55.6	47.96	$0.5
Region 5			
Pope, AR	$54.3	45.98	$0.5
Conway, AR	$43.2	46.53	$0.4
Van Buren, AR	$26.5	43.90	$0.2
Cleburne, AR	$47.0	41.94	$0.4
White, AR	$34.4	43.01	$0.3
Jackson, AR	$67.3	46.65	$0.6
Region 6			
Poinsett, AR	$63.0	44.47	$0.6
Cross, AR	$32.2	49.89	$0.3
Region 7			
Mississippi, AR	$32.7	49.70	$0.3
Shelby, TN	$10.0	4.06	$0.2
Tipton, TN	$22.8	2.34	$0.3

1 Estimates for Arkansas counties are based on the state assessment ratio (the share of assessed value subject to taxation) of 20 percent and the average millage rates identified for each county.
2 Estimates for Tennessee are based on the state's assessment ratio for utility property (55 percent), the applicable county appraisal ratios, and the average millage rates identified for each county.
3 The values in this table do not reflect the small changes that would result from application of the minor route variations and adjustments.

Annual ad valorem or property taxes are estimated for Shelby and Tipton counties, Tennessee, using the state's assessment ratio for utility property (55 percent), the applicable county appraisal ratios, and the average millage rates identified for each county in 2012. The transmission line would generate about $0.2 million and $0.3 million in annual ad valorem tax revenues in Shelby and Tipton counties, respectively (Table 3.13-44).

The proposed locations of the three Project components—converter stations, AC transmission lines, and the HVDC transmission line—would result in combined ad valorem tax estimates for Beaver and Texas counties, Oklahoma, and Shelby County, Tennessee. Based on the preceding analyses, combined ad valorem tax revenues would range from $4.5 million to $6.5 million in Texas County and from $1.8 million to $2.3 million in Beaver County, with an estimated combined total of $5.8 million in Shelby County.

3.13.6.2.7.3.3 Decommissioning Impacts

The general tax implications of decommissioning the HVDC transmission line would be similar to those discussed above with respect to the converter stations.

3.13.6.3 Impacts Associated with the DOE Alternatives

3.13.6.3.1 Arkansas Converter Station Alternative and AC Interconnection Siting Area

3.13.6.3.1.1 Construction Impacts

The Applicant has indicated that the Arkansas Converter Station Alternative, which would include construction of an associated switching station and transmission line, would cost an estimated $135 million to construct. The proposed converter station would be located in Region 5 in Pope County and require a similar labor force to that required to build the Oklahoma and Tennessee converter stations (Figure 3.13-2).

3.13.6.3.1.1.1 Population

Based on the assumptions outlined in 3.11.5.2.1.1.1, an estimated average of 123 people would temporarily relocate to the vicinity of the Arkansas converter station over the 32-month construction period, with an estimated total of 213 people relocating during the peak construction period (months 12 to 17). The average increase in population would be equivalent to approximately 0.2 percent of the existing (2012) population in Pope County, with the peak increase equivalent to approximately 0.3 percent. Very few, if any, of the non-local workers employed during the construction phase of the converter station projects would be expected to permanently relocate to the affected areas, so it is unlikely that construction of the converter stations would result in any long-term changes in population.

3.13.6.3.1.1.2 Economic Conditions

Construction of the Arkansas converter station would result in a temporary increase in employment and earnings in the local area. This construction is expected to cost approximately $135 million and employ an average of 138 workers over the 32-month construction period, with total estimated employee earnings of $16.2 million. Construction of the converter station would support an estimated average of 244 total (direct, indirect, and induced) jobs and generate a total of $27.1 million in earnings over the course of the 32-month construction period (Table 3.13-45). Indirect and induced jobs and earnings are estimated at the state level using multipliers for the state of Arkansas.

Table 3.13-45:
Total Economic Impacts from Construction of the Arkansas Converter Station Alternative

Impacts	Employment (Jobs)	Annual Earnings	Earnings Over the Construction Period[1]
Direct Impact	138	$6.1	$16.2
Indirect and Induced Impacts[2]	106	$4.1	$10.9
Total Impacts	244	$10.2	$27.1

1 Construction is expected to take place over a 32-month period.
2 Indirect and induced impacts are estimated using the U.S. Bureau of Economic Analysis RIMS II direct effect multipliers for the state of Arkansas (BEA 2013b).

Potential economic impacts related to mineral development and the Fayetteville shale play are addressed in Section 3.13.6.2.2.3.1.1.

3.13.6.3.1.1.3 Housing

Projected peak housing demand for the Arkansas converter station is compared with estimated supply in Region 5 and Pope County in Table 3.13-46. The data presented in Table 3.13-46 suggest that adequate temporary housing would be available to accommodate Project demand in Region 5, and this would also likely be the case for Pope County alone. Rooms are also available in adjacent counties in Region 5, as well as the cities of Little Rock and North Little Rock to the south.

Table 3.13-46:
Projected Construction-Related Housing Demand for the Arkansas Converter Station Alternative

Housing Demand and Supply	Region 5	Pope County
Projected Peak Housing Demand[1]		
Rental Housing	36	36
Hotel and Motel Rooms	81	81
RV Spaces	63	63
Estimated Available Housing Units[2]		
Rental Housing[3]	4,207	878
Hotel and Motel Rooms[4]	1,137	269
RV Spaces	633	177
Projected Demand as Share of Existing Resources		
Rental Housing	1	4
Hotel and Motel Rooms	7	30
RV Spaces	10	35

1 Projected housing demand is assumed to be divided as follows: rental housing (apartments, houses, or mobile homes) (20 percent), hotel and motel rooms (45 percent), and RV spaces (35 percent).
2 Estimated available housing units are presented by county in Table 3.13-10.
3 Many of these available units include more than one bedroom and, if rented, could be occupied by more than one worker. A large number of in-migrating workers on similar projects typically rent a room in a house or live five in a rented house (BLM 2013).
4 Assumes an average occupancy rate of 75 percent for the purposes of analysis, with 25 percent of total units assumed to be potentially available.

3.13.6.3.1.1.4 Community Services

The potential temporary addition of non-local workers to Pope County, which would be equivalent to 0.3 percent of the existing (2012) population, is not expected to affect the levels of service provided by existing law and fire protection personnel. The number of law enforcement and fire departments per county are identified in Table 3.13-11. Increased demands for local services that could occur from construction workers and family members temporarily relocating to the area would be short term.

The closest medical center to the Arkansas converter station siting location is St. Mary's Regional Medical Center. St. Mary's provides emergency room services and has a medical helicopter pad (Table 3.13-12). The temporary relocation of workers and family members to Pope County is not expected to affect existing levels of health care and medical services. Minor increases in demands for local services that could occur from workers and family members temporarily relocating to the area would be short term.

An average and peak of 10 and 18 school-age children, respectively, are expected to temporarily relocate to the affected county during construction the converter station alternative. This minor potential increase in the number of students is not expected to affect existing average student/teacher ratios in Pope County (Table 3.13-13).

3.13.6.3.1.1.5 Tax Revenues

Construction of the Arkansas Converter Station Alternative would generate sales, use, and lodging tax revenue during the construction period. According to the Applicant, approximately 90 percent of the total estimated construction costs of $135 million would be for materials subject to sales and use tax in Arkansas (Clean Line 2013). Estimated state sales and use tax revenues would be $7.9 million, with estimated county revenues of $1.2 million (Table 3.13-47).

Table 3.13-47:
Estimated Sales and Use Tax Revenues from Construction of the Arkansas Converter Station Alternative ($ million)

County	Total Estimated Cost	Estimated State Revenues	Estimated County Revenues
Pope	$135	$7.9	$1.2

3.13.6.3.1.2 Operations and Maintenance Impacts

3.13.6.3.1.2.1 Population

Operations and maintenance of the Arkansas converter station is expected to employ up to 15 workers. These estimated staffing levels would have no noticeable impact on existing population levels in Pope County.

3.13.6.3.1.2.2 Economic Conditions

Operations and maintenance of the Arkansas converter station would support up to 15 workers, with estimated annual earnings of approximately $1 million. Operations and maintenance activities would support an estimated total (direct, indirect, and induced) of 37 jobs and $1.7 million in annual earnings (Table 3.13-48). Indirect and induced jobs and earnings are estimated at the state level using multipliers for the state of Arkansas.

Table 3.13-48:
Total Annual Economic Impacts from Operations and Maintenance of the Arkansas Converter Station Alternative

Impacts	Employment (Jobs)	Annual Earnings ($ million)[1]
Direct Impact	15	$1.02
Indirect and Induced Impacts[2]	22	$0.63
Total Impacts	37	$1.65

1 Total earnings were estimated based on the 2012 estimate of $67,950 for the annual average wage across the United States for all occupations in the electric power generation, transmission, and distribution industry (BLS 2012).
2 Indirect and induced impacts are estimated using the U.S. Bureau of Economic Analysis RIMS II direct-effect multipliers for the state of Oklahoma (BEA 2013b).

3.13.6.3.1.2.3 Housing

The potential relocation of up to 15 workers to Pope County would have no noticeable impact on existing demand for housing in the potentially affected counties.

3.13.6.3.1.2.4 Community Services

If up to 15 workers and their families were to relocate from elsewhere, the resulting very small increase in population would not be expected to noticeably affect the provision of community services.

3.13.6.3.1.2.5 Tax Revenues

Operations and maintenance of the Arkansas converter station would generate annual property or ad valorem tax revenues in Pope County. Using a simplified cost approach and an assumed value of $135 million, annual ad valorem or property tax revenues generated by the converter station would be about $1.2 million in the first year of operation. These estimates are based on Arkansas' assessment ratio of 20 percent and the 2012 millage rate for Pope County (Table 3.13-20). After the first year of operation, ad valorem taxes would be paid annually and would be based on an annual assessment by the responsible taxing agency.

3.13.6.3.1.3 Decommissioning Impacts

Decommissioning the converter station would require a labor force approximately equal to that needed for its construction. Impacts to population, economic conditions, housing, and community services from decommissioning are, therefore, expected to be similar to those from construction. Decommissioning of the Arkansas converter station and associated transmission line would be expected to generate local sales and use tax, which, adjusted for inflation, would likely be generally equivalent to those estimated for construction, other conditions remaining equal. Removal of the converter station would reduce the value of the affected property and result in a net reduction in ad valorem and property taxes, generally equivalent to the estimates developed for Project operations and maintenance.

3.13.6.3.2 HVDC Alternative Routes

The HVDC alternative routes and their net change in length relative to the Applicant Proposed Route are presented in Table 3.13-49. These alternatives are mainly alternatives to sections of the Applicant Proposed Route in each region, not complete alternative routes.

As described in Appendix M and summarized in Section 2.4.2.2, route adjustments were developed for HVDC Alternative Routes 3-A, 5-B, 5-E, and 6-A to maintain an end-to-end route with Applicant Proposed Route Links that were affected by minor route variations and adjustments. Viewed at a county level, these variations would change the total length by county by less than 1 mile in all cases and would have minor effects on the impact analyses presented in the following subsections.

Table 3.13-49:
HVDC Alternative Routes by Region

Region	Miles by Region[2]	Net Change in Length (miles)[2]	Percent Change in Length[3]	Estimated Change Relative to Applicant Proposed Route During Construction[1]			
				Peak Employment (Local and Non-Local Workers)	Non-Local Workers Temporarily Relocating	Total Number of People Temporarily Relocating	Number of School Age Children
Region 1	115.5						
AR 1-A		9.4	8	19	14	16	1
AR 1-B		-2.0	-2	-4	-3	-3	0
AR 1-C		-1.8	-2	-4	-3	-3	0
AR 1-D		-0.1	0	0	0	0	0
Region 2	106.0						
AR 2-A		2.7	3	5	4	5	0
AR 2-B		-1.5	-1	-3	-2	-3	0
Region 3	161.7						
AR 3-A		-2.4	-1	-5	-4	-5	0
AR 3-B		-2.2	-1	-5	-3	-4	0
AR 3-C		3.1	2	7	5	6	0
AR 3-D		4.2	3	9	7	8	1
AR 3-E		0.8	0	2	1	1	0
Region 4	126.3						
AR 4-A		-2.0	-2	-4	-3	-3	0
AR 4-B		-2.7	-2	-5	-4	-5	0
AR 4-C		1.2	1	2	2	2	0
AR 4-D		0.0	0	0	0	0	0
AR 4-E		-2.0	-2	-4	-3	-3	0
Region 5	112.8						
AR 5-A		0.4	0	1	1	1	0
AR 5-B		3.9	3	9	7	8	1
AR 5-C		4.7	4	11	8	10	1
AR 5-D		1.2	1	3	2	3	0
AR 5-E		3.2	3	8	6	7	1
AR 5-F		3.6	3	9	6	8	1
Region 6	54.3						
AR 6-A		-1.5	-3	-2	-2	-2	0
AR 6-B		4.5	8	7	5	7	1
AR 6-C		-1.7	-3	-3	-2	-2	0
AR 6-D		0.6	1	1	1	1	0

Table 3.13-49:
HVDC Alternative Routes by Region

Region	Miles by Region[2]	Net Change in Length (miles)[2]	Percent Change in Length[3]	Estimated Change Relative to Applicant Proposed Route During Construction[1]			
				Peak Employment (Local and Non-Local Workers)	Non-Local Workers Temporarily Relocating	Total Number of People Temporarily Relocating	Number of School Age Children
Region 7	42.8						
AR 7-A		14.7	34	21	16	19	2
AR 7-B		0.2	1	0	0	0	0
AR 7-C		10.6	25	15	11	14	1
AR 7-D		0.1	0	0	0	0	0

1 Estimated changes relative to the Applicant Proposed Route are based on the per-mile values of the affected resource category by region.
2 The values in this table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
3 Percent change is the net change in length as a percent of the total miles per region.

3.13.6.3.2.1 Construction Impacts

3.13.6.3.2.1.1 Population

Viewed by region, proposed changes in length range from a decrease of 2.7 miles in Region 4 (HVDC Alternative Route 4-B) to an increase of 10.6 miles and 14.7 miles in Region 7 (HVDC Alternative Routes 7-C and 7-A, respectively) (Table 3.13-49). HVDC Alternative Route 1-A would also result in a relative large increase, a net gain of 9.4 miles. Net changes to the projected temporary peak increases in population summarized in Table 3.13-23, range from decreases of about 5 people in Region 3 (HVDC Alternative Route 3-A) and Region 4 (HVDC Alternative Route 4-B) to increases of 16 people in Region 1 (HVDC Alternative Route 1-A) and 19 people in Region 7 (HVDC Alternative Route 7-A) (Table 3.13-49). These changes would have very small to no effect on the estimated changes in population summarized Table 3.13-23.

3.13.6.3.2.1.2 Economic Conditions

Substituting one or more of the HVDC alternative routes for the corresponding links of the Applicant Proposed Route would not substantially affect the regional economic impact estimates presented by region in Tables 3.13-25 and 3.13-26. Estimated changes in peak direct employment (local and non-local workers) by HVDC alternative route would range from -5 workers in Region 3 (HVDC Alternatives 3-A and 3-B) to 21 workers in Region 7 (HVDC Alternative Route 7-A) and 19 workers in Region 1 (HVDC Alternative Route 1-A) (Table 3.13-49).

3.13.6.3.2.1.3 Housing

The net change in the number of people who would temporarily relocate to each region, relative to the Applicant Proposed Route, is identified by HVDC alternative route in Table 3.13-49. The largest net increases would occur in Region 1 with the addition of 16 people (HVDC Alternative Route 1-A) and Region 7 where 14 and 19 more people could be added (HVDC Alternative Routes 7-C and 7-A, respectively). Substituting one of more of the HVDC alternative routes for the corresponding section of the Applicant Proposed Route would not substantially affect the findings of the housing analysis summarized in Section 3.13.5.2.4.

3.13.6.3.2.1.4 Community Services

The estimated net changes in workers and family members temporarily relocating to the affected regions identified in Table 3.13-49 are not expected to alter the conclusions presented with respect to the Applicant Proposed Route and community services in Section 3.13.5.2.6. The majority of the HVDC alternative routes would not affect the peak number of school age children temporarily relocating to the affected regions. In other cases, there would be a potential increase of one to two school-age children relative to the Applicant Proposed Route for that region (Table 3.13-49).

3.13.6.3.2.1.5 Tax Revenues

Changes in the projected length of the transmission line by county would result in corresponding changes in construction-related sales and use tax revenues expected to accrue to the affected counties and states. Net changes in estimated sales and use tax revenues, relative to the Applicant Proposed Route, are identified by county in Table 3.13-50. In most cases, the miles of transmission line in each county are affected by more than one alternative. The largest estimated change (positive or negative) relative to the Applicant Proposed Route is identified by county in Table 3.13-50 to ensure that the largest potential variation is considered in the following assessment.

Table 3.13-50:
Estimated Tax Revenues by HVDC Alternative Route and County

County[1]	Total Crossed by Applicant Proposed Route	Largest Net Change (miles)[2]	Percent Change in Miles	Estimated Change Relative to the Applicant Proposed Route		
				Construction Phase Sales and Use Tax Revenues ($ million)		Ad Valorem and Property Tax Revenues ($ million)[3]
				State	County	
Region 1						
Texas, OK	23.8	1.4	6	$0.11	$0.03	$0.04
Beaver, OK	56.0	4.3	8	$0.35	$0.15	$0.12
Harper, OK	35.6	3.8	11	$0.31	$0.14	$0.12
Region 2						
Woodward, OK	32.4	-0.9	-3	-$0.07	-$0.02	-$0.03
Major, OK	52.2	3.6	7	$0.29	$0.02	$0.15
Garfield, OK	22.2	1.6	7	$0.13	$0.01	$0.07
Region 3						
Garfield, OK	22.2	7.0	32	$0.6	$0.0	$0.29
Kingfisher, OK	3.4	-3.4	-100	-$0.28	-$0.05	-$0.14
Logan, OK	20.8	-7.0	-34	-$0.57	-$0.13	-$0.31
Payne, OK	35.7	-8.5	-24	-$0.69	-$0.12	-$0.34
Lincoln, OK	10.0	9.1	91	$0.74	$0.16	$0.36
Creek, OK	27.4	-0.2	-1	-$0.02	$0.00	-$0.01
Okmulgee, OK	27.7	-0.7	-3	-$0.06	-$0.02	-$0.03
Muskogee, OK	39.5	4.2	11	$0.34	$0.05	$0.17
Region 4						
Sequoyah, OK	39.9	-1.1	-3	-$0.09	-$0.03	-$0.04
Crawford, AR	28.4	-3.5	-12	-$0.41	-$0.06	-$0.07
Franklin, AR	19.8	1.9	10	$0.22	$0.05	$0.04
Johnson, AR	27.8	1.0	4	$0.12	$0.02	$0.02

Table 3.13-50:
Estimated Tax Revenues by HVDC Alternative Route and County

County[1]	Total Crossed by Applicant Proposed Route	Largest Net Change (miles)[2]	Percent Change in Miles	Estimated Change Relative to the Applicant Proposed Route: Construction Phase Sales and Use Tax Revenues ($ million) — State	Construction Phase Sales and Use Tax Revenues ($ million) — County	Ad Valorem and Property Tax Revenues ($ million)[3]
Pope, AR	27.1	-3.1	-11	-$0.36	-$0.06	-$0.06
Region 5						
Pope, AR	27.1	1.1	4	$0.13	$0.02	$0.02
Conway, AR	21.6	0.1	0	$0.01	$0.00	$0.00
Van Buren, AR	13.2	-13.2	-100	-$1.54	-$0.48	-$0.23
Cleburne, AR	23.5	-23.5	-100	-$2.75	-$0.69	-$0.39
Faulkner, AR	0.0	21.8	100	$2.55	$0.20	$0.34
White, AR	17.2	17.6	102	$2.06	$0.48	$0.59
Jackson, AR	33.7	-0.5	-1	-$0.06	-$0.02	$0.00
Region 6						
Jackson, AR	33.7	4.4	13	$0.51	$0.18	$0.00
Poinsett, AR	31.5	14.4	46	$1.68	$0.32	$0.13
Cross, AR	16.1	-16.1	-100	-$1.88	-$0.58	$0.00
Region 7						
Mississippi, AR	16.3	12.2	75	$1.43	$0.44	$0.00
Shelby, TN	5.0	12.9	257	$1.63	$0.52	$0.58
Tipton, TN	11.4	4.1	36	$0.52	$0.17	$0.11

1 The values in this table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
2 The miles of transmission line in some counties would be affected under more than one alternative. This column presents the largest change (positive or negative) relative to the Applicant Proposed Route that could occur in each county.
3 Estimated as valorem tax revenues for the Applicant Proposed Route in Oklahoma counties are based on average low and high millage rates (Table 3.13-43). This sensitivity analysis is based on the average of this range of estimates for each county.

Viewed as a relative share of the Applicant Proposed Route, estimated changes in miles of HVDC transmission line by county would range from less than 1 percent to 257 percent. In four counties the largest change relative to the Applicant Proposed Route would be a 100 percent decrease because the corresponding HVDC alternative route would no longer cross that county. The four counties that would no longer be crossed are Kingfisher County, Oklahoma (Region 3), Van Buren and Cleburne counties, Arkansas (Region 5), and Cross County, Arkansas (Region 6). Two of the alternative routes for Region 5 (HVDC Alternative Routes 5-B and 5-E) would cross Faulkner County, Arkansas, which is not crossed by the Applicant Proposed Route. The largest change for Faulkner County would occur under HVDC Alternative 5-E, which would involve construction of 21.8 miles of HVDC transmission line across the county (Table 3.13-50).

Relative to the Applicant Proposed Route, the largest changes in estimated sales and use tax revenue that would accrue to the respective state would occur in counties in Region 5 and range from a decrease of $2.75 million (-100 percent) in Cleburne County to an increase of $2.55 million (100 percent) in Faulkner County. Changes in estimated sales and use tax that would be paid to each county would range from a decrease of about $0.7 million in Cleburne County, Arkansas (Region 5) to an estimated increase of $0.5 million in Shelby County, Tennessee (Region 7) (Table 3.13-50).

3.13.6.3.2.2 Operations and Maintenance Impacts

3.13.6.3.2.2.1 Population, Economic Conditions, Housing, and Community Services

Substituting one of more of the HVDC alternative routes for the corresponding link of the Applicant Proposed Route would not affect estimated operations and maintenance employment for the HVDC and AC transmission lines. Potential impacts to population, economic conditions, housing, and community services from operations and maintenance related to estimated operations and maintenance employment would be the same or very similar to those described above for the Applicant Proposed Route.

3.13.6.3.2.2.2 Property Values

The discussion of property value impacts in Section 3.13.6.2.5 would also apply to the HVDC alternative routes.

3.13.6.3.2.2.3 Tax Revenues

Changes in the projected length of the transmission line by county would result in corresponding changes in the property and ad valorem tax revenues expected to accrue to the affected counties. Net changes in estimated property and ad valorem tax revenues, relative to the Applicant Proposed Route, are identified by county in Table 3.13-50. These changes would be less than $1 million in all cases, ranging from a decrease of about $0.4 million in Cleburne County, Arkansas (Region 5), which would not be crossed by HVDC Alternative Routes 5-B and 5-E, to a relative increase of $0.6 million in Shelby County, Tennessee (Region 7) (Table 3.13-50).

3.13.6.3.2.3 Decommissioning Impacts

3.13.6.3.2.3.1 Population, Economic Conditions, Housing, and Community Services

Decommissioning of the proposed HVDC transmission line would require a labor force approximately equal to that needed for its construction. This would be the case for the Applicant Proposed Route and all the HVDC alternative routes. Impacts to population, economic conditions, housing, and community services from decommissioning are, therefore, expected to be similar to those from construction.

3.13.6.3.2.3.2 Tax Revenues

The general tax implications of decommissioning the HVDC transmission line would be similar to those discussed with respect to the converter stations in Section 3.13.5.2.7 for the Applicant Proposed Route and all the HVDC alternative routes.

3.13.6.4 Best Management Practices

A potential impact related to housing demand exists specifically in Region 1: there is a projected shortage of hotel and motel rooms and RV spaces in this region that would be further exacerbated if the construction schedules for the Oklahoma converter station, AC collection system, and HVDC transmission line were to overlap. The analysis assumes that 25 percent of total hotel and motel units would typically be available. This availability could be further reduced by other outside activities in the ROI such as other construction projects, community-sponsored events, and hunting and other recreational activities.

The Applicant has developed a comprehensive list of EPMs that will help avoid and minimize impacts to socioeconomic resources. A complete list of EPMs for the Project is provided in Appendix F; EPMs that pertain to socioeconomic resources are identified in Section 3.13.6.1. Additionally, the Applicant will prepare and implement a workforce housing strategy that would minimize potential impacts to housing availability. This strategy would consider Project component construction schedules, workforce required, and other outside influences.

3.13.6.5 Unavoidable Adverse Impacts

No unavoidable adverse impacts to socioeconomic resources were identified.

3.13.6.6 Irreversible and Irretrievable Commitment of Resources

No irreversible or irretrievable commitments of socioeconomic resources were identified. Construction and operation of the Project would involve the use of capital and labor resources. Construction of the Project would also involve the use of temporary housing resources in the Project vicinity. These types of short-term resource use have opportunity costs (resources used for the Project cannot be used for other concurrent projects), but they are not irreversible or irretrievable.

3.13.6.7 Relationship between Local Short-term Uses and Long-term Productivity

Potential short-term impacts to socioeconomic resources are not expected to outweigh the long-term benefits of the Project. In the long term, the Project would be expected to increase economic productivity through the delivery of renewable energy generated in the Oklahoma Panhandle region to load-serving entities in the mid-south and southeast regions of the United States.

3.13.6.8 Impacts from Connected Actions

3.13.6.8.1 Wind Energy Generation

For the purposes of analysis, the Applicant assumed that 90 percent of this capacity would be constructed over a 2-year timeframe leading up to the commercial operation date of the Project, with the remaining 10 percent expected to be built within a year following this date (Clean Line 2014b). Individual wind farms could range in capacity from 50MW to 1,000MW in a single phase; multiple-phased projects are possible. Future nameplate capacities for a single turbine are assumed to range from 1.5MW to 3.5MW (Clean Line 2014b).

The potential socioeconomic impacts of the development of approximately 4,000MW of wind generating capacity in the 12 identified WDZs (Table 3.13-21) are assessed using data derived from the DOE National Renewable Energy Laboratory's Jobs and Economic Development Impacts (JEDI) Wind model (NREL 2014). The JEDI Wind model allows the user to identify potential impacts assuming general wind industry averages.

The following analysis assesses two potential scenarios based on the range of potential capacity for individual wind farms (50MW to 1,000MW per facility). These scenarios recognize that there are labor-related economies of scale associated with larger facilities, during both construction and operation. The two scenarios are as follows: (1) 74 facilities with a nameplate capacity of 53MW, for a total capacity of 3,885MW; and (2) four facilities with a nameplate capacity of 975MW, for a total capacity of 3,900MW. The first scenario assumes an average facility (wind farm) consists of sixteen 3.5MW turbines. The second scenario assumes an average facility (wind farm) consists of six hundred fifty 1.5MW turbines. In both scenarios, the proposed generating capacity is assumed to be divided equally between Oklahoma and Texas, with the same total capacity and number of facilities located in the WDZs in each state. Construction is also assumed to spread evenly over the 2 years prior to the transmission line Project's commercial operation date.

3.13.6.8.1.1 Population

3.13.6.8.1.1.1 Construction Impacts

Total annual employment estimates are presented by wind development scenario and stated in Table 3.13-51. Viewed in FTEs, total direct employment under Scenario 1 would be equivalent to 2,080 FTEs. Total direct employment under Scenario 2 would be less than half this total (1,012 FTEs), reflecting the labor economies of scale involved in constructing four 975MW facilities (Scenario 2) versus seventy-four 53MW facilities (Scenario 1). FTEs are employment estimates based on 12 months (2,080 hours) employment. These numbers do not translate into individual workers who may be employed for shorter periods.

Table 3.13-51:
Estimated Annual Change in Population During Construction by Potential Wind Development Scenario

Workers/Population[1]	Scenario 1[2]			Scenario 2[2]		
	Oklahoma	Texas	Region 1 Total	Oklahoma	Texas	Region 1 Total
Workers[3]						
Commute to Job Site Daily[4]	589	589	1,179	276	270	547
Move to the Affected Region alone[5]	414	397	812	215	204	419
Move to the Affected Region with family[5]	46	44	90	24	23	47
Total	1,050	1,031	2,080	515	497	1,012
Population						
2012 Population[6]	28,658	19,322	51,652	28,658	19,322	51,652
Number of People Temporarily Relocating[7]	552	530	1,082	287	272	558
Percent of 2012 Population	1.9	2.7	2.1	1.0	1.4	1.1

1 Data are annual estimates and assume that construction would be spread evenly over 2 years.
2 Scenario 1 consists of 74 wind generation facilities with a nameplate capacity of 53MW, for a total capacity of 3,885MW; Scenario 2 consists of four facilities with a nameplate capacity of 975MW, for a total capacity of 3,900MW.
3 The JEDI Wind model was used to estimate construction workforce requirements by scenario and state. Jobs are FTEs for a period of one year (1 FTE = 2,080 hours).
4 The share of the annual construction workforce expected to be hired locally was estimated using the JEDI Wind model and varies slightly by state and scenario.
5 An estimated 90 percent of workers temporarily relocating to the region are assumed to do so alone. The remaining 10 percent are assumed to be accompanied by their families for the purposes of analysis.
6 2012 population totals are as follows:
Oklahoma = Cimarron, Texas, and Beaver counties
Texas = Hansford, Ochiltree, and Sherman counties
Region 1 Total = The above six counties plus Harper County, Oklahoma (see Table 3.13-4).
7 Number of people temporarily relocating assumes an average family size of 3 (two adults and one school-age child).

The share of the annual construction workforce expected to be hired or contracted locally was estimated using the JEDI Wind model and varies slightly by state and scenario. According to the JEDI Wind model, an estimated 56 percent (Oklahoma) and 57 percent (Texas) of workers under Scenario 1 would be hired locally; 54 percent (Oklahoma and Texas) of the annual construction workforce would be expected to be hired locally under Scenario 2. The remaining workforce would be expected to temporarily relocate to Region 1 for the duration of their employment, possibly commuting home on weekends, depending on the location of their primary residence.

Very few, if any, of the non-local workers employed during the construction phase of the potential wind facilities would be expected to permanently relocate to the affected areas. For the purposes of analysis, 10 percent of non-local workers temporarily relocating to the area are assumed to be accompanied by family members; the average size of a family that is relocating is assumed to be three, two adults and one school-age child (Clean Line 2013). The estimated annual change in population would be equivalent to approximately 2.l percent of the total Region 1 population in 2012 under Scenario 1 and approximately 1.1 percent under Scenario 2 (Table 3.13-51).

3.13.6.8.1.1.2 Operations and Maintenance Impacts

Operations and maintenance of the potential wind facilities would employ an estimated total of 140 full-time employees in Oklahoma and 140 full-time employees in Texas under Scenario 1 and 88 full-time employees in each state under Scenario 2, reflecting the labor economies of scale associated with operating a substantially smaller number (4 versus 74) of much larger (975MW versus 53MW) facilities (Table 3.13-52). These estimates were developed using the JEDI Wind model and general wind industry averages. Assuming these employees would all permanently relocate to the area from elsewhere with an average family size of three (two adults and one school-age child), estimated total population increases in Region 1 would be 840 and 530 under Scenarios 1 and 2, respectively, which would be equivalent to 1.6 percent and 1.0 percent of the total population in Region 1 in 2012 (Table 3.13-52).

Table 3.13-52:
Estimated Annual Change in Population During Operations and Maintenance by Potential Wind Development Scenario

Workers/Population[1]	Scenario 1[2]			Scenario 2[2]		
	Oklahoma	Texas	Region 1 Total	Oklahoma	Texas	Region 1 Total
2012 Population[3]	28,658	19,322	51,652	28,658	19,322	51,652
Number of Workers[4]	140	140	280	88	88	177
Number of People Permanently Relocating[5]	420	420	840	265	265	530
Percent of 2012 Population	1.5	2.2	1.6	0.9	1.4	1.0

1 Data are annual estimates and assumed to continue for the operating lives of the potential facilities.
2 Scenario 1 consists of 74 wind generation facilities with a nameplate capacity of 53MW, for a total capacity of 3,885MW; Scenario 2 consists of four facilities with a nameplate capacity of 975MW, for a total capacity of 3,900MW.
3 2012 population totals are as follows:
Oklahoma = Cimarron, Texas, and Beaver counties
Texas = Hansford, Ochiltree, and Sherman counties
Region 1 Total = The above six counties plus Harper County, Oklahoma (see Table 3.13-4).
4 The JEDI Wind model was used to estimate annual operations and maintenance workforce requirements by scenario and state. Jobs are FTEs for a period of one year (1 FTE = 2,080 hours).
5 Number of people permanently relocating assumes that all the onsite workers would relocate from elsewhere and represent an average family size of three (two adults and one school-age child).

3.13.6.8.1.1.3 Decommissioning Impacts

Decommissioning of the potential wind generation facilities would require a labor force approximately equal to that needed for their construction. Impacts to population from decommissioning are, therefore, expected to be similar to those from construction.

3.13.6.8.1.2 Economic Conditions

3.13.6.8.1.2.1 Construction Impacts

Construction of the two potential wind development scenarios would result in a temporary increase in employment and earnings in the surrounding area. Annual estimates are presented by scenario and state in Table 3.13-53. Construction would support an estimated total (direct, indirect, and induced) of 9,910 jobs in Region 1 under Scenario 1 and 8,762 jobs under Scenario 2. Construction would also support estimated total (direct, indirect, and induced) earnings of $494 million and $435 million under Scenarios 1 and 2, respectively (Table 3.13-53). These annual impacts would occur each year for 2 years leading up to the commercial operation date of the Project.

Table 3.13-53:
Total Annual Economic Impacts During Construction by Potential Wind Development Scenario

Impacts[1]	Scenario 1[2]			Scenario 2[2]		
	Oklahoma	Texas	Region 1 Total	Oklahoma	Texas	Region 1 Total
Employment (Jobs)[3]						
Direct Impact	1,050	1,031	2,080	515	497	1,012
Indirect and Induced Impacts	3,986	3,843	7,830	3,962	3,789	7,750
Total Impacts	5,036	4,874	9,910	4,477	4,285	8,762
Annual Earnings ($ million)[4]						
Direct Impact	$48.34	$63.24	$111.58	$24.83	$31.71	$56.53
Indirect and Induced Impacts	$170.72	$211.61	$382.33	$169.60	$208.60	$378.20
Total Impacts	$219.05	$274.85	$493.90	$194.43	$240.31	$434.73

1 The JEDI Wind model was used to estimate direct, indirect, and induced impacts. Indirect impacts during construction are identified in the model as turbine and supply chain impacts. Data are annual estimates and assume that construction would be spread evenly over 2 years. Indirect and induced impacts are estimated at the state level.
2 Scenario 1 consists of 74 wind generation facilities with a nameplate capacity of 53MW, for a total capacity of 3,885MW; Scenario 2 consists of four facilities with a nameplate capacity of 975MW, for a total capacity of 3,900MW.
3 Jobs are FTEs for a period of one year (1 FTE = 2,080 hours).
4 Annual earnings are expressed in millions of dollars in year 2014 dollars.

3.13.6.8.1.2.2 Operations and Maintenance Impacts

Operations and maintenance of the potential wind facilities would employ an estimated total of 140 full-time employees in Oklahoma and 140 full-time employees in Texas under Scenario 1 and 88 full-time employees in each state under Scenario 2 (Table 3.13-54).

Operations and maintenance would support an estimated total (direct, indirect, and induced) of 798 jobs under Scenario 1 and 665 jobs under Scenario 2. Operations and maintenance would also support estimated total (direct, indirect, and induced) earnings of $41.2 million and $32.9 million under Scenarios 1 and 2, respectively (Table 3.13-54). These annual impacts would occur each year for the operating life of the potential facilities.

Table 3.13-54:
Total Annual Economic Impacts During Operations and Maintenance by Potential Wind Development Scenario

Impacts[1]	Scenario 1[2]			Scenario 2[2]		
	Oklahoma	Texas	Region 1 Total	Oklahoma	Texas	Region 1 Total
Employment (Jobs)[3]						
Direct Impact	140	140	280	88	88	177
Indirect and Induced Impacts	237	281	518	224	264	488
Total Impacts	377	421	798	312	352	665
Annual Earnings ($ million)[4]						
Direct Impact	$7.12	$9.56	$16.68	$4.17	$5.60	$9.77
Indirect and Induced Impacts	$9.87	$14.65	$24.52	$9.41	$13.72	$23.13
Total Impacts	$17.00	$24.21	$41.20	$13.58	$19.32	$32.90

1 The JEDI Wind model was used to estimate direct, indirect, and induced impacts. Indirect impacts during construction are identified in the model as local revenue and supply chain impacts. Data are annual estimates and assumed to continue for the operating lives of the potential facilities. Indirect and induced impacts are estimated at the state level.
2 Scenario 1 consists of 74 wind generation facilities with a nameplate capacity of 53MW, for a total capacity of 3,885MW; Scenario 2 consists of four facilities with a nameplate capacity of 975MW, for a total capacity of 3,900MW.
3 Jobs are FTEs for a period of one year (1 FTE = 2,080 hours).
4 Annual earnings are expressed in millions of dollars in year 2014 dollars.

3.13.6.8.1.2.3 Decommissioning Impacts

Decommissioning of the HVDC transmission line would require a labor force approximately equal to that needed for its construction. Local expenditures on materials and supplies and payments to workers would likely be similar, resulting in broadly similar economic impacts to those from construction.

3.13.6.8.1.3 Agriculture

Agriculture is the primary existing land use in the 12 WDZs. An estimated 3 to 5 percent of the land within the boundaries of each potential wind energy facility is expected to be affected during construction, with 1 percent or less expected to be affected during the operations and maintenance phase of each facility. Assuming full build-out, 20 to 30 percent of the area within the WDZs would involve an estimated total of 6,492 to 16,230 acres of primarily agricultural land would be affected during construction, with 2,164 to 3,246 acres affected during operations and maintenance (see Section 3.2). This potential disturbance represents a very small share of the 5.9 million acres of land in farms in Region 1 (Table 3.13-9) and is unlikely to noticeably affect overall agricultural production and employment in the affected counties.

In cases where turbines are located on agricultural land, land owners typically receive lease payments. Wind lease agreements usually include provisions to minimize construction-related losses, including minimizing soil compaction and revegetating temporary work areas. In addition, these types of agreement typically stipulate compensation for landowners for other potential losses, such as damage to or loss of crops, gates, fences, landscaping and trees, irrigation, and livestock.

3.13.6.8.1.4 Housing

3.13.6.8.1.4.1 Construction Impacts

Using the same assumptions employed in the above transmission line Project analysis, an estimated 45 percent of the workers temporarily relocating during construction are expected to require motel or hotel rooms, with the remaining non-local workers expected to require rental housing (apartments, houses, or mobile homes) (20 percent), or provide their own housing in the form of RVs or pop-up trailers (35 percent). Projected average annual housing demand based on the number of FTE workers for the anticipated 2-year construction period is compared with estimated supply in Table 3.13-55.

Table 3.13-55:
Estimated Construction-Related Housing Demand by Potential Wind Development Scenario

Housing/Geographic Area	Scenario 1[1]			Scenario 2[1]		
	Oklahoma	Texas	Region 1 Total	Oklahoma	Texas	Region 1 Total
Projected Non-Local Employment[2]	460	442	902	239	226	465
Projected Peak Housing Demand						
Rental Housing	92	88	180	48	45	93
Hotel and Motel Rooms	207	199	406	108	102	209
RV Spaces	161	155	316	84	79	163
Estimated Available Housing Units[3]						
Rental Housing	279	38	370	279	38	370
Hotel and Motel Rooms[4]	194	76	273	194	76	273
RV Spaces	48	161	235	48	161	235
Projected Demand as a Share of Existing Resources						
Rental Housing	33	232	49	17	119	25
Hotel and Motel Rooms	107	262	149	55	134	77
RV Spaces	336	96	134	174	49	69

1 Scenario 1 consists of 74 wind generation facilities with a nameplate capacity of 53MW, for a total capacity of 3,885MW; Scenario 2 consists of four facilities with a nameplate capacity of 975MW, for a total capacity of 3,900MW.

2 The JEDI Wind model was used to estimate construction workforce requirements by scenario and state. Jobs are FTEs for a period of one year (1 FTE = 2,080 hours). According to the JEDI Wind model analysis, an estimated 44 percent (Oklahoma) and 43 percent (Texas) of workers under Scenario 1 would be hired locally, with 46 percent (Oklahoma and Texas) of the annual construction workforce expected to be hired locally under Scenario 2.

3 Estimated housing unit totals are for the following counties:
Oklahoma = Cimarron, Texas, and Beaver counties
Texas = Hansford, Ochiltree, and Sherman counties
Region 1 Total = The above six counties plus Harper County, Oklahoma (see Table 3.13-10).

4 Assumes an average occupancy rate of 75 percent for the purposes of analysis, with 25 percent of total units assumed to be available.

This comparison indicates that temporary housing demand under Scenario 1 (74, 53MW facilities built over 2 years) would be more than double (232 percent) of the supply of rental housing in the three Texas counties. Demand under Scenario 1 would also exceed the estimated supply of available hotel and motel rooms in the counties in both states and Region 1 as a whole. Demand for RV spaces would exceed the total identified spaces in the three Oklahoma counties and Region 1 as a whole, and be almost equal to the number of identified spaces in the three Texas counties (Table 3.13-55).

Projected housing demand would be lower under Scenario 2 (four 975MW facilities) due to labor economies of scale. This scenario represents the low end of the range of potential effects on housing; Scenario 1 represents the high end of this range. Under this scenario, demand would exceed supply for rental housing in the three Texas counties. Demand would also exceed the estimated supply of available hotel and motel rooms in the three Texas counties, as well as the total number of identified RV spaces in the three Oklahoma counties (Table 3.13-55).

3.13.6.8.1.4.2 Operations and Maintenance Impacts

Operations and maintenance of the potential wind facilities would employ an estimated total of 140 full-time employees in Oklahoma and 140 full-time employees in Texas under Scenario 1, and 88 full-time employees in each state under Scenario 2. If all these employees permanently relocated to the area, a corresponding demand for permanent housing would be created. This potential demand is compared with housing data in Table 3.13-56. In the short-term, workers relocating would likely stay in hotels or motels while looking for a more permanent residence to rent or purchase.

Table 3.13-56:
Estimated Housing Demand by Potential Wind Development Scenario under Operations and Maintenance

Housing/Geographic Area[2]	Scenario 1[1]			Scenario 2[1]		
	Oklahoma	Texas	Region 1 Total	Oklahoma	Texas	Region 1 Total
Number of Households Permanently Relocating[3]	140	140	280	88	88	177
Vacant Housing Units						
For Rent or Sale	450	79	597	450	79	597
Rented or Sold, Not Occupied	242	113	365	242	113	365
Seasonal, Recreational, or Occasional use	158	192	409	158	192	409
Other Vacant4	1,349	544	2,153	1,349	544	2,153
Total	2,199	928	3,524	2,199	928	3,524

1 Scenario 1 consists of 74 wind generation facilities with a nameplate capacity of 53MW, for a total capacity of 3,885MW; Scenario 2 consists of four facilities with a nameplate capacity of 975MW, for a total capacity of 3,900MW.

2 Estimated housing unit totals are for the following counties:
Oklahoma = Cimarron, Texas, and Beaver counties
Texas = Hansford, Ochiltree, and Sherman counties
Region 1 Total = The above six counties plus Harper County, Oklahoma

3 Number of households relocating is based on estimated total annual employment and assumes that all workers would permanently relocate to the area from elsewhere.

4 According to the U.S. Census Bureau, a housing unit is classified as “other vacant” when it is unoccupied and does not fit into one of the other categories identified in the above table. Common reasons a housing unit is labeled as “other vacant” are that nobody lives in the unit and the owner is making repairs or renovating, does not want to rent or sell, or the unit is being held for settlement of an estate or in foreclosure (Kresin 2013).

Economic development organizations in the Oklahoma Panhandle region have identified a potential shortage in permanent housing in and around the city of Guymon in Texas County, with these problems expected to be further exacerbated by this type of wind energy development (Fleming 2013). Estimated demand under Scenario 1 in the three Oklahoma counties would be equivalent to 31 percent of the housing units available for rent or sale in 2012 (140 versus 450). Demand in the three Texas counties would be almost 1.8 times the number of housing units available for rent or sale under Scenario 1 (140 versus 79), and 1.1 times under Scenario 2 (88 versus 79) (Table 3.13-56). This imbalance may be partially offset by some of the housing units currently identified as “other vacant" coming on the market for rent or sale. "Other vacant" housing units comprised 59 percent of the vacant housing in the three Texas counties in 2012.

3.13.6.8.1.4.3 Decommissioning Impacts

Decommissioning of the wind facilities would require a labor force approximately equal to that needed for their construction. Impacts to housing from decommissioning are, therefore, expected to be similar to those from construction.

3.13.6.8.1.5 Community Services

3.13.6.8.1.5.1 Construction Impacts

Increased demands for local services that would likely occur from wind facility construction workers and family members temporarily relocating to the affected areas would be short term. The estimated number of workers and family members expected to temporarily relocate to Region 1 during construction ranges from 558 (Scenario 2) to 1,082 (Scenario 1) (Table 3.13-51). This estimated increase in population would be equivalent to approximately 1.1 percent to 2.1 percent of total Region 1 population in 2012 (Table 3.13-51). The temporary addition of these workers and family members to local communities is not expected to affect the levels of service provided by existing law and fire protection personnel.

Medical facilities located in Region 1 are identified in Table 3.3-12 and discussed with respect to the AC collection system routes in Section 3.13.2.4.2. The temporary relocation of workers and family members to the counties in the region is not expected to affect existing levels of health care and medical services.

The estimated number of children expected to temporarily relocate to Region 1 during peak construction ranges from about 47 (Scenario 2) to 90 (Scenario 1) (Table 3.13-51). These children would likely be located in a number of different school districts throughout Region 1 and would not be expected to affect existing average student/teacher ratios (Table 3.13-13).

Spending by relocating workers and their families would likely generate economic benefits for community commercial and retail services, as would be the case with other local construction-related expenditures.

3.13.6.8.1.5.2 Operations and Maintenance Impacts

Operations and maintenance of the potential wind facilities would employ between 177 (Scenario 2) and 280 (Scenario 1) workers. If these workers and their families were all to relocate from elsewhere, the estimated increase in population would be equivalent to approximately 1.0 percent to 1.6 percent of total Region 1 population in 2012 (Table 3.13-52). The permanent addition of these workers and family members would not be expected to affect the provision of community services in the affected areas.

3.13.6.8.1.5.3 Decommissioning Impacts

Decommissioning of the transmission lines would require a labor force approximately equal to that needed for their construction. Impacts to community services from decommissioning are, therefore, expected to be similar to those from construction.

3.13.6.8.1.6 Tax Revenues

3.13.6.8.1.6.1 Construction Impacts

Construction of the potential wind facilities would generate sales, use, and lodging tax during the construction period. All equipment and material costs are assumed for the purposes of analysis to be subject to sales and use tax. Wind facility equipment would include turbines, blades, and towers. Materials would include transformers, electrical equipment, and construction materials (concrete, rebar, and construction equipment). Estimated equipment and material costs are approximately $95 million for a single 50MW wind facility and $1.79 billion for a single 1,000MW facility. These costs were estimated using the JEDI Wind model and general wind energy averages. The use of these averages results in total estimated equipment and material costs of $6,981 million and $7,159 million for Scenarios 1 and 2, respectively.

State sales and use tax rates are 4.5 percent in Oklahoma and 6.25 percent in Texas (Tables 3.13-15 and 3.13-14, respectively). Estimated state sales and use tax revenues would range from $158 million to $161 million in Oklahoma and from $217 million to $223 million in Texas, with the higher end of the range in each case estimated for Scenario 2.

None of the potentially affected Texas counties levy local sales and use tax. In the three Oklahoma counties, local county sales and use tax rates are either 1 percent (Texas County) or 2 percent (Cimarron and Beaver counties) (Table 3.13-15). Based on these rates, estimated county sales and use tax revenues per facility would range from $0.9 million to $1.9 million for a 50MW facility and from $17.9 million to $35.7 million for a 1,000MW facility.

3.13.6.8.1.6.2 Operations and Maintenance Impacts

Operations and maintenance of the potential wind facilities would generate annual property or ad valorem tax revenues in the counties where they would be located. Estimated installed costs are approximately $105 million for a single 50MW wind facility and $1.95 billion for a single 1,000MW facility. These costs were estimated using the JEDI Wind model and general wind energy averages. The use of these averages results in total estimated installed costs of $7,774 million and $7,798 million for Scenarios 1 and 2, respectively.

Millage rates for the potentially affected Oklahoma counties range from 52.19 to 80.73 (Table 3.13-19). Adjusting the range of estimated installed costs for a single wind facility by the state assessment ratio (the state share of assessed value subject to taxation) of 22.85, the application of these millage rates would result in ad valorem tax revenues ranging from $1.9 million (for a 50MW facility in Beaver County) to $36 million (for a 1,000MW facility in Texas County).

Average millage rates (expressed per $1,000 of assessed value) in the three potentially affected Texas counties range from 4.131 (Hansford County) to 4.392 (Sherman County) (Table 3.13-18). Using a simplified cost approach, property tax revenues for a single wind facility could range from $4.3 million (for a 50MW facility in Hansford County) to $85.6 million (for a 1,000MW facility in Sherman County).

3.13.6.8.1.6.3 Decommissioning Impacts

The general tax implications of decommissioning the potential wind generation facilities would be similar to those discussed with respect to the converter stations, above (see Section 3.13.5.2.7.1).

3.13.6.8.2 Optima Substation

Employment during construction of the substation would follow a similar bell-shaped pattern as construction of the proposed converter stations (see Figure 3.13-2) but would likely involve fewer workers. Impacts would be similar to those discussed for the Oklahoma converter station, but smaller. Some workers would likely temporarily relocate to the Texas County area for the duration of their employment. Adequate temporary housing likely exists to accommodate this demand, but a potential shortage in temporary housing could occur if construction of the future Optima Substation were to coincide with construction of the Oklahoma converter station, AC collection system routes, or HVDC transmission line in this area. The Applicant proposes to prepare and implement a workforce housing strategy for the Project designed to minimize potential impacts to housing availability.

3.13.6.8.3 TVA Upgrades

The required TVA upgrades could result in potential impacts to population, economic conditions, housing, property values, community services, and tax revenues. A short-term increase in the influx of temporary workers and increased demand for temporary housing resources and goods and services would be expected during construction activities, particularly construction of the new 500kV electric transmission line. The temporary relocation of construction workers to the affected areas could create increased demand for community services such as education, medical facilities, municipal services, police, and fire in addition to retail services. These potential effects would be short term and temporary. New permanent employment associated with the operation of the upgraded and new facilities would not likely have a noticeable effect on existing short- or long-term population trends or demand for housing and goods and services.

Local expenditures, employment, and construction-related earnings would have a positive impact on the local economy and employment for the duration of construction. Construction of the required TVA upgrades would generate sales and use tax revenues through expenditures on construction supplies and equipment. Long-term economic impacts from the required TVA upgrades would be primarily associated with operation and maintenance-related expenditures for materials and supplies. As a federal agency, TVA does not pay property taxes. Instead, it returns 5 percent of its power sales revenues as in-lieu tax payments to the states and local governments where it sells electricity or has power properties. These tax equivalent payments are allocated among the states according to the power sales and value of TVA power properties within each state. The new 500kV transmission line could result in a small increase in tax equivalent payments to affected counties. Overall, economic impacts would be expected to be small.

3.13.6.9 Impacts Associated with the No Action Alternative

Under the No Action Alternative, DOE assumes for analytical purposes that the Project would not be constructed. There would be no Project-related impacts to socioeconomics.

This page intentionally left blank.

U.S. DEPARTMENT OF ENERGY

DOE/EIS-0486

Final

PLAINS & EASTERN CLEAN LINE TRANSMISSION PROJECT

ENVIRONMENTAL IMPACT STATEMENT

Volume II of VIII

U.S. DEPARTMENT OF ENERGY
Office of Electricity Delivery and Energy Reliability
Washington, DC

October 2015

This page intentionally left blank.

Contents

Tables

Figures Presented in Appendix A

This page intentionally left blank.

3.14 Special Status Wildlife, Fish, Aquatic Invertebrate, and Amphibian Species

3.14.1 Special Status Terrestrial Wildlife Species

3.14.1.1 Regulatory Background

Regulations that directly influence the evaluation of wildlife resources within the region of influence are primarily implemented by the USFWS and state wildlife agencies. The applicable state agencies in this area include the ODWC, the AGFC, Tennessee Wildlife Resources Agency (TWRA), and Texas Parks and Wildlife Department (TPWD). The wildlife regulations relevant to the Project are presented in Table 3.14.1-1.

Table 3.14.1-1:
Relevant Laws and Regulations for Wildlife Species

Regulation	Regulatory Agency	Summary
Endangered Species Act (ESA) (16 USC § 1531 et seq.; 50 CFR Part 402)	USFWS	Establishes lists of threatened or endangered species and their designated critical habitats; requires federal agencies to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of listed species or result in adverse modification to designated critical habitat.
Migratory Bird Treaty Act (MBTA) (16 USC §§ 703–712)	USFWS	Prohibits take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or the parts, nests, or eggs of such a bird unless expressly permitted by federal regulations or authorized under a MBTA permit.
Executive Order 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds"	USFWS	Directs executive departments and agencies to take certain actions to protect and conserve migratory birds. The Executive Order provides broad guidelines on conservation responsibilities and requires the development of more detailed guidance in Memoranda of Understanding (MOUs).
Bald and Golden Eagle Protection Act (BGEPA) (16 USC §§ 668-668d; 50 CFR Part 22)	USFWS	Prohibits the "take" of bald and golden eagles as defined: pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb without a BGEPA Permit.
Oklahoma Statutes 29-5-412.1	ODWC	Establishes list of threatened or endangered species within Oklahoma.
Texas Administrative Code 31-65.171–65.177	TPWD	Establishes list of threatened or endangered wildlife within Texas; prohibits the taking, possession, transportation, or sale of threatened or endangered species within the issuance of a permit.
Arkansas Code Annotated 15-45-301–306	AGFC[1]	Prohibits imports, transportation, sale, purchase, hunting, harassment, or possession of threatened or endangered wildlife or their parts.
Tennessee Administrative Code 70-1-101 et seq.	TWRA	Establishes a list of threatened or endangered wildlife within Tennessee; prohibits the take, attempt to take, possession, transportation, export, processing, selling, offering to sell, shipment of, or knowing receipt of shipment of threatened or endangered wildlife.

1 Arkansas does not have an endangered species law, but does maintain a list of Species of Special Concern.

3.14.1.2 Data Sources

Data sources included a desktop analysis of relevant information, research findings, reports available to the public, a database that includes GIS data from government agencies as well as non-governmental organizations, and information received from both regulatory agencies and stakeholders during the DOE scoping process. Data sources used for this analysis were open source and readily available to the public (i.e., the public may assess them without restrictions). Some specific state wildlife data is considered sensitive information and may not be disclosed at the discretion of wildlife agencies to prevent potential disturbances to specific wildlife species and their habitat. Examples include locations of wildlife breeding sites (e.g., LEPC leks), nesting areas (e.g., eagle nests or interior least tern colonies), and roosting sites (e.g., bald eagles and bats). If available, more general information on distribution and location of special status wildlife species and their habitat was used in this assessment. For example, location data on LEPC leks consisted of approximately 5-square-mile circular areas with no information on the exact location of the lek within that area. General locations of interior least tern colonies were available in published reports. For species where no site specific information was available or was not disclosed to protect the species, it was assumed that the species were present if suitable habitats were present (i.e., a conservative estimate of species use was used). For example, information on bat roost trees or caves used for roosting or hibernation were either not available, were not disclosed to protect the resource, or only regional locations where caves are located were provided. Under CEQ regulations 40 CFR 1502.22 the lack of such information could be considered incomplete and unavailable. However, using available general distributional data and the conservative approach of assuming that species are present if suitable habitat exists in the ROI would assure that potential impacts to those species are considered and evaluated. Data sources are described in more detail in Table 3.14.1-2.

Table 3.14.1-2:
Summary of Data Sources Wildlife

Resource	Data Source	Exception within the ROI
Federal Special Status Terrestrial Wildlife		
Lesser Prairie-Chicken (LEPC)	LEPC Habitat—Southern Great Plains Crucial Habitat Assessment Tool (CHAT) Agency Consultation[1] GIS Data Sources: KBS (2013a, 2013b, 2014)	A 3-mile buffer from each edge of the 1,000-foot-wide corridor was added to the ROI within or in proximity to the Estimated Occupied Range of the LEPC and the general location of LEPC leks, as identified through CHAT data.
Whooping crane	USFWS Cooperative Whooping Crane Tracking Project GIS Data Sources: USFWS (2014b, 2014e, 2014f)	A 15-mile buffer from each edge of the 1,000-foot-wide corridor was added to the ROI within the whooping crane migration corridor.
American burying beetle	USFWS (2008a); GIS Data Source: Jin et al. (2013)[2] Agency Consultation[1]	N/A
Ozark big-eared bat	Ozark Big-Eared Bat *(Corynorhinus townsendii ingens),* 5-Year Review: Summary and Evaluation (USFWS 2008b) Agency Consultation[1]	A 2-mile buffer from each edge of the 1,000-foot-wide corridor was added to the ROI in proximity to known occurrences of the species.
Indiana bat	Indiana Bat *(Myotis sodalis)* Draft Recovery Plan: First Revision, USFWS (2007a) Agency Consultation[1]	A 2-mile buffer from each edge of the 1,000-foot-wide corridor was added to the ROI in proximity to known occurrences of the species
Gray bat	Gray Bat *(Myotis grisescens)* 5-Year Review: Summary and Evaluation (USFWS 2009a) Agency Consultation[1]	A 2-mile buffer from each edge of the 1,000-foot-wide corridor was added to the ROI in proximity to known occurrences of the species
Northern long-eared bat	80 FR 17973, "Endangered and Threatened Wildlife and Plants; Threatened Species Status for the Northern Long-Eared Bat With 4(d) Rule; Final Rule and Interim Rule."	A 2-mile buffer from each edge of the 1,000-foot-wide corridor was added to the ROI in proximity to known occurrences of the species
Interior least tern	Interior Population of the Least Tern (*Stemula antillarum athalassos*) Recovery Plan (USFWS 1990)	A 5-mile buffer from each edge of the 1,000-foot-wide corridor was added to the ROI based on potential foraging distance from nest colonies.

Table 3.14.1-2:
Summary of Data Sources Wildlife

Resource	Data Source	Exception within the ROI
Other terrestrial species protected by the Endangered Species Act (ESA), including: Florida panther Piping plover Red knot Sprague's pipit	USFWS Endangered Species Program Threatened and Endangered Species Range Maps (http://www.fws.gov/endangered/map/index.html) USFWS Recovery Plans USFWS Critical Habitat Portal (http://ecos.fws.gov/crithab/) Agency Consultation[1]	N/A. The Florida panther is not known to occur within the ROI but areas in Arkansas within the ROI are under review by the USFWS for possible re-introduction. No variation from the standard ROI was defined for the piping plover, red knot, and Sprague's pipit.
Bald and Golden Eagle Protection Act (BGEPA)	Agency Consultation1	A 1-mile buffer from each edge of the 1,000-foot-wide corridor was added to the ROI for known occurrences of bald eagle nests or bald and golden eagle roosting areas.
State Special Status Terrestrial Wildlife		
State protected species with potential habitat in the ROI	ODWC Threatened Endangered, and Rare Species List (ODWC 2013) AGFC Endangered Species List (http://www.agfc.com/species/Pages/SpeciesEndangered.aspx) Tennessee Natural Heritage Inventory Program Element Occurrence Polygons2 (http://www.tn.gov/environment/natural-areas/natural-heritage-inventory-program.shtml) TPWD Texas Natural Diversity Database (http://www.tpwd.state.tx.us/huntwild/wild/wildlife_diversity/txndd/) Agency Consultation[1]	N/A

1 Federal and state agencies often maintain non-public data files on species presence and occurrence. The Applicant consulted with federal and state resource agencies to identify and collect such non-public data. Non-public data were included in the analysis to the extent that the data were not confidential, available, and complete.

2 Clean Line created an American burying beetle potential occurrence area data layer by selecting certain categories from the NLCD 2006 data within the counties of occurrence based on habitat requirements identified by USFWS (2008a). Areas considered as potential occurrence areas included the following NLCD 2006 categories: Deciduous Forest, Evergreen Forest, Mixed Forest, Barren Land, Shrub/Scrub, Grassland/Herbaceous, and Pasture/Hay.

3.14.1.3 Region of Influence

3.14.1.3.1 Region of Influence for the Project

The general ROI considered for this Project is described in Section 3.1.1. The following subsection describes where the ROI used for special status wildlife species was expanded beyond the area described in Section 3.1.1. Many avian and bat species can range over a considerable distance, particularly migratory species. The expansion of the ROI does not mean that impacts would necessarily occur at that distance, but instead, it identifies whether species are in the vicinity and could possibly be affected by the Project.

3.14.1.3.2 Variations of the Region of Influence for Special Status Wildlife

The ROI for the following special status wildlife species was expanded to account for potential occurrence of each species and to assess the potential direct and indirect effects to the species as follows:

- LEPC: Winder et al. (2013) found that the strongest predictor of female greater prairie chicken space use for nesting was distance from leks. The Lesser Prairie Chicken Range-wide Conservation Plan recommends avoiding leks by 1.25 miles (Van Pelt et al. 2013). Hagen et al. (2004) state that most female LEPC select nest sites within approximately 2 miles of a lek. However, because of variation among individual prairie chickens and possibly the limited availability of suitable nesting habitat in the vicinity of some leks, a buffer distance of 1.25 miles probably represents an area containing only about 85 percent of the LEPC nests in the vicinity of a lek (Van Pelt et al. 2013). Therefore, to more fully account for potential LEPC in the vicinity of the APR to account for breeding, nesting, and brood rearing habitat, a 3-mile ROI was selected from each edge of the 1,000-foot-wide corridor for the Applicant Proposed Route and HVDC Alternative Routes (Pitman et al. 2005, Hagen et al. 2004).
- Whooping crane: Within the 200-mile-wide whooping crane migration corridor where approximately 95 percent of migrating whooping cranes are observed (95 percent migration corridor), the ROI was expanded to encompass a 15-mile buffer from each edge of the 1,000-foot-wide corridor (Applicant Proposed Route and HVDC alternative routes) to identify any known or potential whooping crane stopover locations in the vicinity of the Project. This distance was based on the known foraging distance from stopover locations and recommended BMPs for transmission lines within the whooping crane migratory corridor (USFWS 2009d).
- Protected bat species: The ROI was expanded for bat species designated as candidate, threatened, or endangered under the Endangered Species Act (ESA) to encompass a 1.5-mile buffer from each edge of the 1,000-foot-wide corridor (Applicant Proposed Route and HVDC alternative routes) in proximity of known occurrences of such species to evaluate potential roosting and hibernacula habitat[1], including the potential for karst or cave features that may serve as habitat for the species. This distance was based upon the recommended review distance for protected bat species habitats (USFWS 2014b, 2014c).
- Interior least tern: The ROI was expanded in proximity to known occurrences of interior least tern nesting to encompass a 5-mile buffer from each edge of the 1,000-foot-wide corridor so that potential impacts to interior least tern within the ROI could be identified and assessed. This distance was based on the known foraging distance for nesting interior least terns (USFWS 1990).

A summary of the data sources used is provided in Table 3.14.1-2.

3.14.1.3.3 Region of Influence for Connected Actions

The ROI for wind energy generation, the future Optima Substation, and TVA upgrades is described in Section 3.1.1.

3.14.1.4 Affected Environment for Terrestrial Special Status Wildlife Species

As discussed in Section 3.17, the ROI crosses multiple ecoregions that support diverse vegetation communities. Overall, the ROI is within the Great Plains and Eastern Temperate Forests Level I Ecoregions (EPA 2012). From the western edge of the ROI in the Oklahoma Panhandle and moving eastward across Oklahoma, Arkansas, and western Tennessee, the vegetation changes from arid to semi-arid grasslands to forests and river valleys as precipitation increases from west to east and elevation changes. Additional information regarding climate may be found in Section 3.3. As such, a variety of wildlife species, both terrestrial and aquatic, is expected to occur within the

[1] A bat hibernaculum is a site where bats hibernate over the winter. These sites are most often caves or abandoned mines.

habitats found within the ROI. The highest species diversity can be expected to occur in areas of greater habitat diversity such as transitional zones between forests and grasslands, wetlands, riparian zones, and open waters.

The following sections provide regional descriptions of special status species known to occur within the ROI or that have the potential to occur within the ROI based on habitat associations and known range information. Detailed descriptions of special status wildlife species in the ROI in Regions 1 through 7 are provided below. Twenty-three route variations to the Applicant Proposed Route in Regions 2–7 were developed in response to public comments on the Draft EIS and are described in Appendix M and summarized in Sections 2.3.1 and 2.4.2.1–2.4.2.7. The route variations are discussed in relation to the terrestrial special status species in the regional descriptions in Section 3.14.1.5. Potential impacts to these species in the route variations are discussed in Section 3.14.1.7.

Thirty federal candidate or listed animal species have been identified within the ROI, including both terrestrial and aquatic species (USFWS 2014a). Of these, 14 of the species are considered terrestrial species. Twelve are either candidates or listed as threatened or endangered under the ESA (Table 3.14.1-3), and two species, the golden and bald eagle, are protected by the BGEPA. Species discussions are presented below by species type (e.g., mammals, birds, etc.) and in increasing order of protection (e.g., candidate, threatened, endangered, etc.). Of the 12 federal candidate or listed terrestrial wildlife species, the whooping crane and Interior least tern are also state protected species. An additional nine species of terrestrial wildlife are protected by state law or regulation, but are not federally protected under the ESA or BGEPA.

Table 3.14.1-3:
Federally Designated Threatened and Endangered Terrestrial Wildlife Potentially Occurring in the ROI

Common Name	Scientific Name	Federal Status	County[2]	Region
Oklahoma				
Mammals				
Northern long-eared bat	*Myotis septentrionalis*	Federally Threatened	Sequoyah, Muskogee, and Okmulgee	3, 4
Ozark big-eared bat	*Corynorhinus townsendii ingens*	Federally Endangered	Sequoyah	4
Gray bat	Myotis grisescens	Federally Endangered	Muskogee and Sequoyah	3, 4
Indiana bat	Myotis sodalis	Federally Endangered	Sequoyah	4
Birds				
Sprague's pipit	*Anthus spragueii*	Federal Candidate	Beaver, Payne, Sequoyah	1,3, 4
Red knot	*Calidris canutus rufa*	Federally Threatened	Occasional transient migrant across the state	1, 2, 3, 4
LEPC	*Tympanuchus pallidicinctus*	Federally Threatened[3]	Beaver, Harper, Woodward, and Texas	1, 2
Piping plover	*Charadrius melodus*	Federally Threatened	Texas, Beaver, Harper, Woodward, Garfield, Kingfisher, Logan, Payne, Lincoln, Okmulgee, and Muskogee	1,2, 3
Whooping crane	*Grus americana*	Federally Endangered	Beaver, Woodward, Major, Garfield, Kingfisher, Logan, Muskogee, and Sequoyah	1, 2, 3
Interior least tern	*Stemula antillarum athalassos*	Federally Endangered	Texas, Beaver, Harper, Woodward, Major, Kingfisher, Payne, Logan, Lincoln, Creek, Okmulgee, Muskogee, and Sequoyah	1, 2, 3, 4
Terrestrial Invertebrate				
American burying beetle	*Nicrophorus americanus*	Federally Endangered	Payne, Lincoln, Creek, Okmulgee, Muskogee, and Sequoyah	3, 4

Table 3.14.1-3:
Federally Designated Threatened and Endangered Terrestrial Wildlife Potentially Occurring in the ROI

Common Name	Scientific Name	Federal Status	County[2]	Region
Arkansas				
Mammals				
Northern long-eared bat	*Myotis septentrionalis*	Federally Threatened	Cleburne, Conway, Crawford, Cross, Franklin, Jackson, Johnson, Mississippi, Poinsett, Pope, Van Buren, and White	4, 5, 6, 7
Ozark big-eared bat	*Corynorhinus townsendii ingens*	Federally Endangered	Crawford, Franklin, Johnson, and Pope	4, 5
Gray bat	*Myotis grisescens*	Federally Endangered	Crawford, Franklin, Johnson, Pope, Van Buren, Cleburne, White, and Jackson	4, 5, 6
Indiana bat	*Myotis sodalis*	Federally Endangered	Cleburne, Crawford, Franklin, Jackson, Johnson, Pope, and Van Buren	4, 5, 6
Florida panther	*Puma concolor coryi*	Federally Endangered	Conway and Johnson[1]	4
Birds				
Sprague's pipit	*Anthus spragueii*	Federal Candidate	Crawford, Franklin, and White	4, 5
Red knot	*Calidris canutus rufa*	Federally Threatened	Occasional transient migrant across the state	4, 5, 6, 7
Piping plover	*Charadrius melodus*	Federally Threatened	Crawford, Johnson, Pope, Conway, Faulkner, White, and Mississippi	4, 5, 7
Interior least tern	*Stemula antillarum athalassos*	Federally Endangered	Crawford, Franklin, Johnson, Pope, Conway, Faulkner, White, Cross, Poinsett, and Mississippi	4, 5, 6, 7
Terrestrial Invertebrate				
American burying beetle	*Nicrophorus americanus*	Federally Endangered	Crawford, Franklin, and Johnson	4
Tennessee				
Mammals				
Northern long-eared bat	Myotis septentrionalis	Federally Proposed Endangered	Tipton and Shelby	7
Indiana bat	*Myotis sodalis*	Federally Endangered	Tipton and Shelby	7
Birds				
Red knot	*Calidris canutus rufa*	Federally Proposed Threatened	Occasional transient migrant across the state	7
Interior least tern	*Stemula antillarum athalassos*	Federally Endangered	Tipton and Shelby	7
Texas				
Birds				
Red knot	*Calidris canutus rufa*	Federally Threatened	Occasional Transient migrant across the state	AC collection system
LEPC	*Tympanuchus pallidicinctus*	Federally Threatened	Ochiltree	AC collection system

1 Although counties were identified by the USFWS (2014a) for potential reintroduction, the species is considered extinct in Arkansas.
2 No designated critical habitats are found within the Project's ROI or the various counties crossed by the Project for listed terrestrial species or those species proposed for listing.

3 The USFWS listed the LEPC (Tympanuchus pallidicinctus) as a threatened species under the ESA in a final rule published in 2014 (79 FR 19974, April 10, 2014). USFWS also issued a special take rule for the LEPC under Section 4(d) of the ESA (79 FR 20074, April 10, 2014). On September 1, 2015, a federal court in Texas vacated the final rule listing the LEPC as a threatened species. *Permian Basin Petroleum Ass'n v. Dep't of Interior*, No. MO–14–CV–50, 2015 WL 5192526 (W.D. Tex. Sept. 1, 2015). Given that appeals are possible in this matter, the legal status of the LEPC will continue to be considered as threatened for the purposes of this EIS.

Source: USFWS (2014a)

3.14.1.4.1 Federally Listed Terrestrial Mammals

3.14.1.4.1.1 Northern Long-eared Bat

The northern long-eared bat *(Myotis septentrionalis)* is a federally threatened species (80 FR 17974, April 2, 2015). The northern long-eared bat ranges throughout much of the eastern and north-central United States (USFWS 2014a). Within this species' range in the ROI, it has been documented or has the potential to occur in the following counties within or near the ROI: Muskogee, Okmulgee, and Sequoyah counties in east-central Oklahoma (Regions 3 and 4); Crawford, Conway, Franklin, Johnson, Pope, Van Buren, Cleburne, White, Jackson, Poinsett, Mississippi, and Cross counties in northern Arkansas (Regions 4–5); and Tipton and Shelby counties in southwestern Tennessee near the Arkansas border (Regions 6–7; 78 FR 61045).

The northern long-eared bat is a migratory bat that uses two habitat types during different seasons of the year: caves for hibernacula in winter and dense forest stands that contain trees with exfoliating bark or cavities for maternity roosts in spring, summer, and fall. The northern long-eared bat does not appear dependent on a particular tree species but opportunistically uses those species that form cavities, crevices, or retain bark such as oaks, maples, black locust, American beech, and shortleaf pine (78 FR 61045). Hibernacula may occur within suitable caves and/or abandoned mines throughout its range, generally the eastern and north-central United States, and are established in October and begin to break up in March or April. This species has shown fidelity to particular hibernation caves from year to year; however, some bats may not use the same hibernacula in successive years (Caceres and Barclay 2000). Northern long-eared bats emerge from hibernacula in the spring and migrate to summer foraging areas. Movements between summer roosts and winter hibernacula in the late fall are typically short (35 to 55 miles); however, movements from hibernacula to summer maternity colonies have ranged up to 168 miles (78 FR 61045). Seven caves in the Ozark Plateau National Wildlife Refuge located in Adair County, Oklahoma, north of Sequoyah County, are known to be inhabited by northern long-eared bats (80 FR 17974, April 2, 2015).

Northern long-eared bats are nocturnal insectivores and have a diverse diet including moths, flies, leafhoppers, caddisflies, and beetles (78 FR 61045, October 2, 2013). As insectivores, preferred forage habitat includes the forest interior in areas below the canopy but above the shrub layer where insects are most commonly found. This species also may occasionally forage in open areas, such as forest clearings, along waterways, and roads (78 FR 61045).

Historically, this species has been documented as common throughout its range and has not been considered at risk in the United States. The USFWS listed the northern long-eared bat as threatened in April 2015 based on the species' risk of extinction, which is predominately related to the threat of white-nose syndrome, a fungal infection that has reduced some bat populations in the eastern United States by 30 to 99 percent (USFWS 2014d). Additional threats to the northern long-eared bat include destruction or degradation of habitat through deforestation and loss of forest connectivity (i.e., habitat fragmentation) and disturbance (e.g., recreational caving and vandalism) of bat hibernacula (78 FR 61045).

3.14.1.4.1.2 Ozark Big-eared Bat

The Ozark big-eared bat *(Corynorhinus townsendii ingens)* is a federally endangered species. The range of the Ozark big-eared bat is limited to a small number of counties in Oklahoma and Arkansas, including documented occurrences in the following counties in Region 4 and 5: Sequoyah County in east-central Oklahoma near the Arkansas border and Crawford, Franklin, Johnson, and Pope counties in northern Arkansas near the Oklahoma border (78 FR 61045). Oklahoma has 10 caves of known use by Ozark big-eared bats in Adair County, one cave in Sequoyah County, and one in Cherokee County identified as essential to the species. Fifty other caves in Oklahoma are known to be infrequently used by the Ozark big-eared bat. These caves may be used by small groups or solitary males during the maternity season. Arkansas has seven caves considered essential sites, of which none occurs in counties within the ROI (USFWS 2008b). In January 2015, Ozark big-eared bats were found in two caves in the vicinity of Lee Creek Reservoir within the ROI. It is not known whether the species also uses these caves during the summer for roosting.

Ozark big-eared bats are a cave obligate species that rely on limestone and sandstone talus caves associated with karst topography for roosting and hibernation (USFWS 2008b). This species has shown fidelity to particular hibernation caves from year to year, but may occasionally move between caves (USFWS 2008b). Hibernation generally is initiated in October, when Ozark big-eared bats typically seek out the coldest regions of selected caves with temperatures ranging from 46 to 50 Fahrenheit (°F) and 86 to 93 percent humidity (USFWS 2008b). When bats come out of hibernation in April, maternity colonies begin forming in late April and early May with births occurring in May or June (USFWS 2008b).

This species forages over forests and grasslands for moths, their primary prey, but it also glean beetles and other flying insects (USFWS 2008b). Open areas allow for easy foraging because bats are not obstructed by branches while pursuing prey and are able to discriminate insects at greater distances. Ozark big-eared bats have smaller home ranges compared to other bats and generally have a foraging distance of approximately 1.2 miles to a maximum of 5 miles and exhibit an avoidance of areas of human development and cropland (Graening et al. 2011). Current threats to the Ozark big-eared bat consist of human disturbance of occupied caves (i.e., recreational caving); loss and fragmentation of foraging habitat; and disturbance of talus slopes, abandoned buildings, and bridges that may be used by solitary roosting bats.

3.14.1.4.1.3 Gray Bat

The gray bat *(Myotis grisescens)* is a federally endangered species. The range of the gray bat includes the southeastern United States (USFWS 2014a). Within this species' range in the ROI, it has been documented or has the potential to occur in the following counties within, or near, the ROI: Muskogee and Sequoyah counties in east-central Oklahoma near the Arkansas border (Region 3 and 4), and Crawford, Franklin, Johnson, Pope, Van Buren, Cleburne, White, and Johnson counties in northern Arkansas (Regions 4 and 5) (USFWS 2013b). Gray bats are cave obligate species using different caves for winter hibernation and summer roosting. Oklahoma is home to nine summer colonies of gray bats, though none stay through hibernation (Martin 2007). Two summer colonies are located in Adair County, Oklahoma. Six active gray bat hibernacula are in Arkansas counties crossed by, or near, the Project (Martin 2007).

Gray bats emerge from hibernacula in late March or early April and select summer caves near water sources for prime insect foraging locations. Gray bats are strictly insectivorous, feeding only on insects, especially aquatic insects such as mayflies, caddisflies, and stoneflies (USFWS 2009a). River edges and reservoirs provide abundant supplies of insects for gray bats (Tuttle 1976). Colonies reside in multiple caves during different times of the year; however, the unifying factor is that gray bats are only found in limestone karst areas in the southeastern United States (Tuttle 1975). Hibernacula caves are typically deep vertical caves selected in early October with females arriving prior to males (Martin 2007). No hibernation colonies are known from Oklahoma (USFWS 2011b). Gray bats have specific cave requirements, selecting cold caves in winter and warm caves near water in summer, resulting in 95 percent of gray bats using only nine caves (USFWS 2009a).

Historically, threats to gray bats have included pollutants that impact insect populations; alterations to caves that change temperature, airflow, humidity, or light, and cave flooding (USFWS 1997; Fremling and Johnson 1989). However, current threats have expanded to include white-nose syndrome that causes hibernation disruptions that, in turn, can deplete energy stores and may result in mortality from starvation (USFWS 2009a). Disturbance of caves, both those used for winter hibernation and for maternity roosts, are potential threats to the species.

3.14.1.4.1.4 Indiana Bat

The Indiana bat *(Myotis sodalis)* is a federally endangered species. The Indiana bat range includes the northeastern east-central, and Midwestern United States (USFWS 2014a). Within this species' range in the ROI, it has been documented or has the potential to occur in the following counties within the ROI: Sequoyah County in east-central Oklahoma near the Arkansas border; Crawford, Franklin, Johnson, Pope, Van Buren, Cleburne, and Jackson counties in northern Arkansas; and Shelby County in southwestern Tennessee near the Arkansas border (USFWS 2014a). An inhabited hibernaculum, known as Rosson Hollow Crevices, is located in Franklin County, Arkansas. Portions of the ROI pass through USFWS-recognized Karst Conservation Zones in which Indiana bat habitat may occur (USFWS 2013b). The Ozark Plateau Wildlife Refuge in Adair County, north of Sequoyah County in east-central Oklahoma, has been identified by the USFWS as important to the Indiana bat because of the availability of cave hibernacula.

The Indiana bat is a migratory bat that uses caves for hibernacula in winter and is found in dense forest stands using exfoliating bark or tree cavities for maternity roosts in spring, summer, and fall. Hibernacula may occur in suitable caves and/or abandoned mines throughout its range and are usually established by November, earlier in more northern regions, and begin to break up in April. This species has shown fidelity to particular hibernation caves from year to year.

Indiana bats emerge from hibernacula in spring from late March to mid-May and migrate to summer foraging areas that can be up to 350 miles from hibernacula (USFWS 2007a). This species will use the sloughing bark of dead/dying trees, tree cavities, and exfoliating bark of live trees for maternity colonies and summer roosts. Primary roost trees are usually larger than the surrounding forest trees and are located in forest canopy openings, fence lines, or along wooded edges (USFWS 2007a). Common roost tree species used include ash, elm, oak, hickory, maple, and poplar. Maternity roost habitat includes riparian areas, bottomland hardwood forests, and other forested wetlands, as well as upland forests. Indiana bats are nocturnal insectivores that feed almost exclusively on flying insects. Preferred foraging areas include sites around water sources (e.g., rivers, streams, ponds, etc.) or open woodlands (USFWS 2007a). Foraging usually occurs within 2 miles of a primary roost tree but may occur up to 5 miles from the roost (USFWS 2007a).

Current threats to the Indiana bat include loss of habitat (i.e., roost sites and foraging areas) from deforestation and loss of forest connectivity (i.e., habitat fragmentation), degradation of hibernacula by human activities (recreational caving, vandalism, etc.), and white-nose syndrome (USFWS 2012b, 2009b).

3.14.1.4.1.5 Florida Panther

The Florida panther (*Puma concolor coryi*) is a federally endangered species. This species' range is limited to southern and south-central Florida and it is considered extinct in Arkansas (USFWS 2008c), and therefore is not present in the ROI. However, the USFWS has considered reintroducing the Florida panther into Arkansas. Areas being considered for reintroduction in proximity to the ROI include the Ozark National Forest and the Ouachita National Forest (USFWS 2008c).

The preferred habitat of the Florida panther includes cypress swamps, pinelands, hardwood swamps, and upland hardwood forests. Threats to the Florida panther in its current range include loss of habitat, urbanization encroachment, disease, intraspecific aggression, and collisions with vehicles (USFWS 2008c).

3.14.1.4.2 Federal Candidate or Listed Birds

3.14.1.4.2.1 Sprague’s Pipit

Sprague's pipit *(Anthus spragueii)* is a candidate for federal ESA listing (79 FR 72449, December 5, 2014). The listing priority number (scale of 1 to 12) of Sprague’s pipit is 11, indicating that threats to the species are medium to low and non-imminent (79 FR 72449). Sprague’s pipit is documented to occur in the ROI in Region 1 (Beaver County in the Oklahoma Panhandle), in Region 3 (Payne County in north-central Oklahoma), in Region 4 (Sequoyah County in east-central Oklahoma near the Arkansas border, and Franklin County in northern Arkansas near the Oklahoma border [USFWS 2014a]). Sprague’s pipit occurs as an uncommon migrant and rare winter resident in Oklahoma and Arkansas. Sprague’s pipit is a small grassland bird noted for its distinct high flights and secretive behaviors. The species is strongly tied to unplowed native prairie throughout its life cycle. Native prairie habitat used by Sprague’s pipit includes short-grass prairie, mixed-grass prairie, alkaline meadows, and wet meadows. Its current breeding distribution includes portions of Montana, North Dakota, South Dakota, and Canada, and its current wintering distribution includes south-central and southeast Arizona, southern New Mexico, Texas, southern Oklahoma, southern Arkansas, northwestern Mississippi, southern Louisiana, and northern Mexico. The majority of sightings occur in Texas (78 FR 70103, November 22, 2013) but Sprague’s pipit is assumed to pass through the states of Oklahoma and Arkansas. Sprague’s pipit also may use stubble and fallow alfalfa, soybean, and wheat fields in the fall and winter.

Current threats to Sprague's pipit include loss, degradation, and fragmentation of native grassland habitat, energy development (i.e., oil, gas, and wind), climate change, and drought (78 FR 70103).

3.14.1.4.2.2 Red Knot

The *rufa* subspecies of the red knot *(Calidris canutus rufa)* is a federally threatened subspecies. This subspecies is a potential migrant in the interior United States and does not breed or winter in the vicinity of the ROI; however, the overall range of the red knot overlaps the vicinity of the ROI. Most *rufa* subspecies of the red knot migrate along the Atlantic Coast during spring and fall; however, every interior state has multiple documented migration records and recent research has shown that birds wintering along the Gulf of Mexico fly to and from breeding grounds via the Central Flyway (78 FR 60023, September 30, 2013). The ROI traverses both the Central and Mississippi Flyways, and potentially lies in the migratory path of the relatively small number of red knots that migrate through the interior United States. No critical habitat has been designated for the red knot.

The red knot is a medium-sized shorebird largely dependent upon high quality habitats that serve as staging areas for their long-distance migration (78 FR 60023). The conditions at these staging areas factor heavily in the annual cycle and survival of red knots. These staging areas, or stopover sites, are primarily along the Atlantic Coast; however, relatively small numbers occur annually across the interior United States (Harrington 2001; 78 FR 60023). Red knots use aquatic habitats with exposed sediments and abundant, readily accessible invertebrates. There are no known primary stopover sites in the vicinity of the ROI, and red knots migrating through the Central Flyway are believed to depart the Texas coast and stopover in the Northern Great Plains and Hudson Bay areas before reaching their Arctic breeding grounds (78 FR 60023). Red knots stopping over in the vicinity of the ROI are expected to be a rare occurrence with relatively few individuals.

Threats to the red knot include climate change, habitat loss, declining food availability at stopover sites, human disturbances at migration and wintering areas, wind energy development, pollution, and predation pressures. Climate change may be one of the more critical threats to red knots (Harrington 2001; 78 FR 60023). Habitat loss and modification also are a major threat to red knots.

3.14.1.4.2.3 Lesser Prairie-Chicken

The LEPC *(Tympanuchus pallidicinctus)* was listed as a federally threatened species (79 FR 19974 and 79 FR 20074, April 10, 2014). The USFWS listed the LEPC (*Tympanuchus pallidicinctus*) as a threatened species under the ESA in a final rule published in 2014 (79 FR 19974, April 10, 2014). USFWS also issued a special take rule for the LEPC under Section 4(d) of the ESA (79 FR 20074, April 10, 2014). On September 1, 2015, a federal court in Texas vacated the final rule listing the LEPC as a threatened species. *Permian Basin Petroleum Ass'n v. Dep't of Interior*, No. MO–14–CV–50, 2015 WL 5192526 (W.D. Tex. Sept. 1, 2015). Given that appeals are possible in this matter, the legal status of the LEPC will continue to be considered as threatened for the purposes of this EIS. The range for the LEPC overlaps with the ROI in Region 1 in Texas, Beaver, and Harper counties, and Woodward County in Region 2 in the Oklahoma Panhandle, and with the AC collection system routes in Ochiltree County, Texas, in the Texas Panhandle (USFWS 2014a) (Figures 3.14-1a and 3.14-1b (located in Appendix A). No critical habitat had been proposed or designated for the LEPC at the time of the final listing rule (USFWS 2014a; 79 FR 19974; 79 FR 20074).

In Oklahoma and Texas, the LEPC occupies sand sagebrush habitat in the western and eastern Panhandle and mixed-grass habitat in the northwest region (Van Pelt et al. 2013). Courtship and breeding occurs on leks formed by groups of male birds, similar to other grouse or prairie-chicken groups. Leks typically occur on knolls or ridges with relatively short and/or sparse vegetation. Developed or manipulated areas may also be used for lek sites and include oil well pads, roads, reverted cropland, cultivated fields, areas treated with herbicides, and recently burned areas (Van Pelt et al. 2013). However, LEPC cannot survive solely in landscapes with greater than 30 percent cultivated or disturbed land (Bidwell et al. 2003). Preferred nesting sites are in sand sagebrush or shinnery oak grasslands with high canopy cover and moderate vertical and horizontal cover (Elmore et al. 2009; ODWC 2012). Brood rearing habitat is generally close to nesting habitat but may contain more structural diversity with shorter grasses and more forbs mixed with taller shrubs and grasses that allow easy travel for broods, insects and seeds for food, and escape cover (Elmore et al. 2009). The LEPC requires large contiguous blocks of habitat to maintain sustainable populations. The minimum size of contiguous grassland required is uncertain but may range from 1,200 to 25,000 acres (Van Pelt et al. 2013).

Through the Western Governors Association CHAT, crucial habitats and important corridors for the LEPC have been mapped in Region 1 and 2 (Figure 3.14-1 in Appendix A). CHAT category 1 habitat (CHAT-1) is considered focal habitat areas for LEPC conservation and represents the best remaining areas of LEPC habitat. CHAT-2 areas comprise habitat connectivity areas that have been identified as those areas important for maintaining large-scale habitat connections between crucial LEPC habitats. Areas mapped as CHAT-3 include those sites modeled as LEPC habitat based on data such as locations of leks and nests, land in the Conservation Reserve Program, land cover type, and abiotic site conditions. CHAT-4 areas are estimated occupied LEPC range based on expert opinion. CHAT categories 1 through 4 represent the best known current potential range of the LEPC.

The primary threats to LEPC include habitat loss through conversion of preferred grassland/shrub land habitat to agricultural uses, degradation and fragmentation, and the subsequent displacement from or avoidance of remaining habitat patches. Threats to this species' sustainability are exacerbated by conservation challenges such as incompatible grazing management, tree encroachment, conversions of rangeland to crop and non-native forage production, energy development, and increased disturbance, particularly of breeding leks and nesting areas (79 FR 19974 and 79 FR 20074, April 10, 2014). Because LEPC prefer relatively large areas of undisturbed habitat, degradation of LEPC habitat occurs through conversion of smaller land areas to agricultural uses and placement of human infrastructure such as windbreaks, communication and transmission towers, wind turbines, and oil and gas wellheads that fragment larger habitat areas (79 FR 19974). Research indicates that LEPC will avoid certain human structures such as roads, wellheads, and vertical structures such as buildings and transmission structures and lines even if suitable habitat occurs in the immediate surroundings (79 FR 19974; Pruett et al. 2009; Robel et al. 2004). Transmission lines and structures may impact this species use of otherwise suitable habitats due to increased predation rates that can result from avian predators perching and roosting along the structures and line. Fragmentation of habitat reduces potential movement (i.e., emigration and immigration) between areas of suitable habitat, thereby reducing the potential augmentation of isolated populations.

3.14.1.4.2.4 Piping Plover

The piping plover *(Charadrius melodus)* is a federally threatened species that has a large range across the Great Plains and East Coast of the United States (USFWS 2014a). The piping plover is a wide-ranging small shorebird typically observed as a migratory species within the ROI. The breeding range for piping plovers that migrate through the Project area is primarily the Northern Great Plains population (USFWS 2009e). Records of nesting piping plovers within the ROI and its vicinity are rare; only two nests are documented at Optima Lake in Texas County, Oklahoma (78 FR 61045, October 2, 2013). In relation to Optima Lake, the ROI for the Applicant Proposed Route is about 7 miles south, HVDC alternative routes are approximately 3 to 5 miles south, and AC Collection System Routes E-1 and NE-2 are approximately 1.5 miles south and 5 miles west, respectively. Documented or potential occurrence of the piping plover include the following counties within the ROI in Regions 1 through 7: Texas, Beaver, Harper in the Oklahoma Panhandle; Woodward County in northwestern Oklahoma; Garfield, Kingfisher, Logan, Payne, Lincoln counties in north-central Oklahoma; Okmulgee and Muskogee counties in east-central Oklahoma near the Arkansas border; Crawford County, Arkansas, in northern Arkansas near the border with Oklahoma; Johnson, Pope, Conway, Faulkner, and White counties in north-central Arkansas and Mississippi County in northeastern Arkansas near the border with Tennessee (USFWS 2014a). No federally designated critical habitat is within the ROI.

The piping plovers within the ROI are individuals of the northern Great Lakes population of piping plovers that breed along open, sparsely vegetated sand or gravel beaches adjacent to alkali wetlands, and on beaches, sand bars, and dredged material islands of major river systems (USFWS 2009c). During migration, typically April and August, the species can be documented throughout Oklahoma at rivers, wetlands, and reservoirs using sandbars, beaches, and sparsely vegetated areas on their way to wintering grounds along the Gulf of Mexico. However, inland populations appear to migrate nonstop from northern breeding areas to winter grounds along the Gulf of Mexico contributing to fewer observations within the ROI (USFWS 2014d).

The primary threat to the piping plover is destruction and degradation of summer and winter habitat. The major threats in the northern Great Plains breeding range include predation, habitat alteration due to impoundments, river channelization and manipulation of water flows, sand and gravel mining, oil and gas production, and invasive species encroachment. All piping plover populations face increasing human disturbance during their coastal migration and in their wintering range. Human presence may inhibit courtship, incubation, and brooding, and impact nesting and foraging activities (USFWS 2009c). Because piping plovers occur primarily along rivers and wetlands, collisions with transmission lines and structures near crossings of rivers appear to be the greatest potential Project impact to the piping plover.

3.14.1.4.2.5 Whooping Crane

The whooping crane *(Grus americana)* is a federally endangered species with a range that extends from Canada through the Great Plains to the Texas Gulf Coast. The Project would cross the migration corridor for the Aransas-Wood Buffalo population of the whooping crane (Tacha et al. 2010; USFWS 2012d, 2014d). The migration corridor range, based on where approximately 95 percent of the documented occurrences of migrating whooping cranes, includes the following Oklahoma counties within the ROI: Beaver County in the Oklahoma Panhandle (Region 1); Woodward and Major counties in northwestern Oklahoma (Region 1 through 2); and Garfield, Kingfisher, Logan, Payne, and Lincoln counties in north-central Oklahoma (Region 3) (USFWS 2014a). The migration corridor is approximately 200 miles wide. Other counties in Oklahoma where whooping cranes could occur during migration but are less likely include Texas County in the Oklahoma Panhandle and Okmulgee and Muskogee counties in east-central Oklahoma (Region 4; USFWS 2014a). No federally designated critical habitat for this species is currently located within the ROI.

The whooping crane is a large migratory crane that overwinters along the Gulf of Mexico at the Aransas National Wildlife Refuge. The Aransas-Wood Buffalo population of whooping cranes migrates through the central United States and breeds in central Canada at Wood Buffalo National Park. Autumn migration normally begins in mid-September, with most birds arriving on the Gulf of Mexico wintering grounds between late October and mid-November. Spring migration departure dates are normally between late March and mid-April, with the last birds usually leaving by May 1 (USFWS 2014a). During the annual migration, whooping cranes use stopover areas for resting and foraging. Whooping cranes will feed in shallow waters along the margin of wetlands, harvested grain fields, pastures, grasslands, and burned upland fields (USFWS 2014d). Roosting habitat is usually shallow, seasonally, and semi-permanent flooded wetlands or wide, sandy rivers. Generally, this species prefers wetlands with less vegetation (USFWS 2009d). The USFWS Cooperative Whooping Crane Tracking Project maps observations of whooping cranes during migration and has identified a primary migration corridor within the central United States (Figure 3.14-2 in Appendix A) (Tacha et al. 2010). This migration corridor is further delineated into sections based upon the percentage of observations from the centerline. Approximately 95 percent of all whooping crane observations during migration occur within 200 miles of the centerline of the migration corridor. Known migration and stopover observations of whooping crane may occur outside the delineated migration corridor, but the migration corridor is indicative of 95 percent of the known migration and stopover observations reported to the USFWS Cooperative Whooping Crane Tracking Project. No whooping crane critical habitat has been designated in the ROI, but the Salt Plains National Wildlife Refuge approximately 35 miles north of the Applicant Proposed Route in north-central Oklahoma in Alfalfa County has been designated critical habitat and is an important migration stopover area (Figure 3.14.-3 in Appendix A).

Current threats to recovery of whooping cranes include ongoing loss and degradation of migratory stopover and coastal wintering habitats, and collisions with structures (e.g., fences, power lines, and communication towers) (Stehn and Wassenich 2006; USFWS 2009d, 2014d). Climate change also may threaten this species' continued existence, reducing inflows of freshwater in wintering, migration, and breeding grounds (USFWS 2009d). Additionally, whooping cranes are sensitive to human disturbance, particularly to the presence of humans on foot (USFWS 2009d, 2014a). Transmission lines and structures bordering fields and wetlands where cranes forage and roost pose a greater collision risk and are of concern (USFWS 2009d).

3.14.1.4.2.6 Interior Least Tern

The interior least tern (*Sternula antillarum athalassos*) is a federally endangered species that ranges from the northern Great Plains through the Texas Gulf Coast in the United States (USFWS 2014a). The breeding range for the interior population of the least tern based on documented occurrences and potential for occurrences includes all counties traversed within the ROI: Texas, Beaver and Harper counties in the Oklahoma Panhandle (Region 1); Woodward and Major counties in northwestern Oklahoma (Region 1 through 2); Kingfisher, Logan, Payne, Lincoln, and Creek counties in central Oklahoma (Region 3); Okmulgee, Muskogee, and Sequoyah counties in east-central Oklahoma (Region 3 through 4); Crawford, Franklin, Pope, Conway, Faulkner, Cross, and Mississippi counties in northern Arkansas (Regions 4 through 6); and Shelby County in southwestern Tennessee near the border with Arkansas (Region 7: USFWS 2014a). No critical habitat has been designated for the interior least tern (USFWS 2014a).

The least tern is the smallest member of the gull family. The interior population of the least tern presently breeds in the Mississippi, Missouri, and Rio Grande River systems from Montana south to Texas and from eastern New Mexico and Colorado to Indiana and Louisiana. Nesting habitat for interior least tern occurs along the Cimarron (Major County in Oklahoma), Arkansas (Muskogee County in Oklahoma), and Mississippi rivers (Mississippi County in Arkansas) (Lott et al. 2013). A nesting colony is known to occur 7 miles north of where the Project would cross suitable foraging and nesting habitat on the Arkansas River near the Robert S. Kerr Lock and Dam (USFWS 2014d). On the Mississippi River, the interior least tern nests on large sandbars primarily from the confluence with the Ohio River south to Louisiana. Nesting interior least terns have been observed along the Mississippi River in Shelby, and Lauderdale counties in Tennessee (Lott et al. 2013). In 2012, interior least tern colonies were documented about 3 miles and 2.5 miles to the north and south of the Mississippi River crossing, respectively (Jones 2012). Arriving on breeding grounds from early April through early June, interior least terns breed colonially on bare or sparsely vegetated sandy or dried mud substrates often along rivers, but also on shores of impoundments, saline flats in salt marshes, and shell beaches. Colonies are typically situated near (less than 7.5 miles) a water resource (e.g., rivers, lakes, reservoirs) with a viable food supply of small fishes and crustaceans (Thompson et al. 1997; USFWS 2014a). Colonies disperse in late August when terns begin migration to wintering grounds along coastlines in Central and South America. Although migration routes are not well understood for the interior least tern, the least tern appears to follow major river basins to the confluence of the Mississippi River (USFWS 2014d). Least terns forage in shallow water and rest on sandbars, beaches, and docks during migration.

The primary threat to this species is loss of sandbar and island habitat from dam construction and river channelization on major rivers throughout the Mississippi, Missouri, and Rio Grande river systems. Dams alter river flows in a way that is not conducive to the creation and maintenance of sandbars with sparse vegetation. Other threats include human disturbance (e.g., degradation of habitat, disturbance at nest and roost sites) and cold-water temperatures in reservoirs, which affect biological activity and growth and, in turn, the quantity of forage fish available (USFWS 2014a; Thompson et al. 1997). Interior least terns may avoid nesting in the vicinity of structures that could serve as perches for avian predators (USFWS 2013a).

3.14.1.4.3 Federally Listed Terrestrial Invertebrates

3.14.1.4.3.1 American Burying Beetle

The American burying beetle *(Nicrophorus americanus)* is a federally endangered species with a range that is generally restricted to the southeastern Great Plains (USFWS 2014a). The American burying beetle range within the ROI is based on documented occurrences and potential for occurrences and includes Payne, Lincoln, Creek, Okmulgee, Muskogee, and Sequoyah counties in east-central Oklahoma (Regions 3-4); and Crawford, Franklin, and Johnson counties in northern Arkansas near the border with Oklahoma (Region 4; USFWS 2014a). No critical habitat has been designated for the American burying beetle (USFWS 2014a). The USFWS has identified conservation priority areas for the American burying beetle in Okmulgee, Muskogee, and Sequoyah counties in east-central Oklahoma that are crossed by the ROI of the Applicant Proposed Route and HVDC alternative routes (USFWS 2014e). There are two publicly identified American burying beetle populations in the vicinity of the Project. Camp Gruber sits approximately 7 miles north of the Project in Muskogee County, Oklahoma, and Fort Chaffee is approximately 15 miles south of the Project in Crawford County, Arkansas (USFWS 2008). The USFWS' Oklahoma Ecological Services Field Office has published American burying beetle location data resulting from presence/absence surveys conducted in Kansas, Oklahoma, and Texas from 2012 to 2014. A single survey location, which is located approximately 0.48 mile north of the 200-foot-wide HVDC ROW in Okmulgee County, Oklahoma, yielded positive detection of American burying beetles in 2013 within the ROI (USFWS 2015).

The American burying beetle is a habitat generalist that prefers areas that exhibit a high biomass of small mammals and birds suitable for scavenging (Holloway and Schnell 1997); however, American burying beetles do exhibit habitat selectivity with regard to areas conducive for carcass burial and breeding activities (Lomolino et al. 1995). During carcass burial and breeding, studies have suggested that American burying beetles have a preference for forested sites, likely due to an increase in leaf litter and deeper, less compacted soils found in forested sites (Lomolino and Creighton 1996). However, the distribution of burying beetles is limited more by the availability of properly sized carrion (i.e., presence of small bird/mammal carrion), the number of competing scavengers (e.g., ants), and the soil characteristics conducive to carcass burial rather than vegetation structure and plant species composition as burying beetles are also found in shrublands, grasslands, and forest edges (Lomolino et al. 1995; Holloway and Schnell 1997; USFWS 2012a).

The USFWS has published impact assessment guidelines for the American burying beetle (USFWS 2014e). Sites considered unfavorable for the burying beetle exhibit the following characteristics:

- Land that has already been developed and no longer exhibits surficial topsoil, leaf litter, or vegetation.
- Land that is tilled on a regular basis, planted in monoculture, and does not contain native vegetation.
- Pasture or grassland that is maintained through frequent mowing or herbicide application at a height of 8 inches or less.
- Urban areas with maintained lawns, paved surfaces, or roadways.
- Stockpiled soil without vegetation.
- Wetlands with standing water or saturated soils (defined as sites exhibiting hydric soils and vegetation and/or wetland hydrology (USFWS 2014e). It should be noted that areas adjacent to wetlands and/or riparian areas may be used by the burying beetle and not considered unfavorable. These areas may be important for burying beetles seeking moist soil during dry conditions.

The USFWS lists the majority of threats to the American burying beetle as related to habitat loss, modification, and fragmentation. Fragmentation alters habitat by changing species composition and lowering the reproductive success of the beetles' targeted prey. Fragmentation also increases edge habitat that, in turn, supports a greater density of vertebrate predators and scavengers (e.g., ants, crows, raccoons, foxes, opossums, etc.) that compete with American burying beetles for carrion. Other potential threats or hypotheses for declines in populations include artificial lighting, although the evidence is largely circumstantial, and disease and pesticides (Sikes and Raithel 2002; USFWS 2012b).

3.14.1.4.4 Other Federally Protected Wildlife

3.14.1.4.4.1 Bald Eagles

Bald eagles (*Haliaeetus leucocephalus)* are federally protected under the BGEPA. Bald eagles can occur throughout the ROI as year-round residents, breeders, winter residents, or migrants (Buehler 2000). Bald eagles are opportunistic foragers that prey primarily on fish, but also feed on other aquatic and terrestrial vertebrates as well as on carrion (Buehler 2000). Bald eagles nest in large trees or cliffs. Breeding areas are closely associated with aquatic habitats with forested shorelines or cliffs (Buehler 2000). Within the ROI, nesting generally occurs from April through July, although nest building can occur during the winter and spring (USFWS 2007b). Wintering locations are typically associated with open water areas (i.e., lakes, reservoirs, and rivers) used for foraging on fish. Wintering bald eagles roost (often communally) anywhere between 6 miles and 20 miles from foraging sites depending on abundance of prey.

The ODWC estimates that the statewide overwinter population of bald eagles in Oklahoma is between 800 and 2,000 (ODWC 2011a). The nesting range of the bald eagle has expanded and now includes western Oklahoma. However, the primary nesting area in Oklahoma is the Arkansas River and its main tributaries (USFWS 2014d). Typically, the population of bald eagles within the ROI will increase during the winter as migrants from more northern breeding grounds migrate to overwinter. Migrating bald eagles from more northern regions begin arriving in late November and December. In proximity to the ROI in eastern Oklahoma in Regions 4, known wintering concentrations of bald eagles can be located at Sequoyah State Park and Greenleaf State Park (ODWC 2011b). In Oklahoma, wintering bald eagle concentrations are highest at the following lakes: Kaw, Keystone, Texoma, Tenkiller, Ft. Gibson, Grand, Canton, Great Salt Plains Lakes, Tishomingo, and Spavinaw (ODWC 2011a).Village Creek State Park, Mt. Magazine State Park, and Lake Dardanelle in western Arkansas in Regions 4 and 5 have known wintering concentrations of bald eagles (Arkansas State Parks 2014). Greers Ferry Lake in central Arkansas and the Mississippi River between Arkansas and Tennessee also have populations of wintering bald eagles.

Current threats include collisions with transmission lines that can occur when the birds are distracted (i.e., actively engaged in territorial displays and fights or pursuing prey), during low visibility (i.e., dawn, dusk, or bad weather), and when fledglings have poorly developed flight skills. Electrocution from electric transmission lines is a possibility depending on the spacing of conductors and electrical grounding practices. Disturbances to nests or nesting territories may cause eagles to abandoned their nests and decrease annual productivity. Illegal shooting and lead poisoning are also known causes of bald eagle mortality.

3.14.1.4.4.2 Golden Eagles

Golden eagles (*Aquila chrysaetos)* are most common in the semi-arid western portions of the ROI in Regions 1 and 2, where they can occur as year-round residents, breeders, winter residents, or migrants (Kochert et al. 2002). In Oklahoma, only two to four pairs of golden eagles are known to nest in the state, typically in the far western panhandle in the vicinity of the Black Mesa (ODWC 2011c), outside the ROI; however, golden eagles may occur outside the nesting season as residents throughout the year. Golden eagles in the western United States are most commonly associated with open and semi-open habitats such as shrublands, grasslands, woodland-brushlands, and coniferous forests as well as in cropland and riparian habitats (Kochert et al. 2002). Golden eagles nest on cliff faces or in large trees and breeding areas vary by region, but are generally associated with mountainous canyon land, rimrock terrain of open desert, grassland areas, riparian habitats, and occasionally in forested areas (Kochert et al. 2002). Wintering habitat includes open areas with native vegetation such as sagebrush communities, riparian areas, grasslands, and rolling oak savanna (Kochert et al. 2002).

Golden eagles feed primarily on small mammals such as rabbits, ground squirrels, and prairie dogs, but they will consume birds, reptiles, and carrion. These food items are typically more abundant and accessible in open grasslands and shrub/scrub habitats found in semi-arid habitats in Region 1 and 2.

Golden eagles are more sensitive to human occupation than bald eagles, and disturbance impacts are a potential concern (USFWS 2014d). Current threats to golden eagles include mortality from collisions with transmission lines, wires, wind turbines, structures, and other vertical structures. Trapping and poisoning incidental to mammal control programs and lead poisoning from ammunition remain hazards for this species. Electrocution from electric transmission lines is a hazard, but generally from smaller distribution lines where the spacing of conductors is closer together compared to transmission lines and the eagles' wings can more easily contact more than one conductor. Disturbance to nests or nesting territories can also cause eagles to abandon nests and lower productivity.

3.14.1.4.5 State Designations for Wildlife

In addition to federal designations, there are 11 species of terrestrial wildlife with state level designations that occur within the ROI. Oklahoma and Arkansas do not maintain a state-level threatened or endangered terrestrial wildlife list. The state-designated wildlife of Tennessee and Texas that could potentially occur in the ROI are listed in Table 3.14.1-4.

Table 3.14.1-4:
State Designated Threatened and Endangered Terrestrial Wildlife Potentially Occurring in the ROI

Common Name	Scientific Name	State Status	County
Oklahoma			
The ODWC recognizes the federally designated threatened or endangered terrestrial wildlife. No additional state threatened or endangered terrestrial wildlife are found within the ROI.			
Arkansas			
The AGFC recognizes the federally designated threatened or endangered terrestrial wildlife. No additional state threatened or endangered terrestrial wildlife are found within the ROI.			
Tennessee			
Reptiles			
Northern pinesnake	*Pituophis melanoleucus melanoleucus*	State Threatened	Shelby
Birds			
Bewick's wren	*Thryomanes bewickii*	State Endangered	Shelby
Interior least tern[1]	*Sterna antillarum athalassos*	State Endangered	Tipton and Shelby
Lark sparrow	*Chondestes grammacus*	State Threatened	Shelby
Texas			
Mammals			
Black bear	*Ursus americanus*	State Threatened	Sherman
Gray wolf	*Canis lupus*	State Endangered	Sherman, Hansford, Ochiltree
Reptiles			
Texas horned lizard	*Phrynosoma cornutum*	State Threatened	Sherman, Hansford, Ochiltree
Birds			
American peregrine falcon	*Falco peregrinus anatum*	State Threatened	Sherman, Hansford, Ochiltree
Bald eagle	*Haliaeetus leucocephalus*	State Threatened	Sherman, Hansford, Ochiltree
Peregrine falcon	*Falco peregrinus*	State Threatened	Sherman, Hansford, Ochiltree
Whooping crane[1]	*Grus americana*	State Endangered	Sherman, Hansford, Ochiltree

1 Federally designated species (see Table 3.14.1-3).
Sources: ODWC (2013), ANHC (2013), TDEC (2014), TPWD (2013)

3.14.1.5 Regional Description

As discussed above, 12 terrestrial special status wildlife species are known to occur or have the potential to occur within the ROI. A summary of the terrestrial special status wildlife species and habitat occurrence by Project region is provided in the sections below. The highest diversity of special status wildlife species occurs in Regions 4 and 5, because the variability of habitats is high within these two regions. The special status species that could occur in the 23 route variations developed in response to public comments on the Draft EIS are discussed for each region. The route variations are minor adjustments. The new route variations are relatively short, usually several miles or less and typically within 0.5 mile or less of the original route. The habitats within the route variations are similar to the original routes with only minor differences and typically include a subset of the regional habitats because the route variations are relatively short. Some special status species, therefore, would not be affected because suitable habitat does not occur in the route variations.

3.14.1.5.1 Region 1

The ROI in Region 1 is referred to as the Oklahoma Panhandle Region and includes the Applicant Proposed Route, HVDC Alternative Routes I-A through I-D, Oklahoma converter station and AC interconnection, and the AC collection system. None of the 23 route variations of the Applicant Proposed Route occurs in Region 1.

No federally listed bat species are known to occur within the Region 1 ROI in Oklahoma.

Of the five federally listed bird species and one federal candidate bird species, four of the species are known to occur or to have the potential to occur within the ROI in Region 1. The piping plover has two historical nests at Optima Lake in Texas County, Oklahoma (USFWS 2014d). In relation to Optima Lake, the Applicant Proposed Route would be approximately 7 miles south at its nearest point to the lake, and the Oklahoma Converter Station Siting Area would be located approximately 10 miles southwest. As described in Section 3.10, the predominant land cover in the Region 1 ROI is grassland/herbaceous. Piping plovers are unlikely to use the grassland/herbaceous habitat that dominate the ROI in Region 1 for nesting habitat; however, the proximity to Optima Lake, and known nesting occurrences, near the western terminus of the Applicant Proposed Route suggests that piping plovers may occur during the nesting and breeding session. Although the interior least tern has been documented in counties traversed by the Project in Region 1, no known breeding colonies are known to occur in the region. There are no known stopover locations of whooping crane within the overall ROI. The nearest known stopover location would be approximately 4 miles from HVDC Alternative Route 1-A; however, portions of the eastern edge of Region 1 ROI are within the 95 percent corridor of known whooping crane observations (USFWS 2009d) indicating that whooping cranes may occur within the overall ROI during migration (Figure 3.14-2 in Appendix A). In contrast to the piping plover, the whooping crane may use the grassland/herbaceous habitat that dominate the ROI in Region 1. Further, limited areas of open water, and woody wetlands occur along portions of the ROI in Region 1 (see Section 3.19 for additional discussion). The LEPC has the potential to occur throughout the ROI in Region1 based on documented occurrences within the Applicant Proposed Route and HVDC Alternative 1-A through 1-D (Van Pelt et al. 2013) (Figure 3.14-1a in Appendix A). The LEPC may occur within the grassland/herbaceous habitat that dominate the ROI; however, specific habitat use within the ROI is dependent upon the quality of habitats (Hagen et al. 2013).

Bald and golden eagles are known to winter around Optima Lake WMA in Texas County, Oklahoma, approximately 7 miles north of the Applicant Proposed Route and 10 miles northeast of the Oklahoma Converter Station Siting Area (ODWC 2014a). Bald eagles are less likely to occur within the ROI in Region 1 due to lack of suitable habitat within the ROI; however, proximity to known winter occurrences at Optima Lake WMA suggests that some occurrence during migration and during winter may occur. In contrast, golden eagles are more likely to occur year-round within the ROI of Region 1, due to suitability of habitat, namely grassland/herbaceous land cover suitable for foraging, and the proximity to both known wintering and nesting occurrences.

3.14.1.5.1.1 AC Collection System

The AC collection system routes are located entirely within Region 1. The four primary land cover types that compose the AC collection system routes are cultivated crops, grassland/herbaceous, shrub/scrub, and developed open space (see Section 3.10.6.2.2, Table 3.10-13).

No federally listed bat species are known to occur within the ROI for the AC collection system routes.

Of the five federally listed bird species and one federal candidate bird species, three are known to occur or to have the potential to occur within the ROI in Region 1. The piping plover has two historical nests at Optima Lake in Texas County, Oklahoma (USFWS 2014d). In relation to Optima Lake, the ROI for the AC collection system routes NE-1 and E-1 would be approximately 1.5 miles south and 3.8 miles west, respectively. As described in Section 3.10, the predominant land cover in the ROI for the AC collection system routes is grassland/herbaceous. Piping plovers are unlikely to use the primary habitat (land cover types) that dominate the ROI of the AC collection system routes for nesting habitat; however, the proximity to Optima Lake and known nesting occurrences in the vicinity of the AC collection system routes suggests that piping plovers may occur in the area during the nesting and breeding session. Riverine habitat used by the least tern is limited to Region 1, where the bird has been documented. There are no known stopover locations of whooping crane within the ROI for the AC collection system routes. The nearest known migratory and stopover locations are approximately 2.5 miles from AC Collection System Route E-1. Further, the AC collection system routes are outside the 95 percent corridor of known whooping crane observations (USFWS 2009d), indicating that whooping cranes are unlikely to occur within the ROI for the AC collection system routes during migration (Figure 3.14-2 in Appendix A). Any whooping cranes that do migrate through the area may infrequently use the grassland/herbaceous habitat and occasionally use the cultivated cropland that dominates the ROI for the AC collection system routes. Further, limited areas of open water and woody wetlands occur along portions of the AC collection system routes (see Section 3.19 for additional discussion). The LEPC occurs within eight of the counties in the ROI for the AC collection system routes, including focal area habitat mapped within AC Collection System Route E-1 in Beaver County, Oklahoma (Kansas Biological Survey 2013; Van Pelt et al. 2013). The LEPC is likely to occur within the grassland/herbaceous habitat that dominates the ROI for the AC collection system routes; however, specific habitat use within the ROI is dependent upon the quality of habitats (Figure 3.14-1 in Appendix A). The ROI associated with AC Collection System Routes E-3, SE-1, SE-3, and E-2 would cross the edges of the Schultz WMA and State Park while Routes SE-3 and E-2 would cross the Shorb WMA. Both areas are managed by the ODWC for wildlife habitat and hunting.

The ODWC indicated that bald and golden eagles are known to winter around Optima Lake WMA in Texas County, Oklahoma (ODWC 2014a). The southern edges of the Optima NWR and WMA would be located within the ROI for AC Collection System Route E-1. Bald eagles have a low likelihood of occurring within the AC collection system routes during the breeding season given the lack of suitable habitat within the ROI; however, proximity to known winter occurrences at Optima Lake WMA suggests that some occurrence during migration and during winter may occur. In contrast, golden eagles are more likely to occur year-round within the AC collection system routes given the suitability of the habitat, namely grassland/herbaceous land cover suitable for foraging, and the proximity to both known wintering and nesting occurrences.

3.14.1.5.2 Region 2

The ROI in Region 2 is referred to as the Oklahoma Central Great Plains Region and includes the Applicant Proposed Route and HVDC Alternative Routes 2-A through 2-B.

No federally listed bat species are known to occur within the ROI in Region 2 in Oklahoma.

Of the five federally listed bird species and one federal candidate bird species, four have known occurrences or potential for occurrences within the ROI. The dominant land cover within the ROI in Region 2 is grassland/herbaceous followed by cropland (i.e., cultivated crops) (see Section 3.10). There are no known stopover locations of whooping crane within the ROI. As discussed above, whooping cranes will use grassland/herbaceous land cover when in proximity to wetlands. Limited wetlands occur within the ROI. Portions of the ROI are within the 95 percent to 75 percent corridor of known whooping crane observations (USFWS 2009c), which suggests that whooping cranes may occur within the ROI during migration even in limited habitats (Figure 3.14-2 in Appendix A). Furthermore, the nearest known migration and stopover location for migratory whooping cranes is approximately 1.8 miles from the Applicant Proposed Route. Interior least terns are known to nest along the Cimarron River, the closest occurrence (1 to 3 miles) of which is located near HVDC Alternative Route 2-A in Major County (Lott 2006, Lott et al. 2013). Although limited suitable nesting habitats for interior least terns occur within the ROI, the known nesting occurrences of interior least terns suggest that the species may occur during migration generally from April through June. The piping plover is a potential migrant through Region 2 and uses habitat along rivers, lakes, and reservoirs, but it does not concentrate in large numbers at inland locations and seems to stop opportunistically; single individuals of the species are often reported (USFWS 2009e). Many piping plovers are believed to fly directly to and from breeding and wintering grounds. The LEPC has the potential to occur within Woodward County within Region 2 (Van Pelt et al. 2013); however, specific habitat use within the ROI is dependent upon the quality of habitats (Figure 3.14-1b in Appendix A) (Hagen et al. 2013). The red knot is considered an occasional transient migrant through the state of Oklahoma.

The ODWC indicates that bald eagles are known to winter around Canton Lake WMA in Blaine County, Oklahoma (ODWC 2014b), which is located approximately 3.5 miles south of the Applicant Proposed Route. Bald eagles are less likely to occur within the ROI in Region 2, given a lack of suitable habitat within the ROI; however, proximity to known winter occurrences at Canton Lake WMA suggests that some occurrence during migration and during winter may occur. Two route variations to the Applicant Proposed Route were developed in Region 2 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.2. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route. The only special status species that would possibly occur in the vicinity of Link 1, Variation 1, would be the LEPC. The whooping crane would be a potential migrant through Link 2, Variation 2, but the route variation does not contain any potential stopover habitat similar to the original route. Both route variations in Region 2 would cross through the same types of vegetation and habitat as the original Applicant Proposed Route Links 1 and 2.

3.14.1.5.3 Region 3

Region 3 is referred to as the Oklahoma Cross Timbers Region and includes the Applicant Proposed Route and HVDC Alternative Routes 3-A through 3-E.

As discussed in Section 3.10, the ROI in Region 3 is more varied than in Regions 1 and 2. It primarily consists of grassland/herbaceous (33.9 percent), deciduous forest (27.7 percent), and pasture/hay (23.4 percent). Because of this increased variation in habitats, the diversity of special status wildlife species increases as well.

Two of the four federally listed bat species occur within Region 3. The gray bats have been documented to occur within Muskogee County in Oklahoma (USFWS 2014d). Gray bats are cave obligate species (i.e., use caves for both summer roosting and winter hibernation) and are limited in occurrence to cave and karst features within Region 3. The northern long-eared bat is known or believed to occur in Okmulgee and Muskogee counties, Oklahoma. Unlike the gray, the northern long-eared bat uses forested areas as summer roosting sites and caves for winter hibernation.

Of the five federally listed bird species and one federal candidate bird species, four have known occurrences or potential for occurrences within the ROI. The red knot is an occasional transient migrant through Region 3. The Sprague's pipit has been documented in Payne County, Oklahoma; however, the exact location of the documented occurrence is not provided by the USFWS (USFWS 2014d). Sprague's pipit is a grassland species, and occurrences are likely to be limited to portions of the ROI with the highest percentage of grasslands. The piping plover has been documented in numerous counties in the ROI (USFWS 2014d). However, piping plovers are limited to open areas, sparsely vegetated sand or gravel beaches adjacent to alkali wetlands, and on beaches, sand bars, and dredged material islands of major river systems. Within Region 3, these areas are limited to the Canadian and Cimarron rivers (see Section 3.20). The western edge of the ROI in Region 3 is within the 75 percent to 95 percent corridor of known whooping crane observations (USFWS 2009d) (Figure 3.14-2 in Appendix A). However, the nearest known migration or stopover observation is approximately 2.3 miles from the HVDC Alternative Route 3-A. As discussed above, whooping cranes will use grassland/herbaceous land cover when wetlands are nearby. Limited grassland/ herbaceous land cover or wetlands occur within the ROI, suggesting that although no stopover locations were documented within the ROI, there is the potential for whooping crane to occur. Interior least terns have been documented along the Cimarron River within 1 to 2 miles of the proposed HVDC transmission line in Payne County, Oklahoma; and along the Arkansas River (within 3 to 4 miles) in Muskogee County, Oklahoma (Lott 2006, Lott et al. 2013). Although limited suitable nesting habitats for interior least terns occur within the ROI, the known nesting occurrences of interior least terns suggest that the species may occur during migration, which generally occurs from April through June.

The American burying beetle has the potential to occur in the ROI (USFWS 2014d). However, based on habitat characteristics considered unfavorable for the American burying beetle (USFWS 2014e), the American burying beetle is expected to most likely occur within undisturbed native vegetation types within the ROI (Section 3.17.5.3). It is most likely to occur within deciduous and coniferous forests and also possibly native grasslands, but not in cultivated, maintained pasture or grassland, or developed areas (USFWS 2014e).

Bald eagles are likely to occur within the ROI given the proximity to suitable habitat, specifically habitat along the Arkansas River, suggesting that some occurrence during migration and during winter may occur. The Tulsa Audubon Society has numerous documented occurrences of bald eagles at Greenleaf State Park, which is located approximately 3 miles north of the Applicant Proposed Route in Muskogee County, Oklahoma (Tulsa Audubon Society 2009).

Five route variations to the Applicant Proposed Route were developed in Region 3 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.3. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route. The Sprague's pipit is the only terrestrial special status species that would possibly occur in Links 1 and 2, Variation 1, and Link 1, Variation 2, similar to the original Applicant Proposed Route Links 1 and 2. However, Link 1, Variation 2, would increase the amount of forest and native prairie within the ROI. The American burying beetle is the only special status species that would possibly occur in Link 4, Variation 1, and Link 4, Variation 2. The northern long-eared bat, gray bat and American burying beetle are the only terrestrial special status species that would possibly occur in Link 5, Variation 2, in Muskogee County, Oklahoma.

3.14.1.5.4 Region 4

Region 4 is referred to as the Arkansas River Valley Region and includes the Applicant Proposed Route, including the Lee Creek Variation, and HVDC Alternative Routes 4-A through 4-E.

Publically available USFWS information shows documented occurrences of the four protected bat species in Region 4 (USFWS 2014d). All four bat species potentially occur at the Ozark Plateau NWR, which is located approximately 15.5 miles north of the Applicant Proposed Route. In addition, portions of the Area of Potential Bat Caves, as indicated by the USFWS (2014d), overlap portions of the ROI in Region 4 in Sequoyah County, Oklahoma. Rosson Hollow Crevices, a hibernacula of Indiana bats, is located in Franklin County, Arkansas; however, the exact location of the entrance of the hibernacula is protected by the USFWS (USFWS 2007a). Protected bats may use suitable cave and karst features located within Region 4 ROI during winter hibernation. Ozark big-eared bats and gray bats also use caves for summer roosting. During the spring and summer, northern long-eared and Indiana bats may use suitable deciduous and evergreen forest that can be found throughout the region (see Section 3.10). Evergreen forests are predominantly found along the eastern portions of the region. However, the Indiana bat and northern long-eared bat could occupy forested areas of the ROI that contain suitable maternity roost trees. In January 2015, staff of the city of Fort Smith and AGFC confirmed the presence of hibernating Ozark big-eared bats in two new caves in Crawford County, Arkansas. It is not known whether the Ozark big-eared bat also uses these caves as summer roosts.

Of the five federally listed bird species and one federal candidate bird species, four have known occurrences or potential for occurrences within the ROI in Region 4. The Sprague’s pipit has been documented in Franklin County, Arkansas; however, exact location of the occurrence in Franklin County is not provided by the USFWS. Sprague’s pipit is a grassland species, and occurrences are likely to be limited because grasslands comprise a relatively small proportion of the ROI in Region 4. Interior least terns and piping plovers have been documented within three counties in the ROI in Region 4 in Arkansas (Lott 2006; USFWS 2014a; Lott et al. 2013). Interior least terns and piping plovers are likely to use suitable habitat along the Arkansas River, which would be crossed by the Applicant Proposed Route (USFWS 2014d). Although limited suitable nesting habitats for interior least terns and piping plover occur within the ROI, which is dominated by pasture/hay land cover, the known nesting occurrences of interior least terns and piping plover suggest that the species may occur during migration, which generally occurs from April to June. The red knot is a potential transient migrant through Region 4 and would likely only occur where aquatic habitats with exposed sediments and abundant aquatic invertebrates are present.

The American burying beetle has the potential for occurrence along the ROI (USFWS 2014d). However, based on habitat characteristics considered unfavorable for the American burying beetle (USFWS 2014e), the American burying beetle is expected to most likely occur within undisturbed, native vegetation types within the ROI (Section 3.17.5.4) such as deciduous and coniferous forests and also possibly native grasslands, but not in cultivated, maintained pasture or grassland, or developed areas (USFWS 2014e).

There are documented occurrences of bald eagles along the Arkansas River in Sequoyah County, Oklahoma (Lish and Sherrod 1986). Bald eagles are likely to occur within the ROI in Region 4, due to the proximity of suitable habitat, specifically habitat along the Arkansas River and at Lake Dardanelle, suggesting that some occurrence during migration and during winter may occur. Furthermore, Lake Dardanelle (which is located approximately 6 to 10 miles south of Alternative Route 4-E and 7 to 14 miles south of the Applicant Proposed Route in Johnson and Pope counties, Arkansas) has documented high wintering concentrations of bald eagles (ANHC 2013). In contrast, golden eagles are not likely to occur within the ROI of Region 4 given a lack of suitable habitat, namely grassland/herbaceous land cover suitable for foraging. Although the OBS (2013, as cited in USFWS 2014d) has a documented occurrence of golden eagle in Sequoyah County, Oklahoma, the observation is limited and suggests that golden eagle occurrence may be limited to migration within the region.

Seven route variations to the Applicant Proposed Route were developed in Region 4 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.4. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route. The northern long-eared bat, gray bat, Indiana bat, Ozark big-eared bat, and American burying beetle are the only terrestrial special status species that would possibly occur in Applicant Proposed Route Link 3, Variation 1, and Link 3, Variation 2, in Sequoyah County, Oklahoma. The original Applicant Proposed Route associated with Link 3, Variation 2, is also being carried forward for continued consideration. The new Variation 2 contains more forested land and karst features than the original Applicant Proposed Route Link 3 but also parallels more existing infrastructure. The northern long-eared bat, gray bat, Indiana bat, Ozark big-eared bat, and American burying beetle are the only terrestrial special status species that would possibly occur in Link 3, Variation 3; Link 6, Variation 1; Link 6, Variation 2; and Link 6, Variation 3, in Crawford County, Arkansas. Link 3, Variation 3, was developed to avoid two recently found cave hibernacula for the Ozark big-eared bat. The new route variation also reduces forested land in the route. Link 9, Variation 1, is in Pope County, Arkansas, and the northern long-eared bat, gray bat, Indiana bat, and Ozark big-eared bat would possibly occur in the vicinity.

3.14.1.5.5 Region 5

Region 5 is referred to as the Central Arkansas Region and includes the Applicant Proposed Route and HVDC Alternative Routes 5-A through 5-F.

All four protected bat species have documented occurrences in Region 5 based on publically available information on known occurrence from the USFWS (2014d). There are documented occurrences of northern long-eared bats, Ozark big-eared bats, gray bat, and Indiana bat occur in Pope County (USFWS 2014d). A hibernaculum for gray bat is documented in Pope County, which is located south-southwest of the proposed HVDC transmission line, as well as Independence County which is located north of the proposed HVDC transmission line (Martin 2007). Protected bats may use suitable cave and karst features located within Region 5 ROI during winter hibernation. Ozark big-eared bats and gray bats also use caves for summer roosting. During the spring and summer, northern long-eared and Indiana bats may use suitable deciduous and evergreen forest that can be found throughout the Region. Evergreen forests are predominantly found along the eastern portions of the Region. No studies to document the occurrence of protected bat species within the ROI in Region 5 have been completed; however, the BISON database did contain two occurrences of gray bats within the ROI of Region 5.

Conway County has historical occurrences of Florida panther (USFWS 2014d); however, as discussed above, the Florida panther is currently considered extirpated in Arkansas.

Of the five federally listed bird species and one federal candidate bird species, two have known occurrences or potential for occurrences within the ROI in Region 5. Interior least terns and piping plovers have been documented within three counties in Region 5 in Arkansas. Interior least terns and piping plovers are likely to use suitable habitat along the Arkansas River located approximately 7 miles south from the Applicant Proposed Route at its nearest point (Lott 2006; Lott et al. 2013; USFWS 2014d). Although limited suitable nesting habitats for interior least terns occur within the ROI, which is dominated by deciduous forest and pasture/hay land cover, the known nesting occurrences of interior least terns suggest that the species may occur during migration, which generally occurs from April through June. Sprague's pipit and the red knot are unlikely migrants in the region.

Bald eagles are likely to occur within the ROI in Region 5 given the proximity to suitable habitat, specifically habitat at Greers Ferry Lake, suggesting that some occurrence during migration and during winter may occur. Greers Ferry Lake (which is located approximately 6 to 10 miles north of the Applicant Proposed Route in Van Buren and Cleburne County, Arkansas) has documented high wintering concentrations of bald eagles (ANHC 2013). Bald eagles may migrate through the ROI for the HVDC transmission line routes to reach the Arkansas River approximately 10 to 18 miles to the south in Pope and Conway counties.

Five route variations to the Applicant Proposed Route were developed in Region 5 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.5. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route. The northern long-eared bat, gray bat, Indiana bat, and Ozark big-eared bat are the only terrestrial special status species that would possibly occur in Link 1, Variation 2; Link 2, Variation 2; and Links 2 and 3, Variation 1, in Pope County, Arkansas, and they would cross through the same types of vegetation and habitats as the original Applicant Proposed Route. The northern long-eared bat, gray bat, and Indiana bat are the only terrestrial special status species that would possibly occur in Links 3 and 4, Variation 2, in Van Buren County, and Link 7, Variation 1, in White County, Arkansas.

3.14.1.5.6 Region 6

Region 6 is referred to as the Cache River and Crowley's Ridge Region and includes the Applicant Proposed Route and HVDC Alternative Routes 6-A through 6-D.

Of the four protected bat species, the northern long-eared bat, gray bat, and Indiana bat have may occur in Jackson County, Arkansas, in Region 6 based on publically available information on known occurrence from the USFWS (USFWS 2014d, 2014a). Protected bats are limited in occurrence to cave and karst features (see Section 3.6) within Region 6 during winter hibernation; however, occurrence during the spring through fall is likely to be limited given a lack of suitable foraging and roosting habitat. Region 6 is dominated by croplands, and little to no forested habitat occurs within the ROI except for about 3 miles that crosses Crowley's Ridge. No studies to document the occurrence of protected bat species within the ROI in Region 6 have been completed, and the BISON database did not contain any documented occurrences of these listed bat species within the ROI of Region 6 (USGS 2014).

Of the five federally listed bird species and one federal candidate bird species, two have known occurrences or potential for occurrences in the Region 6 ROI. However, because of limited preferred habitat in the ROI for both species, the presence of either species is likely to be limited. Piping plovers have documented occurrences in Jackson County, Arkansas based on publically available information on known occurrences from the USFWS (2014a). Interior least terns and piping plovers have been documented within Cross and Crittenden counties in the ROI in Region 6 in Arkansas based on publically available information from the USFWS and published scientific studies (Lott 2006; Lott et al. 2013; USFWS 2014a). Piping plovers are limited to open sparsely vegetated sand or gravel beaches adjacent to alkali wetlands, and on beaches, sand bars, and dredged material islands of major river systems that do not occur in Region 6. Neither the piping plovers nor interior least terns are likely to use the croplands habitat that dominates Region 6 for nesting habitat. The Mississippi River is about 25 miles east of Region

6 where known nesting occurs and both piping plovers and interior least terns may occasionally occur in Region 6 during the nesting and breeding session.

Bald eagles have been documented throughout Region 6 in Jackson, Poinsett, Cross and Crittenden counties, Arkansas (ANHC 2013), and the Mississippi River in Region 7 is known to have a high wintering concentration of bald eagles. However, the ANHC (2013) does not indicate whether bald eagles are known to occur within the ROI in Region 6, rather the occurrences are provided on a county-level. Nevertheless, the available evidence indicates that bald eagles are likely to occasionally occur within the ROI in Region 6 because of nearby suitable habitat and known winter concentrations, specifically habitat along the Mississippi River, suggesting that some occurrence during migration and during winter may occur.

One route variation to the Applicant Proposed Route in Region 6 (i.e., Applicant Proposed Route Link 2, Variation 1) was developed in response to public comments on the Draft EIS. This route variation is described in Appendix M and summarized in Section 2.4.2.6. The variation is illustrated in Exhibit 1 of Appendix M. This variation represents a minor adjustment to the Applicant Proposed Route. The route variation crosses cultivated cropland. None of the terrestrial special status species would likely occur in Link 2, Variation 1, except as an occasional migrant through the area.

3.14.1.5.7 Region 7

Region 7 is referred to as the Arkansas Mississippi River Delta and Tennessee Region and includes the Applicant Proposed Route and HVDC Alternative Routes 7-A through 7-D.

Of the four protected bat species, the northern long-eared bat and Indiana bat potentially occur in Region 7 (USFWS 2014d, 2014a) based on publically available information on known occurrence from the USFWS. These two species of bats are limited in occurrence to cave and karst features (see Section 3.6) within Region 7 during winter hibernation; however, occurrence during the spring through fall is likely to be limited given a lack of suitable foraging and roosting habitat. Region 7 is dominated by croplands, and little forested habitat, except in the vicinity of the Mississippi River, occurs within the ROI. The BISON database did not contain any documented occurrences of these listed bat species within the ROI of Region 7 (USGS 2014). However, forested areas in Tipton County, Tennessee, and bottomland forest in Mississippi County in Arkansas could potentially contain maternity roost habitat for the northern long-eared bat and Indiana bat.

Of the five federally listed bird species and one federal candidate bird species, two have known occurrences or potential for occurrences within in the ROI in Region 7. Interior least terns nest along the Mississippi River in Region 7 (TDEC 2014; Lott et al. 2013), and have been documented in Crittenden and Mississippi counties in Arkansas and Tipton and Shelby counties in Tennessee (Lott 2006). Interior least terns are unlikely to use the croplands habitat that dominates Region 7 for nesting habitat; however, the Mississippi River provides known nesting habitat in the ROI of the proposed HVDC transmission line (Lott et al. 2013). Piping plovers could potentially use sandbars and sparsely vegetated shore habitats along the Mississippi River and have been documented in Mississippi County in Arkansas.

Bald eagles are likely to occur within the ROI in Region 7 given the proximity of suitable habitat and known winter concentrations along the Mississippi River.

Three route variations to the Applicant Proposed Route were developed in Region 7 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.7. The variations are illustrated in Exhibit 1 of Appendix M. None of the terrestrial special status species would likely occur in Link 1, Variation 1, because it crosses cultivated cropland. The northern long-eared bat would possibly occur in Link 1, Variation 2, but it is unlikely because the route is predominately cropland. The northern long-eared bat and Indiana bat are the only terrestrial special status species that would possibly occur in Link 5, Variation 1, in Tennessee.

3.14.1.6 Connected Actions

3.14.1.6.1 Wind Energy Generation

Wind energy generation would likely occur within WDZs. The potential WDZs are identified in Section 3.1.1 and occur in the Oklahoma and Texas panhandles within a 40-mile radius of the Oklahoma converter station. The special status wildlife species that could potentially occur in the WDZs include Sprague's pipit, red knot, golden eagle, LEPC, and whooping crane. Within all of the WDZs there is a lack of suitable riverine habitat for piping plovers and the interior least tern and both species are unlikely to occur in the WDZs; however, there is the potential for piping plover and interior least tern to occur within the WDZs during migration, especially those near Optima Lake. Migration generally occurs from April to June. Sprague's pipit could occur but is uncommon and likely migrates through the area. The red knot is a rare migrant and is unlikely to occur in the WDZs. The golden eagle is a wide-ranging species and could occur throughout the region, but would most likely occur in areas with native grasslands and shrub lands that support small mammal prey species.

The LEPC is a resident species in the vicinity of the WDZs. Most of the occupied LEPC habitat occurs north and east of WDZs (Figure 3.14-1a, Appendix A). Although LEPC will occasionally use developed or disturbed areas such as oil well pads, roads, and croplands for lek sites because they provide open visible areas for courtship displays, LEPC require large contiguous blocks of grassland or shrub/grasslands. Areas that contain 30 percent or more of cropland typically do not provide adequate habitat to sustain populations of LEPC (see Section 3.14.1.4.2.3). Croplands are predominant throughout the region of the WDZs, which would limit potential habitat for LEPC. However, larger contiguous tracts of undeveloped grassland would provide suitable habitat for the LEPC. Throughout the region, private property may be enrolled in the Candidate Conservation Agreement with Assurances program, the goal of which is to implement habitat management practices for the LEPC on private lands.

Individual or small groups of whooping cranes could possibly migrate through the WDZs even though the WDZs are west of the primary migration corridor (Figure 3.14-2, Appendix A). Suitable whooping crane roosting habitats (i.e., semi-permanent shallow wetlands or open, sandy riverine habitat) have limited acreage in the region of the WDZs. However, whooping cranes will use any available habitat such as croplands if forced to descend unexpectedly during migration by inclement weather. Wetland areas that may potentially be used by special status wildlife species are described in more detail in Section 3.19. The dominant land cover for each WDZ is described in Section 3.10.5.8.

3.14.1.6.1.1 WDZ-A

The dominant land cover in WDZ-A is croplands. Other land cover types potentially used by special status wildlife species include grassland/herbaceous, and shrub/scrub. LEPC and whooping crane may use the croplands that are predominant within WDZ-A; however, whooping crane occurrence within WDZ-A is likely to be limited to infrequent migratory and stopover occurrences (e.g., Optima Lake). LEPC occurrence within WDZ-A is likely to be limited to more suitable grassland/herbaceous and shrub/scrub cover types that are limited to the northwestern side of WDZ-A.

3.14.1.6.1.2 WDZ-B

The dominant land cover in WDZ-B is croplands. Other land cover types potentially used by special status wildlife species include grassland/herbaceous, and shrub/scrub. LEPC and whooping crane may use the croplands that are predominant within the WDZ-B; however, whooping crane occurrence within the WDZ-B is likely to be limited to infrequent migratory and stopover occurrences while LEPC occurrence within WDZ-B is likely to be limited based on lack of more suitable grassland/herbaceous and shrub/scrub habitats.

3.14.1.6.1.3 WDZ-C

The dominant land cover in WDZ-C is grassland/herbaceous. Other land cover types potentially used by special status wildlife species include croplands (primarily center-pivot irrigated with some dryland areas), and shrub/scrub. LEPC and whooping crane may use the grassland/herbaceous land cover that is predominant within WDZ-C; however, whooping crane occurrence within WDZ-C is likely to be limited to infrequent migratory and stopover occurrences. Occurrence of the LEPC is most likely in native grasslands.

3.14.1.6.1.4 WDZ-D

The dominant land cover in WDZ-D is grassland/herbaceous. Other land cover types potentially used by special status wildlife species include croplands (primarily center-pivot irrigated with some dryland areas), and shrub/scrub. LEPC and whooping crane may use the grassland/herbaceous land cover that is predominant within WDZ-D; however, whooping crane occurrence within WDZ-D is likely to be limited to migratory and stopover occurrences in the adjacent Optima Lake area. WDZ-D contains the Schultz ODWC WMAs, and the eastern end of the WDZ is within the estimated occupied range of the LEPC.

3.14.1.6.1.5 WDZ-E

The dominant land cover in WDZ-E is croplands (primarily center-pivot irrigated with some dryland areas). Other land cover types potentially used by special status wildlife species include grassland/herbaceous, and shrub/scrub. LEPC and whooping crane may use the croplands that are predominant within WDZ-E; however, whooping crane occurrence within WDZ-E is likely to be limited to migratory and stopover occurrences while LEPC occurrence within WDZ-E is likely to be limited due to lack of suitable grassland/herbaceous and shrub/scrub habitats.

3.14.1.6.1.6 WDZ-F

The dominant land cover in WDZ-F is grassland/herbaceous. Other land cover types potentially used by special status wildlife species include croplands (primarily center-pivot irrigated with some dryland areas), and shrub/scrub. LEPC may use the grassland/herbaceous vegetation that is predominant within WDZ-F. Whooping crane occurrence within WDZ-F is likely to be limited to infrequent migratory and stopover occurrences.

3.14.1.6.1.7 WDZ-G

The dominant land cover in the WDZ-G is grassland/herbaceous. Other land cover types potentially used by special status wildlife species include croplands (primarily center-pivot irrigated with some dryland areas), and shrub/scrub. LEPC may use the grassland/herbaceous that is predominant within WDZ-G. The northern end of WDZ-G is close to quality LEPC habitat in southwestern Kansas. Whooping crane occurrence within WDZ-G is likely to be limited to infrequent migratory and stopover occurrences.

3.14.1.6.1.8 WDZ-H

The dominant land cover in WDZ-H is grassland/herbaceous. Other land cover types potentially used by special status wildlife species include croplands (primarily center-pivot irrigated with some dryland areas), and shrub/scrub. LEPC may use the grassland/herbaceous that is predominant within WDZ-H that may contain large areas suitable for LEPC. Whooping crane occurrence within WDZ-H is likely to be limited to infrequent migratory and stopover occurrences.

3.14.1.6.1.9 WDZ-I

The dominant land cover in WDZ-I is croplands (primarily center-pivot irrigated with some dryland areas). Other land cover types potentially used by special status wildlife species include grassland/herbaceous, and shrub/scrub. LEPC may use the croplands that are predominant within the WDZ-I. WDZ-I is adjacent to quality LEPC to the southeast. Whooping crane occurrence within WDZ-I is likely to be limited to migratory and stopover occurrences. WDZ-I is north of Optima Lake. LEPC occurrence within WDZ-I is likely to be limited due to lack of suitable grassland/herbaceous and shrub/scrub habitats, primarily toward the eastern end.

3.14.1.6.1.10 WDZ-J

The dominant land cover in the WDZ-J is grassland/herbaceous. Other land cover types potentially used by special status wildlife species include croplands (primarily center-pivot irrigated with some dryland areas), and shrub/scrub. LEPC may use the grassland/herbaceous that is predominant within the WDZ-J. Whooping crane occurrence within WDZ-J is likely to be limited to infrequent migratory and stopover occurrences. Because WDZ-J contains a higher proportion of grassland/herbaceous cover and is located adjacent to CHAT-1 LEPC habitat and possible leks, LEPC may occur in greater abundance in this WDZ. The Shorb WMA is located outside the western boundary of WDZ-J.

3.14.1.6.1.11 WDZ-K

The dominant land cover in the WDZ-K is croplands (primarily center-pivot irrigated with some dryland areas). Other land cover types potentially used by special status wildlife species include grassland/herbaceous, and shrub/scrub. LEPC may use the croplands that are predominant within WDZ-K; however, the eastern end of the WDZ contains suitable grassland/herbaceous and possibly several lek sites and is adjacent to quality habitat (CHAT-1) to the east (Figure 3-14-1a, Appendix A). Whooping crane occurrence within WDZ-K is likely to be limited to migratory and stopover occurrences; WDZ-K is the closest of the WDZs to the primary whooping crane migration corridor (Figure 3.14-2, Appendix A).

3.14.1.6.1.12 WDZ-L

The dominant land cover in the WDZ-L is croplands (primarily center-pivot irrigated with some dryland areas). Other land cover types potentially used by special status wildlife species include grassland/herbaceous, and shrub/scrub. LEPC may use the croplands that are predominant within WDZ-L. LEPC occurrence within WDZ-L is most likely on the eastern end of the WDZ near more suitable grassland/herbaceous and shrub/scrub habitats. Whooping crane occurrence within WDZ-L is likely to be limited to infrequent migratory and stopover occurrences.

3.14.1.6.2 Optima Substation

The future Optima Substation would be constructed within a 160-acre site that is mostly grassland/herbaceous, with smaller areas of shrub/scrub and developed open space. The limited available potentially suitable habitat for piping plover, interior least tern, or bald eagle in the area suggests that none of these species are likely to occur within the future Optima Substation site. However, LEPC and whooping crane may use the grassland/herbaceous habitats that occur in the vicinity of the Optima Substation site. Whooping crane occurrence is likely to be limited to infrequent migratory and stopover occurrences. The future Optima Substation site is located west of the primary whooping crane migratory corridor in Oklahoma; however, some whooping cranes will migrate across the Oklahoma Panhandle where the Substation may be located. The substation site is located west of areas mapped as high conservation priority habitat for the LEPC; however, existing roads, power poles, and croplands adjacent to the Optima Substation site decrease the potential quality of the habitat for LEPC. Golden eagles likely occur in the region, but no suitable nesting habitat occurs in the vicinity of the future Optima Substation.

3.14.1.6.3 TVA Upgrades

The ROI for the direct assignment facilities (which are included in the Applicant Proposed Project) would occur within the Tennessee Converter Station Siting Area and more specifically within the Shelby Substation. The ROI for the network upgrades, and in particular TVA's future 500kV transmission line, cannot be fully determined at this time. The new 500kV line would be in western Tennessee. The upgrades to existing facilities would mostly be in western and central Tennessee. Upgrades to existing infrastructure would include upgrading terminal equipment at three existing 500kV substations and six existing 161kV substations; making appropriate upgrades to increase heights on 16 existing 161kV transmission lines to increase line ratings, and replacing the conductors on eight existing 161kV transmission lines. All of the network upgrades would likely occur within the range of the northern long-eared bat, Indiana bat, and bald eagle. Some upgrades to existing facilities could occur within the range of the gray bat and other special status wildlife species. Where possible, general impacts to special status terrestrial wildlife species that could occur from the required TVA upgrades are discussed in the impact sections that follow.

3.14.1.7 Impacts to Special Status Terrestrial Wildlife Species

3.14.1.7.1 Methodology

Within the ROI, Project activities were assessed that could potentially impact special status wildlife species and their habitats. Special status wildlife species and their habitats evaluated include species known to occur or to have the potential to occur within the ROI and are federally protected or proposed for federal protection under the ESA and state protected species. Potential impacts on special status wildlife resources and their habitats include the following and are discussed for each phase of the Project:

- Potential impacts from temporary or long-term displacement of special status wildlife species
- Fragmentation of special status wildlife habitat
- Potential disturbance to known populations and/or suitable habitat for species designated as candidate, threatened or endangered under the ESA
- Potential for avian collisions and/or electrocution

Species were considered at risk of experiencing these impacts if their range overlapped with the ROI and suitable habitat for the species occurred within the ROI.

The AC collection system consists of thirteen 2-mile-wide routes in Oklahoma (Beaver, Cimarron, and Texas counties) and Texas (Hansford, Ochiltree, and Sherman counties) within which an AC collection system transmission line could be sited and would connect wind energy facilities to the Project.

The Applicant has developed EPMs that would be implemented during design/engineering, construction, and operations and maintenance. The complete list of EPMs is provided in Appendix F. Implementation of these EPMs is assumed throughout the impact analysis that follows for the Project. During the initial construction phase of the Project, both general EPMs and those specific to wildlife resources would be implemented to avoid or minimize impacts to wildlife resources as described below.

General EPMs for the Project that relate to special status wildlife resources include the following:

- GE-1: Clean Line will train personnel on health, safety, and environmental matters. Training will include practices, techniques, and protocols required by federal and state regulations and applicable permits.
- GE-2: Clean Line will design, construct, maintain, and operate the Project following current Avian and Power Line Interaction Committee guidelines to minimize risk of avian mortality.
- GE-3: Clean Line will minimize clearing vegetation within the ROW, consistent with a Transmission Vegetation Management Plan (TVMP) filed with NERC, and applicable federal, state, and local regulations. The TVMP may require additional analysis under NEPA depending on whether and under what conditions DOE decides to participate in the Project.
- GE-4: Vegetation removed during clearing will be disposed of according to federal, state, and local regulations.
- GE-5: Any herbicides used during construction and operations and maintenance will be applied according to label instructions and any federal, state, and local regulations.
- GE-6: Clean Line will restrict vehicular travel to the ROW and other established areas within the construction, access, or maintenance easement(s).
- GE-7: Roads not otherwise needed for maintenance and operations will be restored to preconstruction conditions. Restoration practices may include decompacting, recontouring, and re-seeding. Roads needed for maintenance and operations will be retained.
- GE-9: Clean Line will avoid and/or minimize damage to drainage features and other improvements such as ditches, culverts, levees, tiles, and terraces; however, if these features or improvements are inadvertently damaged, they will be repaired and or restored.
- GE-13: Emergency and spill response equipment will be kept on hand during construction.
- GE-14: Clean Line will restrict the refueling and maintenance of vehicles and the storage of fuels and hazardous chemicals within at least 100 feet from wetlands, surface waterbodies, and groundwater wells, or as otherwise required by federal, state, or local regulations.
- GE-20: Clean Line will conduct construction and scheduled maintenance activities on the facilities during daylight hours, except in rare circumstances that may include, for example, emergency or unsafe situations, to avoid adverse environmental effects, to minimize traffic disruptions, or to comply with regulatory or permit requirements.
- GE-21: Clean Line will maintain construction equipment in good working order. Equipment and vehicles that show excessive emissions of exhaust gasses and particulates due to poor engine adjustments or other inefficient operating conditions will be repaired or adjusted.
- GE-22: Clean Line will impose speed limits during construction for access roads (e.g., to reduce dust emissions, for safety reasons, and for protection of wildlife).

- GE-28: Hazardous materials and chemicals will be transported, stored, and disposed of according to federal, state, or local regulations or permit requirements.
- GE-30: Clean Line will minimize the amount of time that any excavations remain open.

Agriculture-specific EPMs for the Project that relate to special status wildlife resources include the following:

- AG-3: Clean Line will consult with landowners and/or tenants to identify the location and boundaries of agriculture or conservation reserve lands and to understand the criteria for maintaining the integrity of these committed lands.

Fish, vegetation, and wildlife specific EPMs for the Project that relate to special status wildlife resources include the following:

- FVW-1: Clean Line will identify environmentally sensitive vegetation (e.g., wetlands, protected plant species, riparian areas, and large contiguous tracts of native prairie) and avoid and/or minimize impacts to these areas.
- FVW-2: Clean Line will identify and implement measures to control and minimize the spread of non-native invasive species and noxious weeds.
- FVW-3: Clean Line will clearly demarcate boundaries of environmentally sensitive areas during construction to increase visibility to construction crews.
- FVW-4: If construction- and/or decommissioning-related activities occur during the migratory bird breeding season, Clean Line will work with USFWS to identify migratory species of concern and conduct pre-construction surveys for active nests for such species. Clean Line will consult with USFWS and/or other resource agencies for guidance on seasonal and/or spatial restrictions designed to avoid and/or minimize adverse effects.
- FVW-5: If construction occurs during important time periods (e.g., breeding, migration, etc.) or at close distances to environmentally sensitive areas with vegetation, wildlife, or aquatic resources, Clean Line will consult with USFWS and/or other resource agencies for guidance on seasonal and/or spatial restrictions designed to avoid and/or minimize adverse effects.
- FVW-6: Clean Line will avoid and/or minimize construction within 300 feet of caves known to be occupied by threatened or endangered species.

Water EPMs have been developed for the Project; the following EPMs relate to special status wildlife resources:

- W-1: Clean Line will avoid and/or minimize construction of access roads in special interest waters.
- W-2: Clean Line will identify, avoid, and/or minimize adverse effects to wetlands and waterbodies. Clean Line will not place structure foundations within the Ordinary High Water Mark of Waters of the United States.

Additional site-specific EPMs may be developed as part of the ongoing consultation process between the Applicant and the federal and state agencies.

The following plans will be developed and implemented by the Applicant to avoid or minimize impacts:

- Blasting Plan: This plan will describe measures designed to minimize adverse effects due to blasting.
- Restoration Plan: This plan will describe post-construction activities to reclaim disturbed areas.
- Spill Prevention, Control and Countermeasures (SPCC) Plan: This plan will describe the measures designed to prevent, control, and clean up spills of hazardous materials.

- Storm Water Pollution Prevention Plan (SWPPP): This plan, consistent with federal and state regulations, will describe the practices, measures, and monitoring programs to control sedimentation, erosion, and runoff from disturbed areas.
- Transmission Vegetation Management Plan (TVMP): This plan would be developed and implemented pursuant to the North American Electric Reliability Corporation (NERC) Reliability Standard FAC-003 and will describe how Clean Line will conduct work on its right-of-way to prevent outages due to vegetation. The TVMP may require additional analysis under NEPA depending on whether and under what conditions DOE decides to participate in the Project.
- Avian Protection Plan (APP): This plan, consistent with Avian Power Line Interaction Committee (APLIC) guidelines, will describe a program of specific and comprehensive actions that, when implemented, reduce risk of avian mortality.

3.14.1.7.2 Impacts Associated with the Applicant Proposed Project

This section identifies the potential impacts on special status wildlife and their habitat based on three phases of the Project: (1) construction, (2) operations and maintenance, and (3) decommissioning. The Applicant would conduct each phase in compliance with applicable state and federal laws, regulations, and permits related to environmental protection. EPMs would be implemented as described in Section 3.14.1.7.1 to avoid or minimize impacts to special status wildlife. In addition, consultation with USFWS has been initiated pursuant to Section 7 of the ESA regarding the potential effects of the Project on listed species and any designated critical habitat. This consultation review is a parallel, but separate analysis conducted pursuant to the requirements of Section 7 of the ESA and the applicable implementing regulations. Through the consultation process, additional protection measures may be identified to avoid and/or minimize the impacts of the Project upon listed species and any designated critical habitat.

3.14.1.7.2.1 Construction Impacts

Mortality and Injury

Mortality, by definition, is a direct, permanent impact to an individual (i.e., the individual no-longer exists); however, the effect of an individual mortality on the larger population could vary depending on the dynamics and characteristics of the population. Smaller populations and those species with a low fecundity rate may be sensitive to individual mortalities (e.g., mortality of an individual whooping crane could have future impacts to population viability due to current low population size and a low reproductive rate). Species with larger populations or that have higher fecundity rates can more easily recover from mortalities of individuals. In general, many small mammals, small birds, and amphibians typically have higher average fecundity rates and are less sensitive to mortality. Bats are an exception because they typically bear only a single litter per year, produce one young at a time, and do not breed until their second year (Nagorsen and Brigham 1993). Large birds (e.g., raptors) typically have lower fecundity rates because of small clutch size and delayed sexual maturity. Populations of special status wildlife species may be more susceptible to mortalities because of low population size and lower average fecundity rates.

Construction of the Project could result in the direct mortality or injury of special status wildlife species. Of the construction activities, vegetation clearing and work site preparation would pose the greatest risk of mortality and injury. Most of the special status wildlife species are relatively mobile (i.e., birds and bats) and could avoid construction activities by moving to other areas. Sedentary species (e.g., American burying beetle, juvenile bats, and fledgling birds) would be most at risk for mortality because they are unable to move away from the disturbed area. Mortalities/injuries could be minimized by timing the construction activities to avoid sensitive periods (e.g., the breeding seasons) (see EPM FVW-5); however, some mortality events would occur even with the implementation of seasonal and spatial restriction. Other activities that could cause mortality or injury of special status wildlife species include exposure to hazardous materials (e.g., accidental spills and pesticides) (see Table 3.8-4). The Applicant would implement EMPs GE-1, GE-5, GE-13, GE-21, and GE-28, as well as the measures that would be outlined in the required SPCCP and SWPPP to minimize these risks.

Disturbance

A disturbance response is a behavioral response by wildlife species to a perturbation. The perturbation could be presence of human activity, noise, vibration, or other external stimulus that is sensed by wildlife species. Disturbance impacts could include physiological stress, habitat displacement, increase vulnerability to predation, and disruption of life history functions such foraging, breeding (e.g., leks), and parental care (e.g., nesting). Disturbance impacts from construction are expected to be relatively short term (e.g., limited to the construction phase), but they could last more than a year if disturbances cause reproductive failures (e.g., nest or breeding territory abandonment). Options that may be used to avoid or minimize disturbance impacts include adjusting construction schedules and the location of construction staging areas to avoid sensitive areas that are known or identified as breeding, nesting or roosting sites for special status species.

Habitat Loss and Modification

Special status wildlife species could also be impacted through either loss or modification of habitat. Habitat loss is often a major factor contributing to wildlife species being protected as either state or federal special status species. Loss of wildlife habitat could occur directly through clearing of vegetation or disturbance of non-vegetation habitats (e.g., caves, cliffs, rock outcrops) during construction. Habitat modification such as fragmentation (i.e., the breaking up of contiguous areas of vegetation/habitat into smaller patches) can reduce habitat quality and decrease species survival and reproduction. Some wildlife species require contiguous habitat of certain size and connectivity to carry out life history functions such as foraging, protective cover, breeding, parental care, and dispersal of young to adjacent suitable habitat. Habitat disturbances such as access roads could divide contiguous habitats into smaller patches that may be of lower quality or inadequate in size for some species. In addition, habitat modification includes altering the vegetation structure such as tree or shrub removal or application of herbicides. Although vegetation would remain on an area, the vegetation structure and wildlife habitat could be different and may no longer provide acceptable habitat components required by a particular species. Habitats can also be modified through the unintentional introduction or facilitation of the spread of invasive species that can alter the quality of the habitat or fire regimes (e.g., increase fire frequency). Clearing of vegetation and disturbance to soils could promote the spread and or establishment of invasive plant species. The Applicant would implement EPM FVW-2 to minimize the risk of spreading or creating new infestations of invasive plant species. Section 3.17 discusses in more detail the potential effects of invasive plants species as well as the measures that would be taken to minimize the risk of these effects.

3.14.1.7.2.2 Operations and Maintenance Impacts

Mortality and Injury

It is assumed that during the operations and maintenance phase of the Project that land disturbances and vegetation clearing would not occur as it would have during construction and these disturbances would not be a potential source of mortality and injury to special status wildlife. Some vegetation trimming would occur within the transmission line ROW to prevent regrowth of trees that could interfere with the conductors. Vegetation maintenance is not likely to be a source of mortality to special status wildlife species (e.g., bats) as large suitable roost trees for bats would not be present in the ROW during operations. American burying beetles could possibly be at risk during vegetation maintenance activities but impacts could be reduced if vehicle access was restricted to existing roads. Project structures (i.e., transmission lines and structures) present during operations and maintenance could pose a mortality and injury risk to special status avian species during migration and foraging. A variety of factors influence the rate of avian collisions with power lines or other anthropogenic structures, including: configuration and location of power lines; the tendency of specific species to collide with structures; and environmental factors such as weather, topography, and habitat (APLIC and USFWS 2005). Powerline placement with respect to other structures and topography can influence the collision rate of avian species. Because of sensory abilities unique to birds, birds may be susceptible to human structures not part of their normal environment (Martin 2014). Collisions usually occur near water or migration corridors, and occur more often during inclement weather. Less agile birds, such as large-bodied birds or birds that travel in flocks, are more likely to collide with overhead lines because they lack the ability to quickly negotiate obstacles. Among the avian special status species, the whooping crane, golden eagle, and bald eagle are the most likely species to be susceptible to collision because they are large birds with a wide wingspan (79 to 87 inches) and are less maneuverable than smaller species. The interior least tern is a small and agile flyer with a wingspan of about 20 inches that can readily avoid power lines if they are visible (Dinan et al. 2012). Data regarding collision risk for the interior least terns are inconclusive; some studies report higher risk compared to other species (McNeil et al 1985) and other studies reporting a low risk for collisions (Henderson et al. 1996; Savereno et al. 1996, Dinan et al. 2012). The potential risk of piping plover, red knot, and Sprague's pipit colliding with structures is uncertain; however, it is likely low compared to other avian species as these species are not amongst those that are typically reported to collide with structures and are smaller bodied species that are more maneuverable. The LEPC is a ground-dwelling bird that flies low in short flights and is at lower risk for collisions with power lines but higher risk for collisions with fences (Wolfe et al. 2007).

Avian species are also susceptible to electrocutions by power lines. For a bird to become electrocuted it needs to come into contact with two energized conductors at the same time. As a result, multiple factors influence the risk of avian electrocutions including: the spacing between energized conductors, the tendency of a species to perch along power lines or fly near conductors, as well as the avian species body-size and wing-length. Raptors (including eagles) have the highest probability of becoming electrocuted because these taxa will commonly perch along transmission lines and they have relatively large-bodies and wingspans compared to other taxa of birds. As described in Appendix F, the spacing for the conductors as currently proposed would minimize the risk of avian species coming into contact with two energized conductors and/or becoming electrocuted. To further minimize the risk of avian electrocutions, the Applicant would develop and implement an APP (as described in Section 3.20) consistent with APLIC guidelines.

During ROW maintenance, use of herbicides to manage vegetation and possibly control weeds and invasive species could pose a mortality risk to special status wildlife species; however, many herbicides are non-toxic to animals and use of these chemicals could be an option. Smaller, less mobile species such as the American burying beetle or juvenile individuals would be more susceptible.

Disturbance

Maintenance and repair work on the transmission system (i.e., structures and lines) would require access along the ROW. Because this activity would be periodic and short-term, disturbance impacts to special status wildlife species are not expected to be substantial unless the maintenance or repair work occurs during particular seasons when activities such as breeding (e.g., leks), nesting (e.g., eagles), roosting sites (e.g., bats, eagles, whooping cranes), and hibernation (i.e., bats) could be disrupted.

Habitat Loss and Modification

Impacts such as habitat loss and modification from construction would remain during operations and maintenance unless particular land disturbances were no longer needed and vegetation was restored. It is assumed that additional habitat loss from land clearing would not occur during the operations and maintenance phase of the Project (i.e., additional areas beyond those impacted during construction would not be directly affected during operations and maintenance). However, additional habitat loss could occur indirectly through habitat displacement (behavioral response). Some wildlife species avoid areas near human activities or structures even though the habitat has not been physically disturbed or altered. For example, transmission lines and structures may impact this species use of otherwise suitable habitats due to increased predation rates that can result from avian predators perching and roosting along the structures and line (USFWS 2014d). Recent research also suggests that avoidance of transmission lines may be linked to ultraviolet (UV) discharges on power lines and the ability of birds and mammals to detect UV light (Tyler et al. 2014).

Both physical habitat disturbances from access roads and habitat loss from behavioral avoidance could contribute to fragmentation of habitat for particular special status wildlife species. Some species such as the LEPC require large contiguous areas of undisturbed habitat. Physical disturbances and presence of vertical structure could divide habitat into smaller blocks of habitat that could be less preferred or become unsuitable.

Land disturbances during construction could provide an opportunity for weed species and invasive plant species to become established along the ROW and possibly spread into adjacent areas. Section 3.17 discusses the potential effects of invasive plant species on native habitats as well as measures that could be taken to minimize this risk. The effects of invasive plant species on native habitats could occur slowly or rapidly depending on the invasive plant species involved. In some cases, invasive species may alter the natural fire regime, making an area more susceptible to fire and thereby changing the composition of the vegetation community.

3.14.1.7.2.3 Decommissioning Impacts

Decommissioning of the Project would involve methods similar to those that would be required to construct the Project. As a result, the impacts of decommissioning would be similar to those previously described for construction. The Applicant would follow the same general and resource-specific EPMs during decommissioning that would be implemented during construction. In addition, the Applicant would develop a Decommissioning Plan prior to any decommissioning actions for review and approval by the appropriate state and federal agencies.

Although decommissioning would have short-term adverse impacts to wildlife (similar to what was discussed for construction related impacts), it is assumed that decommissioning of the Project would have long-term beneficial impacts to wildlife species and their habitats, because it would remove the Project and its related impacts from the environment.

3.14.1.7.2.4 Converter Stations and AC Interconnection Siting Areas

A detailed description of the converter stations and other terminal facilities is provided in Section 2.1.2.1.

3.14.1.7.2.4.1 Oklahoma Converter Station Siting Area and AC Interconnection Siting Area

The Oklahoma Converter Station and AC Interconnection Siting Areas are located in Region 1 of the Project in the central part of the Oklahoma Panhandle. The converter station would occupy an area of approximately 45 to 60 acres and the AC interconnection would consist of approximately 3 miles of transmission line. Region 1 is the driest area of the Project and contains vegetation adapted to semi-arid conditions (Section 3.17). Sprague's pipit, red knot, LEPC, piping plover, whooping crane, interior least tern, and golden eagle are believed to be present within Texas County in Region 1 where the Oklahoma converter station and associated AC interconnection system would be constructed (Table 3.14.1-3). Bald eagles have been documented in the area but are not common.

3.14.1.7.2.4.1.1 Construction Impacts

No mortality impacts to any of the special status species are expected from the construction of the Oklahoma converter station or the AC interconnection. Each of the special status species potential present in this area is mobile and would likely avoid construction activity. Construction would disturb approximately 60 acres of habitat, resulting in some habitat loss. Grasslands and croplands would be the dominant habitat type impacted by the Oklahoma converter station and associated AC interconnection (Sections 3.10 and 3.17). The habitat loss is unlikely to have substantial long-term direct impacts to special status wildlife populations in the area.

The only recorded occurrence of nesting piping plovers in the vicinity is at Optima Lake. No disturbance impacts or loss or modification of piping plover habitat is expected. The piping plover primarily uses riverine/lacustrine shorelines or sandbars which are not expected to be affected by construction of the Oklahoma converter station and AC interconnection. Construction would occur in Texas County, Oklahoma, west of the primary whooping crane migration corridor. It is possible that whooping cranes occasionally migrate through the Project area. No migration stopover areas occur near the siting areas for the converter station and the AC interconnection. The golden eagle occurs in the area as a resident and seasonal migrant. The golden eagle is a wide-ranging species and construction activity at the converter station and associated 3 mile AC interconnection is unlikely to cause disturbance or habitat impacts. The known existing range of the LEPC occurs east of the Oklahoma converter station and the AC interconnection (Figure 3.14-1 in Appendix A). Semi-arid grassland/herbaceous land cover is the predominant vegetation in this area. Depending on the specific quality of the habitat at the Project area, LEPC could possibly occur there. Impacts to LEPC habitats are not anticipated, but could be minimized or avoided by locating facilities in previously disturbed sites or habitat of lower quality. Suitable habitat for the interior least tern is not found within the affected area. Suitable habitat (i.e., native grasslands) for Sprague's pipit occurs in area. However, the species is an uncommon migrant and rare winter resident in Oklahoma. The low probability of occurrence would minimize impacts, and if native grasslands are avoided to the extent practicable, impacts would be low.

3.14.1.7.2.4.1.2 Operation and Maintenance Impacts

Potential impacts during operations and maintenance could include mortalities from collisions with transmission lines and building structures as well as habitat loss from potential avoidance of areas surrounding facility structures (CEC 2005). No impact to the piping plover is expected because suitable habitat does not occur in the vicinity of the Project area. The AC interconnection transmission lines and structures could pose a mortality risk to migrating whooping cranes; however, the transmission lines are only about 3 miles in length, which minimizes the potential risk. Also, the Project area is outside the whooping cranes primary migratory corridor, which is approximately 250 miles wide, and no migratory stopover areas exist in the area (Figure 3.14-2 in Appendix A). The expected risk of collision mortality is low. The golden eagle is a resident and seasonal migrant in the area. The relatively small size of the converter station (45 to 60 acres) and the AC interconnection system (3 miles) would minimize the potential collision hazard for golden eagles.

The Project area is west of the occupied range of the LEPC. If LEPC occur near the converter station and AC interconnection system, any avoidance of areas due to the potential for increased predation rates (due to consolidation of raptors and corvids along the AC lines) would constitute a loss of habitat. No impacts are expected during operations and maintenance to the Sprague's pipit, red knot, and interior least tern because of a low probability of occurring in the vicinity of the Project in Region 1. Either suitable habitat does not exist (interior least tern) or the species is an uncommon (Sprague's pipit) or rare migrant (red knot) through the Project area. Because the converter station area would be a developed site with approximately 45 acres fenced, the routine presence of operations and maintenance staff would not have any added disturbance impacts to any special status wildlife species.

3.14.1.7.2.4.1.3 Decommissioning Impacts

The type of potential impacts during Project decommissioning are expected to be similar to those during construction except areas of new land disturbance would be less than during initial construction. The Applicant would follow the same general and resource-specific EPMs during decommissioning that would be implemented during construction. In addition, the Applicant would develop a Decommissioning Plan prior to any decommissioning actions for review and approval by the appropriate state and federal agencies.

3.14.1.7.2.4.2 Tennessee Converter Station Siting Area and AC Interconnection Tie

The Tennessee Converter Station Siting Area and AC Interconnection Tie are located in Region 7 of the Project, located in Shelby County, Tennessee. The converter station would occupy an area of approximately 45 to 60 acres within the siting area. The AC Interconnection Tie would be within the footprint of the converter station and the existing TVA Shelby Substation. Region 7 receives approximately 50 inches of precipitation annually and contains vegetation adapted to relatively moist conditions (Section 3.17). Vegetation in the Tennessee Converter Station Siting Area and AC Interconnection Tie is dominated by deciduous forest (33 percent or 71 acres), pasture/hay (31 percent or 67 acres), and croplands (20 percent or 44 acres). Some woody wetlands (12 percent or 25 acres) also occur in the siting area. The northern long-eared bat, Indiana bat, interior least tern, and red knot are believed to be present within Shelby County in Region 7 where the Tennessee converter station and associated AC interconnection tie would be constructed (Table 3.14.1-3). Suitable habitat for the interior least tern and red knot do not occur in the siting area and no impacts to those species are expected. Bald eagles occur along the Mississippi River and could occur near the converter station siting area; however, the deciduous forest, croplands and pastureland habitat within the siting area is not preferred bald eagle habitat. Therefore, the following impact assessment only considers the northern long-eared bat or Indiana bat.

3.14.1.7.2.4.2.1 Construction Impacts

No mortality impacts are expected during construction to either the northern long-eared bat or Indiana bat. No winter hibernacula (i.e., caves or man-made abandoned mines) that could be disturbed by construction activities are known to occur in the Project area. Both bat species use forested or wooded habitats. Forested areas (deciduous forests or woody wetlands) compose about 45 percent of the Project area and either species could potentially occur in the area during the summer roosting season. Potential disturbance impacts could occur if construction occurred in or near forested areas. However, the siting area is composed largely of croplands and pasture land (51 percent or 111 acres), so potential impacts could be avoided. No loss of bat habitat is expected so long as construction does not require removal of any potential roost trees that may occur in forested areas.

3.14.1.7.2.4.3 Operation and Maintenance Impacts

No impacts to either the northern long-eared bat or Indiana bat are expected during operations and maintenance of the Tennessee converter station and AC interconnection tie. No disturbance to any potential bat roost trees in the adjacent areas is expected. Bats are expected to avoid any vertical structures. Because bats typically forage at dusk or during the night, the presence of maintenance personnel and equipment would not impact any bat foraging activity. EPM GE-20 as described in Section 3.14.1.7.1 would be implemented to avoid or minimize operations related direct and indirect impacts to the northern long-eared and Indiana bats.

The potential impacts (e.g., collision with Project structures and transmission lines) to the interior least tern and red knot during operations and maintenance of the converter station and AC interconnection system are not expected. Suitable habitat for the interior least tern occurs west of the Project area along the Mississippi River but not in the converter station siting area. The red knot is an occasional transient migrant across the state of Tennessee, but is not commonly found in this area; indicating that the likelihood of this species being present within the affected area and being impacted is unlikely.

Because the converter station area would be a developed site with approximately 45 acres fenced, the routine presence of operations and maintenance staff would not have any added disturbance impacts to any special status wildlife species.

3.14.1.7.2.4.4 Decommissioning Impacts

The type of potential impacts during Project decommissioning are expected to be similar to those during construction except areas of new land disturbance would be less than during initial construction. The Applicant would follow the same general and resource-specific EPMs during decommissioning that would be implemented during construction. In addition, the Applicant would develop a Decommissioning Plan prior to any decommissioning actions for review and approval by the appropriate state and federal agencies.

3.14.1.7.2.5 AC Collection System

A description of the AC collection system is provided in Section 2.1.2.3.

Semi-arid grasslands/herbaceous and croplands comprise most of the wildlife habitat in the Project area. The habitats found along the AC collection system routes are similar among the routes with variation in the proportion of grasslands and agricultural crops being the primary difference. Of the seven special status wildlife species described in Section 3.14.1.5 that potentially occur in this area, no impacts are expected to three species: piping plover, red knot and interior least tern. Two documented nesting occurrences of piping plover have been reported at Optima Lake in Texas County, Oklahoma. Given the lack of suitable habitat within the ROI for the AC collection system, no impacts to the piping plover are expected. The red knot could occur as a rare migrant through the region. Impacts to the red knot are also not expected because of the lack of suitable habitat and low probability of occurrence. Although a documented occurrence of the least tern has been made in Texas County, Oklahoma, the primary occurrence of least terns in Oklahoma occurs along the Cimarron River in Region 2 of the Project. Therefore, impacts to the interior least tern also are not expected from the development of the AC Collection system.

The special status wildlife species potentially affected by construction and operations and maintenance of the AC collection system include Sprague's pipit, LEPC, whooping crane, and golden eagle.

3.14.1.7.2.5.1 Construction Impacts

No mortality impacts are expected to Sprague's pipit, LEPC, golden eagle, and the whooping crane during construction. Sprague's pipit is an uncommon migrant and rare winter resident in Oklahoma. The AC collection system is west of the primary whooping crane migration corridor, although some individuals are likely to occasionally migrate through the area (Figure 3.14-2 in Appendix A). Therefore, construction-related mortalities to either species are not expected. The LEPC is a resident prairie grouse in western Oklahoma that prefers grasslands with a mix of shrubs (e.g., shinnery oak or sand sage) for cover and nesting. The LEPC is a ground-dwelling gamebird that typically flies in low, short flights that could avoid construction activity, and; therefore mortality impacts are not expected.

LEPCs are susceptible to disturbance. Data suggest that prairie chickens avoid buildings, roads, and other human disturbances. Of particular concern are communal breeding leks in the spring. Construction activity in the vicinity of a lek could cause abandonment and reduce reproductive success. This potential impact could be mitigated by identifying known leks and avoiding construction in the area during the breeding season (March and April). Similar disturbance impacts could occur during the nesting season and cause abandonment of nests. Most of the current estimated occupied range of the LEPC and mapped habitat occurs on the eastern half or in the northwestern corner of the AC collection system (Figure 3.14-1 in Appendix A) (Van Pelt et al. 2013). Potential AC transmission routes in those areas (AC Collection System Routes E-1, E-2, E-3, NE-1, NE-2, SE-1, and SE-3) would have a higher probability of disturbance impacts. To the extent that the AC collection transmission lines follow existing roads, transmission lines, and other ROWs, potential disturbance impacts would be minimized.

Because the whooping crane and Sprague's pipit are seasonal migrants through the area and could be present in the area for a very short time, it is unlikely that construction activities would have a disturbance impact on either species. Golden eagles occur in the area as residents and seasonal migrants. The Applicant would coordinate with the USFWS to identify any potential nest sites that could be affected and develop procedures to avoid impacts (EPM FVW-5). Known golden eagle nests occur farther west in the Oklahoma Panhandle outside of the ROI (USFWS 2014d).

Construction of the AC collection system would require land clearing for the construction of access roads and installation of transmission structures (Sections 2.1.2.3 and 2.1.2.4). Habitat loss and fragmentation of existing grassland habitat is one of the primary threats to the LEPC (79 FR 19974 and 79 FR 20074, April 10, 2014). The highest quality LEPC habitat (CHAT-1 and CHAT-2) occurs on the east side of the AC collection system area (Figure 3.14-1 in Appendix A). To the extent that the AC transmission lines and access roads cross contiguous areas of native grasslands, construction of the AC collection system may contribute to the loss of potential LEPC habitat. These impacts could be minimized with routes that follow existing ROWs, areas of cultivated fields, and grassland areas already fragmented by other activities that are areas of low quality prairie chicken habitat. The Sprague's pipit also uses native grasslands and could be similarly affected by loss of habitat and fragmentation.

3.14.1.7.2.5.2 Operations and Maintenance Impacts

Potential impacts to special status wildlife species during operations and maintenance of the AC collection system include mortalities from collisions with transmission lines and structures and possible electrocutions, disturbance impacts from routine maintenance activity, and loss of habitat by behavioral avoidance of areas surrounding vertical structures (i.e., transmission structures and lines). There is a potential risk of mortalities to whooping cranes from collisions with transmission lines and structures. The risk of collision mortality is expected to be low because the ROI is outside the primary whooping crane migration corridor reducing the probability of occurrence. However, whooping cranes could occasionally migrate through the area and some risk of collision mortality would exist. Golden eagles are also residents and winter migrants in western Oklahoma and transmission lines could be a potential collision and mortality risk. Transmission lines are unlikely to be a source of mortality for either the LEPC or Sprague's pipit. The prairie chicken is a low flier and typically avoids areas surrounding tall structures. Sprague's pipit occurs only as a winter migrant in low numbers and is a smaller, more maneuverable flier that could more likely avoid transmission lines. Routine maintenance and inspection work along the AC collection system transmission lines is unlikely to impact special status wildlife species other than a temporary displacement while work is performed. Additional loss of habitat is not expected during operations and maintenance. However, any avoidance of areas by the LEPC due to the potential for increased predation rates (due to consolidation or raptors and corvids along the AC collection lines) could constitute a potential impact to the LEPC.

3.14.1.7.2.5.3 Decommissioning Impacts

Potential impacts during Project decommissioning are expected to be similar to those during construction except areas of new land disturbance would be less than during initial construction. The Applicant would follow the same general and resource-specific EPMs during decommissioning that would be implemented during construction. In addition, the Applicant would develop a Decommissioning Plan prior to any decommissioning actions for review and approval by the appropriate state and federal agencies.

3.14.1.7.2.6 HVDC Applicant Proposed Route

The HVDC transmission line is described in Sections 2.1.2.2 and 2.4.2. The transmission line would extend approximately 700 miles from the semi-arid Oklahoma Panhandle to western Tennessee which has a humid, continental climate. Because of the significant change in vegetation and available wildlife habitats that occurs along the Applicant Proposed Route, the special status wildlife species that could be affected by the construction and operations and maintenance of the Project also varies along the route (Table 3.14.1-3 and 3.14.1-4). For the purposes of analysis and discussion, the Project has been divided into seven regions from west to east. Potential impacts to special status wildlife species from construction and operations and maintenance are discussed for each region. Impacts from decommissioning would be common to the regions and would be the same as those identified in Section 3.14.1.7.2.

See Sections 3.10 and 3.17 for a list of the types of habitats that would be impacted by the Applicant Proposed Route in each region as well as the acres that would be impacted. Table 3.14.1-5 lists the approximate length of the Applicant Proposed Route in each region, how much of the route is parallel to existing infrastructure, the predominant habitat type that would be impacted (see Sections 3.10 and 3.17 for more details regarding the acres of impact that would occur), and the special status wildlife species potentially present along the Applicant Proposed Route by region. The 23 route variations developed in response to public comments on the Draft EIS did not significantly increase or decrease (typically less than 1 mile) either the total length of the Applicant Proposed Route in each region or the length of route parallel to existing infrastructure (Table 3.14.1-5). Changes in potential impacts from the route variations are discussed for each region.

Table 3.14.1-5:
Special Status Wildlife Species Summary Information Regarding the Applicant Proposed Route

Region	Total Length of APR (miles)	Length Parallel to Existing Infrastructure (miles)	Predominant Land Cover	Special Status Species Potentially Present in the Region
1	115	Approximately 20 miles, or 18 percent of the route	Grassland/herbaceous, croplands (grasslands and croplands likely used by whooping cranes for feeding habitat)	Sprague's pipit, red knot, whooping crane, LEPC, interior least tern, and piping plover, and golden and bald eagles
2	106	Approximately 27 miles, or 25 percent of the route	Grassland/herbaceous, croplands (grasslands and croplands likely used by whooping cranes and LEPC for feeding habitats)	Whooping crane, interior least tern, and LEPC, piping plover, red knot, golden eagle
3	162	Approximately 21 miles, or 13 percent of the route	Grassland/herbaceous, deciduous forest (grasslands likely used by whooping cranes for feeding habitat; forests likely used by gray bats for foraging)	Gray bat, Sprague's pipit, interior least tern, piping plover, whooping crane, and American burying beetle, red knot, golden eagle
4	126	Approximately 11 miles, or 9 percent of the route	Grassland/herbaceous, deciduous forest, pasture/hay (forests likely used by northern long-eared bat, Ozark big-eared bat, gray bat, and Indiana bat for foraging)	northern long-eared bat, Ozark big-eared bat, gray bat, Indiana bat, Sprague's pipit, interior least tern, piping plover, American burying beetle, and bald eagle
5	113	Approximately 15 miles, or 13 percent of the route	Deciduous forest, pasture/hay (forests likely used by northern long-eared bat, Ozark big-eared bat, gray bat, and Indiana bat for foraging habitat)	northern long-eared bat, gray bat, Ozark big-eared bat, Indiana bat, interior least tern, bald eagle, and piping plover
6	54	Approximately 11 miles, or 20 percent of the route	Croplands	northern long-eared bat, Indiana bat, and piping plover
7	43	Approximately 7 miles, or 17 percent of the route	Croplands, deciduous forest (forests likely used by northern long-eared bat, and Indiana bat for foraging habitat)	northern long-eared bat, Indiana bat, interior least tern, piping plover, and bald eagle

APR = Applicant Proposed Route

The following subsections discuss region-specific factors that would affect special status wildlife species; however, refer to Sections 3.14.1.7.1 for a discussion of general impacts that would occur, and Table 3.14.1-5 for a list of the special status wildlife species potentially present.

3.14.1.7.2.6.1 Region 1

The Applicant Proposed Route in Region 1 is approximately 115 miles long. Approximately 20 miles, or 18 percent of the route, is parallel to existing infrastructure (Table 3.14.1-5). Special status wildlife species that could occur in Region 1 are Sprague's pipit, red knot, interior least tern, LEPC, whooping crane, piping plover, and golden eagle. Two documented nesting occurrences of piping plover have been reported at Optima Lake in Texas County, Oklahoma. Because of the lack of suitable habitat within the ROI for the Applicant Proposed Route, no impacts to the piping plover are expected. The red knot could occur as a rare migrant through the region. Impacts to the red knot are also not expected because of the lack of suitable habitat and low probability of occurrence. Although a documented occurrence of the least tern has been made in Texas County, Oklahoma, the primary occurrence of least terns in Oklahoma occurs along the Cimarron River in Region 2 of the Project (Lott et al. 2013). Suitable habitat for the interior least tern does not occur in the ROI. Therefore, impacts to the interior least tern also are not expected from the development of the Applicant Proposed Route in Region 1.

3.14.1.7.2.6.1.1 Construction Impacts

Species that could potentially be affected during construction include the Sprague's pipit, LEPC, whooping crane, and golden eagle. Sprague's pipit is a migrant through the ROI and could be an occasional winter resident, although the primary wintering range for the species is farther south. No mortality impacts are expected as the pipit could avoid construction activity. Construction could temporarily displace individuals during the winter, if present, but no impacts to pipit populations are expected. Sprague's pipit primarily uses native prairie and habitat loss and fragmentation of remaining native prairie is of primary concern. Disturbance and clearing of prairie habitat for access roads and placement of transmission structures could affect Sprague's pipit. However, winter ranges for the Sprague's pipit include a broader array of habitats (e.g., stubble and fallow alfalfa, soybean, and wheat fields and pastures with non-native grasses) and alternative migration habitat would be available in the vicinity of the ROI (Robbins and Dale 1999; USFWS 2011a). Because of the low probability of winter residents occurring in Region 1 and other migratory habitat would remain, measurable impacts to Sprague's pipit populations from construction of the HVDC transmission line in Region 1 is not expected.

The Applicant Proposed Route crosses the LEPC range in Region 1 (Figure 3.14-1 in Appendix A). The primary impacts that could occur during construction are disturbance and habitat loss and fragmentation. Disturbances to leks during the spring could disrupt and reduce reproduction. Similarly, construction disturbance near habitats used for nesting and brood rearing also could reduce reproduction. LEPC require large blocks of contiguous habitat (Van Pelt et al. 2013). Vegetation clearing for access roads and transmission structures would cause habitat loss but also could fragment remaining patches of habitat. Focal LEPC habitat areas and connectivity habitat areas have been mapped in Region 1 using an internet mapping tool (CHAT). Focal and connectivity habitats occur near or within the ROI in Region 1. In addition, construction disturbance could impact private lands that have been previously enrolled in the LEPC Candidate Conservation Agreements with Assurances program to preserve and restore LEPC habitat. However, the Applicant Proposed Route follows existing transmission lines through Region 1 where LEPC may occur on either side of the route, so the suitability of the habitat for LEPC is likely lower than other undisturbed areas. The route would pass adjacent (south side) to the Shorb WMA managed by the ODWC.

The whooping crane occurs as a spring and fall migrant through the region. No stopover areas have been identified in Region 1. The Applicant Proposed Route occurs on the western side of the primary whooping crane migratory corridor. No impacts to whooping cranes are expected during construction as occurrence in a construction area is unlikely and the whooping crane could avoid areas of construction.

Golden eagles occur as residents and migrants in Region 1. Golden eagles prefer the open semi-arid habitats such as grassland and shrub habitats for foraging and cliffs or ledges for nesting. Golden eagles are wide-ranging birds that could easily avoid construction and impacts are not expected. Of potential concern would be construction disturbances of nest sites in the late winter and spring that could prevent nesting or disrupt rearing of young. The preferred canyons and rocky cliff habitat occur farther west in the Oklahoma Panhandle but the Applicant would work with wildlife agencies to identify and avoid any eagle nests (EPM FVW-5) that could occur near the Applicant Proposed Route. Bald eagles have expanded their range within Oklahoma and have been observed in the Region 1 (Optima Lake).

3.14.1.7.2.6.1.2 Operations and Maintenance

Operation and maintenance of the HVDC transmission line is not expected to have an impact on Sprague's pipit. Impacts to the LEPC could include avoidance of areas by the LEPC surrounding the transmission line because of increased predation rates (resulting from consolidation of raptors and corvids along the line). Research in Kansas suggests the avoidance of suitable habitat (potently due to increased predation rates along tall structures) could extend approximately 2000 feet from a transmission line (Robel et al. 2004). The Western Association of Fish and Wildlife Agencies adopted a 1,300-foot impact zone in the *The Lesser Prairie-Chicken Range-Wide Conservation Plan* for calculating impacts from transmission lines (>69kV) (Van Pelt et al. 2013). Such a zone could increase fragmentation of LEPC habitat and create a zone of potential habitat that LEPC may avoid. However, not all habitat along the Applicant Proposed Route in Region 1 is suitable LEPC habitat, and the Applicant Proposed Route follows an existing transmission line along which LEPC may occur. Therefore, any potential habitat avoidance impacts would not be completely additive to comparable impacts that may have occurred from existing transmission lines in areas of potential suitable LEPC habitat.

Potential impacts to whooping cranes during operations and maintenance include potential mortalities from collisions with transmission lines. Although Region 1 of the Project lies west of the primary whooping crane migration corridor, some cranes migrate through the region in the spring and fall (Figure 3.14-2 in Appendix A). Although collision mortalities are possible, a lower probability of occurrence of whooping cranes and the lack of any stopover areas in the ROI would minimize the potential for mortalities in Region 1.

The transmission lines also pose a potential mortality risk to resident or migrant golden eagles. Electrocution risks to golden eagles would be lower if the transmission lines are spaced further apart than an eagle's wingspan (approximately 80 inches).

3.14.1.7.2.6.2 Region 2

The Applicant Proposed Route in Region 2 is approximately 106 miles long. Approximately 27 miles, or 25 percent of the route, is parallel to existing infrastructure. Special status wildlife species that occur in Region 2 are the red knot, interior least tern, LEPC, whooping crane, piping plover, golden eagle, and bald eagle. The piping plover is a shorebird species that is typically found along open, sandy rivers or reservoirs with sandy beaches. No documented occurrences of piping plover nests have been reported in Region 2 although the species could occur in the ROI where the Applicant Proposed Route crosses the Cimarron River. No impacts to the piping plover are expected from the construction or operations and maintenance of the Project. The red knot could occur as a rare migrant through the region. Impacts to the red knot are also not expected because of the lack of suitable habitat and low probability of occurrence.

One of the two route variations of the Applicant Proposed Route developed in Region 2 (Link 1, Variation 1) in response to public comments on the Draft EIS, would increase the amount of lower quality LEPC habitat that may be affected by less than 40 acres. Link 2, Variation 2, occurs in the whooping crane migration corridor, but it would not change any potential impacts to the whooping crane. No other species would be affected by the Region 2 route variations.

3.14.1.7.2.6.2.1 Construction Impacts

There are documented occurrences of interior least terns along the Cimarron River in Region 2 (Lott et al. 2013). Nesting locations are not well documented near the ROI crossing of the Cimarron River, but least terns are known to forage and migrate through the area. Potential short-term disturbance impacts to interior least terns could occur if construction across the Cimarron River occurs in the spring (approximately April) or fall (approximately August to early September). No construction impacts to least tern habitat or mortality impacts are expected.

The Applicant Proposed Route crosses a portion of the estimated occupied range of the LEPC in Woodward County in the western end of Region 2 (Van Pelt et al. 2013). No focal LEPC habitat areas and connectivity habitat areas have been mapped in Region 2, although some suitable habitat could occur in the area (Figure 3.14-1 in Appendix A). The primary impacts that could occur during construction are disturbance and habitat loss and fragmentation. Disturbances to leks during the spring could disrupt and reduce reproduction success. Similarly, construction disturbance near habitats used for nesting and brood rearing also could reduce reproduction success. LEPCs require large blocks of contiguous habitat (Van Pelt et al. 2013). Vegetation clearing for access roads and transmission structures would cause habitat loss but also could fragment remaining patches of habitat. To the extent that the Applicant Proposed Route avoids larger contiguous blocks of native prairie and shrub grassland, impacts to LEPCs would be minimized.

The whooping crane occurs as a spring and fall migrant through Region 2. No stopover areas have been identified in the ROI in Region 2. The Applicant Proposed Route crosses the primary whooping crane migratory corridor (approximately 75 percent of the observations) (Figure 3.14-2 in Appendix A). Minimal direct impacts to whooping cranes are expected during construction because occurrence in a construction area is unlikely and the whooping crane could avoid areas of construction. Any disturbance impacts in foraging areas would be short-term and occur only if the construction activity coincided with migration.

Golden eagles occur as residents and migrants in Region 2. Golden eagles prefer the open semi-arid habitats such as grassland and shrub habitats for foraging and cliffs or ledges for nesting. Golden eagles are wide-ranging birds that could easily avoid construction and direct impacts are not expected. Golden eagle nests are unlikely in the ROI in Region 2 because of lack of suitable habitat, but the Applicant would work with wildlife agencies to identify and avoid any potential eagle nest sites that could occur near the Applicant Proposed Route.

Bald eagles occur in Region 2 as potential nesters and winter migrants. The closest bald eagle wintering habitat is found at Canton Lake (3.5 miles south of the ROI); therefore, construction impacts to bald eagles are not expected due to the lack of suitable habitat within the ROI.

3.14.1.7.2.6.2.2 Operations and Maintenance

Operation and maintenance of the transmission line along the Applicant Proposed Route in Region 2 could impact the interior least tern, whooping crane, golden eagle, and bald eagle (e.g., result in potential collisions). Interior least terns have been documented along the Cimarron River, suggesting that interior least terns may occur within the Applicant Proposed Route ROI from about April through June. However, the least tern is a small agile flier that forages along streams, rivers, and reservoirs and would likely avoid transmission lines and the potential for collision impacts is considered to be low.

Although no known migratory or stopover locations for whooping crane have been documented in the Applicant Proposed Route ROI, the route crosses the primary whooping crane migratory corridor and cranes would typically pass through the area in March through April and September through October (Figure 3.14-2 in Appendix A). The transmission lines could cause potential whooping crane mortalities from collisions. Project locations near (e.g., approximately 1 mile) whooping crane feeding and resting sites would have the greatest potential for collisions as the birds would be flying at lower elevations.

Golden and bald eagles potentially occur in the vicinity of the ROI. Both species are wide ranging and could pass through the ROI. Each species could be at risk for potential collisions with the transmission lines, although the probability is expected to be low. The risk of electrocution for any of the large birds (eagles or cranes) would depend on the distance between wires. Wire spacing greater than the average eagle wingspan would reduce potential electrocution risk. The Applicant would develop and implement an APP, consistent with APLIC guidelines that describes a program of specific and comprehensive actions that when implemented, would reduce risk of avian mortality. Additionally, the Applicant would implement EPMs (FVW-1, FVW-2, and GE-2) to reduce risk of avian mortality.

3.14.1.7.2.6.3 Region 3

The Applicant Proposed Route in Region 3 is approximately 162 miles long. Approximately 21 miles, or 13 percent of the route, are parallel to existing infrastructure. Special status wildlife species that occur in Region 3 are the gray bat, Sprague's pipit, interior least tern, piping plover, whooping crane, American burying beetle, and red knot. The red knot could occur as a rare migrant through the region. Impacts to the red knot are not expected because of the lack of suitable habitat and low probability of occurrence. No documented occurrences of piping plover nesting have been reported in Region 3, although the species could occur in the ROI where the Applicant Proposed Route crosses the Cimarron River. Piping plovers are rarely seen at inland stopover locations as most individuals may migrate directly to wintering ranges. No impacts to the piping plover are expected from the construction or operations and maintenance of the Project. Region 3 represents a transition to more forested vegetation, which supports two special status wildlife species: the gray bat and American burying beetle.

Five route variations of the Applicant Proposed Route were developed in Region 3 in response to public comments on the Draft EIS. Sprague's pipit (Link 1 and 2, Variation 1, and Link 1, Variation 2), American burying beetle (Link 4, Variations 1 and 2, and Link 5, Variation 2), and the gray and northern long-eared bats (Link 5, Variation 2) are the only federally listed species potentially affected by the new route variations. The potential impacts to these species during construction and operations and maintenance would be similar to those of the original Applicant Proposed Route. Approximately 20 acres more forested land area and 20 acres of native prairie would potentially be affected by these changes in Region 3.

3.14.1.7.2.6.3.1 Construction Impacts

Sprague's pipit is a migrant through the ROI and could be an occasional winter resident, although the primary wintering range for the species is farther south. Sprague's pipit has been documented in Payne County. No mortality impacts are expected as the pipit could avoid construction activity. Construction could temporarily displace individuals during the winter, if present, but no impacts to pipit populations are expected. Sprague's pipit primarily uses native prairie and habitat loss and fragmentation of remaining native prairie is of primary concern. Disturbance and clearing of prairie habitat for access roads and placement of transmission structures could affect Sprague's pipit. However, winter ranges for the Sprague's pipit include a broader array of habitats (e.g., stubble and fallow alfalfa, soybean, and wheat fields and pastures with non-native grasses) and alternative migration habitat would be available in the vicinity of the ROI (Robbins and Dale 1999; USFWS 2011a). Because the probability of winter residents occurring in Region 3 is low and because other migratory habitat would remain, measurable impacts to Sprague's pipit populations from construction of the HVDC transmission line in Region 3 are not expected.

Documented occurrences of the least tern have been made along the Cimarron River in Region 3 of the Project (Lott et al. 2013). Nesting locations are not well documented near the ROI crossing of the Cimarron River in Payne County, but least terns are known to forage and migrate through the area (USFWS 2014d). Potential short-term disturbance impacts to least terns could occur if construction across the Cimarron River occurs in the spring (approximately April) or fall (approximately August to early September). No construction impacts to least tern habitat or mortality impacts are expected.

The whooping crane occurs as a spring and fall migrant through Region 3. No stopover areas have been identified in the ROI in Region 3. The Applicant Proposed Route crosses the eastern portion of whooping crane migratory corridor (≤ 25 percent of the migratory observations) (Figure 3.14-2 in Appendix A). No impacts to whooping cranes are expected during construction as occurrence in a construction area is unlikely and the whooping crane could avoid areas of construction. Any disturbance impacts in foraging areas would be short-term and occur only if the construction activity coincided with migration.

Golden eagles become less common along the Applicant Proposed Route as the route moves east into less semi-arid vegetation. Golden eagles prefer the more open semi-arid habitats in Regions 1 and 2 but both residents and migrants occur in Region 3. Golden eagles are wide-ranging birds that could easily avoid construction and impacts are not expected. Of potential concern would be construction disturbances of nest sites in the late winter and spring that could prevent nesting or disrupt rearing of young. The Applicant would work with wildlife agencies to identify and avoid any potential eagle nest sites that could occur near the proposed route. Bald eagles occur in Region 3 as potential nesters and winter migrants. Construction impacts to bald eagles are not expected because of lack of suitable habitat in the ROI.

Although the presence of the American burying beetle has not been documented in the ROI, favorable undisturbed forested and grassland habitats do occur along the corridor in Region 3. A review of presence/absence surveys conducted in Kansas, Oklahoma, and Texas from 2012 to 2014 indicated one positive survey location in Okmulgee County, Oklahoma, approximately 0.48 mile north of the 200-foot-wide representative ROW for the Applicant Proposed Route (USFWS 2015). The American burying beetle is relatively sedentary and often occurs just under soil surface, making it at risk of mortality during construction activities (especially during vegetation clearing) if it is present within the Project's ROI. Depending on the number of mortalities relative to the local population size, these impacts would be short term (mortalities low relative to population size) or long term (mortalities high relative to local population size). Herbicides used for weed control could also pose a mortality risk.

The gray bat is strictly insectivorous and inhabits caves though the year. The range of the gray bat includes Adair, Muskogee, and Sequoyah counties in Region 3 (USFWS 2014d). The gray bat has not been documented by previous studies in the ROI. Areas with known and potential caves for gray bats occur farther north in Adair County, Oklahoma and to the east in Region 4. Potential use of the ROI in Region 3 by the gray bat is likely restricted to spring through fall (USFWS 2014d). Implementation of seasonal restrictions if needed could minimize impacts to this species (see EPM FVW-5).

3.14.1.7.2.6.3.2 Operation and Maintenance

The Sprague's pipit has been observed in Payne County but the species uses grassland habitats and typically occurs near the ground and is very secretive. Empirical data that demonstrates that overhead transmission lines are a hazard to this species are lacking.

Operation and maintenance of the transmission line along the Applicant Proposed Route in Region 3 could impact the interior least tern, whooping crane, golden eagle, and bald eagle from potential collisions. Interior least terns have been documented along the Cimarron River, suggesting that interior least terns may occur within the Applicant Proposed Route from about April through June. However, the least tern is a small agile flier that forages along streams, rivers, and reservoirs and would likely avoid transmission lines and the potential for mortalities from collisions is considered to be low.

Although no known migratory or stopover locations for whooping crane have been documented in the Applicant Proposed Route and ROI, the route crosses the eastern side of whooping crane migratory corridor and cranes would typically pass through the area in March through April and September through October (Figure 3.14-2 in Appendix A). The transmission lines could cause potential mortalities from collisions. Project locations near (e.g., approximately 1 mile) whooping crane feeding and resting sites would have the greatest potential for collisions as the birds would be flying at low elevations.

Golden eagles become less common along the Applicant Proposed Route as the route moves east into less semi-arid vegetation. Golden eagles prefer the more open semi-arid habitats in Regions 1 and 2, but both residents and migrants occur in Region 3. Bald eagles are more common on the eastern end of Region 3 in Muskogee County as the Applicant Proposed Route approaches the Arkansas River. Each species could be at risk for potential collisions with the transmission lines, although the probability of collisions is difficult to predict. The ROI does not contain suitable habitat that would attract either species of eagle, so the risk could be low compared to locations near river crossings or areas where eagles concentrate. The risk of electrocution for any of the large birds (eagles or cranes) would depend on the spacing between transmission wires. Spacing transmission lines wider (approximately 80 inches) than an eagle's wingspan would reduce the risk. The Applicant would develop and implement an APP, consistent with APLIC guidelines that describes a program of specific and comprehensive actions that when implemented, would reduce risk of avian mortality. Additionally, the Applicant would implement EPMs (FVW-1, FVW-2, and GE-2) to reduce risk of avian mortality.

Potential indirect impacts to the American burying beetle during operations and maintenance could occur because of continuing effects from alteration or loss of habitat during construction. The American burying beetle depends on carrion prey. Any habitat loss or change (e.g., creation of edge habitat) that decreases potential carrion prey or increases the number of vertebrate (e.g., crows, raccoons, foxes, opossums, etc.) or invertebrate (ants) scavengers that would compete for carrion would have a long-term impact on local populations.

No impacts are expected to the gray bat during operations and maintenance as additional land disturbances are not expected.

3.14.1.7.2.6.4 Region 4

The Applicant Proposed Route in Region 4 is approximately 126 miles long. Approximately 11 miles, or 9 percent of the route, is parallel to existing infrastructure. As the Applicant Proposed Route moves east into Region 4 (Arkansas River Valley Region), the vegetation changes to more forested types (deciduous hardwoods and evergreen). In addition to the gray bat that also occurred in Region 3, the northern long-eared bat, Ozark big-eared bat, and Indiana bat could potentially occupy the Project's ROI in Region 4. Except for the Ozark big-eared bat, the occurrence and use of the ROI by these species has not been documented by previous studies. The Ozark big-eared bat was found in the ROI in two new cave hibernacula in January 2015 in Crawford County, Arkansas. The specific location of these caves is not publicly available to protect the caves and the hibernating bats. Whether the Ozark big-eared bat also uses these two caves for summer roosting is not yet known. Clean Line conducted a survey of a portion of the ROI (300-foot-wide corridor) within the range of the four species of federally listed bats (Muskogee County, Oklahoma, to Shelby County, Tennessee) to identify suitable bat habitat including potential summer roost trees (northern long-eared bat and Indiana bat) and karst features that could be used as cave roosts (Ozark big-eared bat and gray bat) or hibernacula (all four species). The report is not being made publicly available to protect the locations so the bats can use them. Potential summer bat roost trees were found throughout the ROI in Region 4. Karst features such as rock shelters and rock crevices also were found throughout Region 4 but were less numerous and few show signs of bat activity. Most of the karst features were too small or not deep enough to be used as significant hibernacula or even maternity roosts. The primary use of the ROI by bats in Region 4 is likely for roosting during the spring through fall time frame. Proper implementation of seasonal restrictions could minimize impacts to this species (see EPM FVW-5). Other special status wildlife species that could occur in the ROI for the Applicant Proposed Route include Sprague's pipit, interior least tern, piping plover, American burying beetle, and bald eagle.

The piping plover likely occurs in Region 4 as a migratory species and major rivers such as the Arkansas River could serve as migration pathways and stopover areas. However, the Project is not expected to affect the riverine or lacustrine shoreline and sandbar habitats of the piping plover as the transmission line would span the waterways. Therefore construction of the Applicant Proposed Route is not expected to impact the piping plover in Region 4.

Seven route variations of the Applicant Proposed Route were developed in Region 4 in response to public comments on the Draft EIS. The northern long-eared bat, gray bat, Ozark big-eared bat, Indiana bat, and American burying beetle are the only listed species that would potentially be affected by these variations. The potential impacts from construction or operations and maintenance activities would be similar to the original Applicant Proposed Route, even though Link 3, Variation 3, was developed specifically to avoid two recently discovered cave hibernacula used by the Ozark big-eared bat as discussed in the following sections.

3.14.1.7.2.6.4.1 Construction Impacts

Although the presence of the American burying beetle has not been documented in the areas that would be affected by the Applicant Proposed Route, it is suspected to occur within undisturbed forested and grassland habitats found in Region 4. The American burying beetle is relatively sedentary and spends part of its lifecycle within the top several inches of soil and is susceptible to traffic (vehicular and foot). Therefore, construction of Applicant Proposed Route could cause mortality of American burying beetle in suitable habitat areas that are disturbed for construction of access roads and transmission structures.

Sprague's pipit has been observed in Sequoyah County in Oklahoma and Franklin County in Arkansas. Sprague's pipit is a migrant through the ROI and could be an occasional winter resident. No mortality impacts are expected as the pipit could avoid construction activity. Construction could temporarily displace individuals during the winter, if present, but no impacts to pipit populations are expected. Sprague's pipit primarily uses native prairie and habitat loss and fragmentation of remaining native prairie is of primary concern. Disturbance and clearing of prairie habitat for access roads and placement of transmission structures could affect Sprague's pipit. However, winter ranges for the Sprague's pipit include a broader array of habitats (e.g., stubble and fallow alfalfa, soybean, and wheat fields and pastures with non-native grasses) and alternative migration habitat would be available in the vicinity of the ROI (Robbins and Dale 1999; USFWS 2011a). Because of the low probability of winter residents occurring in Region 4 and other migratory habitat would remain, measurable impacts to Sprague's pipit populations from construction of the HVDC transmission line in Region 4 are not expected.

There are documented occurrences of the least tern along the Arkansas River in Region 4 (Lott et al. 2013). Nesting locations are not well documented near the ROI crossing of the Arkansas River in Sequoyah County, but least terns could forage and migrate through the area. Sand bar habitat is limited in the vicinity of the crossing location just below Webbers Falls dam. No construction impacts to least tern habitat or mortality impacts are expected. Bald eagles are known to nest and winter along the Arkansas River and at Lake Dardanelle in Arkansas, which is located south of the Applicant Proposed Route. Construction activity could affect bald eagle nesting and winter roosting at the Arkansas River crossing depending on locations of nests or roosting sites with respect to construction. The Applicant would work with wildlife agencies to identify any nests or roosting sites and coordinate construction activity to avoid either nesting eagles or winter roosting areas (EPM FVW-5).

Of the four special status bat species, the gray bat and Ozark big-eared bat use caves for winter hibernacula and for roosting during the spring, summer, and fall, although the caves used for hibernating and roosting can be different. The northern long-eared bat and Indiana bat use caves for winter hibernation but use roost trees and snags with loose barks, cavities, or crevices and occasionally man-made structures for roosting sites. Caves occur in the Ozark Plateau region north of the Applicant Proposed Route in Region 4, but are limited in the ROI, although two new caves with hibernating Ozark big-eared bats were found within the ROI in Crawford County, Arkansas. Construction is not expected to impact cave hibernacula for any of the bat species or roosting caves for the gray and Ozark big-eared bats because the caves would be avoided by a minimum of 300 feet (EPM FVW-6) or re-routed completely to avoid a sensitive area. Trees may be removed to construct access roads and clear sites for structures on segments of the route that pass through either deciduous or evergreen forest. Trees also would be cut in the ROW to allow stringing of transmission lines and eliminate vegetation interference with overhead wires. The potential exists for the loss of bat roost trees and foraging areas during construction. Approximately 6,700 acres of forests (i.e., deciduous, evergreen, and mixed) occur within a 1,000-foot-wide corridor along the Applicant Proposed Route in Region 4 (Table 3.17-22), although the typical ROW width would range from 150 to 200 feet. Removal of roost trees could cause habitat loss and possibly mortality of bats. The Applicant would coordinate with the USFWS to minimize potential loss of bat habitat within the ROI (EPM FVW-5).

3.14.1.7.2.6.4.2 Operations and Maintenance

The Sprague's pipit has been observed in Franklin County but the species uses grassland habitats and typically occurs near the ground and is very secretive. There is a lack of empirical data that demonstrates that overhead transmission wires are a mortality hazard to this species. Impacts to Sprague's pipit are not expected from the operations and maintenance of the transmission line.

Operation and maintenance of the transmission line along the Applicant Proposed Route in Region 4 could impact the interior least tern, golden eagle, and bald eagle from potential collisions. Interior least terns have been documented along the Arkansas River, suggesting that interior least terns may occur within the Applicant Proposed Route from about April through June. However, the least tern is a small agile flier that forages along streams, rivers, and reservoirs and would likely avoid transmission lines and the potential for mortalities from collisions is considered to be low.

Bald eagles are common along the Arkansas River in Sequoyah County in Oklahoma and Crawford and Johnson counties in Arkansas. Bald eagles could be at risk for potential collisions with the transmission lines. The majority of the ROI in Region 4 does not contain suitable habitat that would attract eagles to the area, other than near the Arkansas River crossing; furthermore, the Applicant Proposed Route is north of the Arkansas River and Lake Dardanelle in Arkansas, both of which are bald eagle wintering areas. As a result, migrating bald eagles would have to cross the Applicant Proposed Route to reach their wintering areas. The risk of electrocution for eagles is expected to be low as the distance between transmission conductors is greater than the average wingspan of this species.

The Applicant would develop and implement an APP, consistent with APLIC guidelines that describes a program of specific and comprehensive actions that when implemented, would reduce risk of avian mortality. Additionally, the Applicant would implement EPMs (FVW-1, FVW-2, and GE-2) to reduce risk of avian mortality.

No additional impacts are expected to any of the four bat species during operations and maintenance as additional land disturbances are not expected. However, any bat roost trees removed during construction in the ROW underneath the transmission lines would not be allowed to regrow because of potential interference and damage to the electrical lines and would be habitat lost for the length of Project operations.

Potential indirect impacts to the American burying beetle during operations and maintenance could occur from continuing effects from alteration or loss of habitat during construction. The American burying beetle depends on carrion prey. Any habitat loss or change (e.g., creation of edge habitat) that decreases potential carrion prey or increases the number of vertebrate (e.g., crows, raccoons, foxes, opossums, etc.) or invertebrate (ants) scavengers that would compete for carrion would have a long-term impact on local populations.

3.14.1.7.2.6.5 Region 5

The Applicant Proposed Route in Region 5 is approximately 113 miles long. Approximately 15 miles, or 13 percent of the route, is parallel to existing infrastructure. Special status wildlife species that could potentially occur in the ROI along the Applicant Proposed Route include the gray bat, northern long-eared bat, Ozark big-eared bat, and Indiana bat, interior least tern, piping plover, and bald eagle.

The piping plover likely occurs in Region 5 as a migratory species and major rivers such as the Arkansas River could serve as migration pathways and stopover areas. The Arkansas River occurs south of the Applicant Proposed Route (≥ 12 + miles at the closest location). Therefore the Applicant Proposed Route is not expected to affect riverine or lacustrine shorelines and sandbars which are suitable habitat for the piping plover; and the Applicant Proposed Route is not expected to impact the piping plover in Region 5.

Documented occurrence of the least tern has been made along the Arkansas River in Region 5 of the Project. The Arkansas River occurs south of the Applicant Proposed Route (≥ 12 + miles at the closest location) and the Project is not expected to affect bare or sparsely vegetated sandy or dried mud substrates along rivers or reservoirs preferred by least terns. Therefore, the Project is not expected to impact the interior least tern in Region 5.

Five route variations of the Applicant Proposed Route were developed in Region 5 in response to public comments on the Draft EIS. The northern long-eared bat, gray bat, Ozark big-eared bat, and Indiana bat are the only special status species that would potentially be affected by these variations. The potential impacts to these species from construction or operations and maintenance activities would be similar to the original Applicant Proposed Route as discussed in the following sections.

3.14.1.7.2.6.5.1 Construction Impacts

No suitable nesting or winter roost habitat exist within the ROI and impacts to bald eagles during construction are not expected.

Of the four special status bat species, the gray bat and Ozark big-eared bat use caves for winter hibernacula and roosting during the spring, summer, and fall although the caves used for hibernating and roosting are different. The northern long-eared bat and Indiana bat use caves for winter hibernation but use roost trees or snags with loose barks, cavities, or crevices and occasionally man-made structures for roosting sites. Known caves used as winter hibernacula (all species) and summer roosts (gray bat and Ozark big-eared bat) occur in the Ozark Plateau region north of the Applicant Proposed Route in Region 5 but not in the ROI. Surveys have documented potential bat roost trees in the ROI that could be used by Indiana bat and northern long-eared bat. Several karst features also were found in the ROI in Region 5, but they showed no sign of bat use and are too small or not deep enough to serve as cave hibernacula. Construction is not expected to impact cave hibernacula for any of the bat species or roosting caves for the gray and Ozark big-eared bats. The Applicant would implement EPM FVW-6 to ensure that caves are protected from potential disturbance impacts. Trees may be removed to construct access roads and clear sites for structures on segments of the route that pass through deciduous, evergreen, or mixed forest. Trees also could be cut in the ROW to allow stringing of transmission lines and eliminate vegetation interference with overhead wires. The potential exists for the loss of roost trees for the Indiana bat and northern long-eared bat and foraging areas during construction. Removal of roost trees could cause habitat loss and possibly mortality of bats. Approximately 7,500 acres of forests occur within a 1,000-foot-wide corridor in Region 5 (Table 3.10-9), although the typical ROW width would range from 150 to 200 feet. The Applicant would coordinate with USFWS to minimize potential loss of bat habitat within the ROI. Implementation of seasonal restrictions could minimize potential impacts to these species (see EPM FVW-5).

3.14.1.7.2.6.5.2 Operations and Maintenance

Bald eagles could be at risk for potential collisions with the transmission lines. However, the risk for collision mortality is likely low because the ROI in Region 5 does not contain suitable habitat that would attract eagles and the nearest points of water bodies frequented by bald eagles are approximately 6 to 10 miles from the Applicant Proposed Route. Migrating bald eagles could cross the Applicant Proposed Route to reach wintering areas along the Arkansas River and Lake Dardanelle; therefore, some potential risk of collision related mortalities would exist.

The Applicant would develop and implement an APP, consistent with APLIC guidelines that describes a program of specific and comprehensive actions that when implemented, would reduce risk of avian mortality. Additionally, the Applicant would implement EPMs (FVW-1, FVW-2, and GE-2) to reduce risk of avian mortality.

No additional impacts are expected to any of the four bat species during operations and maintenance as additional land disturbances are not expected. However, any bat roost trees removed during construction in the ROW underneath the transmission lines would not be allowed to regrow because of potential interference and damage to the electrical conductors and would be habitat lost for the length of Project operations.

3.14.1.7.2.6.6 Region 6

The Applicant Proposed Route in Region 6 is approximately 54 miles long. Approximately 11 miles, or 20 percent of the route, is parallel to existing infrastructure. Special status wildlife species that could occur in the ROI along the Applicant Proposed Route in Region 6 include the northern long-eared bat, gray bat, Indiana bat, piping plover, interior least tern, and bald eagle.

The vegetation along the Applicant Proposed Route in Region 6 is dominated by croplands (78 percent) with about 8 percent in forests. Because of the large amount of cultivated land, there is very little habitat available in the Region 6 ROI for special status wildlife species. The piping plover prefers riverine or lacustrine shorelines and sandbars. The interior least tern prefers bare or sparsely vegetated sandy or dried mud substrates along rivers or reservoirs. While both species may occasionally occur in the area, the ROI does not contain suitable habitat for either species and no impacts are expected from construction and operations and maintenance of the Project. Bald eagles have been observed in Poinsett and Cross counties in Region 6. However, suitable nesting and winter habitat for bald eagles is absent or very limited in the ROI and impacts are not expected, although the presence of the transmission lines would remain a potential hazard to migrating bald eagles.

The relatively flat topography and lack of large forested areas within the ROI limits the available habitat for the three species of special status bats that occur in Region 6. Surveys of the ROI indicated few bat roost trees. Because the gray bat uses caves for both summer roosts and for hibernation, the distribution of the gray bat is limited to the western portion of Jackson County, Arkansas, located in Region 6. Cave hibernacula or cave roosting sites do not occur in ROI and impacts to the gray bat are not expected in Region 6.

One route variation of the Applicant Proposed Route was developed in Region 6 in response to public comments on the Draft EIS. The route variation crosses cultivated cropland and none of the special status species would be affected by this variation from the original Applicant Proposed Route. Some of the avian special status species may occur as occasional migrants through the area, but potential impacts from construction or operations and maintenance activities would be similar to those of the original Applicant Proposed Route as discussed in the following sections.

3.14.1.7.2.6.6.1 Construction Impacts

Impacts to the Indiana bat and the northern long-eared bat from construction of Applicant Proposed Route in Region 6 are not expected because of the absence of cave hibernacula and lack of forested habitat that could be used for summer roosting in this area. A forested ridge (i.e., Crowley's Ridge) that bisects Poinsett and Cross counties from north to south could provide potential roosting habitat, but this ridge is separated from other forested areas and cave hibernacula by expanses of croplands on both the west and east sides, potentially limiting its value as bat habitat.

3.14.1.7.2.6.6.2 Operations and Maintenance

Operations and maintenance of the Project is not expected to impact any of the three special status bat species that could occur in Region 6. The lack of quality habitat limits the potential for any of the three species to occur in the ROI. No additional habitat loss is expected during the operations and maintenance phase of the Project which would limit the possibility of impacts.

3.14.1.7.2.6.7 Region 7

The Applicant Proposed Route in Region 7 is approximately 43 miles long. Approximately 7 miles, or 17 percent of the route, is parallel to existing infrastructure. Special status wildlife species that could occur in the ROI along the Applicant Proposed Route in Region 7 include the northern long-eared bat, Indiana bat, piping plover, interior least tern, and bald eagle.

The vegetation along the Applicant Proposed Route in Region 7 is dominated by croplands (70 percent) with about 8 percent in deciduous forests and 7 percent in woody wetlands (Table 3.17-48). Because of the large amount of cultivated land, there is very little habitat available in the Region 7 ROI for special status wildlife species except for forested areas near the Mississippi River crossing and on the river bluffs on the east side of the river and riverine habitats (e.g., mudflats and sandbars) along the Mississippi River. Three route variations of the Applicant Proposed Route were developed in Region 7 in response to public comments on the Draft EIS. None of the special status species would likely be affected by Link 1, Variation 1, in Mississippi County, Arkansas, because the route crosses cultivated cropland. The northern long-eared bat could potentially occur in Link 1, Variation 2, but it is unlikely because the route is predominately cropland. The northern long-eared bat and Indiana bat are the only special status species that would potentially be affected by Link 5, Variation 1, in Tipton and Shelby counties in Tennessee. The potential impacts to these species from construction or operations and maintenance activities would be similar to the original Applicant Proposed Route as discussed in the following sections.

3.14.1.7.2.6.7.1 Construction Impacts

Construction of the Applicant Proposed Route could have some impact on Indiana and northern long-eared bat roosting habitat near the Mississippi River crossing from Mississippi County in Arkansas to Tipton County in Tennessee. Bats of both species could potentially use trees on either side of the river for roost sites. If trees are removed to allow stringing of lines and reduce interference with the transmission lines, potential bat habitat could be lost. No caves that could be used for hibernacula are known to occur in the ROI along the route in Region 7.

The interior least tern occurs along the Mississippi River using bare or sparsely vegetated sandy or dried mud substrates (Jones 2012; Lott et al. 2013). Potential construction impacts would be limited to where Applicant Proposed Route crosses the Mississippi River. Although construction is not expected to physically disturb potential least tern habitat, construction activity could temporarily disturb least terns in the vicinity and cause nesting terns (June and July) to abandon their nests. Nesting locations are known to occur along the Mississippi River in Shelby and Tipton County, Tennessee.

The piping plover prefers open, sparsely vegetated sand and gravel beaches or islands with similar characteristics. It is possible that piping plovers could occur where the transmission line would cross the Mississippi River. Potential impacts during construction could be temporary disturbance (i.e., displacement). Measures taken to reduce potential impacts to interior least terns would likely help minimize any potential disturbances to piping plovers.

Construction activity could potentially impact both nesting and wintering bald eagles in the vicinity of the Mississippi River crossing. Although construction activity would be a temporary disturbance, nesting eagles, if present, could abandon their nests and wintering eagles could be displaced from roosting sites. The Applicant would coordinate with USFWS to identify any potential nest sites and roosting areas that would need to be avoided (EPMs FVW-4 and FVW-5).

3.14.1.7.2.6.7.2 Operations and Maintenance

No additional habitat disturbance is expected during operations and maintenance, so impacts to either the Indiana bat or northern long-eared bat during this phase are not expected. Any roost trees in the ROW underneath the transmission lines removed during construction would not be allowed to regrow because of interference with the lines and would remain as lost habitat during the life of the Project.

Mortalities from transmission line collisions and electrocution are potential impacts to the avian special status wildlife species. Of most concern is the area surrounding the Mississippi River crossing where habitat exists for the interior least tern, piping plover, and bald eagle. Most of the remaining area of the Applicant Proposed Route in Region 7 is croplands that lack suitable conditions for these species. The least tern and piping plover, species that both forage and/or nest along the Mississippi River, are both small and agile fliers that could likely avoid transmission lines (Dinan et al. 2012). The potential for mortalities from transmission line collisions for both species is considered to be low. The bald eagle is a much larger and less maneuverable species that frequently flies for foraging and movement between feeding and roosting locations and is more susceptible to potential collisions. Marking of the transmission lines near the Mississippi River to make the lines more visible could reduce the potential risk to all avian species. Risks of electrocution hazards to eagles would depend on the electrical line spacing and would decrease if the spacing is greater than the eagle's wingspan preventing contact between two or more electrical conductors. The Applicant would implement EPM GE-2 to minimize risk of avian mortality.

The Applicant would develop and implement an APP, consistent with APLIC guidelines that describes a program of specific and comprehensive actions that when implemented, would reduce risk of avian mortality. Additionally, the Applicant would implement EPMs (FVW-1, FVW-2, and GE-2) as described in Section 3.14.1.7 to reduce risk of avian mortality.

3.14.1.7.3 Impacts Associated with the DOE Alternatives

This section identifies the potential direct and indirect impacts on special status wildlife species related to the DOE alternatives.

3.14.1.7.3.1 Arkansas Converter Station Alternative and AC Interconnection Siting Areas

A detailed description of the Arkansas converter station and other terminal facilities is provided in Section 2.4.3.1. The Arkansas Converter Station Alternative and AC Interconnection Siting Areas are located near the western end of Region 5 in Pope County. The special status wildlife species that could occur in the Project ROI include the gray bat, northern long-eared bat, Ozark big-eared bat, and Indiana bat, interior least tern, piping plover, and bald eagle. Evergreen forest (22 percent), deciduous forest (33 percent), and pasture/hay (27 percent) comprise most of the vegetation in the 360-acre converter station siting area. Hay or pasture land (72 percent) and evergreen forest (11 percent) compose most of the 662-acre Arkansas Converter Station AC Interconnection Siting Area. A substation (25- to 35-acre site) would interconnect the AC transmission line to an existing 500kV transmission line. This substation would be located near an existing transmission line in an area that is primarily grassland with some forest land. Given the absence of suitable habitat for the interior least tern and piping plover within the siting area, impacts to either species are not expected. No impacts to any of the four threatened or endangered bat species or the bald eagle are expected from the AC interconnection line or the substation owing to lack of suitable habitat for these species.

3.14.1.7.3.1.1 Construction Impacts

Sections 3.10 and 3.17 list the types of habitats that would be affected and the acres that would be impacted by the Project. As discussed in Section 3.10, the Arkansas converter station (20–35 acres) would be located within a 360-acre siting area. The AC interconnection line would be approximately 5 miles long and located within an approximate 662-acre area. The substation to connect the AC interconnection line to an existing 500 KV line would disturb 25–35 acres with an additional 5 acres disturbed during construction for materials. Cave hibernacula for the four bat species and summer roosting caves for the gray bat and Ozark big-eared bat occur farther north in the karst region of the Ozark Plateau and not within the siting areas. The converter station siting area contains about 55 percent forested habitat (197 acres) that could potentially be used by the Indiana bat and northern long-eared bat for summer roosting and foraging. The occurrence and use of forested habitat by the northern long-eared bat and Indiana bat, and possibly by the Ozark big-eared bat and gray bat as foraging, within the Project ROI is likely restricted to the spring through fall. The substation location is mostly grassland with some forested areas. To the extent that construction of the converter station, associated AC interconnection transmission line, and substation avoids forested areas, impacts to bat habitat (i.e., removal of roost trees or temporary disturbance of roost sites) would be minimized or avoided. Appropriate EPMs would be implemented (FVW-5, GE-6, GE-13, GE-20, and GE-22) to minimize potential impacts.

No bald eagle nesting or winter roost sites are known to exist within the siting area but any potential sites would be identified prior to construction and appropriate mitigation measures would be implemented to avoid potential impact to nests or winter roosts.

3.14.1.7.3.1.2 Operations and Maintenance Impacts

Once constructed, no additional land disturbance is expected to occur near the converter station or along the AC interconnection lines. No impacts to any of the special status bat species are expected from operations and maintenance of the facility. The vegetation in the ROW underneath the AC transmission lines would be maintained in a low stature to prevent interference with electrical conductors. However, most of the Arkansas Converter Station AC Interconnection Siting Area and the substation site is existing grassland and removal of trees would be minimal. Any trees removed during construction would not be allowed to regrow, including any trees that had been used as bat roost trees.

The transmission lines of the AC Interconnection could pose a risk to wintering bald eagles in the region. There is no suitable habitat within the siting area that would attract eagles to the area from surrounding wintering areas and the potential risk of collisions with the transmission lines is considered low.

3.14.1.7.3.1.3 Decommissioning Impacts

Decommissioning of the Project would involve methods similar to those that would be required to construct the Project. As a result, the impacts of decommissioning would be similar to those previously described for construction. The Applicant would follow the same general and resource-specific EPMs during decommissioning that would be implemented during construction. In addition, the Applicant would develop a Decommissioning Plan prior to any decommissioning actions for reviewed and approval by the appropriate state and federal agencies.

3.14.1.7.3.2 HVDC Alternative Routes

Descriptions of the HVDC alternative routes are provided in Section 2.4.3.2. The impacts that could occur to special status wildlife species from construction and operations and maintenance of the Applicant Proposed Route are discussed in Section 3.14.1.7.2. The expected types of impacts from construction and operations and maintenance of the HVDC alternative routes in each region would be similar to those for the Applicant Proposed Route. However, because of differences in routing (i.e., location) the potential for impacts may be slightly different (e.g., the route may be closer to or farther from an important habitat). The discussion in this section will focus on the differential impacts that could occur under each of the HVDC alternative routes compared to the Applicant Proposed Route. This discussion is broken out by construction and operational-related impacts.

3.14.1.7.3.2.1 Construction Impacts

Table 3.14.1-6 lists the approximate length of the HVDC alternative routes by region, the predominant habitat type that would be impacted (see Section 3.10 for more details regarding the acres of impact that would occur), and any significant differences in impacts by alternative compared to the Applicant Proposed Route. The difference in potential impacts to terrestrial special status wildlife species between the HVDC alternative routes and the Applicant Proposed Route each region is also discussed in Table 3.14.1-6.

HVDC Alternative Routes 1-A, 2-A, 3-C, 4-B, and 4-D could have potential for increased impacts to special status wildlife species compared to the Applicant Proposed Route (Table 3.14.1-6). HVDC Alternative Route 1-A has the potential to impact (habitat loss and fragmentation of existing habitat) more LEPC habitat mapped focal areas (CHAT-1) or connectivity zone habitat (CHAT-2) than Links 2, 3, 4, and 5 of the Applicant Proposed Route. It also has the potential to impact lands with multiple leks. HVDC Alternative Route 1-B also has the potential to impact (i.e., habitat disturbance or avoidance of habitat by LEPC) LEPC and their habitat but likely less so than HVDC Alternative Route 1-A.

HVDC Alternative Route 2-A is parallel to the Cimarron River for a portion of the route. This portion of the Cimarron River is known to be used by the interior least tern and the potential for construction impacts (disturbances) would be greater compared to Link 2 of the Applicant Proposed Route. HVDC Alternative Route 2-A also would run adjacent to ODWC's Major County WMA, which has the potential to attract migratory birds. HVDC Alternative Route 3-C has slightly more forested land and therefore could potentially impact the American burying beetle more than Links 3, 4, 5, and 6 of Applicant Proposed Route in Region 3 during construction.

HVDC Alternative Route 4-B runs north of Links 2 through 8 of the Applicant Proposed Route in Region 4. This area includes more forested lands and is closer to the Ozark Plateau region, which contains cave hibernacula for special status bat species. Because there are more undisturbed forested areas, there is a potential for greater mortality impacts to the American burying beetle during construction. The increase in forested land in closer proximity to areas of caves known to be or potentially used by bats increases the potential impacts (e.g., disturbances to or loss of roost trees) to the special status bat species along this route compared to the Applicant Proposed Route. Similarly, HVDC Alternative Route 4-D also contains more undisturbed forested land than corresponding Link 4 of the Applicant Proposed Route in Region 4. Therefore, construction impacts could also be greater to the American burying beetle and the special status bat species than along the corresponding Link 4.

3.14.1.7.3.2.2 Operations and Maintenance Impacts

It is expected that most of the HVDC alternative routes would have impacts during operations and maintenance similar to those of the Applicant Proposed Route because the habitat and species composition is similar. The presence of transmission lines in the alternative routes would have similar potential for collision mortalities for the same species as the Applicant Proposed Route. The potential impacts of HVDC Alternative Routes 1-A, 2-A, 3-C, 4-B, and 4-D could have potential for increased impacts to special status wildlife species compared to the Applicant Proposed Route for the reasons discussed in Table 3.14.1-6. HVDC Alternative Route 1-A has the potential to impact (behavioral avoidance and fragmentation of existing habitat) more LEPC habitat mapped as focal area (CHAT-1) or connectivity zone habitat (CHAT-2) than Links 2, 3, 4, and 5 of the Applicant Proposed Route. HVDC Alternative Route 1-B also has the potential to impact LEPC habitat but likely less so than HVDC Alternative Route 1-A.

HVDC Alternative Route 2-A is closer to and parallels the Cimarron River for a portion of the route compared to Link 2 of the Applicant Proposed Route. The potential for collision mortalities from the transmission lines could be potentially greater with the closer proximity to known interior least tern habitat along the river. However, terns are agile fliers and the probability of mortality is considered low.

HVDC Alternative Route 3-C has slightly more undisturbed forested land and therefore could potentially impact the American burying beetle more than Links 3, 4, 5, and 6 of the Applicant Proposed Route in Region 3; therefore, impacts to the American burying beetle from operations and maintenance likely would not be greater than those along the Applicant Proposed Route.

HVDC Alternative Route 4-B runs north of Links 2 through 8 of the Applicant Proposed Route in Region 4. This area includes more forested lands and is closer to the Ozark Plateau region that contains cave hibernacula for special status bat species; therefore, impacts to the American burying beetle from operations and maintenance likely would not be greater than those along the Applicant Proposed Route. The increase in forested land in closer proximity to areas of caves known to be or potentially used by bats increases the potential impacts (e.g., disturbances to or loss of roost trees) to the special status bat species along this route compared to the Applicant Proposed Route. Similarly, HVDC Alternative Route 4-D also contains more forested lands than the corresponding Link 4 of the Applicant Proposed Route in Region 4. Any bat roost trees or foraging habitat lost from clearing the ROW underneath the transmissions lines during construction would remain a long-term impact during operations and maintenance as the ROW would be maintained with low stature plants to avoid interference with electrical conductors.

Table 3.14.1-6:
Special Status Wildlife Species Summary Information Regarding the HVDC Alternative Routes

Region	HVDC Alternative Route	Total Length of Route (miles)	Predominant Land Cover	Impacts to Wildlife that would Differ Compared to the Applicant Proposed Route
1	1-A	123	Grassland/herbaceous (approximately 2,265.4 acres or 75.4 percent)	This alternative compares to the Applicant Proposed Route Links 2, 3, 4, and 5. HVDC Alternative Route 1-A has intersects some CHAT 1 and 2 LEPC habitat, focal areas, and connectivity zones (Van Pelt et al. 2013) that the APR does not, indicating that construction of HVDC alternative transmission lines may have more impacts from habitat loss and modification, sensory disturbance and mortality and/or injuries than the APR.
	1-B	52	Grassland/herbaceous (approximately 886.6 acres or 69.9 percent)	This alternative compares to the Applicant Proposed Route Links 2 and 3. No significant impact differences are anticipated between the Applicant Proposed Route and this alternative.
	1-C	52	Grassland/herbaceous (approximately 892.3 acres or 70.1 percent)	This alternative compares to the Applicant Proposed Route Links 2 and 3. No significant impact differences are anticipated between the Applicant Proposed Route and this alternative.
	1-D	33.5	Grassland/herbaceous (approximately 568.9 acres or 69.4 percent)	This alternative compares to the Applicant Proposed Route Links 3 and 4. No significant impact differences are anticipated between the Applicant Proposed Route and this alternative.
2	2-A	57	Grassland/herbaceous (approximately 833.5 acres or 59.7 percent)	This alternative compares to the Applicant Proposed Route Link 2. HVDC Alternative 2-A has the potential to have greater construction impacts to interior least terns compared to the Applicant Proposed Route or Alternative Route 2-B, based on proximity of this route to known nesting occurrences along the Cimarron River (as this route is located closer to the river than Alternative Route 2-B or the Applicant Proposed Route). This alternative also runs adjacent to the ODWC's Major County WMA, which has the potential to attract migratory birds.
	2-B	30	Croplands (approximately 440.3 acres or 60.5 percent) and grassland/herbaceous (approximately 240 acres or 33 percent)	This alternative compares to the Applicant Proposed Route Link 3. No significant impact differences are anticipated between the Applicant Proposed Route and this alternative.
3	3-A	38	Grassland/herbaceous (approximately 497.3 acres or 54.1 percent) and deciduous forest (187.7 acres or 20.4 percent)	This alternative compares to the Applicant Proposed Route Link 1. No significant impact differences are anticipated between the Applicant Proposed Route and this alternative.

Table 3.14.1-6:
Special Status Wildlife Species Summary Information Regarding the HVDC Alternative Routes

Region	HVDC Alternative Route	Total Length of Route (miles)	Predominant Land Cover	Impacts to Wildlife that would Differ Compared to the Applicant Proposed Route
	3-B	48	Grassland/herbaceous (approximately 645.2 acres or 55.3 percent) and deciduous forest (219 acres or 18.8 percent)	This alternative compares to the Applicant Proposed Route Links 1, 2, and 3. No significant impact differences are anticipated between the Applicant Proposed Route and this alternative.
	3-C	122	Grassland/herbaceous (approximately 1,061.2 acres or 358 percent), deciduous forest (869.2 acres or 29.3 percent), and pasture/hay (773.4 acres or 26.1 percent)	This alternative compares to the Applicant Proposed Route Links 3, 4, 5, and 6. Impacts to the American burying beetle may be higher compared to the Applicant Proposed Route due to slightly more forested areas that would be impacted, but less for the gray bat because less foraging areas near water would be impacted.
	3-D	39	Primarily pasture/hay (approximately 491.8 acres or 51.3 percent), grassland/herbaceous (188.9 acres or 19.7 percent), and deciduous forest (184.3 acres or 19.2 percent	This alternative compares to the Applicant Proposed Route Links 5 and 6. No significant impact differences are anticipated between the Applicant Proposed Route and this alternative.
	3-E	8.5	Pasture/hay (approximately 98.3 acres or 47.3 percent) and deciduous forest (74.1 acres or 35.7 percent)	This alternative compares to the Applicant Proposed Route Link 6. No significant impact differences are anticipated between the Applicant Proposed Route and this alternative.
4	4-A	58	Deciduous forest (approximately 624 acres or 43.8 percent) and pasture/hay (497.4 acres 34.9 percent)	This alternative compares to the Applicant Proposed Route Links 3, 4, 5, and 6. No significant impact differences are anticipated between the Applicant Proposed Route and this alternative.
	4-B	79	Deciduous forest (approximately 873.2 acres or 45.5 percent) and pasture/hay (459.6 acres or 23.9 percent)	This alternative compares to the Applicant Proposed Route Links 2–8. Approximately 102 acres of the federally owned land in the Ozark National Forest and an additional 157 acres of private land within the Ozark National Forest boundary (use unknown) are within the ROW for HVDC Alternative Route 4-B. HVDC Alternative Route 4-B would cross into the Ozark National Forest IBA, potentially indirectly impacting wildlife species during construction, as a result of mortality and/or injury, sensory disturbance, and habitat loss or modification. Furthermore, this route alternative would impact more forested areas compared to the Applicant Proposed Route, thereby increasing the risk of impacts to the American burying beetle. This alternative route also is closer to potential cave hibernacula in the Ozark Plateau and may have a higher potential for bat roosting and foraging in the forested areas.

Table 3.14.1-6:
Special Status Wildlife Species Summary Information Regarding the HVDC Alternative Routes

Region	HVDC Alternative Route	Total Length of Route (miles)	Predominant Land Cover	Impacts to Wildlife that would Differ Compared to the Applicant Proposed Route
	4-C	3	Deciduous forest (approximately 32.4 acres or 39.2 percent) and pasture/hay (19 acres or 23 percent)	This alternative compares to the Applicant Proposed Route Link 5. No significant impact differences are anticipated between the Applicant Proposed Route and this alternative.
	4-D	25	Pasture/hay (approximately 299.9 acres or 48.6 percent) and deciduous forest (179.6 acres or 29.1 percent)	This alternative compares to the Applicant Proposed Route Link 4. This route alternative would impact more forested areas compared to the Applicant Proposed Route, thereby increasing the risk of impacts to the American burying beetle. Because of additional forested habitat, there is potential for more impact to bat roosting and foraging habitat.
	4-E	37	Pasture/hay (approximately 395.5 acres or 44.1 percent) and evergreen forest (218.7 acres or 24.4 percent)	This alternative compares to the Applicant Proposed Route Links 8 and 9. No significant impact differences are anticipated between the Applicant Proposed Route and this alternative.
5	5-A	13	Evergreen forest (130.4 acres or 42.3 percent) and deciduous forest (78.8 acres or 25.5 percent)	This alternative compares to the Applicant Proposed Route Link 1. No significant impact differences are anticipated between the Applicant Proposed Route and this alternative.
	5-B	71	Pasture/hay (approximately 740.3 acres or 42.7 percent) and deciduous forest (479.5 acres or 27.7 percent)	This alternative compares to the Applicant Proposed Route Links 3, 4, 5, and 6. No significant impact differences are anticipated between the Applicant Proposed Route and this alternative.
	5-C	9	Deciduous forest (approximately 99.9 acres or 44.5 percent) and pasture/hay (70.9 acres or 31.6 percent)	This alternative compares to the Applicant Proposed Route Links 6 and 7. No significant impact differences are anticipated between the Applicant Proposed Route and this alternative.
	5-D	22	Deciduous forest (approximately 246.5 acres or 46.5 percent) and croplands (92 acres or 17.4 percent)	This alternative compares to the Applicant Proposed Route Link 9. No significant impact differences are anticipated between the Applicant Proposed Route and this alternative.
	5-E	36	Pasture/hay (approximately 383.5 acres or 43.3 percent) and deciduous forest (249.3 acres or 28.2 percent)	This alternative compares to the Applicant Proposed Route Links 4, 5, and 6. No significant impact differences are anticipated between the Applicant Proposed Route and this alternative.
	5-F	22	Pasture/hay (approximately 209.9 acres or 38.6 percent) and deciduous forest (153.2 acres or 28.1 percent)	This alternative compares to the Applicant Proposed Route Links 5 and 6. No significant impact differences are anticipated between the Applicant Proposed Route and this alternative.

Table 3.14.1-6:
Special Status Wildlife Species Summary Information Regarding the HVDC Alternative Routes

Region	HVDC Alternative Route	Total Length of Route (miles)	Predominant Land Cover	Impacts to Wildlife that would Differ Compared to the Applicant Proposed Route
6	6-A	16	Croplands (approximately 328.6 acres or 83 percent)	This alternative compares to the Applicant Proposed Route Links 2, 3, and 4. No significant impact differences are anticipated between the Applicant Proposed Route and this alternative.
	6-B	14	Croplands (approximately 272.1 acres or 79.2 percent) and woody wetlands (44.6 acres or 13 percent)	This alternative compares to the Applicant Proposed Route Link 3. No significant impact differences are anticipated between the Applicant Proposed Route and this alternative.
	6-C	23	Croplands (approximately 410.6 acres or 72.6 percent)	This alternative compares to the Applicant Proposed Route Links 6 and 7. No significant impact differences are anticipated between the Applicant Proposed Route and this alternative.
	6-D	9	Croplands (approximately 205.3 acres or 91.8 percent)	This alternative compares to the Applicant Proposed Route Link 7. No significant impact differences are anticipated between the Applicant Proposed Route and this alternative.
7	7-A	43	Croplands (approximately 827.8 acres or 78.7 percent) and woody wetlands (110.5 acres or 10.5 percent)	This alternative compares to the Applicant Proposed Route Link 1. No significant impact differences are anticipated between the Applicant Proposed Route and this alternative.
	7-B	9	Croplands (approximately 86.4 acres or 41.2 percent), deciduous forest (42.7 acres or 20.3 percent), pasture/hay (34 acres or 16.2 percent),and shrub/scrub (32.7 acres or 15.6 percent)	This alternative compares to the Applicant Proposed Route Links 3 and 4. No significant impact differences are anticipated between the Applicant Proposed Route and this alternative.
	7-C	24	Croplands (approximately 350.6 acres or 60.6 percent), pasture/hay (72.2 acres or 12.5 percent), and deciduous forest (58.4 acres or 10.1 percent)	This alternative compares to the Applicant Proposed Route Links 3, 4, and 5. No significant impact differences are anticipated between the Applicant Proposed Route and this alternative.
	7-D	7	Croplands (approximately 76.8 acres or 48.1 percent), pasture/hay (32.2 acres or 20.2 percent), and shrub/scrub (20.6 acres or 12.9 percent)	This alternative compares to the Applicant Proposed Route Links and 5. No significant impact differences are anticipated between the Applicant Proposed Route and this alternative.

GIS Data Source: Jin et al. 2013.

3.14.1.7.3.2.3 Decommissioning Impacts

Potential impacts during decommissioning of the HVDC alternative routes would be similar to those of the construction phase. Once the decommissioning is complete, all land could return to the pre-construction land uses according to the Restoration Plan as described in Section 3.14.1.7. The Applicant would follow the same general and resource-specific EPMs during decommissioning that would be implemented during construction. In addition, the Applicant would develop a Decommissioning Plan prior to any decommissioning actions for reviewed and approval by the appropriate state and federal agencies.

3.14.1.7.4 Best Management Practices

The Applicant has developed a comprehensive list of EPMs intended to avoid or minimize impacts to wildlife resources. A complete list of EPMs for the Project is provided in Appendix F; those EPMs that would specifically minimize the potential for impacts to special status wildlife species are summarized in Section 3.14.1.7.1. DOE and the Applicant have prepared a Biological Assessment (Appendix O of the EIS) of potential impacts on special status species protected under the ESA as part of the Section 7 consultation between DOE and the USFWS. The Section 7 consultation review is a parallel but separate process conducted pursuant to the requirements of ESA and the applicable implementing regulations. A Biological Opinion will be issued by USFWS prior to the Record of Decision. Through this process, protective measures may be identified and adopted to avoid and/or minimize impacts to special status species.

3.14.1.7.5 Unavoidable Adverse Impacts

The Applicant would implement EPMs to avoid or minimize impacts. However, some adverse impacts may remain even with the implementation of these measures. Construction and operations and maintenance of the Project could result in the mortality of some special status wildlife species if they are present in the affected areas during construction or operations and maintenance, including, but not limited to, potential mortalities associated with the clearing of vegetation as well as avian collisions with Project structures during operations and maintenance. Potential mortalities would be highest if vegetation clearing was conducted during the breeding season. Construction-related disturbances could result in temporary loss of some wildlife habitats through noise and visual disturbances. Potential loss of special status wildlife habitat during operation and maintenance could result from the effects of fragmentation, edge effects, and invasive plant species. ROW maintenance in forested habitats as well as the footprint of Project structures would result in a permanent loss of mature forest habitat.

3.14.1.7.6 Irreversible and Irretrievable Commitment of Resources

The potential permanent loss or alteration of established trees in mature forests in the eastern portion of the Project (in Regions 3, 4, 5, and 7) would last throughout the life of the Project; however, gradual recovery of habitat may occur once the Project is decommissioned. Because the exact state of this recovery is not known (e.g., substantial changes related to climate, land-use, and/or weeds or pathogens may occur during the 80 year lifespan of the Project) and mature forests are subject to long-term climatic regimes, it is reasonable to assume that some portions of the habitat for special status wildlife species in these forests would be irreversibly and irretrievably impacted.

3.14.1.7.7 Relationship between Local Short-term Uses and Long-term Productivity

Both the Applicant Proposed Route and the DOE Alternatives may result in a short-term disturbance to special status wildlife; however, these impacts should not affect the long-term productivity of populations of special status wildlife.

3.14.1.7.8 Impacts from Connected Actions

3.14.1.7.8.1 Wind Energy Generation

Potential special status wildlife species that could occur within the six-county region in Texas and Oklahoma which contain the WDZs include LEPC, whooping crane, interior least tern, piping plover, Sprague's pipit, red knot, golden eagle, and bald eagle. Specific wind farm development locations are unknown in the 6-county area; therefore, impacts to specific special status species and their habitat could vary greatly depending on where wind farms are developed. Impacts could be reduced by locating wind farms on previously disturbed lands (e.g., croplands) that have little value has habitat for special status species.

Wind energy developers are expected to develop and construct wind energy projects based on guidance outlined by the USFWS Land-Based Wind Energy Guidance (USFWS 2012c) and the APLIC guidelines (APLIC 2012). These guidelines may include the development of conservation strategies and specific actions that, when implemented, could reduce the risk of impacts to special status wildlife species and their habitats. The estimated acreage of land that could be disturbed during construction and would remained disturbed during operation (e.g., permanent access roads, footprint of wind turbines and electrical stations) of the wind farms are listed in Table 3.14.1-7. These estimates assume a 30 percent build-out of the WDZs that would supply the electrical transmission capacity of the Applicant Proposed Project with an estimated 2 percent disturbance of land area during construction and a 1 percent land disturbance remaining during operation of the wind farms.

Table 3.14.1-7:
Description of the WDZ and the Potential Special Status Wildlife Species That May Occur In Area

WDZ Name	Potentially Suitable Area for Wind Development (acres)	Estimated Acres of Impact during Construction[1]	Estimated Acres of Impact during Operation[1]	Special Status Species Potentially Present in the WDZ
WDZ-A	101,000	606 acres of primarily croplands and grasslands	303 acres	Potentially suitable habitat for piping plover is limited; however, there is a potential for piping plover to occur during migration (which generally occurs from April to June). LEPC and whooping crane may feed within the croplands and grasslands that are common in WDZ-A; however, the whooping crane occurrence within the WDZ-A is likely to be limited to occasional migratory stopover occurrences.
WDZ-B	108,000	648 acres of primarily croplands and grasslands	324 acres	Potentially suitable habitat for piping plover is limited; however, there is a potential for piping plover to occur during migration (which generally occurs from April to June). LEPC and whooping crane may feed within the croplands and grasslands that are common in WDZ-B; however, the whooping crane occurrence within the WDZ-B is likely to be limited to occasional migratory and stopover occurrences.

Table 3.14.1-7:
Description of the WDZ and the Potential Special Status Wildlife Species That May Occur In Area

WDZ Name	Potentially Suitable Area for Wind Development (acres)	Estimated Acres of Impact during Construction[1]	Estimated Acres of Impact during Operation[1]	Special Status Species Potentially Present in the WDZ
WDZ-C	123,000	738 acres of primarily croplands and grasslands	369 acres	Potentially suitable habitat for piping plover is limited; however, there is a potential for piping plover to occur during migration (which generally occurs from April to June). LEPC and whooping crane may feed within the croplands and grasslands that are common in WDZ-C; however, the whooping crane occurrence within the WDZ-C is likely to be limited to occasional migratory and stopover occurrences.
WDZ-D	43,000	258 acres of primarily grasslands	129 acres	Potentially suitable habitat for piping plover is limited; however, there is a potential for piping plover to occur during migration (which generally occurs from April to June). LEPC and whooping crane may feed within the grasslands that are common in WDZ-D; however, the whooping crane occurrence within the WDZ-D is likely to be limited to migratory and stopover occurrences. WDZ-D contains the ODWC Schultz WMAs.
WDZ-E	43,000	258 acres of primarily croplands and grasslands	129 acres	Potentially suitable habitat for piping plover is limited; however, there is a potential for piping plover to occur during migration (which generally occurs from April to June). This WDZ contains extensive cropped areas and less potential to support LEPC. Whooping crane may feed within the grasslands that are common in WDZ-E; however, the whooping crane occurrence within the WDZ-E is likely to be limited to migratory and stopover occurrences.
WDZ-F	82,000	492 acres of primarily grasslands and croplands	246 acres	Potentially suitable habitat for piping plover is limited; however, there is a potential for piping plover to occur during migration (which generally occurs from April to June). LEPC and whooping crane may feed within the croplands and grasslands that are common in WDZ-F; however, the whooping crane occurrence within the WDZ-F is likely to be limited to migratory and stopover occurrences. This WDZ is located farther from existing mapped LEPC habitat but contains grassland habitats with the potential to support LEPC.
WDZ-G	159,000	954 acres of primarily grasslands and croplands	477 acres	Potentially suitable habitat for piping plover is limited; however, there is a potential for piping plover to occur during migration (which generally occurs from April to June). WDZ-G is just south of high-quality LEPC habitat in southeastern Colorado and southwestern Kansas and could affect populations across the border in Oklahoma. Whooping crane may feed within the croplands and grasslands that are common in WDZ-G; however, the whooping crane occurrence within the WDZ-G is likely to be limited to occasional migratory and stopover occurrences.
WDZ-H	67,000	402 acres of primarily grasslands and croplands	201 acres	Potentially suitable habitat for piping plover is limited; however, there is a potential for piping plover to occur during migration (which generally occurs from April to June). Has some large grassland areas with the potential to support LEPC. Whooping crane may feed within the croplands and grasslands that are common in WDZ-H; however, the whooping crane occurrence within the WDZ-H is likely to be limited to occasional migratory and stopover occurrences.

Table 3.14.1-7:
Description of the WDZ and the Potential Special Status Wildlife Species That May Occur In Area

WDZ Name	Potentially Suitable Area for Wind Development (acres)	Estimated Acres of Impact during Construction[1]	Estimated Acres of Impact during Operation[1]	Special Status Species Potentially Present in the WDZ
WDZ-I	85,000	510 acres of primarily grasslands and croplands	255 acres	Potentially suitable habitat for piping plover and interior least tern is limited; however, there is a potential for both species to occur during migration (which generally occurs from April to June). This WDZ is just northwest of an area with LEPC, including leks. Development here could affect movement of LEPC from the Oklahoma/Kansas border to the eastern panhandle area. Whooping crane may feed within the grasslands that are common in WDZ-I; however, the whooping crane occurrence within the WDZ-I is likely to be limited to occasional migratory and stopover occurrences.
WDZ-J	44,000	264 acres of primarily grasslands	132 acres	Potentially suitable habitat for piping plover and interior least tern is limited; however, there is a potential for both species to occur during migration (which generally occurs from April to June). Whooping crane may feed within the grasslands that are common in WDZ-J; however, the whooping crane occurrence within the WDZ-J is likely to be limited to migratory and stopover occurrences. The LEPC habitat within WDZ-J is categorized as CHAT category 1 (i.e., focal area) suggesting that large areas of undeveloped, contiguous grassland/herbaceous land cover occur within the WDZ. Development here may also affect LEPC movements from the northwest to the southeast and vice versa. The ODWC Shorb WMA is located outside the western boundary of this WDZ.
WDZ-K	84,000	504 acres of primarily grasslands and croplands	252 acres	The LEPC occurs in this WDZ, particularly the eastern portion that is near existing leks and focal habitat. Potentially suitable habitat for piping plover and interior least tern is limited; however, there is a potential for both species to occur during migration (which generally occurs from April to June). Whooping crane may feed within the grasslands that are common in WDZ-K; however, occurrence within the WDZ-K is likely to be limited to occasional migratory and stopover occurrences.
WDZ-L	144,000	864 acres of primarily grasslands and croplands	432 acres	Potentially suitable habitat for piping plover is limited; however, there is a potential for piping plover to occur during migration (which generally occurs from April to June). The eastern portion of WDZ-L contains quality LEPC habitat and is near focal habitat and several leks. Whooping crane may feed within the grasslands that are common in WDZ-L; however, the whooping crane occurrence within the WDZ-L is likely to be limited to migratory and stopover occurrences.

1 The estimated acres of impact assumes a 30 percent build-out with 2 percent of the land affected during construction and 1 percent affected during operations based on the potentially suitable area for wind development in each WDZ (Table 2.5-1).

Potential impacts during wind farm development could include short-term disturbances to species (i.e., displacement in the vicinity of construction activity) during construction, loss of habitat from land disturbance, and potential mortality from vehicle collisions. Impacts to the interior least tern, piping plover, and red knot are not expected during construction. These three species use sparsely vegetated shorelines, sandbars, mudflats, and islands of rivers, lakes, and reservoirs. These habitats are relatively uncommon in the WDZs and are not likely sites that would be developed for wind energy. The LEPC could be potentially impacted during construction of wind farms by clearing of grassland habitats for access roads, wind turbines, and electrical stations.

Although the proportion of land potentially disturbed during wind farm construction is relatively small (2 percent), construction in undisturbed grasslands could fragment LEPC habitat that could reduce overall LEPC habitat quality in a larger area surrounding a wind farm. The potential for construction impacts to the LEPC and its habitat is greater in WDZs D, I, J, K, and L. These WDZs occur in eastern Texas County and western Beaver County in Oklahoma and western Ochiltree County in Texas. These WDZs are closest to areas mapped as focal and connectivity habitat areas in the LEPC Range-Wide Conservation Plan (Van Pelt et al. 2013) and include the ODWC Shultz and Shorb WMAs. Although impacts to LEPC could occur on land outside the identified focal and connectivity habitat areas, the focal areas represent high priority conservation areas to preserve larger more contiguous blocks of LEPC habitats and to encourage development in areas with less potential impact.

Sprague's pipit also is an occupant of grasslands, but it occurs as an uncommon migrant and rare winter resident in the vicinity of the WDZs and impacts to this species are expected to be minimal from construction activities (USFWS 2014d). Construction impacts to either golden eagles or bald eagles are not expected as both species are wide-ranging and nesting habitat for the golden eagle is limited in the WDZs. Once construction has been completed, temporary construction areas would revert to their previous use. Only turbines, access roads, generation tie-lines (if necessary), substations, and operations and maintenance buildings would remain. Existing land uses, primarily agriculture and grazing, would be expected to return to almost all areas of the facilities unless deemed incompatible with the operations of a wind energy development. During the operations and maintenance phase of wind energy developments, approximately 1 percent of the land could be affected (i.e., occupied by turbines, electrical stations, access roads). For the 12 WDZs, assuming 30 percent build-out, 3,249 acres could be impacted (Table 3.14.1-7).

Operation and maintenance of wind energy developments are known to have the potential to directly impact some special status wildlife species, specifically avian and bat species, due to collisions with wind turbine blades, collisions and electrocutions associated with generation tie-lines, barotrauma (physical tissue damage caused by air pressure differences) of bat species, and potential avoidance of otherwise suitable habitat surrounding vertical structures such as wind turbines and transmission structures. None of the four special status bat species (three listed as endangered, one proposed as endangered) that occurs on the Applicant Proposed Project occurs in Region 1, so none would be affected by potential wind energy development. Historically, the average number of avian species fatalities associated with operations of a wind energy facilities has varied among developments and is considered a function of a number of factors, including the proximity to known staging areas, winter ranges, nesting sites, migration stopovers or corridors, and leks or other areas of seasonal importance (USFWS 2012c).

Given the limited habitat for either the piping plover or interior least tern in the wind development zones, impacts to either species is not expected. Some whooping cranes migrate through the WDZ region, although the area is west of the primary whooping migration corridor. Because of their large size and lower maneuverability, whooping cranes could be at risk for collisions with wind turbines. Because Sprague's pipit is a relatively uncommon migrant through the region, potential collision mortalities are possible but probably unlikely. The preferred cliff and canyon nesting habitat of the golden eagle occurs west of the WDZs. However, migrant golden eagles, and some bald eagles, may occur in the WDZ region and could be at risk for mortality collisions. Occurrence of avian special status species within the WDZ and collision mortalities from wind energy facilities would likely be documented by wind energy developers under the Land-Based Wind Energy Guidelines (USFWS 2012c), in accordance with appropriate state and federal regulations.

Indirect impacts causing habitat loss and/or modification have been reported for some species of prairie-grouse; however, little is known about effects of wind farms on LEPC (Van Pelt et al. 2013). Behavioral avoidance by LEPC of otherwise suitable habitat surrounding wind turbine towers may increase the area of impact (Pruett et al. 2009, Winder et al. 2014). Empirical data on impact distances from vertical structures for LEPC is limited; however, appropriate buffer distances and restrictions near LEPC occupied habitat would be determined during any ESA consultation by the wind energy developer. The resulting habitat loss and/or modification may reduce the overall fitness of birds, reduce reproductive success, and inhibit movement and gene flow of birds (Van Pelt et al. 2013; 79 FR 20074, April 10, 2014). Although specific empirical data currently are not publically available, the suggestion that LEPC may avoid otherwise suitable habitat has led the USFWS to recommend the consideration of occupied prairie-grouse habitat (i.e., includes habitat used only periodically or temporarily during some portion of its life history) in locating wind farm facilities (USFWS 2012c).

Once the decommissioning phase has concluded, lands occupied by wind energy developments may be restored to their pre-construction conditions depending on specific contracts between the landowner and developer. Structures, including wind turbines and generation tie-lines, would be dismantled. Impacts associated with the construction, operations and maintenance of wind turbines, generation tie lines, and other permanent structures could therefore be reduced or eliminated as these areas are restored.

3.14.1.7.8.2 Optima Substation

No impacts to piping plovers, interior least terns, and bald eagles are expected from construction and operations and maintenance of the future Optima Substation because the site does not contain suitable habitat for any of these species. Because of the relatively small size (up to 160 acres) of the substation, potential collision mortalities to whooping cranes that migrate through the Oklahoma Panhandle region are unlikely to occur. The existing roads, power poles, and croplands that occur on and/or adjacent to the substation decrease the quality of the LEPC habitat. It is possible that some LEPC occur in grassland habitats in the vicinity of the future Optima Substation; however, potential impacts (loss of habitat and mortality) to LEPC and their habitat are expected to be minor. No leks are known to occur in the vicinity of the future Optima Substation and impacts to leks are not expected to occur (Figure 3.14-1a in Appendix A).

3.14.1.7.8.3 TVA Upgrades

Potential impacts are expected to be lower in areas affected by upgrades to existing TVA facilities than in areas where the new electric transmission line would be constructed. Generally, construction of the new transmission line could involve mortalities or new disturbances of habitat used (e.g., for breeding, nesting, brood-rearing, wintering, or foraging) by special status wildlife species, similar to the Project. Impacts during new construction could include loss of habitat from land clearing, temporary disturbance displacement, and possible mortality or injury by vehicles and construction equipment. These impacts would be short term except for habitat loss on sites used for the ROW, structures or access (i.e., roads) and any wildlife mortality. The new 500kV transmission line could result in mortality and injury of avian special status wildlife species from collisions and electrocutions during operations and maintenance. Existing TVA transmission lines would require fewer construction activities to complete upgrades than the new transmission line and would have proportionally fewer impacts as activities would occur primarily in previously disturbed areas. Upgrading and modifying existing substations would likely have no impact on special status wildlife.

TVA would consider potential impacts to special wildlife status species and their habitats during the siting of the new transmission line and while planning the upgrades to existing transmission facilities. TVA would avoid impacts to these species and their habitats to the extent practicable. Over the last decade, about 18 percent of TVA transmission construction projects have affected federally listed or candidate species (wildlife, fish, aquatic invertebrate, amphibian species, and plants) and about 30 percent of projects have affected state-listed special status species. Pursuant to Section 7 of the ESA, TVA is required to consult with USFWS with respect to effects of its construction of any new or upgraded transmission facilities upon threatened, endangered or candidate species.

3.14.1.7.9 Impacts Associated with the No Action Alternative

Under the No Action Alternative, the Project would not be constructed or operated, and impacts to special status wildlife species and their habitats would be consistent with current levels of disturbance related to natural conditions in the environment, such as annual changes in climates, land use changes, and wildfires. No Project-related disturbances or impacts would occur to special status wildlife or their habitats under the No Action Alternative.

3.14.2 Special Status Fish, Aquatic Invertebrate, and Amphibian Species

3.14.2.1 Regulatory Background

Regulations that influence the evaluation of special status fish, aquatic invertebrate, and amphibian species within the region of influence are primarily implemented by the USFWS and state agencies. The applicable state agencies to the Project include the ODWC, AGFC, TWRA, and TPWD. The special status fish, aquatic invertebrate, and amphibian species regulations relevant to the Project are presented in Table 3.14.2-1.

Table 3.14.2-1:
Relevant Laws and Regulations for Fish, Aquatic Invertebrate and Amphibian Species

Regulation	Regulatory Agency	Summary
Endangered Species Act (ESA) (16 USC § 1531 *et seq*.; 50 CFR Part 402)	USFWS	Establishes lists of threatened or endangered species and their designated critical habitats; requires federal agencies to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of listed species or result in adverse modification to designated critical habitat.
Oklahoma Statutes 29-5-412.1 Oklahoma Administrative Code Title 800, “Department of Wildlife Conservation”	ODWC	Establishes list of threatened or endangered species within Oklahoma. Describes the function, organization, powers, and duties of the ODWC with respect to managing fish and wildlife resources.
Texas Administrative Code 31-65.171–65.177	TPWD	Establishes list of threatened or endangered wildlife within Texas; prohibits the taking, possession, transportation, or sale of threatened or endangered species within the issuance of a permit.
Arkansas Code Annotated 15-45-301–306	AGFC[1]	Prohibits imports, transportation, sale, purchase, hunting, harassment, or possession of threatened or endangered wildlife or their parts.
Tennessee Administrative Code 70-1-101 et seq.	TWRA	Establishes a list of threatened or endangered wildlife within Tennessee; prohibits the take, attempt to take, possession, transportation, export, processing, selling, offering to sell, shipment of, or knowing receipt of shipment of threatened or endangered wildlife.

1 Arkansas does not have an endangered species law, but does maintain a list of Species of Special Concern.

3.14.2.2 Data Sources

Data sources included a desktop analysis of relevant information; research findings; and reports available to the public; a database that includes GIS data from government agencies as well as and non-governmental organizations; and information received from both regulatory agencies and stakeholders during the DOE scoping process. All data sources used for this analysis were limited to those that were open source and readily available to the public (i.e., the public may assess them without restrictions). For special status fish, aquatic invertebrate, and amphibian species, the following data sources were reviewed:

- USFWS Endangered Species Program Threatened and Endangered Species Range Maps
- USFWS Critical Habitat Portal
- Arkansas Geographic Information Office Ecologically Sensitive Streams and Waterbodies
- ADEQ Extraordinary Resource Water
- TCEQ Stream Use and Quality Information

Table 3.14.2-2 lists additional data sources analyzed for the ROI. Information and data sources have been provided for areas with exceptions to the ROI in Section 3.14.2.3.1.

Table 3.14.2-2:
Summary of Data Sources for Fish and Aquatic Invertebrate Species

Resource	Data Sources
General fishery classifications in the ROI	EPA National Rivers and Streams Assessment (http://water.epa.gov/type/rsl/monitoring/riverssurvey/index.cfm) USGS National Hydrography Dataset (GIS Data Source: USGS 2014a) NPS Nationwide Rivers Inventory (GIS Data Source: USGS 1996)
Federal and state special status aquatic species: Arkansas darter (*Etheostoma cragini*) Arkansas river shiner (*Notropis girardi*) Ozark cavefish (*Amblyopsis rosea*) Yellowcheek darter (*Etheostoma moorei*) Pallid sturgeon (*Scaphirhynchus albus*) Spectaclecase (*Cumberlandia monodonta*) Pink mucket (*Lampsilis abrupta*) Neosho mucket (*Lampsilis rafinesqueana*) Speckled pocketbook (*Lampsilis streckeri*) Scaleshell mussel (*Leptodea leptodon*) Fat pocketbook (*Potamilus capax*) Rabbitsfoot (*Quadrula cylindrica cylindrical*) Curtis' pearlymussel (*Epioblasma florentina curtisii)* Fanshell (*Cyprogenia stegaria*) Snuffbox (*Epioblasma triquetra*) Ozark hellbender (*Cryptobranchus alleganiensis bishopi*)	USFWS Endangered Species Program Threatened and Endangered Species Range Maps (http://www.fws.gov/endangered/map/index.html) USFWS Critical Habitat Portal (http://ecos.fws.gov/crithab/) Arkansas Geographic Information Office Ecologically Sensitive Streams and Waterbodies (http://www.geostor.arkansas.gov/metadata/ENVIR.DBO.REG_2_ESW_WATERBODIES_ADEQ.xml) ADEQ Extraordinary Resource Water (http://www.adeq.state.ar.us/water/branch_planning/pdfs/wqs_extraordinary_resource_stream_designations_011001.pdf) TCEQ Stream Use and Quality Information (http://tceq4apmgwebp1.tceq.texas.gov:8080/swav/Controller/index.jsp?wtrsrc)

3.14.2.3 Region of Influence

The general ROI considered for the Project and connected actions is described in Section 3.1. The following subsection describes where the ROI used for special status fish, aquatic invertebrate, and amphibian species was expanded beyond the area described in Section 3.1. The expansion of the ROI does not mean that impacts would necessarily occur at that distance, but instead, it identifies whether species are in the vicinity and could possibly be affected by the Project.

3.14.2.3.1 Variations of the Region of Influence for Special Status Fish, Aquatic Invertebrate, and Amphibian Species

The ROI for special status fish, aquatic invertebrate, and amphibian species consists of multiple waterbodies (e.g., perennial, intermittent) traversed by the Project, including special interest waterbodies. The ROI covers aquatic habitats and potential fish, aquatic invertebrate, and amphibian species that may be present based on literature reviews and data provided by Clean Line (2013). To thoroughly identify and assess potential occurrences of special status fish, aquatic invertebrate, and amphibian species, the ROI described in Section 3.1 was expanded to include a 3-mile buffer both upstream (1.5 miles) and downstream (1.5 miles) of the Applicant Proposed Route and HVDC alternative routes. The assessment within the 3-mile buffer included identifying waterbodies within the buffer that have documented occurrences of special status fish, aquatic invertebrate, and amphibian species designated as candidate, threatened, or endangered under the ESA and state-designated threatened and endangered species. This addition of the 3-mile buffer was identified to appropriately take into consideration the mobility of special status fish, aquatic invertebrate, and amphibian species. The assessment entailed adding the 3-mile buffer to the 1,000-foot-wide corridor and conducting database searches within the 3-mile buffer for waterbodies with documented occurrences of both state and federally protected fish, aquatic invertebrate, and amphibian species. Considering the mobility of fish and larval mussels, the 3-mile buffer is necessary both upstream and downstream of stream crossings, and extensive enough, to account for the various ranges of special status fish and aquatic invertebrate species, including the unique and varied habitat that each species potentially occupies.

To quantify potential impacts to special status fish, aquatic invertebrate, and amphibian species associated with the Applicant Proposed Route and the HVDC alternative routes, a 3-mile buffer at crossing locations (i.e., 1.5-miles upstream and 1.5-miles downstream) and a 195-foot-wide USFWS polygon of designated critical habitat were used to calculate acres of critical habitat within the 1,000-foot-wide ROI and 200-foot-wide ROW. This calculation provided the acres of USFWS designated critical habitat crossed and within the 1,000-foot-wide ROI and 200-foot-wide ROW for the Applicant Proposed Route and the HVDC alternative routes.

In general, the converter stations and Oklahoma AC interconnection are not located close to waterbodies that would affect special status species; however, any potential waterbody that may contain one or more special status fish, aquatic invertebrate, and amphibian species would be subject to the same qualifications listed above.

3.14.2.4 Affected Environment for Special Status Fish, Aquatic Invertebrate, and Amphibian Species

The following sections provide descriptions of special status fish, aquatic invertebrate, and amphibian species known to occur within or in proximity to the ROI as described above in Section 3.14.2.3.1. Section 3.14.2.4.1 provides an overview of federally proposed or listed fish, aquatic invertebrate, and amphibian species. Sections 3.14.2.4.2 and 3.14.2.4.3 provide information specific to each of the federally proposed or listed fish or aquatic invertebrate species, respectively. Section 3.14.2.4.4 provides an overview of state designations for aquatic wildlife. Descriptions of special status fish, aquatic invertebrate, and amphibian species in the ROI by Regions 1 through 7 are provided in Section 3.14.2.5.

Twenty-three route variations to the Applicant Proposed Route in Regions 2–7 were developed in response to public comments on the Draft EIS and are described in Appendix M and summarized in Sections 2.3.1 and 2.4.2.1–2.4.2.7. The route variations are discussed in relation to the special status fish, aquatic invertebrate, and amphibian species in the regional descriptions in Section 3.14.2.5. Potential impacts to these species in the route variations are discussed in Section 3.14.2.7.

3.14.2.4.1 Federally Proposed or Listed Fish, Aquatic Invertebrate, and Amphibian Species

Sixteen listed, proposed or candidate fish, aquatic invertebrate, and amphibian species designated by the USFWS under the ESA are within or in proximity to the ROI. There are a few species found north of the ROI, but within tributaries of streams where the species occur, so there is a possibility that those species could travel to areas within the ROI. These 16 fish, aquatic invertebrate, and amphibian species are within the ROI, or close enough for a review, including 12 endangered species, 3 threatened species, and 1 candidate for listing species. Table 3.14.2-3 lists the federally listed fish, aquatic invertebrate, and amphibian species potentially occurring in the ROI by state.

Table 3.14.2-3:
Federally Designated Candidate, Threatened, and Endangered Fish, Aquatic Invertebrate, and Amphibian Species Potentially Occurring in the ROI by State

Common Name[1]	Scientific Name[1]	Federal Status	County	Region
Oklahoma: Fish				
Arkansas darter	*Etheostoma cragini*	Federal Candidate	Beaver, Harper, and Woodward	1, 2
Arkansas River shiner	*Notropis girardi*	Federally Threatened	Beaver,[2] Harper,[2] Woodward,[2] Major,[2] Kingfisher,[2] Logan,[2] Garfield, and Payne	1, 2, 3
Arkansas: Fish				
Ozark Cavefish	*Amblyopsis rosea*	Federally Threatened	N/A[3]	4
Yellowcheek darter	*Etheostoma moorei*	Federally Endangered	Van Buren and Cleburne	5
Pallid sturgeon	*Scaphirhynchus albus*	Federally Endangered	Mississippi	7
Arkansas: Aquatic Invertebrates				
Spectaclecase	*Cumberlandia monodonta*	Federally Endangered	Franklin and Johnson	4
Pink mucket	*Lampsilis abrupta*	Federally Endangered	White and Jackson	5, 6
Neosho mucket	*Lampsilis rafinesqueana*	Federally Endangered	N/A[3]	4
Speckled pocketbook	*Lampsilis streckeri*	Federally Endangered	Van Buren, Pope, Cleburne, and White	4, 5
Scaleshell mussel	*Leptodea leptodon*	Federally Endangered	Crawford, Cross, Franklin, Mississippi, Poinsett, White, and Jackson	4, 5, 6
Fat pocketbook	*Potamilus capax*	Federally Endangered	White, Cross, Poinsett, Jackson, and Mississippi	5, 6, 7
Rabbitsfoot	*Quadrula cylindrica cylindrical*	Federally Threatened	Van Buren,[2] White,[2] Cleburne,[2] and Jackson[2]	5, 6
Curtis' pearlymussel	*Epioblasma florentina curtisii*	Federally Endangered	Jackson[5]	5
Fanshell	*Cyprogenia stegaria*	Federally Endangered	N/A[3]	None
Snuffbox	*Epioblasma triquetra*	Federally Endangered	Pope, Cross, Poinsett, and Mississippi	4, 5, 6, 7

Table 3.14.2-3:
Federally Designated Candidate, Threatened, and Endangered Fish, Aquatic Invertebrate, and Amphibian Species Potentially Occurring in the ROI by State

Common Name[1]	Scientific Name[1]	Federal Status	County	Region
Arkansas: Amphibians				
Ozark hellbender	*Cryptobranchus alleganiensis bishopi*	Federally Endangered	Jackson	5
Tennessee: Fish				
Pallid sturgeon	*Scaphirhynchus albus*	Federally Endangered	Tipton[6]	7
Texas: None[7]				

1 Does not include federally listed plant species or terrestrial wildlife species.
2 USFWS critical habitat occurs in this county.
3 Species not documented in counties crossed by the ROI.
4 USFWS proposed critical habitat occurs in this county.
5 Species historically known to occur in county; however, not observed since the 1990s.
6 No Tennessee counties specified by the USFWS, but species range encompass the Mississippi River in Tipton County, Tennessee, which the ROI crosses.
7 The USFWS identified the Arkansas River shiner as occurring in Hemphill, Roberts, Hutchinson, and Potter counties, Texas, all of which are outside the ROI.

Sources: USFWS (2014c, 2015a, 2015b)

3.14.2.4.2 Federally Candidate, Proposed or Listed Fish Species

3.14.2.4.2.1 Arkansas Darter

The Arkansas darter (*Etheostoma cragini*) is a candidate species for ESA listing. The species habitat exists in the Cimarron, Neosho, and Spring rivers and associated tributaries, across northern Oklahoma (USFWS 2010a). Within the ROI, populations of the Arkansas darter may exist in Beaver, Harper, and Woodward counties in western Oklahoma (USFWS 2014c). In eastern Oklahoma and into Arkansas, the species occurs north of the ROI.

The Arkansas darter is a small (approximately 2 inch) stout-bodied member of the perch family (KDWPT 2011; Natureserve 2014a). Its preferred habitat is shallow, clear cool spring-fed tributaries or headwater streams with slow currents and sand or sandy-gravel substrates (Natureserve 2014a). They prefer areas with herbaceous aquatic broad-leaved vegetation such as watercress or other aquatic plants and are often found in pools or near-shore areas with low flow and sand, fine gravel, or organic detritus as substrate (Eberle and Stark 2000; Natureserve 2014a).

The largest threat to this species is groundwater depletion, which is a result of current and likely continuing agricultural irrigation (USFWS 2010a). Habitat can be impacted by alterations in stream flow from invasive vegetation, such as saltcedar (*Tamarix* spp.), through water withdrawals and transpiration, in addition to trapping of floodwater, which decreases water quality and quantity. Water quality is also impacted by waste products from confined-animal feeding operations. An additional threat includes the creation of dams and reservoirs, which can segment drainages, block upstream and downstream movements, and cause population fragmentation (USFWS 2010a).

3.14.2.4.2.2 Arkansas River Shiner

The Arkansas River shiner (*Notropis girardi*) is a threatened species under the ESA. Within the ROI, populations of the Arkansas River shiner may exist within the Cimarron River in Beaver, Harper, Woodward, Major, Kingfisher, Logan, Garfield, and Payne counties in Oklahoma (USFWS 2014c, 2015b). The Cimarron River throughout Beaver, Harper, Woodward, Major, Kingfisher, and Logan counties in Oklahoma is designated critical habitat for the species, subject to protection under the ESA, including a lateral distance of 300 feet on each side of the stream width at bankfull discharge (USFWS 2014c). Figure 3.14-3 in Appendix A shows critical habitat for the Arkansas River Shiner.

The Arkansas River shiner is a small species of minnow that reaches a maximum length of 3 inches (CRMWA 2005; Natureserve 2014b). Its preferred habitat is wide, shallow, unshaded channels of rivers or large streams in the Arkansas River basin with silt and shifting sand bottoms (GIS Data Source: USFWS 2014a; Natureserve 2014b). Adults inhabit areas downstream of sand ridges, and are uncommonly found in quiet pools or backwaters, and are even rarer in deeper tributaries with mud or stone substrates (CRMWA 2005; Natureserve 2014b). Juveniles and larvae inhabit backwater pools, side channels, and island habitat types (GIS Data Source: USFWS 2014a; Natureserve 2014b).

Threats to this species include stream channelization, reservoir construction, streamflow alteration and depletion (from dam construction or invasive species), and possibly water quality degradation. Additional threats include off-road or all-terrain vehicle activity in and near the Cimarron River, as well as predation by introduced game fish (CRMWA 2005).

3.14.2.4.2.3 Ozark Cavefish

The Ozark cavefish (*Amblyopsis rosea*) is a threatened species under the ESA. This species' range is limited to the Springfield Plateau of the Ozark Highlands ecoregion, stretching across southwestern Missouri, northwestern Arkansas, and northeastern Oklahoma. There are 41 active caves and wells found across 10 counties in this ecoregion (USFWS 2011a). Within the ROI, occurrences of this species have not been documented. Known occurrences are north of the ROI in Oklahoma and Arkansas.

The Ozark cavefish is a small, pale, eyeless fish with a low reproductive capacity (Natureserve 2014e). The Boone and Burlington limestone formations of the Springfield Plateau Aquifer are where this species is found (USFWS 2011a). Habitat is restricted to dark caves, sinkholes, springs, or sometimes wells in clear streams with gravel or chert rubble substrates, or pools with silt or sand bottoms (USFWS 2011a; MDC 2014a; Natureserve 2014e). The Ozark cavefish is typically found in areas with the water source upwelling from the groundwater table, and rarely found in cave streams with surface water sources (USFWS 2002). Preferred habitat includes caves where gray bats (*Myotis grisescens*) reside (AGFC 2011a). Bat guano is the main energy and nutrient source for cavefish prey (AGFC 2011a).

Threats to this species include agriculture, urbanization and development, and humans entering bat caves. Additional threats include reservoirs causing cave flooding, cave entrance closures that inhibit bat use, the introduction of predatory game fish, and diminished bat populations due to white-nose syndrome of bats (USFWS 2011a).

3.14.2.4.2.4 Yellowcheek Darter

The yellowcheek darter (*Etheostoma moorei*) is an endangered species under the ESA. Within the ROI, populations of this species may exist in Van Buren and Cleburne counties in Arkansas (77 FR 63604, October 16, 2012). The only currently known population of this species is approximately 10 miles north of the ROI. Although data on movement and dispersal are generally not available (Natureserve 2014l), it is unlikely that the yellowcheek darter occupy aquatic habitat within the ROI because the ROI is approximately 10 miles from the currently known population occurrence. Aquatic habitat that is not occupied and greater than 6 miles away from a known population suggests a low probability of occurrence by the known population (Natureserve 2014l). Fish and aquatic habitat field surveys that assess seasonal changes in habitat would be required to ascertain whether the yellowcheek darter has the potential to occupy habitat within the ROI.

The yellowcheek darter is a small darter with a compressed deep body and a sharp snout (Natureserve 2014l). This species is endemic to only four streams of the Little Red River (77 FR 63604, October 16, 2012). Its preferred habitat is small to medium high-gradient clear headwater streams with high dissolved oxygen levels and gravel, rubble, or boulder bottoms (77 FR 63604; Natureserve 2014l). They are typically found in high gradient riffle areas, with adults occurring at depths of 10 to 20 in and juveniles occurring in shallower riffles (Natureserve 2014l). They are rarely found in pools or water with slower velocity (USFWS 2007a). Spawning occurs in swift, turbulent, riffles under or around large substrate particles (Natureserve 2014l).

Much of the known habitat for this species within the ROI was destroyed in 1962 as a result of the construction of the Greers Ferry Dam, which resulted in a new reservoir, Greers Ferry Lake (USFWS 2008). This limited the species' range to four headwater streams of the Little Red River above Greers Ferry Lake, creating a habitat that is vulnerable to alterations in both physical habitat characteristics and water quality degradation, as a result of gravel mining, unrestricted cattle encroachment, agricultural and recreational water withdrawals, diminishing riparian buffers, road construction and maintenance, and non-point pollution (USFWS 2008). Downstream of the Greers Ferry Lake, the yellowcheek darter was extirpated from portions of the main stem Little Red River because of cold tailwater releases from the dam (77 FR 63604, October 16, 2012). Within two tributaries of the Little Red River below Greers Ferry Dam, extensive sampling resulted in no observations of yellowcheek darter (USFWS 2008). The lack of observations suggests a low probability of occurrence of yellowcheek darter within the portion of the ROI that crosses the Little Red River based on the distance from currently known population occurrence.

3.14.2.4.2.5 Pallid Sturgeon

The pallid sturgeon (*Scaphirhynchus albus*) is an endangered species under the ESA. Within the ROI, this species occurs in the Mississippi River in Arkansas (Mississippi County) and Tennessee (Tipton County) (USFWS 2014c).

The pallid sturgeon is a large fish (up to 66 inches) with a flat, shovel-like snout that inhabits the Mississippi and Missouri river basins from Montana to Louisiana (USFWS 2014a; Natureserve 2014f). It is a large river obligate, occupying turbid free-flowing riverine habitat and occurring in strong currents over a substrate they select on a seasonal basis (EPA 2007; USFWS 2014a; Natureserve 2014f). Sand, gravel, and rocky bottoms are utilized during the winter and spring, while sand bottoms are utilized during the summer and fall (USFWS 2014a).

Threats to this species include river channelization, impoundments, and dam effluence causing altered hydrology, turbidity, and temperature (USFWS 2009a). Another threat is illegal commercial or recreational fishing, which can be a result of misidentification of the species as shovelnose sturgeon (USFWS 2009a). Additional threats include water quality degradation, dredging operations, irrigation diversions, flood control structures, and the potential for entrainment in hydroelectric dam intakes (USFWS 2013).

3.14.2.4.3 Federally Proposed or Listed Aquatic Invertebrates Species

3.14.2.4.3.1 Spectaclecase

The spectaclecase (*Cumberlandia monodonta*) is an endangered species under the ESA (USFWS 2014c). The Mulberry River, which flows generally westward through Johnson and Franklin counties, Arkansas, and is crossed by the ROI in Franklin County, is considered to harbor extant populations of the spectaclecase; however the current status of the species in the Mulberry River is unknown (77 FR 14914, March 13, 2012).

The spectaclecase is a freshwater mussel that occurs in large rivers, inhabiting riverine microhabitats that are sheltered from the current (Natureserve 2014k). In Arkansas, preferred habitat includes rocky microhabitats with ledges; large rocks with voids underneath in a moderate to fast current, on silt or fine gravel substrate; and possibly, large, sunken logs where they are adjacent to or underneath the log (Posey and Irwin 2012).

The most important threat to this species involves changes in hydrological regimes due to dam operations or other water diversion activities (Posey and Irwin 2012). Habitat destruction and modification are detrimental to this species, and may occur due to river channel alteration and maintenance, as well as pollution from municipal and industrial sources (USFWS 2012a). Other threats to this species include mining activities, oil and gas development, sedimentation, altered water temperatures, climate change, population fragmentation or isolation, and the establishment of exotic species (77 FR 14914, March 13, 2012).

3.14.2.4.3.2 Pink Mucket

The pink mucket (*Lampsilis abrupta*) is endangered under the ESA. Within the ROI, this species has been documented in tributaries of the White River in both White and Jackson counties in Arkansas (USFWS 2014c).

The pink mucket is a freshwater mussel that inhabits medium to large rivers with fast-flowing water, and can be found in both deep water and shallow riffles (MDC 2014c; USFWS 1997b; Natureserve 2014g). Preferred substrate includes sand, gravel, and rocky pockets in faster moving water, or sand and mud in slower moving water (Gordon and Layzer 1989).

The most important threat to this species is destruction and modification of habitat (USFWS 1985). Additional threats include river impoundments, gravel mining, channelization related to flood control and navigation, non-point source pollution, and erosion caused by mining, logging, farming, or road construction that adds silt to suitable habitat (MDC 2014c; USFWS 1997b). River impoundments can result in flooding of aquatic habitat, which reduces gravel substrate and limits distribution of fish hosts needed for larval development in the species (USFWS 1985; MDC 2014c). Pollution from agricultural or industrial runoff that contains chemicals and toxic metals that concentrate in body tissues of filter-feeding mussels can result in death (USFWS 1997b). Siltation builds up silt in rivers, which can prevent the mussel from feeding or bury it completely (USFWS 1997b).

3.14.2.4.3.3 Neosho Mucket

The Neosho mucket (*Lampsilis rafinesqueana*) is endangered under the ESA. This species occurs in the Illinois River in Adair County, Oklahoma; however, Adair County is not in the ROI. Within the ROI, it may exist within tributaries of the Illinois River (77 FR 63439, October 16, 2012), including the lower Illinois River below Tenkiller Dam, which is within the ROI in Sequoyah County, Oklahoma (Cumming and Cordiero 2012).

The Neosho mucket is a freshwater mussel that occurs in a wide variety of habits in both small rivers and large streams (Natureserve 2014d). Within the Illinois River in Oklahoma, it is associated with shallow riffles or runs with gravel substrate, and moderate to swift river currents (USFWS 2010b; ODWC 2011a). It can also occur in near-shore areas or other areas outside of the main current in a larger tributary, and has been found in silty, backwater areas (ODWC 2011a; Natureserve 2014d).

The estimated population of this species has a wide range of 10,000 to 100,000 individuals. The population for an 89-kilometer reach of the Illinois River, between the Arkansas-Oklahoma state line, downstream to Lake Tenkiller was estimated to be 500 to 1,000 individuals as of 1997 (Vaughn 1997; 77 FR 63440, October 16, 2012). The designated critical habitat for this species includes the Illinois River in Adair County, Oklahoma (80 FR 24692, April 30, 2015), as well as approximately 483 river miles across Oklahoma, Kansas, Arkansas, and Missouri (80 FR 24692). The species has been extirpated from approximately 62 percent of its historical range (Vaughn 1997; 77 FR 63440).

The most important threat to this species is destruction and modification of habitat. Habitat threats include waterbody impoundments, agricultural pollution, lead and zinc mining, channel instability, and sand and gravel mining (USFWS 2010b). Modifications to hydrology, sedimentation, accidental chemical releases, low-water crossings, or in-channel work could result in impacts to the habitat (USFWS 2010b). At least 11 dams have impounded large portions of the historical range of this species by fragmenting both populations and habitats (USFWS 2010b). Additional threats include the overutilization of the species for commercial, recreational, scientific, and educational reasons; disease; predation; and, the lack of regulatory mechanisms in place to protect this species, which leads to harm by construction, grazing, agriculture, silviculture, and public infrastructure works (USFWS 2010b).

3.14.2.4.3.4 Speckled Pocketbook

The speckled pocketbook (*Lampsilis streckeri*) is endangered under the ESA. It is endemic to the Little Red River system in north-central Arkansas (USFWS 2007a). Within the ROI, the species' range includes Van Buren, Pope, Cleburne, and White counties in Arkansas (USFWS 2014c).

The speckled pocketbook is a freshwater mussel that occupies sections of river with clear, constantly flowing water and a substrate ranging from coarse to muddy sand or gravel bottoms, in depths up to half a meter (USFWS 2007a; Natureserve 2014j). Another habitat type would be pools with crevices between large rocks or boulders with some accumulation of sand and gravel (USFWS 2007a).

The most important threat to this species is habitat degradation related to gravel mining, unrestricted cattle access in streams, water withdrawal for agricultural or recreational purposes, a paucity of riparian buffers, construction or maintenance of state and county roads, and non-point source pollution (USFWS 2007b). An additional threat could be drought, which can result in dried riffle habitats, thereby reducing habitat availability (USFWS 2014c). Drought can be exacerbated by both manmade changes to stream channels for flood control and stress caused by low stream flows increasing susceptibility to diseases and isolating gene pools (USFWS 2014b). This species is also preyed on by muskrats and turtles (USFWS 2007a). In addition, a more recent threat in the Little Red River system stems from the large amounts of water needed for fracturing shale during well drilling in the Fayetteville Shale, an unconventional natural gas reservoir on the Arkansas side of the Arkoma Basin (USFWS 2007b). The entire Little River watershed and nearly one-quarter of the state of Arkansas lie within the Arkoma Basin (USFWS 2007b).

3.14.2.4.3.5 Scaleshell Mussel

The scaleshell mussel (*Leptodea leptodon*) is endangered under the ESA. This species' range overlaps the ROI in Crawford, Cross, Franklin, and Jackson counties in Arkansas (USFWS 2014c, 2015b).

The scaleshell mussel is a freshwater mussel occurring in medium to large rivers with low to medium gradients and good water quality, preferably in stretches with stable channels (75 FR 17758, April 7, 2010; Natureserve 2014i). Preferred habitat includes riffles or runs with a moderate current velocity and mud or gravel substrate (75 FR 17758).

Threats to this species include water quality degradation, sedimentation, habitat destruction, and channel destabilization (75 FR 17758). Introduction of an invasive species, the zebra mussel (*Dreissena polymorpha*), along with the short life span of this species, make it vulnerable to man-made changes in the environment (75 FR 17758). These man-made changes include habitat alteration due to dam construction, resource extraction activities, confined animal operations and grazing, non-point source pollution from agriculture, and sedimentation resulting from forestry practices and road construction activities (MDC 2014d).

3.14.2.4.3.6 Fat Pocketbook

The fat pocketbook (*Potamilus capax)* is endangered under the ESA. Within the ROI, this species occurs in tributaries and drainage ditches of the St. Francis River Basin in White, Poinsett, Cross, and Mississippi counties in Arkansas (USFWS 2014c). The current distribution of the species includes that portion of the White River in White County, Arkansas, that is within the ROI (USFWS 2012b; Natureserve 2014c).

The fat pocketbook is a freshwater mussel found in fine-grained substrates such as sand, silt, and clay in large rivers with flowing water in a wide range of depths (USFWS 1989; Natureserve 2014c). It also inhabits slow-moving water in man-made ditches, bayous, sloughs, and streams, often found near the bank in mud or sand substrate in the St. Francis watershed (AGFC 2011b; Natureserve 2014c). Given the thin shell on this species, it can inhabit deep deposits of fine-grained silt, but not gravel substrate in highly erosive flow areas (Miller and Payne 2005).

The most important threat to this species is the destruction and modification of habitat (USFWS 2009b). Habitat threats include waterbody impoundments and channelization due to flood control and navigation practices (USFWS 2009b). In addition, habitat or population fragmentation as a result of human disturbance makes populations vulnerable to drought, non-point source pollution, and chemical spills (USFWS 2009b). Additional threats include construction and operation of hydropower generation facilities, siltation, turbidity, water quality degradation from both non-point and point pollution sources, competition from invasive species (e.g., zebra mussels), climate change, and the decline of host fish populations from channel dredging (USFWS 2012b).

3.14.2.4.3.7 Rabbitsfoot

The rabbitsfoot mussel (*Quadrula cylindrica cylindrica*) is threatened under the ESA. Within the ROI, this species exists in the White River and its tributaries in Van Buren, White, Jackson, and Cleburne counties in Arkansas (USFWS 2014c). The Little Red River in Cleburne and Van Buren counties and the White River through Woodruff, Jackson, White, and Independence counties are designated critical habitat for the species (80 FR 24692, April 30, 2015). In addition, the White River is proposed critical habitat for the species, specifically within the ROI (USFWS 2014c).

The rabbitsfoot mussel is a freshwater mussel that inhabits small to medium rivers with moderate to swift currents in sand or gravel substrate (Natureserve 2014h). Preferred habitat is the shallower water along banks and adjacent runs or shoals where flow rate is relatively low and substrate includes gravel or sand (77 FR 63439, October 16, 2012). It can also be found in smaller streams, inhabiting bars or gravel and cobble close to the current (Natureserve 2014h). It has been found in deeper water runs with depths of 3 meters (77 FR 63439; Natureserve 2014h).Threats to this species include activities related to habitat alteration (impoundments, dredging, channelization) and habitat degradation (chemical contamination, mining, sedimentation, oil and gas development) (77 FR 63439). The most important threat of these is the creation of impoundments or dams, which can alter river flow, increase or trap silt loads, alter the water quality or temperature, and cause isolation of populations (77 FR 63439). All of these potential alterations can affect the feeding and reproduction of this species as well.

3.14.2.4.3.8 Curtis' Pearlymussel

The Curtis' pearlymussel (*Epioblasma florentina curtisii)* is listed as endangered under the ESA (41 FR 24062, June 14, 1976). No critical habitat has been designated. This species is not currently known to occur in the ROI but historically occurred in the White River drainages (e.g., White River, south Fork Spring River, Black River, Little Black River) (USFWS 2010c), which the Project crosses in Jackson County, Arkansas. In the last 30 years it was known to be present in Fulton County, Arkansas, north of the ROI (USFWS 1986, 1997a). But extensive surveys in Arkansas from 1996 to 2006 did not find any specimens in 11 streams sampled (Harris et al. 2007) and it is possible the species has been extirpated from Arkansas (NatureServe 2014p).

Suitable habitat within the basin locations of Curtis' pearlymussel is in silt-free streams between headwaters and lowlands. Habitat is generally stream riffles or runs within this basin area, with preferred habitat of sand- to gravel-dominated substrate where individuals position themselves between cobbles and boulders in water 2 to 30 inches deep (USFWS 1986, 1997a). They remain buried in the substrate except during spring, when ripe females move to the substrate surface.

Because of their need for shallow fast-flowing water, the greatest threat to this species has been river impoundments, channelization and dredging (USFWS 1986, 2010c, 2007a; MDC 2000). These actions have caused direct mussel removal, habitat inundation and destabilization, and modified flow regime. Typical development-induced water quality degradation, such as point and non-point pollution, are also hazards. Invasive non-native species (e.g., zebra mussels) may also cause limitations if they occur in their habitat.

3.14.2.4.3.9 Fanshell

The Fanshell (*Cyprogenia stegaria)* is listed as endangered under the ESA (USFWS 2015b) and is known or assumed to occur in multiple states in the Midwest (i.e., Alabama, Illinois, Indiana, Kentucky, Ohio, Tennessee, Virginia, and West Virginia). In addition, the species is listed on the USFWS (2015b) list for the state of Arkansas. The University of Michigan's Museum of Zoology (2015) lists two specimen collections from the 1930s as having come from the St. Francis River in Cross County and the White River in Jackson County.

3.14.2.4.3.10 Snuffbox

The snuffbox (*Epioblasma triquetra)* is listed as endangered under the ESA (77 FR 8631, February 14, 2012). No critical habitat has been designated. Within the ROI, this species has the potential to occur in perennial streams in Pope, Poinsett, Cross, and Mississippi counties, Arkansas. The USFWS (2015b) lists the species as occurring in 13

Arkansas counties (Baxter, Boone, Clay, Fulton, Greene, Lawrence, Madison, Marion, Newton, Pope, Randolph, Sharp, Stone), only one of which, Pope, is crossed by the ROI. In addition, information provided by the USFWS (2014b) indicates that the species may occur within the ROI in Pope County. Furthermore, the Natureserve watershed based assessment indicates that watersheds within Poinsett, Cross, and Mississippi counties are within the current distribution of the species (NatureServe 2014). Some major rivers north of the Project in Arkansas (e.g. Buffalo River, Strawberry River, and Spring River) have been documented to contain this species (77 FR 8631).

Typical habitat includes fast water riffles in small to medium size streams in water two inches to two feet deep in clear water systems. Substrate ranges from sandy to rocky bottoms. Other than during spawning adults burrow deep into the substrate (77 FR 8631).

The major important threat to this species is the destruction and modification of habitat (Bruenderman et al. 2002; 77 FR 8631, February 14, 2012.). Specific habitat threats include poor water quality, channelization, sand and gravel mining, dredging, sedimentation and impoundments (Bruenderman et al. 2002; 77 FR 8631). Impoundments have effects on both substrate and temperature, which can adversely affect habitat suitability. Construction in or near streams may increase sedimentation, which may affect the suitability of habitat, affect feeding, and can including burial of individuals (Bruenderman et al. 2002; 77 FR 8631). Adverse modification of in-stream flow conditions (e.g., dewatering) may also occur from in-stream construction on a local basis (USFWS 2014d).

3.14.2.4.4 Federally Proposed or Listed Amphibian Species

3.14.2.4.4.1 Ozark Hellbender

The Ozark hellbender (*Cryptobranchus alleganiensis bishopi)* is listed as endangered under the ESA (76 FR 61956, October 6, 2011). No critical habitat has been designated. This species is a large salamander native to the White River drainage in southern Missouri and northern Arkansas (USFWS 2012d, MDC 2014b). They are known to be present in the White River, with the only documented occurrences located in Baxter and Independence counties; both of which occur upstream of the ROI crossing of the White River (which is located in Jackson County) (USFWS 2015b). Viability of populations in the White River system is unknown because much of their habitat was modified by the construction of dams on the Upper White River and records of individuals in this system may be relics separated from North Fork White River populations by the Norfork Reservoir (76 FR 61956).

This salamander requires well oxygenated flowing water of cool temperatures to survive (76 FR 61956). Because they acclimate slowly to temperature changes, they require consistent temperatures often in spring feed streams. Typical adult habitat includes deep (3 to 10 feet deep) fast flowing water where they reside under large flat limestone or dolomite rocks (Johnson 2000; USFWS 2011b; MDC 2014b; 76 FR 61956). Large and small rocks may be used for cover by larvae and juveniles in gravel substrate streams (USFWS 2011b). The territory they occupy in streams is small, and ranges from 92 to 266 square feet in size (Peterson and Wilkinson 1996; 76 FR 61956).

Because they are habitat specialists, the greatest threat to their survival is modification of flowing stream habitat primarily from dam construction and reservoir formation (76 FR 61956). Dam construction changes the water temperature regime and flowing water conditions required for their survival and the stream barrier fragments and isolates populations (76 FR 61956). Because they are habitat specialists, even small modifications to water conditions may affect survival. Other impacts to this species include mine development, turbidity, bank erosion, siltation, and food source (e.g., crayfish) contamination from metals or other toxics. Typical water quality changes resulting from agricultural fertilizer use, and logging can also have adverse effects (76 FR 61956). Recreational vehicle use in streams and active collection of this species (both permitted an unpermitted) also play a role in impacts to their survival (USFWS 2011b; 76 FR 61956). Additional threats include disease (e.g., chytrid fungus), and predation by non-native fish species, such as rainbow trout (USFWS 2011b; 76 FR 61956).

3.14.2.4.5 State Designations for Aquatic Species

In addition to federally listed, proposed, or candidate special status fish, aquatic invertebrate, and amphibian species, three species of aquatic wildlife with state-level designations have the potential to occur within the ROI. Oklahoma has two listed fish and Tennessee has one listed fish. Arkansas recognizes the federally listed species, but has no additional species with state level designations that have the potential to occur within the ROI. Texas has no state-designated aquatic wildlife. The state-designated aquatic wildlife of Oklahoma and Tennessee that could potentially occur in the ROI are summarized in Table 3.14.2-4.

Table 3.14.2-4:
State Designated Threatened and Endangered Aquatic Wildlife Species by State, County, and Region

Common Name	Scientific Name	State Status	County	Region
Oklahoma: Fish				
Black-sided darter	*Percina maculata*	State Threatened	Sequoyah	4
Long-nosed darter	*Percina nasuta*	State Endangered	Sequoyah	4
Arkansas: None[1]				
Tennessee: Fish				
Blue sucker	*Cycleptus elongatus*	State Threatened	Tipton and Shelby	7
Texas: None				

1 Arkansas recognizes the federally listed species, but no additional species are considered state listed within the ROI. Federally designated species are provided in Table 3.14.2-3.

Sources: ODWC (2014), ANHC (2014), TDEC (2014), TPWD (2014)

3.14.2.5 Regional Description

As discussed above, there are 16 federally listed, proposed, or candidate fish, aquatic invertebrate, and amphibian species and three state designated aquatic wildlife species known to occur or have the potential to occur within the ROI. A summary of the federally listed, proposed, or candidate fish, aquatic invertebrates, and amphibian species and USFWS-designated critical habitat occurrence by Project region is provided in the sections below. Information from ANHC Natural Areas and Focal Areas and state natural heritage program species occurrence records, including related waterbodies found by Project region, are included in Table 3.14.2-5.

Table 3.14.2-5:
State Natural Heritage Occurrences within the ROI or Waterbodies Crossed by the ROI

Common Name	Scientific Name	State Rank[1] or Status[2]	Waterbody	Project Region
Oklahoma				
Fish				
Arkansas River shiner	*Notropis girardi*	S1 / ST	Beaver River, Palo Duro Creek, Kiowa Creek, Coldwater Creek, and Cimarron River	1, 2, 3
Long-nosed darter	*Percina nasuta*	S1 / SE	Lee Creek	4

Table 3.14.2-5:
State Natural Heritage Occurrences within the ROI or Waterbodies Crossed by the ROI

Common Name	Scientific Name	State Rank[1] or Status[2]	Waterbody	Project Region
Arkansas				
Fish				
Long-nosed darter	*Percina nasuta*	S2 / INV	Mulberry River[4], Lee Creek[5], Frog Bayou[5], Illinois Bayou Drainage[5], and White River[5]	4, 5
Aquatic Invertebrates				
Speckled pocketbook[3]	*Lampsilis streckeri*	S1 /SE	Big Creek	5
Fat pocketbook[3]	*Potamilus capax*	S1 / SE	St. Francis floodway ditch[4,5], St. Francis River[5], Tyronza River[5], and White River	6, 7
Pink mucket[3]	*Lampsilis abrupta*	S2 /SE	White River[4,5]	5
Rabbitsfoot[3]	*Quadrula cylindrica*	S2 / ST	White River[4]	5
Scaleshell[3]	*Leptodea leptodon*	S1 / SE	Frog Bayou[5], Mulberry River, and White River	4
Snuffbox	*Epioblasma triquetra*	S1 / SC	Perennial streams in designated counties	4, 5, 6, 7
Curtis' pearlymussel	*Epioblasma florentina curtisii*	S1 / SE	White River[6]	5
Amphibians				
Ozark hellbender	*Cryptobranchus alleganiensis bishopi*	S2 / SC	White River	5
Tennessee				
Fish				
Blue sucker	*Cycleptus elongatus*	S2 / ST	Mississippi River	7
Texas				
None				

1 State rank is a conservation rank used by State Heritage Programs and The Nature Conservancy that indicates the relative rarity of and element throughout the state. S1 = Critically imperiled; S2 = Imperiled; S3 = Vulnerable; S4 = Apparently secure; S5 = Secure in the state
2 State status: INV = Inventory Element; SC= Species of Concern, SE = State Endangered; ST = State Threatened.
3 Species has a federal designation, see *Federal Designations* within this section.
4 Occurrence element located within the ROI.
5 Occurrence element located outside the ROI, but within a waterbody that is crossed by the Project.
6 Historical occurrence in this river system but not documented since the 1990s.
Sources: ODWC (2014), ANHC (2014), TDEC (2014), TPWD (2014), AGFC (2013), USFWS (2015b)

3.14.2.5.1 Region 1

The ROI in Region 1 is referred to as the Oklahoma Panhandle Region and includes the Applicant Proposed Route, HVDC Alternative Routes I-A through I-D, Oklahoma converter station and AC interconnection, and the AC collection system. In the ROI in Region 1, there is one federally threatened fish (Arkansas River shiner) and one fish that is a candidate for listing (Arkansas darter). There are documented occurrences of both the Arkansas darter and the Arkansas River shiner within the Oklahoma portion of the ROI. There are no special status species found within the Texas portion of the ROI.

Populations of the Arkansas River shiner may exist within the ROI in the Cimarron River in Beaver, Harper, and Woodward counties in Region 1. Designated critical habitat for the Arkansas River shiner includes portions of the

Cimarron River in Oklahoma (USFWS 2014c). Critical habitat units for this species are located in Beaver, Harper, and Woodward counties in Oklahoma, but these critical habitat units do not occur within the ROI (USFWS 2014c).

Populations of the Arkansas darter may exist within the ROI in the Cimarron River in Beaver, Harper, and Woodward counties in Region 1.

No route variations were proposed in Region 1.

3.14.2.5.1.1 AC Collection System

The AC collection system consists of thirteen 2-mile-wide routes in Oklahoma (Beaver, Cimarron, and Texas counties) and Texas (Hansford, Ochiltree, and Sherman counties) within which an AC collection system transmission line could be sited. Within this area, the AC collection system routes cross the Beaver River, Palo Duro Creek, Dry Sand Draw, Coldwater (Frisco) Creek, North Frisco Creek, Dry Creek, Peacher Creek, and Hackberry Creek. Floodplains in the ROI are discussed in Section 3.19. Of these waterbodies that are crossed, the Beaver River and Palo Duro Creek may have populations of the Arkansas River shiner that may exist within the ROI for the AC collection system.

3.14.2.5.2 Region 2

Region 2 is referred to as the Oklahoma Central Great Plains Region and includes the Applicant Proposed Route and HVDC Alternative Routes 2-A and 2-B. In the ROI in Region 2, there is one federally threatened fish (Arkansas River shiner) and one fish that is a candidate for listing (Arkansas darter). There are documented occurrences of both the Arkansas darter and the Arkansas River shiner within the Oklahoma portion of the ROI.

Populations of the Arkansas River shiner may exist within the ROI in the Cimarron River in Woodward and Major counties in Region 2. Designated critical habitat for the Arkansas River shiner includes portions of the Canadian River and portions of the Cimarron River, both in Oklahoma within the ROI (USFWS 2014c). Critical habitat units for this species are located in Woodward and Major counties within the ROI in Oklahoma (USFWS 2014c).

Populations of the Arkansas darter may exist within the ROI in the Cimarron River in Woodward County of Region 2.

Two route variations to the Applicant Proposed Route were developed in Region 2 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.2. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route. Link 1, Variation 1, as well as Link 2, Variation 2, would cross through the same types of wetlands and habitat as the original Applicant Proposed Route Links 1 and 2.

3.14.2.5.3 Region 3

Region 3 is referred to as the Oklahoma Cross Timbers Region and includes the Applicant Proposed Route and HVDC Alternative Routes 3-A through 3-E. In the ROI in Region 3, there is one federally threatened fish (Arkansas River shiner) and one fish found north of the ROI (Arkansas darter). There are documented occurrences of the Arkansas River shiner within the Oklahoma portion of the ROI.

Populations of the Arkansas River shiner may exist within the ROI in the Cimarron River in Kingfisher and Logan counties in Region 3. Designated critical habitat for the Arkansas River shiner includes portions of the Canadian

River in Oklahoma and portions of the Cimarron River in Oklahoma (USFWS 2014c). Critical habitat units for this species are located in Kingfisher and Logan counties within the Oklahoma portion of the ROI (USFWS 2014c).

Habitat exists for the Arkansas Darter in the Neosho River, as well as associated tributaries, just north of the ROI in Region 3.

Five route variations to the Applicant Proposed Route were developed in Region 3 in response to public comments on the Draft EIS. The route variations are described in Exhibit 1 of Appendix M and summarized in Section 2.4.2.3. These variations represent minor adjustments to the Applicant Proposed Route. Links 1 and 2, Variation 1; Link 1, Variation 2; Link 4, Variation 1; and Link 5, Variation 2, would cross through the same types of wetlands and habitats as the original Applicant Proposed Route Links 1, 2, 4, and 5. The number of waterbodies crossed decreases from three to none in Links 1 and 2, Variation 1, while the number of waterbodies crossed increases from one to two in the Link 1, Variation 2, compared to the original links of the Applicant Proposed Route.

3.14.2.5.4 Region 4

Region 4 is referred to as the Arkansas River Valley Region and includes the Applicant Proposed Route, including the Lee Creek Variation, and HVDC Alternative Routes 4-A through 4-E. In the ROI for Region 4, there are five federally endangered species of aquatic invertebrates (Neosho mucket, spectaclecase, speckled pocketbook, scaleshell mussel, and snuffbox), one candidate fish (Arkansas darter), and one federally endangered fish (Ozark cavefish) found north of the ROI.

In Adair County, Oklahoma, the Neosho mucket is found north of the ROI where there is also proposed critical habitat for this species (USFWS 2014c). Although the ROI crosses just south of Adair County, tributaries of the Illinois River may flow within the ROI.

There are documented occurrences of the scaleshell mussel, the speckled pocketbook, spectaclecase, and the snuffbox within the Arkansas portion of Region 4. The scaleshell mussel has been documented in the ROI in Crawford and Franklin counties. The speckled pocketbook has a range that includes Van Buren, Pope, Cleburne, and White counties in the Little Red River basin in Arkansas. The spectaclecase has been documented in Johnson County, within the ROI. The snuffbox has been documented in streams of Pope County of region 4, and may occur in the ROI.

Habitat exists for the Arkansas Darter in the Neosho and Spring rivers, as well as associated tributaries, just north of the ROI in Region 4.

Known or potential occurrences of the Ozark cavefish occur north of Region 4 in Benton and Madison counties in Arkansas and Ottawa, Delaware, and Mayes counties in Oklahoma.

Seven route variations to the Applicant Proposed Route were developed in Region 4 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.4. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route. Link 3, Variation 1; Link 3, Variation 3, Link 6, Variation 1; Link 6, Variation 2; Link 6, Variation 3; and Link 9, Variation 1, would cross through the same types of wetlands and habitats as the original Applicant Proposed Route Links 3, 6, and 9. The Link 3, Variation 2, would parallel almost four times the length of existing infrastructure as the original Applicant Proposed Route Link 3, and it would cross through areas that contain fewer wetland and waterbody features than the original Applicant Proposed Route.

3.14.2.5.5 Region 5

Region 5 is referred to as the Central Arkansas Region and includes the Applicant Proposed Route and HVDC Alternative Routes 5-A through 5-F. In the ROI in Region 5, there are eight federally endangered species, the yellowcheek darter, the scaleshell mussel, the speckled pocketbook, the pink mucket, the fat pocketbook, the snuffbox, Curtis' pearlymussel, and the Ozark hellbender. Within the Arkansas portion of Region 5, all eight species occur or have the potential to occur. In addition, documented occurrences of the rabbitsfoot, a federally threatened species, occur within the ROI.

The yellowcheek darter's only currently known populations are located 10 miles to the north of ROI in Region 5, but populations may potentially occur in Van Buren and Cleburne counties in tributaries of the Little Red River. Much of their habitat was previously destroyed in these counties, but there is a potential that populations persist.

The scaleshell mussel range overlaps with the ROI in White and Jackson counties. The speckled pocketbook is only found in the Little Red River basin, which covers Pope, Van Buren, Cleburne, and White counties. The pink mucket is found within the ROI in Region 5, with documented occurrences in the tributaries of the White River in both White and Jackson counties in Arkansas. The fat pocketbook occurs within the ROI of the White River in White County in Arkansas. The snuffbox has been documented in streams of Pope County of Region 5, and may occur in the ROI. The Curtis' pearlymussel historically was in the White River system that is crossed by the Project in Jackson County. The salamander (Ozark hellbender) has been documented in the White River in Jackson County, and may occur in the ROI of the White River crossing.

The rabbitsfoot is also found within the ROI in Region 5, with known and potential occurrences in the tributaries of the White River in Van Buren, White, and Jackson counties in Arkansas. Proposed critical habitat for this species occurs in the White River in Van Buren, White, and Jackson counties (USFWS 2014c).

Five route variations to the Applicant Proposed Route were developed in Region 5 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.5. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route. Link 1, Variation 2; Link 2, Variation 2; Links 2 and 3, Variation 1; Links 3 and 4, Variation 2; and Link 7, Variation 1, would cross the same types of wetlands and habitats as the original links of the Applicant Proposed Route.

3.14.2.5.6 Region 6

Region 6 is referred to as the Cache River and Crowley's Ridge Region and includes the Applicant Proposed Route and HVDC Alternative Routes 6-A through 6-D. In the ROI in Region 6, there are four federally endangered species (pink mucket, scaleshell mussel, fat pocketbook, and the snuffbox) and one federally threatened species (rabbitsfoot).

The pink mucket is found within the ROI in Region 6, with documented occurrences in the tributaries of the White River in Jackson County in Arkansas. The scaleshell mussel has been documented within the ROI in Jackson

County. The fat pocketbook occurs within the ROI in tributaries and drainage ditches of the St. Francis River in Poinsett County in Arkansas.

The rabbitsfoot is also found within the ROI in the Arkansas portion of Region 6, with documented occurrences in the White River in Jackson County. The snuffbox has been documented in streams of Poinsett and Cross counties of Region 6, and may occur in the ROI.

One route variation to the Applicant Proposed Route in Region 6 (i.e., Applicant Proposed Route Link 2, Variation 1) was developed in response to public comments on the Draft EIS. This route variation is described in Appendix M and summarized in Section 2.4.2.6. The variation is illustrated in Exhibit 1 of Appendix M. This variation represents a minor adjustment to the Applicant Proposed Route. Link 2, Variation 1, would cross through the same types of wetlands and habitats as the original Applicant Proposed Route Link 2 and includes increased acreage of forested wetland habitat.

3.14.2.5.7 Region 7

Region 7 is referred to as the Arkansas Mississippi River Delta and Tennessee Region and includes the Applicant Proposed Route and HVDC Alternative Routes 7-A through 7-D. In the ROI in Region 7, there are three federally endangered species (the pallid sturgeon, pocketbook, and the snuffbox).

The pallid sturgeon occurs within the ROI along the Mississippi River in Mississippi County in Arkansas and three counties in Tennessee (Lauderdale, Shelby, and Tipton).

The fat pocketbook occurs within the ROI in tributaries and drainage ditches of the St. Francis River in Poinsett and Mississippi counties in Arkansas. The snuffbox has been documented in streams of Poinsett and Mississippi counties of Region 7, and may occur in the ROI.

Three route variations to the Applicant Proposed Route were developed in Region 7 in response to public comments on the Draft EIS. The route variations are described in Exhibit 1 of Appendix M and summarized in Section 2.4.2.7. Link 1, Variation 1; Link 1, Variation 2; and Link 5, Variation 1, would cross through the same types of wetlands and habitats as the original Applicant Proposed Route Links 1 and 5. The number of waterbodies crossed potentially decreased by two in the Applicant Proposed Route Link 1, Variation 2.

3.14.2.6 Connected Actions

3.14.2.6.1 Wind Energy Generation

Wind energy generation would likely occur within WDZs. Two federally designated special status aquatic species potentially occur within the WDZs, the Arkansas darter (a candidate species) and the Arkansas River shiner (a threatened species). Both species occur in Beaver County, Oklahoma. USFWS-designated critical habitat for these species is not located within any WDZs. No aquatic wildlife species with state designations are known to occur within any WDZs.

The Arkansas darter may occur within WDZ-G. Habitat exists for this species in the Cimarron River and its tributaries. Section 3.14.2.4.2 includes a more detailed description of this species and its habitat.

The Arkansas River shiner may occur within WDZ-G. Habitat exists for this species in the Cimarron River and its tributaries. Section 3.14.2.4.2 includes a more detailed description of this species and its habitat.

No Oklahoma or Texas state-listed aquatic wildlife species are known to occur within the WDZs.

3.14.2.6.2 Optima Substation

The future Optima Substation would be constructed within a 160-acre site that is mostly grassland/herbaceous land cover with smaller areas of shrub/scrub and developed open space. Because there are no waterbodies within the future Optima Substation site, there are no likely occurrences of special status fish, aquatic invertebrate, and amphibian species.

3.14.2.6.3 TVA Upgrades

The ROI for the direct assignment facilities (which are included in the Applicant Proposed Project) would occur within the Tennessee Converter Station Siting Area and more specifically within the Shelby Substation. The ROI for the network upgrades, and in particular TVA's future 500kV transmission line, cannot be fully determined at this time. The new 500kV line would be in western Tennessee. The upgrades to existing facilities would mostly be in western and central Tennessee. Upgrades to existing infrastructure would include upgrading terminal equipment at three existing 500kV substations and six existing 161kV substations, making appropriate upgrades to increase heights on 16 existing 161kV transmission lines to increase line ratings, and replacing the conductors on eight existing 161kV transmission lines. Where possible, general impacts associated with the required TVA upgrades are discussed in the impact sections that follow.

3.14.2.7 Impacts to Special Status Fish, Aquatic Invertebrate, and Amphibian Species

3.14.2.7.1 Methodology

The methodology for evaluating impacts on fish, aquatic invertebrate, and amphibian species included comparisons of impacts of the Applicant Proposed Route to impacts of the HVDC alternative routes. Within the ROI, Project activities were assessed that could potentially impact special status fish, aquatic invertebrate, and amphibian species and their habitats. Fish, aquatic invertebrate, and amphibian resources to be evaluated include river, stream, or creek crossings, as well as any perennial waterbodies that fall within the ROI. Potential impacts on fish, aquatic invertebrate, and amphibian resources include the following, and are further discussed for each phase of the Project:

- Potential impacts from permanent removal of terrestrial vegetation, or temporary mechanical damage to terrestrial vegetation
- Possible spread and/or introduction of invasive plants or listed noxious weed species
- Potential impacts associated with ROW vegetation maintenance, including the use of herbicides on terrestrial vegetation during operations and maintenance of the Project
- Potential disturbance to known populations and/or suitable habitat for species designated as candidate, threatened, or endangered under the ESA
- Potential disturbance to known populations of state-listed species of concern
- Potential impacts from construction and maintenance of roads and road crossings
- Potential for sediment loading and introduction of chemicals from spills in aquatic habitat

Sixteen federally listed fish, aquatic invertebrate, and amphibian species may occur in waterbodies located within the ROI or close enough that the warrant inclusion in the discussion on impacts. Two fish are listed as endangered under the ESA, two fish listed as threatened, and one fish that is a candidate for listing. Eight mussels are listed as endangered under the ESA and one mussel is listed as threatened. One salamander is listed as endangered under the ESA.

The Applicant has developed a comprehensive list of EPMs that would cover the protection measures intended to avoid or minimize impacts to special status fish, aquatic invertebrate, and amphibian species. Implementation of these EPMs is assumed throughout the impact analysis that follows for the Project. A complete list of EPMs for the Project is provided in Appendix F; those EPMs that would specifically minimize the potential for impacts on special status fish, aquatic invertebrate, and amphibian species are described below:

General EPMs for the Project that relate to special status fish and aquatic resources:

- GE-1: Clean Line will train personnel on health, safety, and environmental matters. Training will include practices, techniques, and protocols required by federal and state regulations and applicable permits.
- GE-3: Clean Line will minimize clearing vegetation within the ROW, consistent with a TVMP filed with NERC, and applicable federal, state, and local regulations. The TVMP may require additional analysis under NEPA depending on whether and under what conditions DOE decides to participate in the Project.
- GE-5: Any herbicides used during construction and operations and maintenance will be applied according to label instructions and any federal, state, and local regulations.
- GE-7: Roads not otherwise needed for maintenance and operations will be restored to preconstruction conditions. Restoration practices may include decompacting, recontouring, and re-seeding. Roads needed for maintenance and operations will be retained.
- GE-9: Clean Line will avoid and/or minimize damage to drainage features and other improvements such as ditches, culverts, levees, tiles, and terraces; however, if these features or improvements are inadvertently damaged, they will be repaired and or restored.
- GE-10: Clean Line will work with landowners to repair damage caused by construction, operation, or maintenance activities of the Project. Repairs will take place in a timely manner, weather and landowner permitting.
- GE-11: Clean Line will conduct construction, operation, and maintenance activities to minimize the creation of dust. This may include measures such as limitations on equipment, speed, and/or travel routes utilized. Water, dust palliative, gravel, combinations of these, or similar control measures may be used. Clean Line will implement measures to minimize the transfer of mud onto public roads.
- GE-13: Emergency and spill response equipment will be kept on hand during construction.
- GE-14: Clean Line will restrict the refueling and maintenance of vehicles and the storage of fuels and hazardous chemicals within at least 100 feet from wetlands, surface waterbodies, and groundwater wells, or as otherwise required by federal, state, or local regulations.
- GE-15: Waste generated during construction or maintenance, including solid waste, petroleum waste, and any potentially hazardous materials will be removed and taken to an authorized disposal facility.
- GE-21: Clean Line will maintain construction equipment in good working order. Equipment and vehicles that show excessive emissions of exhaust gases and particulates due to poor engine adjustments or other inefficient operating conditions will be repaired or adjusted.

- GE-27: Clean Line will minimize compaction of soils and rutting through appropriate use of construction equipment (e.g., low ground pressure equipment and temporary equipment mats).
- GE-28: Hazardous materials and chemicals will be transported, stored, and disposed of according to federal, state, or local regulations or permit requirements.
- GE-30: Clean Line will minimize the amount of time that any excavations remain open.

Fish, vegetation, and wildlife EPMs have been developed for the Project; the following EPMs relate specifically to special status fish and aquatic resources:

- FVW-1: Clean Line will identify environmentally sensitive vegetation (e.g., wetlands, protected plant species, riparian areas, large contiguous tracts of native prairie) and avoid and/or minimize impacts to these areas.
- FVW-2: Clean Line will identify and implement measures to control and minimize the spread of non-native invasive species and noxious weeds.
- FVW-3: Clean Line will clearly demarcate boundaries of environmentally sensitive areas during construction to increase visibility to construction crews.
- FVW-4: If construction- and/or decommissioning-related activities occur during the migratory bird breeding season, Clean Line will work with USFWS to identify migratory species of concern and conduct pre-construction surveys for active nests for such species. Clean Line will consult with USFWS and/or other resource agencies for guidance on seasonal and/or spatial restrictions designed to avoid and/or minimize adverse effects.
- FVW-5: If construction occurs during important time periods (e.g., breeding, migration, etc.) or at close distances to environmentally sensitive areas with vegetation, wildlife, or aquatic resources, Clean Line will consult with USFWS and/or other resource agencies for guidance on seasonal and/or spatial restrictions designed to avoid and/or minimize adverse effects.

Water EPMs have been developed for the Project; the following EPMs relate specifically to special status fish and aquatic resources:

- W-1: Clean Line will avoid and/or minimize construction of access roads in special interest waters.
- W-2: Clean Line will identify, avoid, and/or minimize adverse effects to wetlands and waterbodies. Clean Line will not place structure foundations within the Ordinary High Water Mark of Waters of the United States.
- W-3: Clean Line will establish streamside management zones within 50 feet of both sides of intermittent and perennial streams and along margins of bodies of open water where removal of low-lying vegetation is minimized.
- W-4: If used, Clean Line will selectively apply herbicides within streamside management zones.
- W-5: Clean Line will construct access roads to minimize disruption of natural drainage patterns including perennial, intermittent, and ephemeral streams.
- W-6: Clean Line will not construct counterpoise or fiber optic cable trenches across waterbodies.
- W-7: Dewatering will be conducted in a manner designed to prevent soil erosion (e.g., through discharge of water to vegetated areas and/or the use of flow control devices).

One EPM that is specifically applicable to the Ozark cavefish:

- FVW-6: Clean Line will avoid and/or minimize construction within 300 feet of caves known to be occupied by threatened or endangered species.

In addition, the following plans will be developed and implemented by the Applicant to avoid or minimize impacts:

- Blasting Plan: This plan will describe measures designed to minimize adverse effects due to blasting.
- Restoration Plan: This plan will describe post-construction activities to reclaim disturbed areas.
- Spill Prevention, Control and Countermeasures (SPCC) Plan: This plan describes the measures designed to prevent, control, and clean up spills of hazardous materials.
- Storm Water Pollution Prevention Plan (SWPPP): This plan, consistent with federal and state regulations, will describe the practices, measures, and monitoring programs to control sedimentation, erosion, and runoff from disturbed areas.
- Transmission Vegetation Management Plan (TVMP): This plan would be developed and implemented pursuant to the North American Electric Reliability Corporation (NERC) Reliability Standard FAC-003 and will describe how Clean Line will conduct work on its right-of-way to prevent outages due to vegetation. The TVMP may require additional analysis under NEPA depending on whether and under what conditions DOE decides to participate in the Project.

3.14.2.7.2 Impacts Associated with the Applicant Proposed Project

The impacts discussed in the sections below are common to all aspects of the Applicant Proposed Project, which includes the Oklahoma Converter Station Siting Area and AC Interconnection Siting Area, the Tennessee Converter Station and AC Interconnection Tie, the Applicant Proposed Route, the AC collection system routes, access roads, multi-use construction yards and other temporary construction areas, and communications sites. The Applicant Proposed Project is described in Sections 2.1.2 through 2.1.7.

The sections below identify the potential impacts to special status fish, aquatic invertebrate, and amphibian species and their aquatic habitat based on the three phases of the Project: (1) construction, (2) operations and maintenance, and (3) decommissioning. The Applicant would conduct each phase of the Project in compliance with applicable state and federal laws, regulations, and permits related to environmental protection. EPMs would be implemented as described in Section 3.14.2.7.1 to avoid or minimize impacts to special status fish, aquatic invertebrate, and amphibian species and aquatic habitat. In addition, consultation with USFWS has been initiated pursuant to Section 7 of the ESA regarding the potential effects of the Project on listed species and any designated critical habitat. This consultation review is a parallel, but separate analysis conducted pursuant to the requirements of ESA, Section 7 and the applicable implementing regulations. Through the consultation process additional protection measures may be the identified to avoid and/or minimize the impacts of the Project upon listed species and any designated critical habitat.

3.14.2.7.2.1 Construction Impacts

During the construction phase of the Project, potential impacts to fish, aquatic invertebrate, and amphibian resources as a result of the Project can be divided into two categories: (1) temporary (short term or long term) and (2) permanent. In addition, impacts may have direct or indirect effects. Direct or indirect effects may be temporary or permanent depending on the type and short- or long-term need of the construction activity. Direct construction impacts that could potentially affect special status fish, aquatic invertebrate, and amphibian species and their habitats include vegetation clearing, grading, access roads, herbicide use, and handling of fuel and lubricants at stream and river crossings. Indirect construction impacts that could potentially affect special status fish, aquatic invertebrate, and amphibian species and their habitats include vegetation clearing, grading, access roads, herbicide use, and handling of fuel and lubricants at locations where construction activities would result in sedimentation or contaminant runoff. Vegetation clearing has the potential to increase sedimentation and decrease cover. Increased sedimentation can directly or indirectly suffocate, bury, or limit feeding of fish, aquatic invertebrate, and amphibian species. Grading and access roads have the potential to increase sedimentation, decrease cover, and increase runoff. Increased runoff can alter stream and river hydrology and provide a mechanism for delivery of sediment, herbicides, and fuel and lubricants to streams and rivers. Herbicide use and handling of fuel and lubricants have the potential to concentrate in body tissues of fish, amphibians, and filter-feeding mussels, which can result in death.

To avoid or minimize impacts during the construction phase of the Project, both general EPMs and those specific to special status fish and aquatic resources, as listed in Section 3.14.2.7.1, would be implemented. Specific to sedimentation and vegetation clearing, detailed EPMs for both construction and ROW maintenance would be in place prior to construction, specifically designed to ensure slope stability, prevent excessive soil erosion, prevent other hazardous runoff to waters, retain low-growing near-stream vegetation, and reduce sedimentation in streams (see Sections 3.14.2.7.1 and 3.20.2.7.1; see Appendix F for a complete list of EPMs). In addition, state permits would need to be obtained prior to construction that will require that Project actions do not violate state water quality standards and further aid in the protection of aquatic resources, including food resources and spawning and rearing habitat. Furthermore, Clean Line would develop a SWPPP that would control sedimentation, erosion, and runoff and would be consistent with the state and federal regulations. Specifically regarding increased sediment load from vegetation clearing, Clean Line has committed to maintaining a streamside management zone (EPM W-3, see Sections 2.1.7 and 3.20.2.7.1 and Appendix F of the EIS) of 50 feet on both sides of streams and waterbodies where removal of low-growing vegetation would be minimized, which would aid in protection of the stream environment and reduce the likelihood of excessive sediment loads reaching the streambed. Pursuant to the NERC Reliability Standard FAC-003, the Applicant is required to create and implement a documented vegetation management program for the Project’s permanent ROW to prevent vegetation-caused outages on the transmission system. The vegetation management program will provide the framework for the Project’s Transmission Vegetation Management Plan (TVMP). The TVMP may require additional analysis under NEPA depending on whether and under what conditions DOE decides to participate in the Project. The EPMs for both construction and ROW maintenance, for which the Applicant will need approval for through the state and federal permitting process, would be in place prior to construction and would ensure actions with the potential to impact water and aquatic resources would be avoided or minimized.

Specific to spills and chemical exposures associated with herbicide use and handling of fuel and lubricants, the Applicant would implement EMPs GE-1, GE-5, GE-13, GE-21, and GE-28, as well as the measures that would be outlined in the required SPCCP and SWPPP to minimize these risks. These EPMs include measures that would reduce the risks of accidental spills (e.g., GE-13, GE-21, GE-28) as well as measures that would ensure that the use of herbicides is conducted in accordance with labeled instructions and any federal, state, and local regulations (i.e., GE-5). In addition, a TVMP would be prepared and would address situations where herbicide use is necessary (e.g., the Applicant would evaluate herbicidal treatment options in consideration of site-specific ecological conditions, surrounding and underlying land uses, and any environmental sensitivities before selecting and applying a control). The Vegetation Program and TVMP would be developed to comply with federal, state, and local regulations and standards for reliability and ROW vegetation clearing and maintenance, including NERC Reliability Standard FAC-003. The Vegetation Program and TVMP would also comply with relevant regulations applicable to all lands, including, but not limited to, the Clean Water Act (CWA) Sections 303(d) and 404 and the Endangered Species Act (ESA) of 1973, as amended in Section 7(a)(2). Section 3.17 provides a detailed discussion of the Vegetation

Program and use of herbicides. The TVMP may require additional analysis under NEPA depending on whether and under what conditions DOE decides to participate in the Project. Furthermore, the USFWS and other resource agencies would be consulted if construction efforts occur during time periods that are important to a species (e.g., spawning) or near environmentally sensitive areas with important aquatic resources, to avoid or minimize impacts to species (EPM FVW-5). The Applicant would identify, avoid, and/or minimize adverse effects to wetlands and waterbodies (EPM W-2).

The following information provides an overview of construction related impacts associated for each of the special status fish, aquatic invertebrate, and amphibian species.

Special Status Fish Species

Arkansas Darter. The Arkansas darter, a candidate species for listing under the ESA, has populations that may exist in Beaver, Harper, and Woodward counties within the Cimarron River in Regions 1 and 2 (USFWS 2014c). Habitat for the species occurs within the Neosho and Spring rivers, and associated tributaries, north of the ROI in Regions 3 and 4 (USFWS 2010a). Construction impacts (i.e., vegetation clearing, grading, access roads, herbicide use, and handling of fuel and lubricants) to this species would be limited to very specific stream and river crossings or locations where construction could result in sedimentation or contaminant runoff to Arkansas Darter habitat within the ROI in Regions 1 and 2. Under EPM FVW-5, for construction in the vicinity of sensitive areas as well as during sensitive time periods (e.g., spawning), the Applicant would consult with the USFWS and/or ODWC for guidance on seasonal and/or spatial restrictions to avoid or minimize adverse effects.

Arkansas River Shiner. The Arkansas River shiner, a federally listed threatened species, has a population that may exist in the Cimarron River across Beaver, Harper, Woodward, Major, Kingfisher, and Logan counties in Oklahoma in Regions 1, 2, and 3 (USFWS 2014c. Construction impacts (i.e., vegetation clearing, grading, access roads, herbicide use, and handling of fuel and lubricants) to this species would be limited to very specific stream and river crossings or locations where construction would result in sedimentation or contaminant runoff to Arkansas River shiner habitat within the ROI in Regions 1, 2, and 3. In Region 2, the HVDC transmission line crosses critical habitat in the Cimarron River for the species within Logan and Major counties, including a lateral distance of 300 feet on each side of the stream width at bankfull discharge (Clean Line 2013). The Applicant has not proposed in-stream activities or installation of transmission structures within the critical habitat boundaries; however, clearing of riparian vegetation would likely be necessary to ensure operational safety and system reliability (Clean Line 2013). The Applicant would establish streamside management zones within 50 feet of both sides of intermittent and perennial streams and along margins of bodies of open water where removal of low-lying vegetation is minimized (EPM W-3). The Applicant would consult with the USFWS and/or ODWC for guidance on seasonal and/or spatial restrictions designed to avoid and/or minimize adverse effects (EPM FVW-5).

Ozark Cavefish. The Ozark cavefish, a federally listed threatened species, has a limited range, only occurring in the Springfield Plateau of the Ozark Highlands ecoregion, which covers southwestern Missouri, northwestern Arkansas, and northeastern Oklahoma (Natureserve 2014e). This species does not have any known occurrences that are in counties crossed by the ROI, so no impacts to this species or its habitat are expected to occur. The closest known occurrences are in caves located north of the ROI in Region 4.

Yellowcheek Darter. The yellowcheek darter, a federally listed endangered species, has populations that may exist in Van Buren and Cleburne counties in Arkansas, but the only currently known populations are located approximately

10 miles north of the ROI (USFWS 2014c). This species is endemic to four streams of the Little Red River, all located north of the ROI (77 FR 63604, October 16, 2012). Construction impacts (i.e., vegetation clearing, grading, access roads, herbicide use, and handling of fuel and lubricants) to this species are not expected, but would be limited to very specific stream and river crossings or locations where construction would result in sedimentation or contaminant runoff to yellow darter habitat within the ROI in Region 5.

Pallid Sturgeon. The pallid sturgeon, a federally listed endangered species, occurs in the Mississippi River across Mississippi County in Arkansas, and Lauderdale, Shelby, and Lake counties in Tennessee (USFWS 2014c). Construction impacts (i.e., vegetation clearing, grading, access roads, herbicide use, and handling of fuel and lubricants) may occur along the representative ROW near the Mississippi River crossing of the ROI within Region 7 (Clean Line 2013). These impacts are expected to be minimal because construction equipment would not enter the Mississippi River. The discharge of sediments or any contaminants into the river would be an unlikely occurrence due to the Applicants implementation of the SWPPP.

Special Status Aquatic Invertebrate Species

For aquatic invertebrates occurring or potentially occurring in the ROI, only mussel species have been given special status. Since freshwater mussels require a fish host to complete their reproductive cycle, all fish-related impacts are also pertinent to mussels, and could affect them as well (Jennings 1998). The Applicant would not place structure foundations within the Ordinary High Water Mark of Waters of the United States, and would minimize construction of access roads in special interest waters as much as possible (EPM W-2). In addition, the USFWS and other resource agencies would be consulted with for guidance on seasonal and/or spatial restrictions to avoid or minimize adverse effects (EPM FVW-5). The Applicant would identify, avoid, and/or minimize adverse effects to wetlands and waterbodies (EPM W-2). The Applicant does not anticipate impacts to mussels because impacts to waters containing these species can generally be avoided through implementation of the EPMs described in Section 3.14.2.7.1.

Spectaclecase. The spectaclecase, a federally listed endangered species, is found within the ROI in Johnson County, Arkansas (USFWS 2014c). There is limited spectaclecase habitat available within the ROI. Construction impacts (i.e., vegetation clearing, grading, access roads, herbicide use, and handling of fuel and lubricants) to this species would be limited to very specific stream and river crossings or locations where construction impacts would result in sedimentation or contaminant runoff to spectaclecase habitat within the ROI in Region 4.

Pink Mucket. The pink mucket, a federally listed endangered species, is found in tributaries associated with the White River in White and Jackson counties in Arkansas (USFWS 2014c). Construction impacts (i.e., vegetation clearing, grading, access roads, herbicide use, and handling of fuel and lubricants) to this species would be limited to crossings of the White River and associated tributaries, or locations where construction impacts would result in sedimentation or contaminant runoff to pink mucket habitat within the ROI in Regions 5 and 6.

Neosho Mucket. The Neosho mucket is a federally listed endangered species. This species occurs in the Illinois River in Adair County, Oklahoma; however, Adair County is not in the ROI. Within the ROI, the species may exist within tributaries of the Illinois River (77 FR 63439, October 16, 2012). Given the current known locations for this species, impacts are not likely to occur to this species or its habitat within the ROI in Region 4.

Speckled Pocketbook. The speckled pocketbook, a federally listed endangered species, is endemic to the Little Red River and its tributaries in Van Buren, Pope, Cleburne, and White counties in Arkansas (USFWS 2007a, 2014b).

Construction impacts (i.e., vegetation clearing, grading, access roads, herbicide use, and handling of fuel and lubricants) to this species would be limited to crossings of and activities adjacent to, the Little Red River and associated tributaries, or locations where construction impacts would result in sedimentation or contaminant runoff to speckled pocketbook habitat within the ROI in Regions 4 and 5.

Scaleshell Mussel. The scaleshell mussel, a federally listed endangered species, has a range that overlaps with the ROI in Crawford, Franklin, White, and Jackson counties in Arkansas (USFWS 2014c). Construction impacts (i.e., vegetation clearing, grading, access roads, herbicide use, and handling of fuel and lubricants) to this species would be limited to very specific stream and river crossings or locations where construction impacts would result in sedimentation or contaminant runoff to scaleshell mussel habitat within the ROI in Regions 4, 5, and 6.

Fat Pocketbook. The fat pocketbook, a federally listed endangered species, occurs in tributaries and drainage ditches within the St. Francis River Basin in White, Poinsett, and Mississippi counties in Arkansas, as well as in the White River (USFWS 2014c; Natureserve 2014c). Construction impacts (i.e., vegetation clearing, grading, access roads, herbicide use, and handling of fuel and lubricants) to this species would be limited to very specific stream and river crossings or locations where construction impacts would result in sedimentation or contaminant runoff to fat pocketbook habitat within the ROI in Regions 5, 6, and 7.

Rabbitsfoot. The rabbitsfoot, a federally listed threatened species, occurs in tributaries of the White River in Van Buren, White, and Jackson counties in Arkansas, while the White River is proposed critical habitat for the species (USFWS 2014c; Natureserve 2014h). Construction impacts (i.e., vegetation clearing, grading, access roads, herbicide use, and handling of fuel and lubricants) to this species would be limited to crossings of the White River and associated tributaries, or locations where construction impacts would result in sedimentation or contaminant runoff to rabbitsfoot habitat within the ROI in Regions 5 and 6. The Applicant would consult with the USFWS and/or other resource agencies for guidance on seasonal and/or spatial restrictions designed to avoid and/or minimize adverse effects (EPM FVW-5) related to the proposed critical habitat associated with potential crossings of the White River.

Snuffbox. The snuffbox, a federally listed endangered species, has a range that overlaps with the ROI in Polk, Cross, Poinsett, and Mississippi. Construction impacts (i.e., vegetation clearing, grading, access roads, herbicide use, and handling of fuel and lubricants) to this species would be limited to very specific stream and river crossings or locations where construction impacts would result in sedimentation or contaminant runoff to snuffbox habitat within the ROI in Regions 4, 5, 6 and 7.

Curtis' Pearlymussel. The Curtis' pearlymussel, a federally listed endangered species, has an historical range that may overlap with the ROI in the White River drainage. Construction impacts (i.e., vegetation clearing, grading, access roads, herbicide use, and handling of fuel and lubricants) to this species would be limited to very specific stream and river crossings or locations where construction impacts would result in sedimentation or contaminant runoff to Curtis' pearlymussel habitat within the ROI in Region 5 if this species were present.

Special Status Amphibian Species

Ozark Hellbender. The Ozark hellbender salamander, a federally listed endangered species, and has a range that overlaps with the ROI in Republic County at the White River Crossing. Construction impacts (i.e., vegetation clearing, grading, access roads, herbicide use, and handling of fuel and lubricants) to this species would be limited to the

White River crossing where construction could result in sedimentation or contaminant runoff to Ozark hellbender habitat within the ROI in Region 5.

3.14.2.7.2.2 Operations and Maintenance Impacts

The operations and maintenance phase of the Project could potentially impact special status fish, aquatic invertebrate, and amphibian resources. Potential impacts in the operations and maintenance phase of the Project would be similar to the potential impacts in the construction phase of the Project; however impacts would occur at a lesser extent than in the construction phase, but occur throughout the life of the Project. During the operations and maintenance phase, the use of both access roads and the ROW for repair and maintenance activities could result in both direct and indirect impacts. In addition, the maintenance of ROW clearing in forested riparian areas could result in both direct and indirect impacts to habitat for special status species. The potential application of herbicides during operations and maintenance of the Project could result in indirect impacts, and to a lesser extent, direct impacts.

Both general EPMs and those specific to fish and aquatic resources as listed in Section 3.14.2.7.1, would be implemented to avoid or minimize impacts to fish and aquatic resources during the operations and maintenance phase of the Project.

Special Status Fish Species

Operations and maintenance impacts of the Project on special status fish species would be similar to the potential impacts in the construction phase of the Project. Routine maintenance or unplanned repairs may require crews and/or machinery to visit an area for ROW maintenance in which a special status fish occurs. This disturbance would not be expected to result in greater impacts than those of construction activities, but it would occur throughout the life of the Project.

Special Status Aquatic Invertebrate Species

Similar to fish, special status aquatic invertebrate species (i.e., special status mussels) may experience direct or indirect impacts during operations and maintenance, though they would likely be less in extent than construction impacts. Crews and equipment may require access to habitat of special status mussels while performing routine maintenance or unplanned repairs within the ROW. This work, however, is not likely to impact special status aquatic invertebrates to a greater extent than construction activities.

Special Status Amphibian Species

Similar to fish, special status amphibian species (i.e., special status salamander) may experience direct or indirect impacts during operations and maintenance, though they would likely be less in extent than construction impacts. Crews and equipment may require access to habitat of special status salamanders while performing routine maintenance or unplanned repairs within the ROW. This work, however, is not likely to impact special status amphibians to a greater extent than construction activities.

3.14.2.7.2.3 Decommissioning Impacts

During the third phase of the Project, decommissioning of the Project could cause potential impacts to special status fish, aquatic invertebrate, and amphibian resources. Decommissioning impacts would be similar in nature to those described for construction phase of the Project. The Applicant would develop a Decommissioning Plan prior to the start of decommissioning that would be submitted for review and approval by the appropriate federal and state resources agencies.

During the decommissioning phase of the Project, all general EPMs and those specific to special status fish and aquatic resources that were implemented during the construction phase of the Project would continue to be implemented to avoid or minimize impacts to fish and aquatic resources (see Section 3.14.2.7.1 for relevant EPMs).

Long-term effects of decommissioning are likely to benefit special status species, as Project impacts would be removed and riparian vegetation and adjacent land use returns to a less disturbed state.

3.14.2.7.2.4 Converter Stations and AC Interconnection Siting Areas

A detailed description of the converter stations and other terminal facilities is provided in Section 2.1.2.1.

This section covers the data reviewed within the footprint of the converter station siting areas and associated AC interconnection siting area and tie. No impacts are expected to affect fish and aquatic resources due to construction or operations and maintenance activities related to these facilities.

3.14.2.7.2.4.1 Construction Impacts

3.14.2.7.2.4.1.1 Oklahoma Converter Station Siting Area and AC Interconnection Siting Area

The western portion of the Project would interconnect to the existing transmission system in Texas County, Oklahoma. The construction of the Oklahoma converter station and AC interconnection would not likely result in any direct or indirect impacts to special status fish, aquatic invertebrate and amphibian species or their habitat because no waterbodies are located within the footprint of the converter station. However upslope erosion associated site or access road construction or use may increase sediment runoff to streams if the station is constructed near a waterbody that contains special status fish, aquatic invertebrate, or amphibian species.

3.14.2.7.2.4.1.2 Tennessee Converter Station Siting Area and AC Interconnection Tie

The Tennessee Converter Station Siting Area is located within Region 7, with the AC Interconnection Tie contained entirely within the Tennessee converter station and the Shelby Substation footprints. The only special status fish, aquatic invertebrate, or amphibian species identified near this portion of the Project include the pallid sturgeon (federally endangered) and blue sucker (state threatened), which occur within the Mississippi River. Although the Mississippi River is more than 10 miles from the siting area, construction activities could impact tributaries draining into the Mississippi River. Big Creek runs adjacent to the western edge of the siting area. Construction activities occurring along the western edge of the siting area could introduce sediment, herbicides, and/or fuel and lubricants into the aquatic system that could travel to the Mississippi River due to construction activities such as road crossings.

3.14.2.7.2.4.2 Operations and Maintenance Impacts

3.14.2.7.2.4.2.1 Oklahoma Converter Station Siting Area and AC Interconnection Siting Area

The operations and maintenance of the Oklahoma converter station and AC interconnection likely not result in any direct or indirect impacts to special status fish, aquatic invertebrate and amphibian species or their habitat because no waterbodies are located within the footprint of the converter station. However upslope erosion associated site or access road construction or use may increase sediment runoff to streams if the station is constructed near a waterbody that contains special status fish, aquatic invertebrate, or amphibian species.

3.14.2.7.2.4.2.2 Tennessee Converter Station Siting Area and AC Interconnection Tie

The Tennessee converter station would interconnect to the existing transmission system in Shelby County, Tennessee. The operations and maintenance of the Tennessee converter station and AC interconnection tie should be less than during construction. The only special status fish, aquatic invertebrate, or amphibian species identified near this portion of the Project include the pallid sturgeon (federally endangered) and blue sucker (state threatened), which occur within the Mississippi River. Although the Mississippi River is more than 10 miles from the siting area, operations and maintenance activities could impact tributaries draining into the Mississippi River. If the converter station is built adjacent to Big Creek, riparian clearing maintenance, road maintenance activities, and facilities operations could result in increased risk of chemical spills and contamination and increased sedimentation that could travel to the Mississippi River.

3.14.2.7.2.4.3 Decommissioning Impacts

The decommissioning of both converter stations and AC interconnection tie would result in short-term impacts, especially in the form of increased sedimentation during structure and road removal, and surface re-contouring activities. Long-term impacts would benefit special status fish, aquatic invertebrate, or amphibian species and their habitat, by removing effects from operations and maintenance activities, as well as removal of road and cleared areas that impact hydrology and sedimentation.

3.14.2.7.2.5 AC Collection System

This section covers the data reviewed within the 2-mile-wide ROI of the AC collection system routes. A description of the AC collection system is provided in Section 2.1.2.3. There is one special status fish, aquatic invertebrate, or amphibian species potentially occurring within the ROI for the AC collection system routes that might be affected: the Arkansas River shiner (federally threatened and state threatened in Oklahoma). The Beaver River and Palo Duro Creek, which are crossed by the ROI for the AC Collection System Routes E-1, E-2, E-3, SE-1, SE-3, NE-1, NE-2, and NW-1, may provide aquatic habitat where populations of the Arkansas River shiner could occur. No USFWS-designated critical habitat is present in the ROI for the AC collection system routes (USFWS 2014c).

3.14.2.7.2.5.1 Construction Impacts

Potential direct impacts to Arkansas River shiner include grading, access roads, herbicide use, and handling of fuel and lubricants where the Beaver River and Palo Duro Creek would be crossed by the AC collection system routes. Because semi-arid grasslands/herbaceous and croplands comprise most of the terrestrial habitats along the AC collection system routes, vegetation clearing is not likely to cause a direct impact. Potential indirect impacts include vegetation clearing, grading, access roads, herbicide use, and handling of fuel and lubricants at locations where construction activities would result in sedimentation or contaminant runoff into the Beaver River and Palo Duro Creek.

During the initial construction phase of the Project, both general EPMs and those specific to fish and aquatic resources as listed in Section 3.14.2.7.1, would be implemented to avoid or minimize impacts.

3.14.2.7.2.5.2 Operations and Maintenance Impacts

Potential impacts in the operations and maintenance phase of the Project would be similar to the potential impacts in the construction phase of the Project; however impacts would be at a lesser extent than in the construction phase, but occur throughout the life of the project. During the operations and maintenance phase, the use of both access roads and the ROW for repair and maintenance activities could result in both direct and indirect impacts to the Arkansas River shiner or its potential habitat in the Beaver River and Palo Duro Creek. In addition, the potential application of herbicides during operations and maintenance of the Project could result in indirect impacts, and to a lesser extent, direct impacts.

During the operations and maintenance phase of the Project, both general EPMs and those specific to fish and aquatic resources as listed in Section 3.14.2.7.1, would be implemented to avoid or minimize impacts to fish and aquatic resources.

3.14.2.7.2.5.3 Decommissioning Impacts

During the third phase of the Project, decommissioning of the AC transmission lines could cause potential direct and indirect impacts to the Arkansas River shiner or its potential habitat in the Beaver River and Palo Duro Creek. Decommissioning impacts would be similar in nature to those described for construction impacts. The Applicant would develop a Decommissioning Plan prior to the start of decommissioning that would be submitted for review and approval by the appropriate federal and state resources agencies.

During the decommissioning phase of the Project, all general EPMs and those specific to special status fish and aquatic resources that were implemented during the construction phase of the Project would continue to be enforced to avoid or minimize impacts to fish and aquatic resources (see Section 3.14.2.7.1 for relevant EPMs).

Long-term effects of decommissioning are likely to benefit the Arkansas River shiner or its potential habitat, as Project impacts would be removed and riparian vegetation and adjacent land use returns to a less disturbed state.

3.14.2.7.2.6 HVDC Applicant Proposed Route

The Applicant Proposed Route is described in Sections 2.1.2.2 and 2.4.2. This section identifies the potential impacts on special status fish, special status aquatic invertebrates, and special status amphibians, and these species aquatic habitat based on the three phases of the Project: construction, operations and maintenance, and decommissioning. Each phase of the Project would be conducted in such a way as to protect the quality of the environment. The Applicant would conduct each phase in compliance with applicable state and federal laws, regulations, and permits related to environmental protection. Specific EPMs developed to avoid or minimize impacts are described in Section 3.14.2.7.1.

3.14.2.7.2.6.1 Construction Impacts

This section covers the data reviewed for impacts to special status fish, aquatic invertebrate, and amphibian species during the construction phase of the Project. Specifically, impacts are assessed within the 1,000-foot-wide ROI of the Applicant Proposed Route and the expanded 3-mile buffer both upstream and downstream of the Applicant Proposed Route along waterbodies that have documented occurrences of special status fish, aquatic invertebrate, and amphibian species designated as candidate, threatened, or endangered under the ESA and state-designated threatened and endangered species. The expansion of the ROI that is specific to special status fish, aquatic invertebrate and amphibian species are described in Section 3.14.2.3.1. Species-specific descriptions are described in Section 3.14.2.4 and by region in Section 3.14.2.5.

Potential impacts to special status aquatic species during construction would be similar to those described in Section 3.14.2.7.2. Impacts to special status fish species would be reduced through implementation of EPMs described in Section 3.14.2.7.1.

3.14.2.7.2.6.1.1 Region 1

In the ROI in Region 1, one federally threatened fish (Arkansas River shiner) and one fish that is a candidate for listing (Arkansas darter) have the potential to be present. Populations of the Arkansas River shiner are known to occur within the ROI in the Cimarron River in Beaver, Harper, and Woodward counties in Region 1.

No route variations were proposed in Region 1.

3.14.2.7.2.6.1.2 Region 2

In the ROI in Region 2, one federally threatened fish (Arkansas River shiner) and one fish that is a candidate for listing (Arkansas darter) have the potential to be present. Populations of the Arkansas River shiner are known to occur within the ROI in the Cimarron River in Woodward and Major counties of Oklahoma in Region 2.

As described in Section 3.14.2.5, two route variations to the Applicant Proposed Route in Region 2 were developed in response to public comments on the Draft EIS7. Because these route variations are located adjacent to the original Applicant Proposed Route, and mostly cross through the same types of habitats as the original Applicant Proposed Route, impacts from most of these route variations on special status aquatic species would be similar to those that would occur as a result of the original Applicant Proposed Route. These variations represent minor adjustments to the Applicant Proposed Route. Link 1, Variation 1, as well as Link 2, Variation 2, would cross through the same types of wetlands and habitat as the original Applicant Proposed Route Links 1 and 2.

3.14.2.7.2.6.1.3 Region 3

In the ROI in Region 3, one federally threatened fish (Arkansas River shiner) has the potential to be present. Populations of the Arkansas River shiner are known to occur within the ROI in the Cimarron River in Kingfisher and Logan counties of Oklahoma in Region 3. One special status fish has the potential to occur north of Region 3, the candidate Arkansas darter; however, this fish potentially occurs just beyond the ROI.

As described in Section 3.14.2.5, five route variations to the Applicant Proposed Route in Region 3 were developed in response to public comments on the Draft EIS. Because these route variations are located adjacent to the original Applicant Proposed Route, and mostly cross through the same types of habitats as the original Applicant Proposed Route, impacts from most of these route variations on special status aquatic species would be similar to those that would occur as a result of the original Applicant Proposed Route. However, the Applicant Proposed Route Link 1, Variation 2, would result in a larger area of impact to wetland habitats (see Section 3.17), thereby potentially resulting in a larger extent of long-term impacts to special status aquatic species and their habitats. In addition, Link 1, Variation 2, would potentially cross more waterbodies, thereby resulting in greater impacts to special status aquatic species and their habitats. In contrast, the Links 1 and 2, Variation 1, would potentially cross fewer waterbodies, thereby resulting in fewer impacts to special status aquatic species and their habitats.

3.14.2.7.2.6.1.4 Region 4

In the ROI in Region 4, there are five federally endangered species of aquatic invertebrates (Neosho mucket, spectaclecase, speckled pocketbook, scaleshell mussel and snuffbox) with the potential to occur. Two special status fish species potentially occur north of Region 4, the candidate Arkansas darter and the federally endangered Ozark cavefish. Note that these fish potentially occur just beyond the ROI.

As described in Section 3.14.2.5, seven route variations to the Applicant Proposed Route in Region 4 were developed in response to public comments on the Draft EIS. Because these route variations are located adjacent to the original Applicant Proposed Route, and mostly cross through the same types of habitats as the original Applicant Proposed Route, impacts from most of these route variations on special status aquatic species would be similar to those that would occur as a result of the original Applicant Proposed Route. Two route variations would result in a significant decrease in acreage of impact to wetland habitats compared to the original Applicant Proposed Route (see Section 3.17), thereby potentially resulting in fewer long-term impacts to fish and aquatic resources and their habitats: Link 3, Variation 1, and Link 3, Variation 2. In addition, Link 9, Variation 1, in Region 4 would potentially cross fewer waterbodies, thereby resulting in fewer impacts to special status aquatic species and their habitats. Link 3, Variation 2, would parallel almost four times the length of existing infrastructure compared to the original Applicant Proposed Route (thereby reducing the impacts to areas that have not already been impacted by existing infrastructure), and would cross through areas that contain fewer wetland and waterbody features compared to the original links of the Applicant Proposed Route.

3.14.2.7.2.6.1.5 Region 5

In the ROI in Region 5, there are seven federally endangered species, one fish (yellowcheek darter) and six mussels (scaleshell mussel, speckled pocketbook, pink mucket, fat pocketbook, snuffbox, and Curtis' pearlymussel), as well as one federally threatened species (rabbitsfoot) with the potential to occur. The yellowcheek darter potentially occurs north of the ROI, but has the potential to inhabit areas within the ROI as well. Also the Ozark hellbender salamander could occur at the White River Crossing in Republic County.

As described in Section 3.14.2.5, five route variations to the Applicant Proposed Route in Region 5 were developed in response to public comments on the Draft EIS. Because these route variations are located adjacent to the original Applicant Proposed Route, and mostly cross through the same types of habitats as the original Applicant Proposed Route, impacts from most of these route variations on special status aquatic species would be similar to those that would occur as a result of the original Applicant Proposed Route. However, Link 1, Variation 2, would result in a significant decrease in acreage of impact to wetland habitats compared to the original Applicant Proposed Route (see Section 3.17), thereby potentially resulting in fewer long-term impacts to special status aquatic species and their habitats. In contrast, Link 7, Variation 1, would potentially cross more waterbodies, thereby resulting in greater impacts to special status aquatic species and their habitats. Link 1, Variation 2, would potentially cross fewer waterbodies, thereby resulting in fewer impacts to special status aquatic species and their habitats.

3.14.2.7.2.6.1.6 Region 6

In the ROI in Region 6, there are four federally endangered mussels (pink mucket, scaleshell, fat pocketbook and snuffbox) and one federally threatened mussel (rabbitsfoot) with the potential to occur.

As described in Section 3.14.2.5, one route variation to the Applicant Proposed Route in Region 6 was developed in response to public comments on the Draft EIS. Because this route variation is located adjacent to the original Applicant Proposed Route, and mostly crosses through the same types of habitats as the original Applicant Proposed Route Link 2, impacts on special status aquatic species would be similar to those that would occur as a result of the original Applicant Proposed Route. This variation represents minor adjustments to the Applicant Proposed Route. However, Link 2, Variation 1, would result in a larger area of impact to wetland habitats (see Section 3.17), thereby potentially resulting in a larger extent of long-term impacts to special status aquatic species and their habitats.

3.14.2.7.2.6.1.7 Region 7

In the ROI in Region 7, three federally endangered species (one fish and two mussels) have the potential to be present (the pallid sturgeon the fat pocketbook, and snuffbox).

As described in Section 3.14.2.5, three route variations to the Applicant Proposed Route in Region 7 were developed in response to public comments on the Draft EIS. Because these route variations are located adjacent to the original Applicant Proposed Route, and mostly cross through the same types of habitats as the original Applicant Proposed Route, impacts from most of these route variations on special status aquatic species would be similar to those that would occur as a result of the original Applicant Proposed Route. However, Link 1, Variation 2, would result in a larger area of impact to wetland habitats (see Section 3.17), thereby potentially resulting in a larger extent of long-term impacts to special status aquatic species and their habitats. In contrast, Link 1, Variation 2, would result in a significant decrease in acreage of impact to wetland habitats compared to the original Applicant Proposed Route (see Section 3.17), thereby potentially resulting in fewer long-term impacts to special status aquatic species and their habitats. Finally, Link 1, Variation 2, would potentially cross fewer waterbodies, thereby resulting in fewer impacts to special status aquatic species and their habitats.

3.14.2.7.2.6.2 Operations and Maintenance Impacts

Impacts to special status fish species (as identified in Section 3.14.2.7.6.1 for each region) during operations and maintenance would be similar to those described in Section 3.14.2.7.2.2. During the operations and maintenance phase of the Project, both general EPMs and those specific to fish and aquatic resources as described in Section 3.14.2.7.1, would be implemented to avoid or minimize impacts to special status fish and aquatic resources.

3.14.2.7.2.6.3 Decommissioning Impacts

The short-term impacts during decommissioning of Applicant Proposed Route would be similar to the impacts that would occur during the construction phase. Structure removal, road decommissioning, and removal of road crossings is likely to have potential impacts to special status fish and aquatic resources due to increased sedimentation from runoff of disturbed areas and direct impact of removal of instream crossing structures. Following EPMs as described in Section 3.14.2.7.1 would help reduce the level of short-term impacts from decommissioning activities.

Long-term impacts of Project decommissioning would benefit special status fish, aquatic invertebrate, and amphibian species due to removal of impacts from Project components, such as roads and road maintenance activities, as well as allowing the vegetation in any cleared ROW areas to regrow.

3.14.2.7.3 Impacts Associated with the DOE Alternatives

This section identifies the potential direct and indirect impacts on special status fish species, special status aquatic invertebrate species, and special status amphibian species and their aquatic habitat related to the DOE alternatives.

3.14.2.7.3.1 Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area

A detailed description of the Arkansas converter station and other terminal facilities is provided in Section 2.4.3.1. The Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area are located near the western end of Region 5 in Pope County. In addition to the Arkansas Converter Station Alternative and AC Interconnection Siting Area, a new substation would be constructed that would interconnect the AC transmission line to an existing 500kV transmission line. This substation would be located near an existing transmission line in an area that is primarily grassland with some forest land.

3.14.2.7.3.1.1 Construction Impacts

The construction of the Arkansas converter station and AC transmission line, as well as the new substation, would not likely result in any direct impacts to special status fish, aquatic invertebrate and amphibian species or their habitat because no major waterbodies are located within the footprint of the construction area or along the interconnection area. However upslope erosion associated site or access road construction or use may increase sediment runoff to streams if the station is constructed near a waterbody that contains special status fish, aquatic invertebrate, or amphibian species.

3.14.2.7.3.1.2 Operations and Maintenance Impacts

The operations and maintenance of the Arkansas converter station and AC transmission line, as well as the new substation, would not likely result in any direct impacts to special status fish, aquatic invertebrate and amphibian species or their habitat because no major waterbodies are located within the footprint of the construction area or along the interconnection area. However upslope erosion associated road use may increase sediment runoff to streams if the station was constructed near a waterbody that contains special status fish, aquatic invertebrate, or amphibian species.

3.14.2.7.3.1.3 Decommissioning Impacts

The impacts during decommissioning of the Arkansas converter station and AC transmission line, as well as the new substation, would be similar to the impacts occurring during the construction phase. Decommissioning would not likely result in any direct impacts to special status fish, aquatic invertebrate and amphibian species or their habitat because no major waterbodies are located within the footprint of the construction area or along the interconnection area. However upslope erosion associated road use may increase sediment runoff to streams if the station was constructed near a waterbody that contains special status fish, aquatic invertebrate, or amphibian species.

3.14.2.7.3.2 HVDC Alternative Routes

Descriptions of the HVDC alternative routes are provided in Section 2.4.3.2. The impacts that could occur to special status fish, aquatic invertebrate, and amphibian species from construction and operations and maintenance of the Applicant Proposed Route are discussed in Section 3.14.2.7.2.6. The expected types of impacts from construction and operations and maintenance of the HVDC alternative routes in each region would be similar to those for the Applicant Proposed Route. However, because of differences in routing (i.e., location) the potential for impacts may be different (e.g., the route may be closer to or farther from an important stream or river crossing). The discussion in this section focuses on the differential impacts that could occur under each of the HVDC alternative routes compared to the Applicant Proposed Route.

3.14.2.7.3.2.1 Construction Impacts

This section describes construction impacts associated with the 1,000-foot-wide ROI of the HVDC alternative routes and the expanded 3-mile buffer both upstream and downstream. Available data used in the impacts comparison include USWFS-designated critical habitat. Analyses are presented for the ROI in Regions 1 through 7. During the construction phase of the Project, all general EPMs and those specific to special status fish and aquatic resources would be implemented to avoid or minimize impacts to fish and aquatic resources (see Section 3.14.2.7.1 for relevant EPMs).

For all regions except Region 2, there would be no difference in impacts between the Applicant Proposed Route and the HVDC alternative routes. For Region 2, the following differences would exist between alternative routes:

- HVDC Alternative Route 2-A is approximately 57 miles long and corresponds to Applicant Proposed Route Link 2. HVDC Alternative Route 2-A has more acres of waters designated by the USFWS as critical habitat for the Arkansas River shiner within the ROI. Both the HVDC Alternative Route 2-A and the corresponding Link 2 of the Applicant Proposed Route cross the Cimarron River at separate locations where it is USFWS designated critical habitat, but HVDC Alternative Route 2-A is within the critical habitat for more acres.
- The Applicant Proposed Route Link 2 has 101 acres of critical habitat for the Arkansas River shiner within Region 2 of the HVDC transmission line 1,000-foot-wide ROI and 3-mile buffer, while HVDC Alternative Route 2-A has 635 acres of critical habitat for the Arkansas River shiner within the ROI and 3-mile buffer.
- The Applicant Proposed Route Link 2 has 95 acres of critical habitat for the Arkansas River shiner within Region 2 of the HVDC transmission line 200-foot-wide ROW and 3-mile buffer, while HVDC Alternative Route 2-A has 586 acres of critical habitat for the Arkansas River shiner within the ROW and 3-mile buffer.
- HVDC Alternative Route 2-B is approximately 30 miles long and corresponds to Applicant Proposed Route Link 3. HVDC Alternative Route 2-B has fewer acres of waters designated by the USFWS as critical habitat for the Arkansas River shiner within the ROI. Neither the HVDC Alternative Route 2-B or the corresponding Link 3 of the Applicant Proposed Route cross the Cimarron River where it is USFWS-designated critical habitat, but HVDC Alternative Route 2-B is within the critical habitat for fewer acres.
- The Applicant Proposed Route Link 3 has 71 acres of critical habitat for the Arkansas River shiner within Region 2 of the HVDC transmission line 1,000-foot-wide ROI and 3-mile buffer, while HVDC Alternative Route 2-B has 6 acres of critical habitat for the Arkansas River shiner within the ROI and 3-mile buffer.
- The Applicant Proposed Route Link 3 has 52 acres of critical habitat for the Arkansas River shiner within Region 2 of the HVDC transmission line 200-foot-wide ROW and 3-mile buffer, while HVDC Alternative Route 2-B has 2 acres of critical habitat for the Arkansas River shiner within the ROW and 3-mile buffer.

As described in Appendix M, a route adjustment was developed for HVDC Alternative Routes 3-A, 5-B, 5-E, and 6-Ato maintain an end-to-end route with the Applicant Proposed Route and the new route variations. These route adjustments would cross through the same types of wetlands and habitats as the original Applicant Proposed Route. HVDC Alternative Routes 5-E and 6-A potentially have a reduction in number of floodplains from two to one for each route, which would potentially result in fewer impacts to special status fish, aquatic invertebrates, and amphibian species and their habitat.

3.14.2.7.3.2.2 Operations and Maintenance Impacts

Impacts to special status fish species (as identified in Section 3.14.2.7.6.1 for each region) during operations and maintenance of the HVDC alternative routes would be similar to those described in Section 3.14.2.7.2.2. The amount of critical habitat for the Arkansas River shiner along HVDC Alternative Routes 2-A and 2-B (as mentioned above for construction) would be the only difference between the alternative routes and the Applicant Propose Route. During the operations and maintenance phase of the Project, both general EPMs and those specific to fish and aquatic resources as described in Section 3.14.2.7.1, would be implemented to avoid or minimize impacts to special status fish and aquatic resources.

3.14.2.7.3.2.3 Decommissioning Impacts

Decommissioning of the HVDC alternative routes could cause potential impacts to special status fish, aquatic invertebrate, and amphibian resources. Decommissioning impacts would be similar in nature to those described during construction. During the decommissioning phase of the Project, all general EPMs and those specific to special status fish and aquatic resources that were implemented during the construction phase of the Project would continue to be implemented to avoid or minimize impacts to fish and aquatic resources (see Section 3.14.2.7.1). The Applicant would develop a Decommissioning Plan prior to the start of decommissioning that would be submitted for review and approval by the appropriate federal and state resources agencies.

3.14.2.7.4 Best Management Practices

The Applicant has developed a list of EPMs intended to avoid or minimize impacts to special status fish, aquatic invertebrate, and amphibian species. A complete list of EPMs for the Project is provided in Appendix F; those EPMs that would specifically minimize the potential for impacting special status fish, aquatic invertebrate, and amphibian species are summarized in Section 3.14.2.7.1. In addition, DOE and the Applicant have prepared a Biological Assessment (Appendix O of the EIS) of potential impacts on special status species protected under the ESA as part of the Section 7 consultation between DOE and the USFWS. The Section 7 consultation review is a parallel but separate process conducted pursuant to the requirements of ESA and the applicable implementing regulations. A Biological Opinion will be issued by USFWS prior to the Record of Decision. Through this process, additional protective measures may be identified and adopted to avoid or minimize impacts to special status fish, aquatic invertebrate and amphibian species and their habitat.

3.14.2.7.5 Unavoidable Adverse Impacts

The Applicant would implement EPMs to avoid or minimize impacts; however, some adverse impacts may occur to special status fish, aquatic invertebrate, and amphibian species or their habitat even with the implementation of these measures. Construction and operations and maintenance of the Project could result in the mortality and injury of some special status fish, aquatic invertebrate, and amphibian species if they are present in the affected areas during construction or operations and maintenance. Construction mortalities and injuries could result from crushing during waterbody crossings with equipment, sedimentation, potential exposure to hazardous materials, and blasting. Operation mortalities and injuries could result from sedimentation and potential exposure to hazardous materials. Unavoidable impacts to special status fish, aquatic invertebrate, and amphibian species and their habitat include the potential loss or alteration of aquatic habitat in streams that may require culverts or vehicle crossings, potential loss or disturbance to riparian vegetation along streams on private or public lands where the ROW is parallel and adjacent to the stream, and potential short-term sedimentation effects on aquatic resources as a result of vehicular traffic causing disturbances within or adjacent to streams. Although these impacts have the potential to occur, the likelihood of occurrence would be limited through implementation of the EPMs.

3.14.2.7.6 Irreversible and Irretrievable Commitment of Resources

The potential permanent loss or alteration of aquatic habitat in smaller streams that may require road crossings would last throughout the life of the Project; however, gradual recovery of habitat may occur once the road crossing was removed. As the exact state of this recovery is not known (e.g., substantial changes related to climate, land-use, and/or watershed hydrology may occur during the 80 year lifespan of the Project), and aquatic habitat is subject to long-term climatic regimes and changes in land-use and watershed hydrology, it is reasonable to assume that some portions of the aquatic habitat for special status fish, aquatic invertebrate, and amphibian species in these smaller streams would be irreversibly and irretrievably impacted.

3.14.2.7.7 Relationship between Local Short-term Uses and Long-term Productivity

The Project may result in a short-term disturbance to special status fish, aquatic invertebrate, and amphibian resources; however, these impacts would not likely affect the long-term productivity of populations of special status fish and aquatic invertebrate species.

3.14.2.7.8 Impacts from Connected Actions

3.14.2.7.8.1 Wind Energy Generation

Two aquatic species listed under the ESA potentially occur within the WDZs, the Arkansas darter (a candidate species) and the Arkansas River shiner (a threatened species). Both species occur in Beaver County, Oklahoma. USFWS-designated critical habitat for these species is not located within the WDZs. Both species are located in close enough proximity to the WDZ to warrant inclusion here. Wind energy developers follow guidance outlined in the Land-based Wind Energy Guidance (USFWS 2012c) to develop, construct, and operate and maintain projects in a manner that would avoid and/or minimize adverse effects on both species.

The Arkansas darter and Arkansas River shiner may occur within the WDZs. Habitat exists for both species in the Cimarron River and its tributaries. WDZ-J and -K are both located in Beaver County, and would be the most likely to have appropriate habitat for both species of all the WDZs.

Potential construction impacts to these species would be similar to those defined in Section 3.14.2.7; however, the severity of impacts would be higher given these species' vulnerability due to reduced population numbers, restricted ranges, and any other limitations. Wind farm developers would need to consider developing site-specific EPMs that would be implemented as necessary after consultation with federal and state agencies regarding seasonal or spatial restrictions. Potential impacts due to operations and maintenance, as well as decommissioning, would be similar to those defined in Section 3.14.2.7.

3.14.2.7.8.2 Optima Substation

Because there are no waterbodies within the future Optima Substation site, occurrences of special status fish, aquatic invertebrate, and amphibian species are not likely. Accordingly, impacts associated with future Optima Substation site to fish, aquatic invertebrate, and amphibian species would not be likely.

3.14.2.7.8.3 TVA Upgrades

The ROI for the direct assignment facilities cannot be determined at this time as described in Section 3.14.2.6.3. A precise ROI has not been identified for the TVA upgrades. Where possible, general impacts associated with the required TVA upgrades are discussed below.

Potential impacts of concern to special status fish, aquatic invertebrate, and amphibian species from the required TVA upgrades, like the Project, could include mortality of individuals, sensory disturbance, and aquatic habitat disturbance or modification by construction or operations and maintenance activities associated with the new transmission line. Generally, construction and operations and maintenance of the new 500kV transmission line would have impacts similar to the Project, although on a smaller scale. These impacts may include mechanical damage and/or removal of vegetation by heavy machinery, potential introduction of invasive species from construction equipment or spread of existing invasive species, alteration of hydrology during road construction, which could affect special status fish, aquatic invertebrate, and amphibian species habitat, sedimentation from grading, access roads, and stream crossings, and contamination from herbicide drift or runoff or from accidental spills of fuels or lubricants that could cause mortality or injury of special status fish, aquatic invertebrate, and amphibian species. These potential impacts would be short term except for habitat loss at sites used for access (i.e., roads and stream crossings) and any special status fish, aquatic invertebrate, and amphibian species mortality.

The required TVA upgrades to existing facilities (including existing transmission lines and existing substations) would require fewer construction activities to complete than the new 500kV transmission line. Existing TVA facilities already experience operations and maintenance activities. As a result, potential impacts would be expected to be less substantial in areas affected by upgrades to existing TVA facilities than in areas where the new 500kV transmission line would be constructed.

TVA would consider potential impacts to special status fish, aquatic invertebrate, and amphibian species and their habitats during the siting of the new 500kV transmission line and while planning the upgrades to existing transmission facilities. TVA would avoid impacts to these species and their habitats to the extent practicable. Pursuant to Section 7 of the ESA, TVA is required to consult with the USFWS with respect to effects of its construction of any new or upgraded transmission facilities upon threatened, endangered, or candidate species.

3.14.2.7.9 Impacts Associated with the No Action Alternative

Under the No Action Alternative, DOE assumes for analytical purposes that the Project would not be constructed. No disturbances would occur due to the Project, including disturbances in waterbodies that could affect special status aquatic species and their habitats. No disturbances related to construction vehicles, equipment, or access roads would affect aquatic resources. No impacts related to the Project would occur due to vegetation removal or the use of herbicides.

Impacts to aquatic species and their habitats would be consistent with present levels of disturbance due to natural conditions in the environment, such as annual changes in stream flow, erosion, and wildfire.

Contents

Tables

Figures Presented in Appendix A

3.15 Surface Water

3.15.1 Regulatory Background

Laws and regulations are associated with the management and protection of surface waters that could affect the Project or the manner in which it would be implemented. Key elements of select federal and state laws and regulations associated with surface water management are summarized in Table 3.15-1.

Table 3.15-1:
Federal and State Laws and Regulations Associated with Surface Water Management

Statute/Regulation	Key Elements
Clean Water Act (33 USC § 1251 *et seq.*)	CWA Section 404 establishes USACE as responsible for regulating the discharge or dredge of fill material to Waters of the U.S.
	CWA Section 401 stipulates that a federal agency (such as the USACE) issuing a permit or license for a discharge to waters of the U.S. must first have the applicable state or tribe grant or waive a Section 401 water quality certification indicating the discharge will comply with the state's water quality standards
	CWA Section 402 establishes the NPDES permit program to regulate discharges of pollutants into surface waters
	CWA Section 303(d) requires states to develop and submit to EPA, lists of impaired waters
	CWA Section 305(b) requires states to develop and periodically update an inventory of the water quality of all water bodies in the state
Rivers and Harbors Appropriation Act of 1899, Section 10 (33 USC § 403)	Section 10 of the Act prohibits obstruction or alteration of any navigable water of the U.S. without a permit from the USACE
Wild and Scenic Rivers Act (16 USC §§ 1271–1287)	Requires federal agencies proposing an action that could affect a Wild and Scenic River to consult with management agency on action and recommended measures to avoid adverse effects
	Per a 1980 CEQ memorandum, federal agencies must consult with the National Park Service on actions that could affect a river segment on the Nationwide Rivers Inventory
Oklahoma Administrative Codes 785:20 and 785:45	Requires a permit be applied for and obtained prior to diversion of surface water Establishes surface water protection measures through water classification, beneficial use designations, and numerical and narrative criteria to maintain and protect such classifications Establishes state policy to protect all waters of the state from degradation of water quality and three levels of protection: Tier 1—attainment and maintenance of an existing or designated beneficial use Tier 2—maintenance or protection of High Quality Waters and Sensitive Public and Private Water Supply Tier 3—no degradation of water quality allowed in Outstanding Resource Waters
Arkansas Natural Resources Commission, Title 3, Rules for the Utilization of Surface Water (ANRC 2009)	Requires anyone proposing to divert surface water for non-riparian use to submit an application to ANRC for determination that the water to be used is excess surface water, is intended for reasonable and beneficial use, and will cause no significant adverse environmental impact
Arkansas Act 81 of 1957	Requires diverters of surface water in excess of 1 acre-foot per year to register their diversion on an annual basis with the ANRC
Arkansas Pollution Control and Ecology Commission, Regulation No. 2, Regulation Establishing Water Quality Standards for Surface Waters of the State of Arkansas (APCEC 2011)	Establishes water quality standards for all surface waters of the State of Arkansas and assigns designated uses per ecoregion (Appendix A of Regulation Number 2).
	As its anti-degradation policy, requires existing in-stream water uses and water quality necessary to protect existing uses be maintained and protected, with High Quality Waters and Outstanding Resource Waters receiving additional protection (sections 2.201 to 2.203)
	Requires (in section 2.305) any work in waters of the state with potential to cause a violation of Water Quality Standards to have a STAA

Table 3.15-1:
Federal and State Laws and Regulations Associated with Surface Water Management

Statute/Regulation	Key Elements
Arkansas Code Annotated 23-3-5	Identifies the Arkansas Public Service Commission as having jurisdiction over crossing of navigable waterways by public service facilities, including electric power lines and specifies filing a petition with the Commission to request approval
Rules of Tennessee Department of Environment and Conservation Chapter 0400-40-03, General Water Quality Criteria (TDEC 2013a) Chapter 0400-45-08, Water Registration Requirements (TDEC 2012)	Establishes surface water classifications and numeric or narrative quality criteria
	Establishes an anti-degradation policy to fully protect existing uses of all surface waters and provides a process for authorizing degradation in waters under specific conditions including if it is in the public interest and there are no other reasonable options
	Requires users withdrawing water from either a surface or groundwater source at an average rate of 10,000 gallons or more per day to be pre-registered with the TDEC (agricultural, emergency and certain non-recurring withdrawals are exempt)
	Purchase of water from a utility is not considered withdrawal
Tennessee Administrative Code 69-3-108	Requires an Aquatic Resource Alteration Permit from the TDEC for alterations or withdrawals from streams, lakes, or wetlands of the state of Tennessee
Texas Water Code, Title 2, Chapter 11	Establishes requirements for temporary water use permits, which the Texas Commission on Environmental Quality may issue provided the temporary use does not interfere with or adversely affect prior appropriations or vested rights on the surface water.
Texas Administrative Code (TAC) 30-1-307	Establishes general water quality criteria applicable to all surface waters of the state unless exempt under TAC 30-307.8–9.
	Establishes Texas's anti-degradation policy and implementation procedures that apply to regulated actions that could increase pollution of water in the state. The policy sets three tiers of protection: (1) protect existing water uses and quality; (2) degradation of waters in excess of fishable/swimmable quality is not allowed unless TCEQ determines it is necessary for important economic or social development; and (3) the quality of Outstanding National Resource waters are to be maintained and protected.

3.15.2 Data Sources

Data were obtained from multiple publicly available sources. GIS datasets were used heavily to develop a picture of resources within the ROI. GIS datasets were obtained primarily from federal and state programs. For example, the USGS National Hydrography Dataset (GIS Data Resource: USGS 2014a) was used as part of the effort to characterize the affected environment. Surface waters of special interest were identified through federal and state listings of special designations as part of water quality or water resource protection efforts. For state designation waters, the listing information was found in state regulations, reports, or plans. Representatives of state agencies were contacted in some cases and information was obtained via conversations or electronic correspondence. Some information presented in this section was obtained from state webpages. References for specific sources of information are provided.

3.15.3 Region of Influence

For surface water, the ROI for the Project and connected actions is the same as described in Section 3.1.1.

3.15.4 Affected Environment

The affected environment for surface water, as described separately for each region below, addresses the following elements:

- Watersheds—This section describes the watersheds where the Project components would be located as a means of identifying the area's surface water drainage features. Watersheds presented here are as defined in the USGS methodology for defining and cataloging the nation's surface water drainage systems (Seaber et al. 1987; GIS Data Source: USGS 2014a). The watersheds or hydrologic units are identified to the eight-digit Hydrologic Unit Code (HUC).
- Surface Water Features—This section characterizes the surface water features within the ROI for the Applicant Proposed Route, HVDC alternative routes, AC collection system routes, and three converter station siting areas. This includes identification of specific water features of special interest, which include the federal and state designations listed in Table 3.15-2. Not all surface water designations identified in the table were applicable to the ROI, but the analysis included a review to make that determination.
- Water Quality—Water quality information is presented primarily in terms of those surface water features that do not meet applicable water quality standards based on the surface water's designated uses and, as a result, have been identified as impaired waters in the states' most recent CWA Section 303(d) reports.
- Water Use—Water use is presented by county based on 2010 data published by the USGS. The USGS compiles water use data every 5 years and since the Draft EIS, the USGS data for 2010 were published and are presented in this Final EIS. The USGS data are presented by use category and include whether a water's source is groundwater or surface water. A detailed summary of water use by county is provided in Section 3.7.

Surface Water Features

Perennial Stream—A stream that normally has water in its channel at all times.

Intermittent Stream—A stream that flows only when it receives water from rainfall runoff or springs, or from some surface source such as snowmelt.

Major Waterbody—For purposes of this evaluation, any surface water feature (perennial stream, lake, pond, etc.) for which a route crossing distance is 100 feet or more.

Feature of Special Interest—A surface water designated by a federal or state agency as having unique natural characteristics and/or requiring added protection.

Table 3.15-2:
Federal and State Surface Water Designations of Special Interest

Government Level	Surface Water Designations of Special Interest
Federal	Rivers listed in the National Park Service's Nationwide Rivers Inventory, a listing of free-flowing U.S. river segments believed to have "outstandingly remarkable" natural or cultural values of more than local or regional significance (GIS Data Source: USGS 1996)
	Rivers listed in the National Wild and Scenic Rivers System, created to preserve rivers with outstanding natural, cultural, and recreational values (National Wild and Scenic Rivers System 2014)
	Waters designated by the USFWS as critical habitat for federally listed threatened or endangered species
	Waters designated by the USACE as navigable waters of the U.S. per Section 10 of the Rivers and Harbors Act of 1899
State—Common to all	State-designated Source Water Protection Areas
	Surface water intakes for public water systems within 3 miles downstream of ROI
Oklahoma	Sensitive Public and Private Water Supplies, Outstanding Resource Waters, and High Quality Waters and their special provision watersheds as identified in Appendix A of OAC 785:45, Oklahoma's Water Quality Standards
	Scenic River Areas, Culturally Significant Waters, or Nutrient Limited Watersheds per Appendix A of OAC 785:45
	Waters of Recreational and/or Ecological Significance per Appendix B of OAC 785:45

Table 3.15-2:
Federal and State Surface Water Designations of Special Interest

Government Level	Surface Water Designations of Special Interest
Arkansas	Extraordinary Resource Waters or Natural and Scenic Waterways per Appendix A of APCEC Regulation No. 2 (APCEC 2014)
	Ecologically Sensitive Waterbodies or Trout Waters per Appendix A of APCEC Regulation No. 2 (APCEC 2014)
Tennessee	Exceptional Tennessee Waters or Outstanding National Resource Waters per Chapter 0400-40-03 of the TDEC Rules (TDEC 2013a)
	State Scenic Rivers pursuant to the Tennessee Scenic Rivers Act
Texas	Sole-source Surface Drinking Water Supplies and their protection zones per Appendix B of TAC 30-307
	Ecologically Unique River and Stream Segments per Texas Administrative Code Title 31, Chapter 357.43

Ephemeral streams, which are streams or segments of streams that flow briefly in direct response to precipitation in the immediate vicinity, are not addressed as unique surface water features in this section, but are considered to be a subset of the intermittent stream category. The USGS National Hydrography Dataset, which was used heavily in characterizing surface water features in the Project vicinity, does not distinguish between ephemeral and other intermittent streams. Where impacts to intermittent streams are discussed they would also apply to ephemeral streams.

Several route variations for the Applicant Proposed Route in Regions 2 to 7 were developed in response to public comments on the Draft EIS and are described in Appendix M and summarized in Section 2.4.2.1 to 2.4.2.7. Brief descriptions of the surface water elements that could be affected by the route variations by Project region, including accompanying HVDC alternative route adjustments, are provided below. The variations are presented graphically in Exhibit 1 of Appendix M.

3.15.5 Regional Description

The following sections provide detailed descriptions of watersheds, surface water features, water quality, and water use in the ROI for Regions 1 through 7. The regional descriptions in this section also identify surface water features and elements found within a representative ROW consisting of a 200-foot-wide corridor within the 1,000-foot-wide ROI of the HVDC transmission line routes. Information for the AC collection system (included in the Region 1 description) is similarly presented in terms of a 2-mile-wide ROI and a 200-foot-wide representative ROW. This information is used in evaluating potential impacts of the Project in Section 3.15.6. The ROW features and elements are included here in the affected environment to provide the reader an easy comparison between features in the ROI and what would be expected in a smaller ROW.

3.15.5.1 Region 1

Region 1 is referred to as the Oklahoma Panhandle Region and includes the Applicant Proposed Route, HVDC Alternative Routes 1-A through 1-D, and the Oklahoma converter station with its associated AC interconnection line. Although the AC collection system routes overlap with portions of the Applicant Proposed Route and HVDC alternative routes, they are addressed separately below because the AC collection system routes would also extend into areas well outside the HVDC transmission corridor.

No route variations were proposed in Region 1.

3.15.5.1.1 Region 1 Watersheds

The ROI, including the AC collection system routes, is within the Arkansas-White-Red drainage system, which combines the drainage areas for the Arkansas, White, and Red rivers, representing a large portion of south-central United States and draining into the Mississippi River. Within that large drainage system, the ROI is primarily within the North Canadian subregion; a small portion of the eastern edge of the ROI is in the Lower Cimarron subregion. The Mississippi River is the end point for the overall drainage system, and the general direction of the primary flow within the Region 1 watersheds is from west to east. Local streams may flow in different directions, even north to south or south to north, but as they join larger streams, the overall progression is from west to east.

At USGS's eight-digit coding level, the ROI lies within eight different watersheds as shown in Figure 3.15-1a (located at Appendix A). A ninth watershed, the Lower Wolf (11100203), is just outside the ROI, but is shown in the figure because it lies between two of the eight. Table 3.15-3 lists the applicable watersheds in a general west-to-east order and provides additional detail, including the primary surface water or waters that drain the watershed. Surface waters for the ROI are shown on Figure 3.15-2 in Appendix A.

Table 3.15-3:
Watersheds Crossed by the Applicant Proposed Routes and HVDC Alternative Routes and the AC Collection System Routes—Region 1

USGS HUC Number and Watershed Name	Area Drained (square miles)	Description of Primary Surface Water Features
11100101, Upper Beaver	2,732	Beaver River drains the watershed that extends from the river's headwaters to its convergence with Goff Creek.
11100102, Middle Beaver	1,356	Beaver River drains the watershed that extends from its convergence with Goff Creek through Lake Optima and to the community of Beaver.
11100103, Coldwater[1]	1,962	Coldwater and Frisco creeks drain the watershed into Lake Optima.
11100104, Palo Duro	1,937	Palo Duro Creek drains the watershed into Beaver River.
11100201, Lower Beaver	1,781	Beaver River, which becomes the North Canadian River, drains the watershed. Several smaller streams converge with the Beaver River within the watershed.
11100202, Upper Wolf	833	Wolf Creek drains the watershed and after running through another watershed joins the Beaver River to form the North Canadian River.
11100301, Middle North Canadian	1,858	North Canadian River drains the watershed, which includes Canton Lake and Ramsey Lake, both on the North Canadian River
11050001, Lower Cimarron-Eagle Chief	2,422	Cimarron River and Eagle Chief Creek drain the watershed. The Cimarron is to the northeast and parallels the North Canadian.

1 The proposed Oklahoma converter station would be within the Coldwater watershed.

GIS Data Source: USGS (2014a)

As outlined in Table 3.15-3, the ROI follows along the Beaver River/North Canadian River drainage from west to east except at the eastern edge of the ROI, where the Applicant Proposed Route and HVDC alternative routes pass into a watershed of the Cimarron River. At this point, the Cimarron River basically flows parallel to the North Canadian River, but at a distance to the northeast.

3.15.5.1.2 Region 1 Surface Water Features

Surface water features are described below in terms of the compiled length of streams or acreage of lakes or reservoirs within the 1,000-foot-wide corridors and 200-foot-wide representative ROWs of the HVDC transmission line routes. Surface water features along the transmission line corridor that are of special interest or of impaired quality are identified individually in subsequent discussions.

Table 3.15-4 lists the total length of perennial streams, intermittent streams, and major waterbodies within the ROI and, in parentheses, the 200-foot-wide representative ROW. The table includes the total acreage of reservoirs, lakes, and ponds that occur within the ROI.

Table 3.15-4:
Miles and Acreage of Surface Water Features within the 1,000-Foot-Wide Corridors (and 200-Foot-Wide Representative ROWs) of the Applicant Proposed Route and HVDC Alternative Routes—Region-1

Route—Proposed and Alternatives[1, 2]	Link 1	Link 2	Link 3	Link 4	Link 5	Region 1 Total
Perennial Streams						
APR (miles)	0.07 (0)	2.01 (0.32)	0	1.22 (0.13)	2.15 (0.41)	5.45 (0.86)
With AR 1-A (miles)	0.07 (0)	3.69 (0.75)				3.76 (0.75)
With AR 1-B (miles)	0.07 (0)	0.64 (0.12)		1.22 (0.13)	2.15 (0.41)	4.08 (0.66)
With AR 1-C (miles)	0.07 (0)	0.95 (0.22)		1.22 (0.13)	2.15 (0.41)	4.39 (0.76)
With AR 1-D (miles)	0.07 (0)	2.01 (0.32)	1.01 (0.13)		2.15 (0.41)	5.24 (0.86)
Intermittent Streams						
APR (miles)	0.98 (0.19)	10.22 (2.37)	0	13.54 (2.57)	4.55 (0.79)	29.29 (5.92)
With AR 1-A (miles)	0.98 (0.19)	42.23 (8.42)				43.21 (8.61)
With AR 1-B (miles)	0.98 (0.19)	16.78 (2.96)		13.54 (2.57)	4.55 (0.79)	35.85 (6.51)
With AR 1-C (miles)	0.98 (0.19)	14.59 (2.59)		13.54 (2.57)	4.55 (0.79)	33.66 (6.14)
With AR 1-D (miles)	0.98 (0.19)	10.22 (2.37)	11.14 (2.24)		4.55 (0.79)	26.89 (5.59)
Major Waterbodies						
APR (miles)	0	0.01 (0.03)	0	0	0	0.01 (0.03)
With AR 1-A (miles)	0	0.02 (0.04)				0.02 (0.04)
With AR 1-B (miles)	0	0.01 (0.01)		0	0	0.01 (0.01)
With AR 1-C (miles)	0	0.02 (0.04)		0	0	0.02 (0.04)
With AR 1-D (miles)	0	0.01 (0.03)	0 (0)		0	0.01 (0.03)
Reservoirs, Lakes, and Ponds						
APR (acres)	0.6 (0)	31.2 (7.2)	0	8.5 (1.0)	8.7 (1.7)	49.0 (9.9)
With AR 1-A (acres)	0.6 (0)	26.4 (6.8)				27.0 (6.8)
With AR 1-B (acres)	0.6 (0)	3.3 (1.1)		8.5 (1.0)	8.7 (1.7)	21.1 (3.8)
With AR 1-C (acres)	0.6 (0)	3.4 (1.2)		8.5 (1.0)	8.7 (1.7)	21.2 (3.9)
With AR 1-D (acres)	0.6 (0)	31.2 (7.2)	6.6 (0.2)		8.7 (1.7)	47.1 (9.1)

1 Each region of the Applicant Proposed Route (APR) is divided into links that lie between points, or nodes, where the APR is intersected by alternative routes (ARs). ARs bypass specific links of the APR as shown in the table.
2 For the ARs, the unshaded portion of the rows provides the data for the length of the AR. The shaded portion of the rows provides the data for the balance of the APR, thereby providing perspective across the region.
GIS Data Source: USGS (2014a)

The analysis included an assumption when compiling the perennial and intermittent stream data shown in Table 3.15-4 and corresponding tables for the other regions. Stream data came from the USGS National Hydrography Dataset, which includes an "artificial path" category in addition to perennial and intermittent streams.

The artificial paths are manually inserted flow lines in place of wide features (expanded river beds, ponds, reservoirs, etc.) in the flow paths of either perennial or intermittent streams. For ease of data compilation, the analysis summed artificial paths as if part of perennial streams. This assumption could make some perennial stream values slightly high and some intermittent stream values slightly low. If the feature is a wide river bed, however, the artificial paths are more often associated with perennial streams; and if the features are ponds or reservoirs that hold water all year even though fed by intermittent streams, it may be more appropriate to characterize them as perennial segments.

DOE also considered the surface water features that would be within the 2-mile-wide corridors and 200-foot-wide representative ROWs of the AC collection system routes. Using similar breakouts to those shown in Table 3.15-4, the lengths and areas of surface water features within the total AC collection system routes are shown in Table 3.15-5.

Table 3.15-5:
Surface Water Features within the 2-Mile-Wide Corridors (and 200-Foot-Wide ROWs) of the AC Collection System Routes

AC Route Designation	Perennial Streams (miles)	Intermittent Streams (miles)	Major Waterbodies (miles)	Reservoirs, Lakes, and Ponds (acres)
E-1	9.17 (0.23)	100.18 (1.61)	0	33.83 (0.45)
E-2	13.47 (0.37)	100.05 (2.18)	0.07 (0.07)	148.99 (0.99)
E-3	10.06 (0.12)	137.62 (2.39)	0.01 (0.01)	36.71 (0.31)
NE-1	24.11 (0.41)	32.97 (0.25)	0.12 (0.12)	141.04 (0)
NE-2	7.75 (0.20)	78.31 (1.33)	0.10 (0.10)	70.77 (1.95)
NW-1	13.05 (0.16)	110.93 (2.03)	0.09 (0.09)	167.26 (0)
NW-2	31.13 (0.51)	77.72 (0.95)	0.18 (0.18)	119.20 (0.04)
SE-1	21.52 (0.42)	75.70 (2.09)	0.04 (0.04)	677.83 (2.61)
SE-2	0.80 (0)	26.67 (0.30)	0	97.95 (0.38)
SE-3	14.47 (0.37)	98.54 (2.07)	0.07 (0.07)	768.03 (1.00)
SW-1	0.97 (0)	58.06 (0.86)	0	14.24 (0)
SW-2	7.98 (0.14)	125.14 (2.91)	0.08 (0.08)	57.42 (0.21)
W-1	6.16 (0.17)	45.09 (1.05)	0.08 (0.08)	9.27 (0.49)

GIS Data Source: USGS (2014a)

The above ROI numbers are large in comparison to the values shown in Table 3.15-4 for the Applicant Proposed Route and HVDC alternative routes primarily because the corridors evaluated for the AC collection system are 2 miles wide and the HVDC corridors are 1,000 feet wide.

The Oklahoma Converter Station and AC Interconnection Siting Areas include 1.6 miles of intermittent streams, no perennial streams, and no major waterbodies. A 200-foot-wide representative ROW for the AC Interconnection Siting Area encompasses 0.2 mile of intermittent streams.

3.15.5.1.2.1 Surface Water Features of Special Interest

Considering the entire HVDC transmission line route, Region 1 has fewer surface water features as compared to Regions 2 through 7. The most prominent water features within Region 1 are the Beaver River and several of its tributaries that are crossed by the Applicant Proposed Route and HVDC alternative routes or are within the area of the AC collection system routes. With the exception of Wolf Creek, DOE identified no surface waters in the ROI in

Region 1 that have federal or state classifications of special interest other than the water quality designations addressed in the next section. Wolf Creek is a Texas stream in the Upper Wolf (11100202) watershed (Table 3.15-3) that is crossed by the AC Collection System Route SE-3. Per guidelines in Texas regulations (TAC 31-357.43), Wolf Creek is designated as an "ecologically unique river or stream segment." It is identified as a reference stream for development of a regionalized index of biotic integrity for Texas and exhibiting high water quality and diverse benthic macroinvertebrate and fish communities (TPWD 2014).

3.15.5.1.3 Region 1 Water Quality

The CWA (33 USC § 1251 et seq.) establishes a framework for regulating quality standards for surface waters and discharges into those waters. Under that framework, the states evaluate their surface waters, determine applicable beneficial uses, set water quality criteria to support those uses, and implement rules and regulations to achieve or maintain water quality criteria. Section 305(b) of the CWA requires states to develop and periodically update an inventory of the water quality of all water bodies in the state. These inventories, provided to EPA and released to the public, indicate if the water quality supports the designated uses. Section 303(d) requires states to develop and periodically update an inventory of water bodies that do not meet water quality standards, which the states also provide to EPA and release to the public.

Table 3.15-6 identifies surface water features within the ROI that do not meet applicable water quality standards based on the surface water's designated uses and, as a result, have been identified as an impaired water in Oklahoma's most recent Section 303(d) list. All of the surface waters in the table cross the 200-foot-wide representative ROWs of the identified Project components as well as the wider ROI. The table identifies the specific water, the designated use that is impaired and what is causing the impairment. A primary element in the process of improving the water quality in impaired waters is the development of "total maximum daily loads" or TMDLs, which are the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. Once TMDLs have been determined, discharge requirements can be developed that will bring a waterbody back into compliance. The table identifies the status of the TMDL development process, generally in the form of a date when the TMDL is expected to be developed and approved. In some instances, a TMDL has already been developed and approved by EPA and is noted as such in the table.

Table 3.15-6:
Waters with Impaired Quality within the 1,000-Foot-Wide Corridors of the Applicant Proposed Route and HVDC Alternative Routes and the 2-Mile-Wide Corridors of the AC Collection System Routes—Region 1

Water Segment and Watershed	Impaired Uses—Impairment	TMDL Status[1]	Project Components Crossing Impaired Segment
Beaver River (North Canadian), OK (OK720510000190_00) Upper Beaver watershed (HUC 11100101)	Fish and Wildlife Propagation/Warm Water Aquatic Community—dissolved oxygen impairment	Priority Date: 2020 Approved TMDLs for fecal coliform, E. Coli, *and Enterococcu*s	AC Collection System Route: NW-1

Table 3.15-6:
Waters with Impaired Quality within the 1,000-Foot-Wide Corridors of the Applicant Proposed Route and HVDC Alternative Routes and the 2-Mile-Wide Corridors of the AC Collection System Routes—Region 1

Water Segment and Watershed	Impaired Uses—Impairment	TMDL Status[1]	Project Components Crossing Impaired Segment
Palo Duro Creek, OK (OK720500020500_00) Palo Duro watershed (HUC 11100104)	Primary Body Contact Recreation—*Enterococcus*, and *E. coli* impairments Fish and Wildlife Propagation/Warm Water Aquatic Community—dissolved oxygen and selenium impairments Agricultural—sulfates and total dissolved solids impairments	Priority Date: 2023 Approved TMDLs for fecal coliform and total suspended solids	HVDC: APR Link 2, ARs 1-A, 1-B, and 1-C AC Collection System Routes: E-1, E-2, E-3, SE-1, and SE-3
Kiowa Creek, OK (OK720500020130_00) Lower Beaver watershed (HUC 11100201)	Primary Body Contact Recreation—*E. coli* impairments	Priority Date: 2023 Approved TMDLs for fecal coliform *and Enterococcus*	HVDC: APR Link 4, ARs 1-A and 1-D
Beaver River (North Canadian), OK (OK720500020010_00) Lower Beaver watershed (HUC 11100201)	Fish Consumption—lead impairment Primary Body Contact Recreation—*E. coli* impairment	Priority Date: 2020 Approved TMDLs for fecal coliform, *and Enterococcus*	HVDC: APR Link 5, AR 1-A
Clear Creek, OK (OK720500020070_00) Lower Beaver watershed (HUC 11100201)	Fish and Wildlife Propagation/Warm Water Aquatic Community—benthic-macroinvertebrate bioassessments	Priority Date: 2020 Approved TMDLs for fecal coliform, *E. coli and Enterococcus*	HVDC: APR Link 4, AR 1-D
Otter Creek. OK (OK720500020050_00) Lower Beaver watershed (HUC 11100201)	Fish and Wildlife Propagation/Warm Water Aquatic Community—benthic-macroinvertebrate bioassessments	Priority Date: 2020 Approved TMDLs for *E. coli and Enterococcus*	HVDC: APR Link 5
Sand Creek, OK (OK620920050050_00) Lower Cimarron-Eagle Chief watershed (HUC 11050001)	Fish and Wildlife Propagation/Warm Water Aquatic Community—dissolved oxygen impairment Agriculture—sulfates impairment	Priority Date: 2023 Approved TMDLs for *E. coli and Enterococcus*	HVDC: AR 1-A

1 TMDL = Total Maximum Daily Load—TMDLs are the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. Once TMDLs have been determined, discharge requirements can be developed that will bring a waterbody back into compliance.

Sources: ODEQ (2014, 2013), EPA (2013b)

Because of the great area and number of surface waters crossed by the ROI, the analysis focuses only on those surface waters identified by the states as being out of compliance, or impaired. The list of surface waters in the table provides an indication of some of the water features that could be encountered along or within the ROIs of the various project components and the types of water pollutants of concern. Table 3.15-6 does not identify surface waters along or within the ROIs that have water quality good enough to meet all of their designated uses.

3.15.5.1.4 Region 1 Water Use

Water use—surface water and groundwater—was previously summarized in Table 3.7-5. The average use of surface water in the four-county area of Beaver, Harper, Texas, and Woodward counties in Oklahoma was about 5.1 million gallons per day in 2010, which was all attributed to irrigation, compared to 372 million gallons per day of groundwater used in the same counties. Surface water, therefore, accounts for only about 1.3 percent of total water usage in the four-county area and none of the area's public water supplies include water from surface sources. The scarcity of surface water also is evidenced in the greater abundance of intermittent streams in this area compared to perennial streams.

Table 3.7-6 summarizes water use in the five-county area of Beaver and Texas counties in Oklahoma and Hansford, Ochiltree, and Sherman counties in Texas that encompass the AC collection system routes. The predominant use of groundwater in the five-county area is even more apparent than for the Region 1 counties. In the five-county area, surface water use at about 2.0 million gallons per day is less than 0.3 percent of the area's total water use of 736 million gallons per day. All of the surface water use in the five-county area is attributed to the categories of irrigation, livestock, and mining.

3.15.5.2 Region 2

Region 2 is referred to as the Oklahoma Central Great Plains Region and includes the Applicant Proposed Route and HVDC Alternative Routes 2-A and 2-B.

Two route variations to the Applicant Proposed Route were developed in Region 2 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.2. The variations (Applicant Proposed Route Link 1, Variation 1, and Applicant Proposed Route Link 2, Variation 2) are illustrated in Exhibit 1 of Appendix M. The discussion of Region 2 surface water elements that follows includes identification of differences, if any, that would be expected with the route variations as compared to the original Applicant Proposed Route.

3.15.5.2.1 Region 2 Watersheds

Still within the large Arkansas-White-Red drainage system, the ROI in Region 2 is primarily within the Lower Cimarron subregion, but portions of the western end of the ROI are within the North Canadian subregion. Primary surface water flow in both of these subregions is from west to east, toward the Mississippi River. Local streams may flow in different directions, even north-south, but as they join larger streams the overall progression is from west to east.

At USGS's eight-digit coding level, the ROI lies within three different watersheds as shown in Figure 3.15-1 in Appendix A. Table 3.15-7 lists the applicable watersheds and provides additional detail, including the primary surface water or waters that drain the watershed. Surface waters for the ROI are shown on Figure 3.15-2 in Appendix A.

Table 3.15-7:
Watersheds Crossed by the Applicant Proposed Route and HVDC Alternative Routes—Region 2

USGS HUC Number and Watershed Name	Area Drained (square miles)	Description of Primary Surface Water Feature(s)
11100301, Middle North Canadian	1,858	North Canadian River drains the watershed, which includes Canton Lake and Ramsey Lake, both on the North Canadian River
11050001, Lower Cimarron-Eagle Chief	2,422	Cimarron River and Eagle Chief Creek drain the watershed. The Cimarron is to the northeast and parallels the North Canadian.
11050002, Lower Cimarron-Skeleton	3,236	Cimarron River is the primary drain for the watershed. Skeleton, Turkey, Kingfisher, and Cottonwood creeks also drain the watershed and are tributaries to the Cimarron River.

GIS Data Source: USGS (2014a)

The watersheds in the ROI in Region 2 are in two different river systems (the Cimarron and the North Canadian), but further downstream, both converge with the Arkansas River (although the North Canadian first joins the Canadian River). Neither of the two route variations to the Applicant Proposed Route developed in Region 2 would change the watersheds that would be crossed.

3.15.5.2.2 Region 2 Surface Water Features

As presented and described for Region 1, Table 3.15-8 lists the total length of perennial streams, intermittent streams, and major waterbodies within the Applicant Proposed Route and HVDC alternative routes in Region 2. The table includes the total acreage of reservoirs, lakes, and ponds located within Applicant Proposed Route and HVDC alternative routes.

Table 3.15-8:
Miles and Acreage of Surface Water Features within the 1,000-Foot-Wide Corridors (and 200-Foot-Wide Representative ROWs) of the Applicant Proposed Route and HVDC Alternative Routes—Region 2

Route—Proposed and Alternatives[1, 2, 3]	Link 1	Link 2	Link 3	Region 2 Total
Perennial Streams				
APR (miles)	0	6.47 (1.32)	0.85 (0.11)	7.32 (1.43)
With AR 2-A (miles)	0	16.90 (3.35)	0.85 (0.11)	17.75 (3.46)
With AR 2-B (miles)	0	6.47 (1.32)	2.47 (0.49)	8.94 (1.81)
Intermittent Streams				
APR (miles)	0	9.34 (1.81)	9.80 (1.94)	19.14 (3.75)
With AR 2-A (miles)	0	4.73 (0.59)	9.80 (1.94)	14.53 (2.53)
With AR 2-B (miles)	0	9.34 (1.81)	8.32 (1.34)	17.66 (3.15)
Major Waterbodies				
APR (miles)	0	0.01 (0.01)	0	0.01 (0.01)
With AR 2-A (miles)	0	0.05 (0.05)	0	0.05 (0.05)
With AR 2-B (miles)	0	0.01 (0.01)	0	0.01 (0.01)
Reservoirs, Lakes, and Ponds				
APR (acres)	1.1 (<0.1)	3.7 (0.8)	8.8 (1.1)	13.6 (1.9)
With AR 2-A (acres)	1.1 (<0.1)	25.2 (6.5)	8.8 (1.1)	35.0 (7.6)
With AR 2-B (acres)	1.1 (<0.1)	3.7 (0.8)	19.4 (1.6)	24.2 (2.4)

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
2 Each region of the Applicant Proposed Route (APR) is divided into links that lie between points, or nodes, where the APR is intersected by alternative routes (ARs). ARs bypass specific links of the APR as shown in the table.
3 For the ARs, the unshaded portion of the rows provides the data for the length of the AR. The shaded portion of the rows provides the data for the balance of the APR, thereby providing perspective across the region.
GIS Data Source: USGS (2014a)

The two Region 2 route variations would involve no changes to the surface water features crossed by the 200-foot-wide representative ROW of the original Applicant Proposed Route. Neither of the route variations has any of the surface water features identified in Table 3.15-8, similar to the original Applicant Proposed Route.

3.15.5.2.2.1 Surface Water Features of Special Interest

As described for the watersheds in the ROI for Region 2, the North Canadian and Cimarron rivers are important surface water features in the area from a drainage system standpoint and the Cimarron River would be crossed by the Applicant Proposed Route as well as Alternative Route 2-A. Table 3.15-9 identifies surface waters within the ROI that have specific federal or state designations of special interest beyond significance as drainage features. The surface water identified in the table is crossed by the 200-foot-wide representative ROW as well as the 1,000-foot-wide corridor of the ROI.

Table 3.15-9:
Surface Waters of Special Interest within the 1,000-Foot-Wide Corridor of the Applicant Proposed Route and HVDC Alternative Routes—Region 2

Surface Water and Watershed	Designation(s)	Basis for Designation	Route/Alternative Affected		
			APR	2-A	2-B
Cimarron River, OK Lower Cimarron-Skeleton watershed (HUC 11050002)	USFWS critical habitat	Critical habitat for federally listed threatened Arkansas River shiner (*Notropis girardi*)	X	X	
	Oklahoma Water of Recreational and/or Ecological Significance	State protected water due to federally listed species (above)	X	X	

Sources: USFWS (2014), Appendix B of OAC 785:45

Neither of the Region 2 route variations would involve changes to the surface waters of special interest within the 1,000-foot-wide corridor of the Applicant Proposed Route.

3.15.5.2.3 Region 2 Water Quality

Table 3.15-10 identifies surface water features within the ROI in Region 2 that do not meet applicable water quality standards based on the surface water's designated uses and, as a result, have been identified as an impaired water in the state's most recent Section 303(d) list. All of the water segments identified in the table would cross the 200-foot-wide representative ROWs of the identified Project components as well as the wider ROI.

Table 3.15-10:
Waters with Impaired Quality within the 1,000-Foot-Wide Corridors of the Applicant Proposed Route and HVDC Alternative Routes—Region 2

Water Segment and Watershed	Impaired Uses—Impairment	TMDL Status[1]	Project Components Crossing Impaired Segment
Main Creek, OK (OK620920010180_00) Lower Cimarron-Eagle Chief watershed (HUC 11050001)	Fish and Wildlife Propagation/Warm Water Aquatic Community—fishes bioassessments impairment Agriculture—sulfates impairment	Priority Date: 2023 Approved TMDLs for *Enterococcus*, *E. coli*, and total suspended solids	AR 2-A
Griever Creek, OK (OK620920010130_00) Lower Cimarron-Eagle Chief watershed (HUC 11050001)	Fish and Wildlife Propagation/Warm Water Aquatic Community—benthic-macroinvertebrate bioassessments impairment Primary Body Contact Recreation—*E. coli* impairment	Priority Date: 2020 Approved TMDL for *Enterococcus*	AR 2-A

Table 3.15-10:
Waters with Impaired Quality within the 1,000-Foot-Wide Corridors of the Applicant Proposed Route and HVDC Alternative Routes—Region 2

Water Segment and Watershed	Impaired Uses—Impairment	TMDL Status[1]	Project Components Crossing Impaired Segment
East Griever Creek, OK (OK620920010140_00) Lower Cimarron-Eagle Chief watershed (HUC 11050001)	Primary Body Contact Recreation—*Enterococcus* impairment Agriculture—sulfates impairment	Priority Date: 2020	APR Link 2, AR 2-A
Cottonwood Creek, OK (OK620920010080_00) Lower Cimarron-Eagle Chief watershed (HUC 11050001)	Primary Body Contact Recreation—*E. coli* and *Enterococcus* impairments Fish and Wildlife Propagation/Warm Water Aquatic Community—pH impairment	Priority Date: 2023 Approved TMDLs for fecal coliform, and total suspended solids	AR 2-A
Cimarron River, OK (OK620910020010_10) Lower Cimarron-Skeleton watershed (HUC 11050002)	Fish and Wildlife Propagation/Warm Water Aquatic Community—selenium impairment Agriculture—sulfates, total dissolved solids, and chloride impairments	Priority Date: 2020 Approved TMDLs for *Enterococcus* and *E. coli*	APR Link 2, AR 2-A
Turkey Creek, OK (OK620910060010_00) Lower Cimarron-Skeleton watershed (HUC 11050002)	Primary Body Contact Recreation—*E. coli* impairment	Priority Date: 2023 Approved TMDLs for fecal coliform and turbidity	APR Link 3, AR 2-B
Buffalo Creek, OK (OK620910060030_00) Lower Cimarron-Skeleton watershed (HUC 11050002)	Fish and Wildlife Propagation/Warm Water Aquatic Community—dissolved oxygen impairment	Priority Date: 2023 Approved TMDLs for fecal coliform and turbidity	APR Link 3, AR 2-B

1 TMDL = Total Maximum Daily Load—TMDLs are the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. Once TMDLs have been determined, discharge requirements can be developed that will bring a waterbody back into compliance.

Sources: ODEQ (2014, 2013), EPA (2013b)

Neither of the two Region 2 route variations would involve changes to the impaired waters within the 1,000-foot-wide corridor of the Applicant Proposed Route or the areas at which such waters would be crossed by the route.

3.15.5.2.4 Region 2 Water Use

As described for Region 1 (Section 3.15.5.1.4), groundwater accounts for the majority of the total water use in the three counties (Garfield, Major, and Woodward counties, Oklahoma) that encompass Region 2. Table 3.7-9 shows that the average use of surface water was about 2.6 million gallons per day in 2010 compared to 49 million gallons per day of groundwater used in the same area. Surface water, therefore, accounts for only about 5 percent of area's total water usage; none of the three counties' public water supplies include water from surface sources. Total water use (groundwater and surface water) is described in more detail in Section 3.7.5.2.4.

3.15.5.3 Region 3

Region 3 is referred to as the Oklahoma Cross Timbers Region and includes the Applicant Proposed Route and HVDC Alternative Routes 3-A through 3-E.

Five route variations to the Applicant Proposed Route were developed in Region 3 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.3. The Applicant

Proposed Route variations (Link 1, Variation 2; Links 1 and 2, Variation 1; Link 4, Variation 1; Link 4, Variation 2; and Link 5, Variation 2) are illustrated in Exhibit 1 of Appendix M. It should be noted that a route adjustment was made for HVDC Alternative Route 3-A to maintain an end-to-end route with Links 1 and 2, Variation 1. The discussion of Region 3 surface water elements that follows includes identification of differences, if any, that would be expected with the route variations as compared to the original Applicant Proposed Route. The element discussions also address any changes attributed to the adjustment to HVDC Alternative Route 3-A.

3.15.5.3.1 Region 3 Watersheds

The ROI in Region 3 remains within the large Arkansas-White-Red drainage system, but passes through five watersheds in three subregions: the Lower Cimarron (1105), the North Canadian (1110), and the Lower Arkansas (1111). The Lower Arkansas subregion begins where the Cimarron and Arkansas rivers converge, so the downstream watershed in the Lower Cimarron subregion transitions directly into the watershed of the Lower Arkansas subregion. The western portion of the ROI in Region 3 is primarily within the Lower Cimarron subregion, the central portion is within the North Canadian subregion, and the eastern end is within the Lower Arkansas subregion. Primary surface water flow in these subregions is still from west to east, possibly southeast, toward the Mississippi River. Local streams may flow in different directions, but as they join larger streams the overall progression is from west to east/southeast.

At USGS's eight-digit coding level, the ROI lies within five different watersheds as shown in Figure 3.15-1 in Appendix A. Table 3.15-11 lists the applicable watersheds and provides additional detail, including the primary surface water or waters that drain the watershed. Surface waters for the ROI are shown on Figure 3.15-2 in Appendix A. None of the five route variations developed for the Applicant Proposed Route in Region 3 would change the watersheds that would be crossed.

Table 3.15-11:
Watersheds Crossed by the Applicant Proposed Route and HVDC Alternative Routes—Region 3

USGS HUC Number and Watershed Name	Area Drained (square miles)	Description of Primary Surface Water Feature(s)
11050002, Lower Cimarron-Skeleton	3,236	Cimarron River is the primary drain for the watershed. Skeleton, Turkey, Kingfisher, and Cottonwood creeks also drain the watershed and are tributaries to the Cimarron River.
11050003, Lower Cimarron	1,385	Cimarron River is the primary drain for the watershed, which extends from the Cimarron's confluence with Skeleton Creek to Keystone Lake. Beaver, Drought, Stillwater, Euchee, and Lagoon creeks also drain the watershed and are tributaries to the Cimarron River. Lake Carl Blackwell is also in this watershed.
11100303, Deep Fork	2,536	Deep Fork River is the primary drain for the watershed, which passes through Deep Fork National Wildlife Refuge and drains into Eufaula Lake in the southeast portion of the watershed.
11110101, Polecat-Snake	1,322	Arkansas River is the primary drain for the watershed. Polecat Creek and Snake Creek also drain portions of the watershed and are tributaries to the Arkansas River.
11110102, Dirty-Greenleaf	797	Arkansas River is the primary drain for the watershed. Dirty Creek and Greenleaf Creek also drain portions of the watershed and are tributaries to the Arkansas River. Greenleaf Lake is on Greenleaf Creek.

GIS Data Source: USGS (2014a)

3.15.5.3.2 Region 3 Surface Water Features

Table 3.15-12 lists the total length of perennial streams, intermittent streams, major waterbodies present within the ROI and the 200-foot-wide representative ROW in Region 3. The table includes the total acreage for reservoirs, lakes, and ponds that occur within the ROI.

Table 3.15-12:
Miles and Acreage of Surface Water Features within the 1,000-Foot-Wide Corridors (and 200-Foot-Wide Representative ROWs) of the Applicant Proposed Route and HVDC Alternative Routes—Region 3

<table>
<tr><th>Route—Proposed and Alternatives[1, 2, 3]</th><th>Link 1</th><th>Link 2</th><th>Link 3</th><th>Link 4</th><th>Link 5</th><th>Link 6</th><th>Region 3 Total</th></tr>
<tr><td colspan="8">Perennial Streams</td></tr>
<tr><td>APR (miles)</td><td>14.62 (2.71)</td><td>2.40 (0.53)</td><td>4.03 (0.82)</td><td>23.45 (4.43)</td><td>10.78 (1.96)</td><td>0.02 (0)</td><td>55.30 (10.45)</td></tr>
<tr><td>With AR 3-A (miles)</td><td>17.33 (3.58)</td><td>2.40 (0.53)</td><td>4.03 (0.82)</td><td>23.45 (4.43)</td><td>10.78 (1.96)</td><td>0.02 (0)</td><td>58.01 (11.32)</td></tr>
<tr><td>With AR 3-B (miles)</td><td colspan="3">21.35 (4.68)</td><td>23.45 (4.43)</td><td>10.78 (1.96)</td><td>0.02 (0)</td><td>55.60 (11.07)</td></tr>
<tr><td>With AR 3-C (miles)</td><td>14.62 (2.71)</td><td>2.40 (0.53)</td><td colspan="4">31.30 (5.55)</td><td>48.32 (8.79)</td></tr>
<tr><td>With AR 3-D (miles)</td><td>14.62 (2.71)</td><td>2.40 (0.53)</td><td>4.03 (0.82)</td><td>23.45 (4.43)</td><td colspan="2">5.91 (0.83)</td><td>50.41 (9.32)</td></tr>
<tr><td>With AR 3-E (miles)</td><td>14.62 (2.71)</td><td>2.40 (0.53)</td><td>4.03 (0.82)</td><td>23.45 (4.43)</td><td>10.78 (1.96)</td><td>0.77 (0.06)</td><td>56.05 (10.51)</td></tr>
<tr><td colspan="8">Intermittent Streams</td></tr>
<tr><td>APR (miles)</td><td>9.71 (2.09)</td><td>0</td><td>0</td><td>18.11 (3.76)</td><td>5.29 (1.13)</td><td>3.72 (0.77)</td><td>36.83 (7.75)</td></tr>
<tr><td>With AR 3-A (miles)</td><td>6.51 (1.33)</td><td>0</td><td>0</td><td>18.11 (3.76)</td><td>5.29 (1.13)</td><td>3.72 (0.77)</td><td>33.61 (6.99)</td></tr>
<tr><td>With AR 3-B (miles)</td><td colspan="3">6.51 (1.33)</td><td>18.11 (3.76)</td><td>5.29 (1.13)</td><td>3.72 (0.77)</td><td>33.61 (6.99)</td></tr>
<tr><td>With AR 3-C (miles)</td><td>9.71 (2.09)</td><td>0</td><td colspan="4">42.19 (8.84)</td><td>51.90 (10.93)</td></tr>
<tr><td>With AR 3-D (miles)</td><td>9.71 (2.09)</td><td>0</td><td>0</td><td>18.11 (3.76)</td><td colspan="2">17.77 (4.17)</td><td>45.59 (10.02)</td></tr>
<tr><td>With AR 3-E (miles)</td><td>9.71 (2.09)</td><td>0</td><td>0</td><td>18.11 (3.76)</td><td>5.29 (1.13)</td><td>5.35 (1.51)</td><td>38.46 (8.49)</td></tr>
<tr><td colspan="8">Major Waterbodies</td></tr>
<tr><td>APR (miles)</td><td>0.02 (0.02)</td><td>0</td><td>0.02 (0.02)</td><td>0.10 (0.10)</td><td>0.01 (0.01)</td><td>0</td><td>0.15 (0.15)</td></tr>
<tr><td>With AR 3-A (miles)</td><td>0</td><td>0</td><td>0.02 (0.02)</td><td>0.10 (0.10)</td><td>0.01 (0.01)</td><td>0</td><td>0.13 (0.13)</td></tr>
<tr><td>With AR 3-B (miles)</td><td colspan="3">0.01 (0.01)</td><td>0.10 (0.10)</td><td>0.01 (0.01)</td><td>0</td><td>0.12 (0.12)</td></tr>
<tr><td>With AR 3-C (miles)</td><td>0.02 (0.02)</td><td>0</td><td colspan="4">0.12 (0.11)</td><td>0.14 (0.13)</td></tr>
<tr><td>With AR 3-D (miles)</td><td>0.02 (0.02)</td><td>0</td><td>0.02 (0.02)</td><td>0.10 (0.10)</td><td colspan="2">0</td><td>0.14 (0.14)</td></tr>
<tr><td>With AR 3-E (miles)</td><td>0.02 (0.02)</td><td>0</td><td>0.02 (0.02)</td><td>0.10 (0.10)</td><td>0.01 (0.01)</td><td>0</td><td>0.15 (0.15)</td></tr>
<tr><td colspan="8">Reservoirs, Lakes, and Ponds</td></tr>
<tr><td>APR (acres)</td><td>34.0 (4.0)</td><td>12.5 (3.2)</td><td>4.6 (<0.1)</td><td>120.3 (25.2)</td><td>39.0 (5.6)</td><td>4.4 (1.5)</td><td>214.8 (39.5)</td></tr>
<tr><td>With AR 3-A (acres)</td><td>53.2 (9.6)</td><td>12.5 (3.2)</td><td>4.6 (<0.1)</td><td>120.3 (25.2)</td><td>39.0 (5.6)</td><td>4.4 (1.5)</td><td>234.0 (45.1)</td></tr>
<tr><td>With AR 3-B (acres)</td><td colspan="3">80.2 (13.2)</td><td>120.3 (25.2)</td><td>39.0 (5.6)</td><td>4.4 (1.5)</td><td>243.9 (45.5)</td></tr>
<tr><td>With AR 3-C (acres)</td><td>34.0 (4.0)</td><td>12.5 (3.2)</td><td colspan="4">137.6 (20.4)</td><td>184.1 (27.6)</td></tr>
<tr><td>With AR 3-D (acres)</td><td>34.0 (4.0)</td><td>12.5 (3.2)</td><td>4.6 (<0.1)</td><td>120.3 (25.2)</td><td colspan="2">52.3 (9.1)</td><td>223.7 (41.5)</td></tr>
<tr><td>With AR 3-E (acres)</td><td>34.0 (4.0)</td><td>12.5 (3.2)</td><td>4.6 (<0.1)</td><td>120.3 (25.2)</td><td>39.0 (5.6)</td><td>6.4 (1.3)</td><td>216.8 (39.3)</td></tr>
</table>

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
2 Each region of the Applicant Proposed Route (APR) is divided into links that lie between points, or nodes, where the APR is intersected by alternative routes (ARs). ARs bypass specific links of the APR as shown in the table.
3 For the ARs, the unshaded portion of the rows provides the data for the length of the AR. The shaded portion of the rows provides the data for the balance of the APR, thereby providing perspective across the region.
GIS Data Source: USGS (2014a)

Region 3, particularly the areas of the Applicant Proposed Route Link 4 and the corresponding portion of Alternative Route 3-C, passes through an area of Oklahoma where there are many small dams and reservoirs constructed by NRCS for flood prevention, management of soil erosion, and irrigation. The Applicant Proposed Route Link 4 contains all or portions of the following:

- Little Deep Fork 12—The dam and part of the small reservoir is inside the 1,000-foot-wide corridor, but outside the 200-foot-wide ROW.
- Little Deep Fork 44—The dam and most of the reservoir is inside the corridor; the southeast end of the dam and a small corner of the reservoir would be inside the 200-foot-wide ROW.
- Little Deep Fork 45—The dam and most of the reservoir is inside the corridor and would be crossed by the 200-foot-wide ROW.
- Little Deep Fork 51r—The dam is to the south and the reservoir extends into the corridor, but not as far as the 200-foot-wide ROW.

The five Region 3 route variations would involve only minor changes to the surface water features crossed by the 200-foot-wide representative ROW of the original Applicant Proposed Route. The ROWs of the variations would have about 0.2 mile less of stream beds (perennial and intermittent), but would incorporate one more minor water body. None of the variations contains major waterbodies. The area of the adjustment to HVDC Alternative Route 3-A includes no surface water features.

3.15.5.3.2.1 Surface Water Features of Special Interest

As described for the watersheds in the ROI for Region 3, the Cimarron, Deep Fork, and Arkansas rivers are important surface water features in the area from a drainage system standpoint. Lake Carl Blackwell, Eufaula Lake, and Greenleaf Lake are notable surface water impoundments within the watersheds. This portion of the ROI has many streams and impoundments throughout its course. Table 3.15-13 identifies surface waters within the ROI in Region 3 that have specific federal or state designations of special interest beyond significance as drainage features. Each of the water features and designations identified in the table is applicable to the 200-foot-wide representative ROWs as well as the wider ROI.

Table 3.15-13:
Surface Waters of Special Interest within the 1,000-Foot-Wide Corridor of the Applicant Proposed Route and HVDC Alternative Routes—Region 3

Surface Water and Watershed	Designation(s)	Basis for Designation	Route/Alternative Affected					
			APR	3-A	3-B	3-C	3-D	3-E
Lake Carl Blackwell, OK Lower Cimarron watershed (HUC 11050003)	Oklahoma Source Water Protection Area	The lake and drainage areas in close proximity are designated for protection because the lake is a drinking water source. ARs 3-A and 3-B cross protected drainage area, but not the lake.		X	X			
	Oklahoma Special Provision Watershed for Sensitive Public and Private Water Supply	The lake is a protected water supply source. ARs 3-A and 3-B cross five protected streams flowing into the lake.		X	X			

Table 3.15-13:
Surface Waters of Special Interest within the 1,000-Foot-Wide Corridor of the Applicant Proposed Route and HVDC Alternative Routes—Region 3

Surface Water and	Designation(s)	Basis for Designation	Route/Alternative Affected					
Cushing Lake, OK Lower Cimarron watershed (HUC 11050003)	Oklahoma Special Provision Watershed for Sensitive Public and Private Water Supply	The lake is a protected water supply source. The APR and AR 3-C cross two and four protected streams, respectively, that flow into the lake.	X L4			X		

Source: OWRB (2011d)

The five Region 3 route variations would involve no changes to the list (Table 3.15-13) of surface waters of special interest within the 1,000-foot-wide corridor of the Applicant Proposed Route. Similarly, the adjustment to HVDC Alternative Route 3-A is not in an area where there are surface waters of special interest.

3.15.5.3.3 Region 3 Water Quality

Table 3.15-14 identifies surface water features within the ROI in Region 3 that do not meet applicable water quality standards based on the surface water's designated uses and, as a result, have been identified as an impaired water in the state's most recent Section 303(d) list. As noted by a table footnote, Dirty Creek would be within the 1,000-foot-wide corridor of the ROI, but not the 200-foot-wide representative ROW. Link 3 of the Applicant Proposed Route would cross Stillwater Creek and the creek would be encompassed by the 1,000-foot-wide corridor of Link 4, but it would be avoided by the 200-foot-wide ROW of Link 4. All of the other segments would cross both the ROI and the ROW.

Table 3.15-14:
Waters with Impaired Quality within the 1,000-Foot-Wide Corridors of the Applicant Proposed Route and HVDC Alternative Routes—Region 3

Water Segment and Watershed	Impaired Uses—Impairment	TMDL Status[1]	Project Components Crossing Impaired Segment
Skeleton Creek, OK (OK620910030010_00) Lower Cimarron-Skeleton watershed (HUC 11050002)	Fish and Wildlife Propagation/Warm Water Aquatic Community—selenium impairment	Priority Date: 2023 Approved TMDLs for *Enterococcus*, *E. coli*, fecal coliform, and total suspended solids	APR Link 1
West Beaver Creek, OK (OK620900030260_00) Lower Cimarron watershed (HUC 11050003)	Primary Body Contact Recreation—*E. coli* and *Enterococcus* impairments	Priority Date: 2023 Approved TMDL for turbidity	ARs 3-A and 3-B
Stillwater Creek, OK (OK620900040040_00) Lower Cimarron watershed (HUC 11050003)	Fish and Wildlife Propagation/Warm Water Aquatic Community—dissolved oxygen impairment	Priority Date: 2017 Approved TMDLs for *Enterococcus*, *E. coli*, and turbidity	APR Link 3 and Link 4[2], AR 3-B
Little Stillwater Creek, OK (OK620900040050_00) Lower Cimarron watershed (HUC 11050003)	Public and Private Water Supply—nitrates impairment	Priority Date: 2017	AR 3-B
Cimarron River, OK (OK620900030010_00) Lower Cimarron watershed (HUC	Fish Consumption—lead impairment	Priority Date: 2017 Approved TMDLs for *Enterococcus* and turbidity	APR Link 4, AR 3-C

Table 3.15-14:
Waters with Impaired Quality within the 1,000-Foot-Wide Corridors of the Applicant Proposed Route and HVDC Alternative Routes—Region 3

Water Segment and Watershed	Impaired Uses—Impairment	TMDL Status[1]	Project Components Crossing Impaired Segment
11050003)			
Little Deep Fork Creek, OK (OK520700060130_10) Deep Fork watershed (HUC 11100303)	Primary Body Contact Recreation—*E. coli* and *Enterococcus* impairments	Priority Date: 2018	AR 3-C
West Spring Creek, OK (OK520700060210_00 Deep Fork watershed (HUC 11100303)	Agriculture—chloride and total dissolved solids impairments	Priority Date: 2020	APR Link 4
Browns Creek, OK (OK520700060050_00) Deep Fork watershed (HUC 11100303)	Fish and Wildlife Propagation/Warm Water Aquatic Community—dissolved oxygen impairment	Priority Date: 2020	APR Link 4, AR 3-C
Begger Creek, OK (OK520700020155_00) Deep Fork watershed (HUC 11100303)	Agriculture—chloride and total dissolved solids impairments	Priority Date: 2023	APR Link 4
Salt Creek, OK (OK520700020150_00) Deep Fork watershed (HUC 11100303)	Agriculture—chloride impairment Fish and Wildlife Propagation/Warm Water Aquatic Community—dissolved oxygen impairment	Priority Date: 2023	APR Link 4, AR 3-C
Adams Creek, OK (OK520700020080_00) Deep Fork watershed (HUC 11100303)	Fish and Wildlife Propagation/Warm Water Aquatic Community—dissolved oxygen impairment	Priority Date: 2023	APR Link 4, AR 3-C
Butler Creek, OK (OK120400020160_00) Dirty-Greenleaf watershed (HUC 11110102)	Fish and Wildlife Propagation/Warm Water Aquatic Community—dissolved oxygen impairment	Priority Date: 2023 Approved TMDLs for *Enterococcus*, *E. coli*, and turbidity	ARs 3-C and 3-D
Dirty Creek, OK (OK120400020010_00) Dirty-Greenleaf watershed (HUC 11110102)	Fish and Wildlife Propagation/Warm Water Aquatic Community—dissolved oxygen impairment	Priority Date: 2020 Approved TMDLs for *Enterococcus* and turbidity	ARs 3-C[2], 3-D[2], and 3-E[2]

1 TMDL = Total Maximum Daily Load—TMDLs are the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. Once TMDLs have been determined, discharge requirements can be developed that will bring a waterbody back into compliance.
2 The 1,000-foot-wide ROI corridor of this route component would encompass the water segment, but the corresponding 200-foot-wide ROW would not.
Sources: ODEQ (2014, 2013), EPA (2013b)

The five Region 3 route variations would involve no changes to the list (Table 3.15-14) of impaired waters within the 1,000-foot-wide corridor of the Applicant Proposed Route or the areas at which such waters would be crossed by the route. Similarly, there are no impaired waters in the area of the adjustment to HVDC Alternative Route 3-A.

3.15.5.3.4 Region 3 Water Use

The contribution of surface water becomes more important in the eight counties (Creek, Garfield, Kingfisher, Lincoln, Logan, Muskogee, Okmulgee, and Payne counties, Oklahoma) that encompass Region 3 as compared to Regions 1 and 2. Table 3.7-12 shows that the average use of surface water was about 81 million gallons per day in 2010 compared to about 267 million gallons per day of groundwater. Surface water, therefore, accounts for about 23 percent of area's total water usage. Total water use (groundwater and surface water) is described in more detail in Section 3.7.5.3.4.

3.15.5.4 Region 4

Region 4 is referred to as the Arkansas River Valley Region and includes the Applicant Proposed Route and HVDC Alternative Routes 4-A through 4-E as well as the Lee Creek Variation.

Seven route variations to the Applicant Proposed Route were developed in Region 4 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.4. The Applicant Proposed Route variations (Link 3, Variation 1; Link 3, Variation 2; Link 3, Variation 3; Link 6, Variation 1; Link 6, Variation 2; Link 6, Variation 3; and Link 9, Variation 1) are illustrated in Exhibit 1 of Appendix M. The discussion of Region 4 surface water elements that follows includes identification of differences, if any, that would be expected with the route variations as compared to the original Applicant Proposed Route.

3.15.5.4.1 Region 4 Watersheds

The ROI in Region 4 is entirely within the Lower Arkansas subregion (1111) of the larger Arkansas-White-Red drainage system. Primary drainage of this subregion is provided by the Arkansas River and, consistent with the Arkansas River flow in this area, the predominant flow direction is to the southeast toward the Mississippi River. Local streams may flow in different directions, but as they join larger streams and eventually the Arkansas River, the overall progression is to the southeast.

At USGS's eight-digit coding level, the ROI lies within five different watersheds as shown in Figure 3.15-1 in Appendix A. Table 3.15-15 lists the applicable watersheds and provides additional detail, including the primary surface water or waters that drain the watershed. Surface waters for the ROI are shown on Figure 3.15-2 in Appendix A. None of the seven route variations to the Applicant Proposed Route developed in Region 4 would change the watersheds that would be crossed.

Table 3.15-15:
Watersheds Crossed by the Applicant Proposed Route and HVDC Alternative Routes—Region 4

USGS HUC Number and Watershed Name	Area Drained (square miles)	Description of Primary Surface Water Feature(s)
11110102, Dirty-Greenleaf	797	Arkansas River is the primary drain for the watershed. Dirty Creek and Greenleaf Creek also drain portions of the watershed and are tributaries to the Arkansas River. Greenleaf Lake is on Greenleaf Creek.
11110103, Illinois	1,654	Illinois River is the primary drain for the watershed. The Illinois River converges with the Arkansas River just downstream of the watershed's south border. Tenkiller Ferry Lake is a major water body in the watershed.
11110104, Robert S. Kerr Reservoir	1,762	Arkansas River is the primary drain for the watershed and the Robert S. Kerr Reservoir, formed by a dam on the Arkansas River is a primary waterbody in the watershed. Sans Bois, Sallisaw, Negro, and Little Vian creeks are some of the streams draining portions of

Table 3.15-15:
Watersheds Crossed by the Applicant Proposed Route and HVDC Alternative Routes—Region 4

USGS HUC Number and Watershed Name	Area Drained (square miles)	Description of Primary Surface Water Feature(s)
		the watershed and flowing into the reservoir. The Canadian River also joins the Arkansas River system at the reservoir. Lee Creek, flowing south from the Ozark National Forest, converges with the Arkansas River near the eastern edge of the watershed.
11110201, Frog-Mulberry	1,286	Arkansas River is the primary drain for the watershed. Frog Bayou and the Mulberry River flow through the Ozark National Forest in the northern portion of the watershed and then flow south into the Arkansas River.
11110202, Dardanelle Reservoir	1,865	Arkansas River is the primary drain for the watershed and the Dardanelle Reservoir, formed by a dam on the Arkansas River is a primary waterbody in the watershed. Big Piney Creek and the Illinois Bayou flow through the Ozark National Forest in the northern portion of the watershed and then flow south into the Arkansas River.

GIS Data Source: USGS (2014a)

3.15.5.4.2 Region 4 Surface Water Features

Table 3.15-16 lists the total length of perennial streams, intermittent streams, and major waterbodies within the ROI and the 200-foot-wide representative ROW in Region 4. The table includes the total acreage for reservoirs, lakes, and ponds that occur within the ROI.

Table 3.15-16:
Miles and Acreage of Surface Water Features within the 1,000-Foot-Wide Corridors (and the 200-Foot-Wide Representative ROW) of the Applicant Proposed Route and HVDC Alternative Routes—Region 4

<table>
<tr><th>Route—Proposed and Alternatives[1, 2, 3]</th><th>Link 1</th><th>Link 2</th><th>Link 3</th><th>Link 4</th><th>Link 5</th><th>Link 6</th><th>Link 7</th><th>Link 8</th><th>Link 9</th><th>Region 4 Total</th></tr>
<tr><td colspan="11">Perennial Streams</td></tr>
<tr><td>APR (miles)</td><td>0.47 (0.08)</td><td>0.02 (0)</td><td>2.60 (0.40)</td><td>0</td><td>0.12 (0.03)</td><td>6.85 (1.28)</td><td>3.91 (0.77)</td><td>0</td><td>4.79 (0.94)</td><td>18.76 (3.50)</td></tr>
<tr><td>With AR 4-A (miles)</td><td>0.47 (0.08)</td><td>0.02 (0)</td><td colspan="4">7.95 (1.35)</td><td>3.91 (0.77)</td><td>0</td><td>4.79 (0.94)</td><td>17.14 (3.14)</td></tr>
<tr><td>With AR 4-B (miles)</td><td>0.47 (0.08)</td><td colspan="7">8.03 (1.56)</td><td>4.79 (0.94)</td><td>13.29 (2.58)</td></tr>
<tr><td>With AR 4-C (miles)</td><td>0.47 (0.08)</td><td>0.02 (0)</td><td>2.60 (0.40)</td><td>0</td><td>0.58 (0.19)</td><td>6.85 (1.28)</td><td>3.91 (0.77)</td><td>0</td><td>4.79 (0.94)</td><td>19.22 (3.66)</td></tr>
<tr><td>With AR 4-D (miles)</td><td>0.47 (0.08)</td><td>0.02 (0)</td><td>2.60 (0.40)</td><td colspan="3">3.75 (0.69)</td><td>3.91 (0.77)</td><td>0</td><td>4.79 (0.94)</td><td>15.54 (2.88)</td></tr>
<tr><td>With AR 4-E (miles)</td><td>0.47 (0.08)</td><td>0.02 (0)</td><td>2.60 (0.40)</td><td>0</td><td>0.12 (0.03)</td><td>6.85 (1.28)</td><td>3.91 (0.77)</td><td colspan="2">2.68 (0.57)</td><td>16.65 (3.13)</td></tr>
<tr><td colspan="11">Intermittent Streams</td></tr>
<tr><td>APR (miles)</td><td>4.23 (1.38)</td><td>1.16 (0.19)</td><td>12.29 (2.59)</td><td>0.60 (0.13)</td><td>1.53 (0.24)</td><td>2.52 (0.93)</td><td>3.37 (0.63)</td><td>0.95 (0.05)</td><td>15.23 (2.82)</td><td>41.88 (8.96)</td></tr>
<tr><td>With AR 4-A (miles)</td><td>4.23 (1.38)</td><td>1.16 (0.19)</td><td colspan="4">16.15 (4.29)</td><td>3.37 (0.63)</td><td>0.95 (0.05)</td><td>15.23 (2.82)</td><td>41.09 (9.36)</td></tr>
<tr><td>With AR 4-B (miles)</td><td>4.23 (1.38)</td><td colspan="7">26.63 (5.93)</td><td>15.23 (2.82)</td><td>46.09 (10.13)</td></tr>
<tr><td>With AR 4-C (miles)</td><td>4.23 (1.38)</td><td>1.16 (0.19)</td><td>12.29 (2.59)</td><td>0.60 (0.13)</td><td>0.55 (0.08)</td><td>2.52 (0.93)</td><td>3.37 (0.63)</td><td>0.95 (0.05)</td><td>15.23 (2.82)</td><td>40.90 (8.80)</td></tr>
</table>

Table 3.15-16:
Miles and Acreage of Surface Water Features within the 1,000-Foot-Wide Corridors (and the 200-Foot-Wide Representative ROW) of the Applicant Proposed Route and HVDC Alternative Routes—Region 4

Route—Proposed and Alternatives[1, 2, 3]	Link 1	Link 2	Link 3	Link 4	Link 5	Link 6	Link 7	Link 8	Link 9	Region 4 Total
With AR 4-D (miles)	4.23 (1.38)	1.16 (0.19)	12.29 (2.59)	7.16 (2.14)			3.37 (0.63)	0.95 (0.05)	15.23 (2.82)	44.39 (9.80)
With AR 4-E (miles)	4.23 (1.38)	1.16 (0.19)	12.29 (2.59)	0.60 (0.13)	1.53 (0.24)	2.52 (0.93)	3.37 (0.63)	14.80 (3.79)		40.50 (9.88)
Major Waterbodies										
APR (miles)	0.03 (0.03)	0	0.23 (0.03)	0	0	0.16 (0.12)	0	0	0.07 (0.06)	0.49 (0.24)
With AR 4-A (miles)	0.03 (0.03)	0	0.09 (0.10)				0	0	0.07 (0.06)	0.19 (0.19)
With AR 4-B (miles)	0.03 (0.03)	0.10 (0.09)							0.07 (0.06)	0.20 (0.18)
With AR 4-C (miles)	0.03 (0.03)	0	0.23 (0.03)	0	0	0.16 (0.12)	0	0	0.07 (0.06)	0.49 (0.24)
With AR 4-D (miles)	0.03 (0.03)	0	0.23 (0.03)	0.04 (0.04)			0	0	0.07 (0.06)	0.37 (0.16)
With AR 4-E (miles)	0.03 (0.03)	0	0.23 (0.03)	0	0	0.16 (0.12)	0	0.06 (0.14)		0.48 (0.32)
Reservoirs, Lakes, and Ponds										
APR (acres)	29.5 (5.5)	1.2 (<0.1)	23.0 (1.5)	0.6 (0.1)	0.8 (0.3)	9.6 (2.5)	11.0 (3.0)	0.5 (0.2)	17.5 (3.0)	93.7 (16.1)
With AR 4-A (acres)	29.5 (5.5)	1.2 (<0.1)	30.2 (5.5)				11.0 (3.0)	0.5 (0.2)	17.5 (3.0)	89.9 (17.2)
With AR 4-B (acres)	29.5 (5.5)	27.6 (5.0)							17.5 (3.0)	74.6 (13.5)
With AR 4-C (acres)	29.5 (5.5)	1.2 (<0.1)	23.0 (1.5)	0.6 (0.1)	2.5 (0.8)	9.6 (2.5)	11.0 (3.0)	0.5 (0.2)	17.5 (3.0)	95.4 (16.6)
With AR 4-D (acres)	29.5 (5.5)	1.2 (<0.1)	23.0 (1.5)	22.1 (3.1)			11.0 (3.0)	0.5 (0.2)	17.5 (3.0)	104.8 (16.3)
With AR 4-E (acres)	29.5 (5.5)	1.2 (<0.1)	23.0 (1.5)	0.6 (0.1)	0.8 (0.3)	9.6 (2.5)	11.0 (3.0)	45.2 (7.5)		120.9 (20.4)

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
2 Each region of the Applicant Proposed Route (APR) is divided into links that lie between points, or nodes, where the APR is intersected by alternative routes (ARs). ARs bypass specific links of the APR as shown in the table.
3 For the ARs, the unshaded portion of the rows provides the data for the length of the AR. The shaded portion of the rows provides the data for the balance of the APR, thereby providing perspective across the region.
GIS Data Source: USGS (2014a)

The Applicant has proposed a route variation in Region 4, the Lee Creek Variation, that is not included in Table 3.15-16. The Lee Creek Variation would move the Applicant Proposed Route slightly to the north in the area of the Lee Creek Reservoir, which is roughly on the Oklahoma-Arkansas border. Within this small variation in Link 3 of the route, surface water features are summarized as follows (GIS Data Source: USGS 2014a):

- Perennial streams—0.25 mile in the 1,000-foot-wide corridor of the ROI and 0.04 mile in the 200-foot-wide ROW

- Intermittent streams—0.79 mile in the 1,000-foot-wide corridor of the ROI and 0.29 mile in the 200-foot-wide ROW
- Major waterbodies—0.01 mile in both the 1,000-foot-wide corridor of the ROI and the 200-foot-wide ROW
- Reservoirs, lakes, and ponds—Neither the ROI nor the ROW include reservoirs, lakes, or ponds

The western end of the ROI in Region 4 passes through the same area of Oklahoma described for the ROI in Region 3 where the NRCS has constructed many small dams and reservoirs for flood prevention, management of soil erosion, and irrigation. The ROI for HVDC Alternative Routes 4-A and 4-B (in a segment where the routes overlap) contains the dam and a small strip of the reservoir named Sallisaw Creek 6, presumably because it is located in a small drainage that drains to the east to Sallisaw Creek (Table 3.15-17 below). The 200-foot-wide ROW for HVDC Alternative Routes 4-A and 4-B would pass roughly 200 feet to the south of the dam and the reservoir.

The seven Region 4 route variations would involve only minor changes to the surface water features crossed by the 200-foot-wide representative ROW of the Applicant Proposed Route. The ROWs of the variations would have about 0.5 mile less of stream beds (perennial and intermittent) and would incorporate two fewer minor water bodies. There would be no change in major waterbodies from the original Applicant Proposed Route.

3.15.5.4.2.1 Surface Water Features of Special Interest

As described in the discussion of watersheds in the ROI in Region 4, the Arkansas and Illinois rivers are important surface water features in the area from a drainage system standpoint, but Mulberry River and Big Piney Creek are identified as being of particular value based on several designations. This portion of the proposed transmission line route passes through or by several Oklahoma and Arkansas communities as well as numerous surface water features. Consistent with the presence of communities in the area, the HVDC transmission line routes also pass through several areas that are protected as waters and drainage areas associated with drinking water supplies. Table 3.15-17 identifies surface waters within the ROI in Region 4 that have specific federal or state designations of special interest beyond significance as drainage features. The surface waters are presented in a rough west-to-east order. Each of the water features and designations identified in the table is applicable to the 200-foot-wide representative ROWs as well as the wider ROI.

Table 3.15-17:
Surface Waters of Special Interest within the 1,000-Foot-Wide Corridors of the Applicant Proposed Route and HVDC Alternative Routes—Region 4

Surface Water and Watershed	Designation(s)	Basis/Description	Route/Alternative Affected					
			APR	4-A	4-B	4-C	4-D	4-E
Arkansas River, OK Dirty-Greenleaf watershed (HUC 11110202)	Section 10 Navigable Waters of the U.S	Any action that would obstruct or alter a navigable water is prohibited without a USACE permit. APR Link 1 crosses the river.	X L1					
Lower Illinois River, OK Illinois watershed (HUC 11110103)	Section 10 Navigable Waters of the U.S	Any action that would obstruct or alter a navigable water is prohibited without a USACE permit. APR Link 1 crosses the river.	X L1					
	Oklahoma High Quality Water	APR Link 1 crosses the river and its special provision watershed.	X L1					

Table 3.15-17:
Surface Waters of Special Interest within the 1,000-Foot-Wide Corridors of the Applicant Proposed Route and HVDC Alternative Routes—Region 4

Surface Water and Watershed	Designation(s)	Basis/Description	Route/Alternative Affected					
			APR	4-A	4-B	4-C	4-D	4-E
Sallisaw Creek, OK Robert S. Kerr Reservoir watershed (HUC 11110104)	Oklahoma High Quality Water	APR Link 3, AR 4-A, and AR 4-B cross the river and its special provision watershed.	X L3	X	X			
Brushy Creek, OK Robert S. Kerr Reservoir watershed (HUC 11110104)	Oklahoma Sensitive Public and Private Water Supply	AR 4-A and AR 4-B cross the special provision watershed of Brushy Creek Reservoir, including two streams with the water supply designation.		X	X			
Little Lee Creek, OK Robert S. Kerr Reservoir watershed (HUC 11110104)	Oklahoma Outstanding Resource Water	AR 4-A and AR 4-B cross the creek and its special provision watershed.		X	X			
	Oklahoma Scenic River Area	AR 4-A and AR 4-B cross the creek		X	X			
Lee Creek, OK Robert S. Kerr Reservoir watershed (HUC 11110104)	National Park Service Nationwide Rivers Inventory	APR Link 3, AR 4-A, and AR 4-B cross the creek	X L3	X	X			
	Oklahoma Outstanding Resource Water	APR Link 3, AR 4-A, and AR 4-B cross the creek and its special provision watershed	X L3	X	X			
	Oklahoma Scenic River Area	AR 4-A and AR 4-B cross the creek where it is designated a Scenic River. (The APR crosses outside of the designated area.)		X	X			
	Arkansas Extraordinary Resource Water	AR 4-B crosses the creek in Crawford County, AR			X			
Briar Creek (Bear Creek), OK Robert S. Kerr Reservoir watershed (HUC 11110104)	Oklahoma Outstanding Resource Water	The creek lies between the APR and AR 4-B, but APR Link 3 crosses the creek's special provision watershed	X L3					
Webbers Creek, OK Robert S. Kerr Reservoir watershed (HUC 11110104)	Oklahoma Outstanding Resource Water	The creek lies south of AR 4-A, but AR 4-A crosses the creek's special provision watershed		X				
Lee Creek Reservoir, OK and AR Robert S. Kerr Reservoir watershed (HUC 11110104)	Lee Creek Reservoir Buffer Zone	The city of Fort Smith manages a 300-foot, restrictive buffer zone around the reservoir. APR Link 3 crosses the buffer zone in both states.	X L3			X	X	X
Not publicly available location (APR Link 3), AR Robert S. Kerr Reservoir watershed (HUC 11110104)	Arkansas Source Water Protection Area (and public water intakes)[1]	APR Link 3, AR 4-A, and AR 4-D cross the area and APR Link 3 is less than 3 miles upstream of the associated source water intake.	X L3	X			X	

Table 3.15-17:
Surface Waters of Special Interest within the 1,000-Foot-Wide Corridors of the Applicant Proposed Route and HVDC Alternative Routes—Region 4

Surface Water and Watershed	Designation(s)	Basis/Description	Route/Alternative Affected					
			APR	4-A	4-B	4-C	4-D	4-E
Mulberry River, AR Frog-Mulberry watershed (HUC 11110201)	Section 10 Navigable Waters of the U.S	Any action that would obstruct or alter a navigable water is prohibited without a USACE permit. APR Link 6, AR 4-A, AR 4-B, and AR 4-D cross the river	X L6	X	X		X	
	Arkansas Extraordinary Resource Water	APR Link 6, AR 4-A, AR 4-B, and AR 4-D cross the river	X L6	X	X		X	
	Arkansas Natural and Scenic Waterway	Same as above	X L6	X	X		X	
Not publicly available location, AR Frog-Mulberry watershed (HUC 11110201)	Arkansas Source Water Protection Area (and public water intakes)[1]	AR 4-A, AR 4-B, and AR 4-D cross the area, but each is greater than 3 miles upstream of the associated source water intake.		X	X		X	
Not publicly available location, AR Frog-Mulberry watershed (HUC 11110201)	Arkansas Source Water Protection Area (and public water intakes)[1]	AR 4-A, AR 4-B, and AR 4-D cross the area. AR 4-B is about 3 miles upstream of the associated source water intake; AR 4-A and AR 4-D are downstream of the intake.		X	X		X	
Not publicly available location (APR Link 7), AR Frog-Mulberry watershed (HUC 11110201)	Arkansas Source Water Protection Area (and public water intakes)[1]	APR Link 7 and AR 4-B cross the area. AR 4-B is just over 3 miles upstream of the associated source water intake; APR Link 7 is downstream of the intake.	X L7		X			
Big Piney Creek, AR Dardanelle reservoir watershed (HUC 11110202)	National Park Service Nationwide Rivers Inventory	APR Link 9 and AR 4-E cross the creek.	X L9					X
	Arkansas Extraordinary Resource Water	Same as above	X L9					X
	Arkansas Natural and Scenic Waterway	Same as above	X L9					
Not publicly available location (APR Link 9, AR 4-E) Dardanelle reservoir watershed (HUC 11110202)	Arkansas Source Water Protection Area (and public water intakes)[1]	APR Link 9 and AR 4-E cross the area. APR Link 9 is over 3 miles upstream of the associated source water intake; AR 4-E is less than 3 miles upstream of the intake.	X L9					

L3 (for example) = Link 3 of the Applicant Proposed Route in Region 4
1 Confidential data are excluded to avoid privacy/security concerns.
Sources: USACE (2014b), USACE (2004), NPS (2010, 2004), NWSRS (2012), OWRB (2011a, 2011b, 2011c, 2011d), APCEC (2011), Clean Line (2013)

It is worth noting that the Mulberry River and Big Piney Creek, both listed in Table 3.15-17, are designated as National Wild and Scenic Rivers. However, in both cases, the designations end when the streams exit the National Forest, which is to the north of the Project components and, as a result, those designations are not shown in the table.

The Lee Creek Variation mentioned above is not included in Table 3.15-17, but this variation would avoid the 300-foot buffer zone established around the reservoir by the city of Fort Smith. The applicable portion of the Applicant Proposed Route (with or without the variation) would be within the area designated as the Lee Creek Outstanding Water Resource special provision watershed (OWRB 2011b) as well as the area established as a Source Water Protection Area.

The seven Region 4 route variations would involve no changes to the list (Table 3.15-17) of surface waters of special interest within the 1,000-foot-wide corridor of the Applicant Proposed Route. Compared to the original Applicant Proposed Route, Link 3, Variation 2 would cross Salisaw Creek at a slightly different location, and Link 9, Variation 1, would cross Big Piney Creek at a slightly different location.

3.15.5.4.3 Region 4 Water Quality

Table 3.15-18 identifies surface water features within the ROI in Region 4 that do not meet applicable water quality standards based on the surface water's designated uses and, as a result, have been identified as an impaired water in the states' most recent Section 303(d) lists. Each of the water segments identified in the table is applicable to the 200-foot-wide representative ROWs as well as the wider ROI.

Table 3.15-18:
Waters with Impaired Quality within the 1,000-Foot-Wide Corridors of the Applicant Proposed Route and HVDC Alternative Routes—Region 4

Water Segment and Watershed	Impaired Uses—Impairment	TMDL Status[1]	Project Components Crossing Impaired Segment
Sallisaw Creek, OK (OK220200030010_10) Robert S. Kerr Reservoir watershed (HUC 11110104)	Primary Body Contact Recreation—*Enterococcu*s impairment	Priority Date: 2017	APR Link 3
Sallisaw Creek, OK (OK220200030010_20) Robert S. Kerr Reservoir watershed (HUC 11110104)	Primary Body Contact Recreation—*Enterococcu*s impairment	Priority Date: 2017	ARs 4-A and 4-B
Little Sallisaw Creek, OK (OK220200020040_00) Robert S. Kerr Reservoir watershed (HUC 11110104)	Fish and Wildlife Propagation/Warm Water Aquatic Community—copper impairment	Priority Date: 2017	APR Link 3, ARs 4-A, and 4-B
Little Lee Creek, OK (OK220200050040_00) Robert S. Kerr Reservoir watershed (HUC 11110104)	Primary Body Contact Recreation—*Enterococcu*s impairment	Priority Date: 2017	ARs 4-A and 4-B
Lee Creek, OK (OK220200050010_00) Robert S. Kerr Reservoir watershed (HUC 11110104)	Primary Body Contact Recreation—*Enterococcu*s impairment Fish and Wildlife Propagation/Cool Water Aquatic Community—lead impairment	Priority Date: 2017	APR Link 3
Lee Creek, OK (OK220200050010_10 Robert S. Kerr Reservoir watershed (HUC 11110104)	Fish and Wildlife Propagation/Cool Water Aquatic Community—copper and lead impairments	Priority Date: 2017	ARs 4-A and 4-B

1 TMDL = Total Maximum Daily Load—TMDLs are the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. Once TMDLs have been determined, discharge requirements can be developed that will bring a waterbody back into compliance.
Sources: ODEQ (2014, 2013), EPA (2013b), ADEQ (2014a, 2014b, 2014c)

The seven Region 4 route variations would involve no changes to the list (Table 3.15-18) of impaired waters within the 1,000-foot-wide corridor of the Applicant Proposed Route. Compared to the original Applicant Proposed Route, Link 3, Variation 2, would cross Salisaw Creek at a slightly different location and Link 3, Variation 1 would cross Little Salisaw Creek at a slightly different location.

3.15.5.4.4 Region 4 Water Use

Water use in the six counties (Muskogee and Sequoyah counties, Oklahoma, and Crawford, Franklin, Johnson, and Pope counties, Arkansas) that encompass Region 4 has clearly shifted in favor of surface water compared to that described for Region 3. Table 3.7-15 shows that average use of surface water was almost 1,090 million gallons per day in 2010 and average use of groundwater was 9.4 million gallons per day. Surface water, therefore, accounts for 99 percent of area's total water usage. Total water use (groundwater and surface water) is described in greater detail in Section 3.7.5.4.4.

3.15.5.5 Region 5

Region 5 is referred to as the Central Arkansas Region and includes the Applicant Proposed Route and HVDC Alternative Routes 5-A through 5-F.

Five route variations to the Applicant Proposed Route were developed in Region 5 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.5. The Applicant Proposed Route variations (Link 1, Variation 2; Link 2, Variation 2; Links 2 and 3, Variation 1; Links 3 and 4, Variation 2; and Link 7, Variation 1) are illustrated in Exhibit 1 of Appendix M. It should be noted that route adjustments were made for HVDC Alternative Route 5-B to maintain an end-to-end route with Links 2 and 3, Variation 1, and for HVDC Alternative Route 5-E to maintain an end-to-end route with Links 3 and 4, Variation 2. The discussion of Region 5 surface water elements that follows includes identification of differences, if any, that would be expected with the route variations as compared to the original Applicant Proposed Route. The element discussions also address any changes attributed to the adjustments to HVDC Alternative Route 5-B and HVDC Alternative Route 5-E.

3.15.5.5.1 Region 5 Watersheds

The ROI in Region 5 is primarily within the Lower Arkansas (1111) and Upper White (1101) subregions of the larger Arkansas-White-Red drainage system. The only exception is in the eastern portion of Region 5 where several of the alternative routes drop southward and cross through the Lower Mississippi-St. Francis subregion (0802) of the larger Lower Mississippi drainage system. The Lower Mississippi drainage system incorporates drainage areas along the Mississippi River downstream of the confluence of the Mississippi and Ohio rivers. Both drainage systems still flow toward the Mississippi River, but the flow routes can be different. By the USGS methodology, as the larger river systems, such as the Arkansas, White, and Red rivers, approach the Mississippi River, they move out of their own subregion and into subregions of the Lower Mississippi drainage system.

At USGS's eight-digit coding level, the ROI lies within six different watersheds as shown in Figure 3.15-1 in Appendix A. Table 3.15-19 lists the applicable watersheds and provides additional detail, including the primary surface water or waters that drain the watershed. Surface waters for the ROI are shown on Figure 3.15-2 in Appendix A. None of the five route variations to the Applicant Proposed Route developed in Region 5 would change the watersheds that would be crossed.

Table 3.15-19:
Watersheds Crossed by the Applicant Proposed Route and HVDC Alternative Routes—Region 5

USGS HUC Number and Watershed Name	Area Drained (square miles)	Description of Primary Surface Water Feature(s)
11110202, Dardanelle Reservoir	1,865	Arkansas River is the primary drain for the watershed and the Dardanelle Reservoir, formed by a dam on the Arkansas River is a primary waterbody. Big Piney Creek and the Illinois Bayou flow through the Ozark National Forest in the northern portion of the watershed and then flow south into the Arkansas River.
11110203, Lake Conway-Point Remove[1]	1,139	Arkansas River is the primary drain for the watershed. Lake Conway (Greens Lake) connects to the Arkansas River through Palarm Creek. Point Remove Creek is also a tributary to the Arkansas River and its upstream branches, West and East Point Remove creeks, are dammed at multiple points to create reservoirs.
11110205, Cadron	757	Cadron Creek is the primary drain for the watershed and flows into the Arkansas River at the southern boundary of the watershed. Other waterbodies of note in this watershed are East Fork Cadron Creek and Beaver Fork Lake.
11010014, Little Red	1,801	Little Red River is the primary drain for this watershed and drains into the White River at the southeastern end of the watershed. Archey Creek, South Fork Little Red River, Beech Fork, and Big Creek are tributaries to the Little Red River. Greers Ferry Lake is located on the Little Red River.
08020301, Lower White-Bayou Des Arc	1,136	White River is the primary drain for this watershed. Cypress Bayou, fed by creeks such as Bayou Des Arc, Bull Creek, and Fourmile Creek, flows into the White River. Wattensaw Bayou also flows into the White River.
11010013, Upper White-Village	740	White River and its tributary Village Creek are primary drains for this watershed. The Black River also drains a portion of the watershed before it converges with the White River. Departee and Glaise creeks are also tributaries of note to the White River.

1 The proposed Arkansas converter station alternative would be within the Lake Conway–Point Remove watershed.

GIS Data Source: USGS (2014a)

As summarized in Table 3.15-19, the Arkansas River is the primary drain for western portion of the ROI in Region 5, but the primary drain changes to the White River in the eastern portion of the region. The White River flows into the Mississippi River just north of where the Arkansas River meets the Mississippi, but in the ROI the White River's flow is primarily to the south.

3.15.5.5.2 Region 5 Surface Water Features

Table 3.15-20 lists the total length of perennial streams, intermittent streams, and major waterbodies within the ROI and the 200-foot-wide representative ROW in Region 5. The table includes the total acreage for reservoirs, lakes, and ponds that occur within the ROI.

Table 3.15-20:
Miles and Acreage of Surface Water Features within the 1,000-Foot-Wide Corridors (and 200-Foot-Wide Representative ROW) of the Applicant Proposed Route and HVDC Alternative Routes—Region 5

Route—Proposed and Alternatives[1, 2, 3]	Link 1	Link 2	Link 3	Link 4	Link 5	Link 6	Link 7	Link 8	Link 9	Region 5 Total
Perennial Streams										
APR (miles)	1.26 (0.31)	0.30 (0.06)	3.15 (0.61)	1.00 (0.11)	1.00 (0.09)	0.97 (0.18)	1.42 (0.32)	0.79 (0.15)	1.78 (0.33)	11.67 (2.16)
With AR 5-A (miles)	0.71 (0.13)	0.30 (0.06)	3.15 (0.61)	1.00 (0.11)	1.00 (0.09)	0.97 (0.18)	1.42 (0.32)	0.79 (0.15)	1.78 (0.33)	11.12 (1.98)

Table 3.15-20:
Miles and Acreage of Surface Water Features within the 1,000-Foot-Wide Corridors (and 200-Foot-Wide Representative ROW) of the Applicant Proposed Route and HVDC Alternative Routes—Region 5

Route—Proposed and Alternatives[1, 2, 3]	Link 1	Link 2	Link 3	Link 4	Link 5	Link 6	Link 7	Link 8	Link 9	Region 5 Total
With AR 5-B (miles)	1.26 (0.31)	0.30 (0.06)	7.78 (1.17)				1.42 (0.32)	0.79 (0.15)	1.78 (0.33)	13.33 (2.34)
With AR 5-C (miles)	1.26 (0.31)	0.30 (0.06)	3.15 (0.61)	1.00 (0.11)	1.00 (0.09)	1.32 (0.42)		0.79 (0.15)	1.78 (0.33)	10.60 (2.08)
With AR 5-D (miles)	1.26 (0.31)	0.30 (0.06)	3.15 (0.61)	1.00 (0.11)	1.00 (0.09)	0.97 (0.18)	1.42 (0.32)	0.79 (0.15)	2.09 (0.35)	11.98 (2.18)
With AR 5-E (miles)	1.26 (0.31)	0.30 (0.06)	3.15 (0.61)	3.83 (0.47)			1.42 (0.32)	0.79 (0.15)	1.78 (0.33)	12.53 (2.25)
With AR 5-F (miles)	1.26 (0.31)	0.30 (0.06)	3.15 (0.61)	1.00 (0.11)	2.95 (0.26)		1.42 (0.32)	0.79 (0.15)	1.78 (0.33)	12.65 (2.15)
Intermittent Streams										
APR (miles)	2.82 (0.59)	2.42 (0.35)	15.45 (3.28)	6.73 (1.16)	8.21 (1.76)	2.39 (0.36)	0.77 (0.29)	0.59 (0.17)	7.21 (1.36)	46.59 (9.32)
With AR 5-A (miles)	5.59 (0.92)	2.42 (0.35)	15.45 (3.28)	6.73 (1.16)	8.21 (1.76)	2.39 (0.36)	0.77 (0.29)	0.59 (0.17)	7.21 (1.36)	49.36 (9.65)
With AR 5-B (miles)	2.82 (0.59)	2.42 (0.35)	41.08 (8.56)				0.77 (0.29)	0.59 (0.17)	7.21 (1.36)	54.89 (11.32)
With AR 5-C (miles)	2.82 (0.59)	2.42 (0.35)	15.45 (3.28)	6.73 (1.16)	8.21 (1.76)	2.73 (0.51)		0.59 (0.17)	7.21 (1.36)	46.16 (9.18)
With AR 5-D (miles)	2.82 (0.59)	2.42 (0.35)	15.45 (3.28)	6.73 (1.16)	8.21 (1.76)	2.39 (0.36)	0.77 (0.29)	0.59 (0.17)	7.74 (1.66)	47.12 (9.62)
With AR 5-E (miles)	2.82 (0.59)	2.42 (0.35)	15.45 (3.28)	22.67 (4.27)			0.77 (0.29)	0.59 (0.17)	7.21 (1.36)	51.93 (10.31)
With AR 5-F (miles)	2.82 (0.59)	2.42 (0.35)	15.45 (3.28)	6.73 (1.16)	13.32 (2.58)		0.77 (0.29)	0.59 (0.17)	7.21 (1.36)	49.31 (9.78)
Major Waterbodies										
APR (miles)	0.02 (0.02)	0	0.04 (0.05)	0.02 (0.02)	<0.01 (0)	0.01 (0.01)	0.02 (0.02)	0	0.12 (0.12)	0.23 (0.24)
With AR 5-A (miles)	0.02 (0.02)	0	0.04 (0.05)	0.02 (0.02)	<0.01 (0)	0.01 (0.01)	0.02 (0.02)	0	0.12 (0.12)	0.23 (0.24)
With AR 5-B (miles)	0.02 (0.02)	0	0.09 (0.10)				0.02 (0.02)	0	0.12 (0.12)	0.25 (0.26)
With AR 5-C (miles)	0.02 (0.02)	0	0.04 (0.05)	0.02 (0.02)	<0.01 (0)	0.05 (0.04)		0	0.12 (0.12)	0.25 (0.25)
With AR 5-D (miles)	0.02 (0.02)	0	0.04 (0.05)	0.02 (0.02)	<0.01 (0)	0.01 (0.01)	0.02 (0.02)	0	0.12 (0.12)	0.23 (0.23)
With AR 5-E (miles)	0.02 (0.02)	0	0.04 (0.05)	0.03 (0.03)			0.02 (0.02)	0	0.12 (0.12)	0.23 (0.24)
With AR 5-F (miles)	0.02 (0.02)	0	0.04 (0.05)	0.02 (0.02)	0.01 (0.01)		0.02 (0.02)	0	0.12 (0.12)	0.23 (0.24)
Reservoirs, Lakes, and Ponds										
APR (acres)	5.7 (0.9)	0.8 (0)	21.8 (6.8)	18.5 (3.6)	13.3 (2.1)	3.5 (1.3)	0.2 (0.1)	0.5 (0.5)	6.4 (2.0)	70.7 (17.3)
With AR 5-A (acres)	4.4 (0.5)	0.8 (0)	21.8 (6.8)	18.5 (3.6)	13.3 (2.1)	3.5 (1.3)	0.2 (0.1)	0.5 (0.5)	6.4 (2.0)	69.4 (16.9)

Table 3.15-20:
Miles and Acreage of Surface Water Features within the 1,000-Foot-Wide Corridors (and 200-Foot-Wide Representative ROW) of the Applicant Proposed Route and HVDC Alternative Routes—Region 5

Route—Proposed and Alternatives[1, 2, 3]	Link 1	Link 2	Link 3	Link 4	Link 5	Link 6	Link 7	Link 8	Link 9	Region 5 Total
With AR 5-B (acres)	5.7 (0.9)	0.8 (0)	60.1 (10.4)				0.2 (0.1)	0.5 (0.5)	6.4 (2.0)	73.7 (13.9)
With AR 5-C (acres)	5.7 (0.9)	0.8 (0)	21.8 (6.8)	18.5 (3.6)	13.3 (2.1)	4.8 (0.4)		0.5 (0.5)	6.4 (2.0)	71.8 (16.3)
With AR 5-D (acres)	5.68 (0.9)	0.8 (0)	21.8 (6.8)	18.5 (3.6)	13.3 (2.1)	3.5 (1.3)	0.2 (0.1)	0.5 (0.5)	9.6 (1.6)	73.9 (16.9)
With AR 5-E (acres)	5.68 (0.9)	0.8 (0)	21.8 (6.8)	21.8 (3.2)			0.2 (0.1)	0.5 (0.5)	6.4 (2.0)	57.2 (13.5)
With AR 5-F (acres)	5.68 (0.9)	0.8 (0)	21.8 (6.8)	18.5 (3.6)	10.4 (0.7)		0.2 (0.1)	0.5 (0.5)	6.4 (2.0)	64.3 (14.6)

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
2 Each region of the Applicant Proposed Route (APR) is divided into links that lie between points, or nodes, where the APR is intersected by alternative routes (ARs). ARs bypass specific links of the APR as shown in the table.
3 For the ARs, the unshaded portion of the rows provides the data for the length of the AR. The shaded portion of the rows provides the data for the balance of the APR, thereby providing perspective across the region.
GIS Data Source: USGS (2014a)

The siting area for the Arkansas converter station alternative would include no perennial streams, 0.63 mile of intermittent streams, no major waterbodies, and 2.6 acres of reservoirs, lakes, and ponds. The 200-foot-wide ROW for the AC interconnection siting area and the site for the substation at the southwestern end of the interconnection line would encompass 0.16 mile of perennial streams, 1.49 miles of intermittent streams, and 1.66 acres of reservoirs, lakes, and ponds (GIS Data Source: USGS 2014a).

The five Region 5 route variations would involve only minor changes to the surface water features crossed by the 200-foot-wide representative ROW of the Applicant Proposed Route. The ROWs of the variations would have about 0.2 mile less of stream beds (perennial and intermittent). There would be no change in major waterbodies from the original Applicant Proposed Route and the number of other minor waterbodies would even out with one less in Link 1, Variation 2, and one more in Link 7, Variation 1. The adjustments to HVDC Alternative Routes 5-B and 5-E would involve no differences in surface water features.

3.15.5.5.2.1 Surface Water Features of Special Interest

As described in the discussion of watershed in the ROI in Region 5, the Arkansas, Little Red, and White rivers along with Cadron Creek are important surface water features in the area from a drainage system standpoint. Table 3.15-21 identifies surface waters within the ROI that have specific federal or state designations of special interest beyond significance as drainage features. The surface waters are presented in a roughly west-to-east order. The ROI for the Arkansas converter station alternative contains no significant surface waters. Each of the water features and designations identified in the table is applicable to the 200-foot-wide representative ROWs as well as the wider ROI.

Table 3.15-21:
Surface Waters of Special Interest within the 1,000-Foot-Wide Corridors of the Applicant Proposed Route and HVDC Alternative Routes—Region 5

Surface Water and Watershed	Designation(s)	Basis/Description	Route/Alternative Affected						
			APR	5-A	5-B	5-C	5-D	5-E	5-F
Illinois Bayou, AR Dardanelle Reservoir watershed (HUC 11110202)	Arkansas Extraordinary Resource Water	APR Link 1 and AR 5-A cross the bayou.	X L1	X					
Not publicly available location (APR Link 3), AR Cadron watershed (HUC 11110205)	Arkansas Source Water Protection Area (and public water intakes)[1]	APR Link 3 and AR 5-B cross the area and both are greater than 3 miles upstream of the associated source water intake.	X L3		X				
Cadron Creek, AR Cadron watershed (HUC 11110205)	National Park Service Nationwide Rivers Inventory	APR Links 3 and 4, AR 5-B, and AR 5-E cross or abut the creek.	X L3 L4		X			X	
	Arkansas Extraordinary Resource Water	Same as above.	X L3 L4		X			X	
East Fork Cadron Creek, AR Cadron watershed (HUC 11110205)	National Park Service Nationwide Rivers Inventory	AR 5-B, AR 5-E, and AR 5-F cross the creek.			X			X	X
Not publicly available location (APR Links 5 to 9), AR Little Red watershed (HUC 11010014)	Arkansas Source Water Protection Area (and public water intakes)[1]	APR Links 5 to 9 and ARs 5-B to 5-F cross; all are greater than 3 miles upstream of the associated source water intake.	X L5 to L9		X	X	X	X	X
Little Red River, AR Little Red watershed (HUC 11010014)	Arkansas Trout Water	APR Link 7 and AR 5-C cross the reach of the river (from below Greers Ferry Dam to Searcy) with this designation.	X L7			X			
Departee Creek, AR Upper White-Village watershed (HUC 11010013)	Arkansas Ecologically Sensitive Waterbody	AR 5-D crosses the reach of the creek with this designation, which is due to the presence of the flat floater mussel (*Anodonta suborbiculata*).					X		
White River, AR Upper White-Village watershed (HUC 11010013)	Section 10 Navigable Waters of the U.S	Any action that would obstruct or alter a navigable water is prohibited without a USACE permit. APR Link 9 and AR 5-D cross the river.	X L9				X		

L1 (for example) = Link 1 of the Applicant Proposed Route in Region 5
1 Confidential data are excluded to avoid privacy/security concerns.
Sources: APCEC (2011), NPS (2004), USACE (2004), Clean Line (2013)

The five Region 5 route variations would involve a minor change to the list (Table 3.15-21) of surface waters of special interest within the 1,000-foot-wide corridor of the Applicant Proposed Route. Using Links 3 and 4, Variation 2, Cadron Creek would no longer be within the 1,000-foot-wide corridor of Link 3, but the creek would still be crossed by Link 4. Comparatively, Link 1, Variation 2, would cross Illinois Bayou at a slightly different location. The minor adjustments to HVDC Alternative Routes 5-B and 5-E would cause no changes to the list of surface waters of special interest.

3.15.5.5.3 Region 5 Water Quality

Table 3.15-22 identifies surface water features within the ROI in Region 5 that do not meet applicable water quality standards based on the surface water's designated uses and, as a result, have been identified as an impaired water in Arkansas' most recent Section 303(d) list. The table identifies the specific water, the designated use that is impaired and what is causing the impairment. The table identifies the status of the TMDL development process. This status is in the form of the priority the state has placed on the TMDL process or that a TMDL has already been developed and approved by EPA. Finally, the table identifies the project elements that would cross the identified surface water. Each of the water segments identified in the table is applicable to the 200-foot-wide representative ROWs as well as the wider ROI.

Table 3.15-22:
Waters with Impaired Quality within the 1,000-Foot-Wide Corridors of the Applicant Proposed Route and HVDC Alternative Routes—Region 5

Water Segment and Watershed	Impaired Uses—Impairment	TMDL Status[1]	Project Components Crossing Impaired Segment
West Fork Point Remove Creek, AR (Reach 016) Lake Conway-Point Remove watershed (HUC 11110203)	Turbidity impairment	Priority: Not Assigned	AR 5-B
West Fork Point Remove Creek, AR (Reach 017) Lake Conway-Point Remove watershed (HUC 11110203)	Turbidity impairment	Priority: Not Assigned	APR Link 3
East Fork Point Remove Creek, AR (Reach 014) Lake Conway-Point Remove watershed (HUC 11110203)	Turbidity impairment	Priority: Not Assigned	APR Link 3, AR 5-B
Cypress Creek, AR (Reach 917) Cadron watershed (HUC 11110205)	Fisheries—copper and zinc impairments	Priority: Low	AR 5-B
Little Red River, AR (Reach 008) Little Red water shed (HUC 11010014)	Pathogens impairment	Completed	APR Link 7
Little Red River, AR (Reach 010) Little Red watershed (HUC 11010014)	Pathogens impairment	Completed	AR 5-C
Ten Mile Creek, AR (Reach 009) Little Red watershed (HUC 11010014)	Turbidity and pathogens impairments	Completed	APR Links 7 and 8, AR 5-C
Glaise Creek, AR (Reach 021) Upper White-Village watershed (HUC 11010013)	Aquatic Life—dissolved oxygen and zinc impairments	Priority: Low	APR Link 9, AR 5-D
Departee Creek, AR Upper White-Village watershed (HUC 11010013)	Fisheries—dissolved oxygen and turbidity impairments	Priority: Low	APR Link 9, AR 5-D

1 TMDL (Total Maximum Daily Load): TMDLs are the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. Once TMDLs have been determined, discharge requirements can be developed that will bring a waterbody back into compliance.

Sources: ADEQ (2014a, 2014b, 2014c), EPA (2013b)

The five Region 5 route variations would involve no changes to the list (Table 3.15-22) of impaired waters within the 1,000-foot-wide corridor of the Applicant Proposed Route. Similarly, the adjustments to HVDC Alternative Routes 5-B and 5-E would involve no changes.

3.15.5.5.4 Region 5 Water Use

Water use in the seven counties (Cleburne, Conway, Faulkner, Jackson, Pope, Van Buren, and White counties, Arkansas) that encompass this region is more even in terms surface water versus groundwater than was described for the ROI in Region 4, but surface water is still the predominant source. As shown in Table 3.7-17, the average use of surface water was about 1,120 million gallons per day in 2010 compared to about 460 million gallons per day of groundwater. Surface water, therefore, accounts for about 71 percent of area's total water usage. Total water use (groundwater and surface water) is described in more detail in Section 3.7.5.5.4.

3.15.5.6 Region 6

Region 6 is referred to as the Cache River and Crowley's Ridge Region and includes the Applicant Proposed Route and HVDC Alternative Routes 6-A through 6-D.

One route variation to the Applicant Proposed Route was developed in Region 6 after publication of the Draft EIS to parallel more parcel boundaries to minimize impacts to agricultural operations and is illustrated in Exhibit 1 of Appendix M. It should be noted that a route adjustment was made for HVDC Alternative Route 6-A to maintain an end-to-end route with the Link 2, Variation 1. The discussion of Region 6 surface water elements that follows includes identification of differences, if any, that would be expected with the route variation as compared to the original Applicant Proposed Route. The element discussions also address any changes attributed to the adjustment to HVDC Alternative Route 6-A.

3.15.5.6.1 Region 6 Watersheds

The ROI in Region 6 begins at the western end of the Upper White subregion (1101) of the larger Arkansas-White-Red drainage system, but to the east it quickly moves into the Lower Mississippi-St. Francis subregion (0802) of the larger Lower Mississippi drainage system. As noted previously, under USGS's methodology, as the larger river systems, such as the Arkansas, White, and Red rivers approach the Mississippi River, they move out of their own subregion and into subregions of the Lower Mississippi drainage system.

At USGS's eight-digit coding level, the ROI lies within four different watersheds as shown in Figure 3.15-1 in Appendix A. Table 3.15-23 lists the applicable watersheds and provides additional detail, including the primary surface water or waters that drain the watershed. Surface waters for the ROI are shown on Figure 3.15-2 in Appendix A. The route variation to the Applicant Proposed Route developed in Region 6 would not change the watersheds that would be crossed.

Table 3.15-23:
Watersheds Crossed by the Applicant Proposed Route and HVDC Alternative Routes—Region 6

USGS HUC Number and Watershed Name	Area Drained (square miles)	Description of Primary Surface Water Feature(s)
11010013, Upper White-Village	740	White River and its tributary Village Creek are primary drains for this watershed. The Black River also drains a portion of the watershed before it converges with the White River. Departee and Glaise creeks are also tributaries of note to the White River.
08020302, Cache	2,007	Cache River is the primary drain for this watershed and it flows into the White River at the watershed's downstream boundary. The watershed also includes Bayou DeView as a tributary to the Cache River.

Table 3.15-23:
Watersheds Crossed by the Applicant Proposed Route and HVDC Alternative Routes—Region 6

USGS HUC Number and Watershed Name	Area Drained (square miles)	Description of Primary Surface Water Feature(s)
08020205, L'Anguille	955	L'Anguille River is the primary drain for this watershed and it converges with the Madison-Marianna Diversion in the southern portion of the watershed. Brushy, First, and Second creeks are noted tributaries to the L'Anguille River.
08020203, Lower St. Francis	3,579	St. Francis River is the primary drain for this watershed, which stretches from Lake Wappepello (in Missouri) south to where the St. Francis River flows into the Mississippi River.

GIS Data Source: USGS (2014a)

In the ROI in Region 6, the rivers that are the primary drains for the watersheds are generally oriented north-south with flow to the south toward the Mississippi River.

3.15.5.6.2 Region 6 Surface Water Features

As described for the watersheds in the ROI for Region 6, the White, Cache, L'Anguille, and St. Francis rivers are important surface water features in the area from a drainage system standpoint. Table 3.15-24 lists the total length of perennial streams, intermittent streams, and major waterbodies within the ROI and the 200-foot-wide representative ROW in Region 6. The table includes the total acreage for reservoirs, lakes, and ponds that occur within the ROI and the ROW.

Table 3.15-24:
Miles and Acreage of Surface Water Features within the 1,000-Foot-Wide Corridors (and 200-Foot-Wide Representative ROW) of the Applicant Proposed Route and HVDC Alternative Routes—Region 6

Route—Proposed and Alternatives[1, 2, 3]	Link 1	Link 2	Link 3	Link 4	Link 5	Link 6	Link 7	Link 8	Region 6 Total
Perennial Streams									
APR (miles)	1.10 (0.18)	0.23 (0.05)	0.71 (0.14)	0.75 (0.12)	0	1.27 (0.16)	8.20 (0.12)	0.26 (0.06)	12.52 (0.83)
With AR 6-A (miles)	1.10 (0.18)	1.10 (0.25)			0	1.27 (0.16)	8.20 (0.12)	0.26 (0.06)	11.93 (0.77)
With AR 6-B (miles)	1.10 (0.18)	0.23 (0.05)	0.48 (0.16)	0.75 (0.12)	0	1.27 (0.16)	8.20 (0.12)	0.26 (0.06)	12.29 (0.85)
With AR 6-C (miles)	1.10 (0.18)	0.23 (0.05)	0.71 (0.14)	0.75 (0.12)	0	6.08 (0.38)		0.26 (0.06)	9.13 (0.93)
With AR 6-D (miles)	1.10 (0.18)	0.23 (0.05)	0.71 (0.14)	0.75 (0.12)	0	1.27 (0.16)	10.05 (0.25)	0.26 (0.06)	14.37 (0.96)
Intermittent Streams									
APR (miles)	0.80 (0.15)	0.58 (0.08)	4.36 (1.93)	1.30 (0.17)	0	4.45 (0.88)	0.75 (0.15)	1.12 (0.12)	13.36 (3.48)
With AR 6-A (miles)	0.80 (0.15)	5.75 (2.18)			0	4.35 (0.88)	0.75 (0.15)	1.12 (0.12)	12.87 (3.48)
With AR 6-B (miles)	0.80 (0.15)	0.58 (0.08)	4.75 (1.48)	1.30 (0.17)	0	4.35 (0.88)	0.75 (0.15)	1.12 (0.12)	13.75 (3.03)
With AR 6-C (miles)	0.80 (0.15)	0.58 (0.08)	4.36 (1.93)	1.30 (0.17)	0	3.88 (1.05)		1.12 (0.12)	12.04 (3.50)

Table 3.15-24:
Miles and Acreage of Surface Water Features within the 1,000-Foot-Wide Corridors (and 200-Foot-Wide Representative ROW) of the Applicant Proposed Route and HVDC Alternative Routes—Region 6

Route—Proposed and Alternatives[1, 2, 3]	Link 1	Link 2	Link 3	Link 4	Link 5	Link 6	Link 7	Link 8	Region 6 Total
With AR 6-D (miles)	0.80 (0.15)	0.58 (0.08)	4.36 (1.93)	1.30 (0.17)	0	4.35 (0.88)	1.29 (0.29)	1.12 (0.12)	13.90 (3.62)
Major Waterbodies									
APR (miles)	0	0	0.02 (0.02)	0 (0.01)	0	0.02 (0.01)	0.02 (0.12)	0 (0.04)	0.06 (0.20)
With AR 6-A (miles)	0	0.01 (0.03)			0	0.02 (0.01)	0.02 (0.12)	0 (0.04)	0.05 (0.20)
With AR 6-B (miles)	0	0	0	0 (0.01)	0	0.02 (0.01)	0.02 (0.12)	0 (0.04)	0.04 (0.18)
With AR 6-C (miles)	0	0	0.02 (0.02)	0 (0.01)	0	0 (0.08)		0 (0.04)	0.02 (0.15)
With AR 6-D (miles)	0	0	0.02 (0.02)	0 (0.01)	0	0.02 (0.01)	0 (0.08)	0 (0.04)	0.04 (0.16)
Reservoirs, Lakes, and Ponds									
APR (acres)	14.3 (3.0)	0	2.7 (0.9)	6.4 (1.0)	0	4.7 (0.1)	0	0.5 (0.2)	28.6 (5.2)
With AR 6-A (acres)	14.3 (3.0)	1.7 (0.4)			0	4.7 (0.1)	0	0.5 (0.2)	21.2 (3.7)
With AR 6-B (acres)	14.3 (3.0)	0	12.4 (2.4)	6.4 (1.0)	0	4.7 (0.1)	0	0.5 (0.2)	38.3 (6.7)
With AR 6-C (acres)	14.3 (3.0)	0	2. 7 (0.9)	6.4 (1.0)	0	9.3 (1.6)		0.5 (0.2)	33.2 (6.7)
With AR 6-D (acres)	14.3 (3.0)	0	2.7 (0.9)	6.4 (1.0)	0	4.7 (0.1)	0	0.5 (0.2)	28.6 (5.2)

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
2 Each region of the Applicant Proposed Route (APR) is divided into links that lie between points, or nodes, where the APR is intersected by alternative routes (ARs). ARs bypass specific links of the APR as shown in the table.
3 For the ARs, the unshaded portion of the rows provides the data for the length of the AR. The shaded portion of the rows provides the data for the balance of the APR, thereby providing perspective across the region.
GIS Data Source: USGS (2014a)

Neither the variation to the Applicant Proposed Route nor the adjustment to HVDC Alternative Route 6-A would involve no changes to the surface water features crossed by the 200-foot-wide representative ROW.

3.15.5.6.2.1 Surface Water Features of Special Interest

As described for the watersheds in the ROI for Region 6, the White, Cache, L'Anguille, and St. Francis rivers are important surface water features in the area from a drainage system standpoint. Table 3.15-25 identifies surface waters within the ROI that have specific federal or state designations of special interest beyond significance as drainage features. The water feature and designation identified in the table are applicable to the 200-foot-wide representative ROW as well as the wider ROI.

Table 3.15-25:
Surface Waters of Special Interest within the 1,000-Foot-Wide Corridors of the Applicant Proposed Route and HVDC Alternative Routes—Region 6

Surface Water and Watershed	Designation(s)	Basis/Description	Route/Alternative Affected				
			APR	6-A	6-B	6-C	6-D
L'Anguille River, AR L'Anguille watershed (HUC 08020205)	National Park Service Nationwide Rivers Inventory	APR Link 6 crosses the reach of the river that the Park Service lists on the inventory. (AR 6-C does not cross that reach.)	X L6				

L6 = Link 6 of the Applicant Proposed Route in Region 6
Sources: NPS (2004), APCEC (2011)

The Region 6 route variation would involve no changes to the list (Table 3.15-25) of surface waters of special interest within the 1,000-foot-wide corridor of the Applicant Proposed Route. Similarly, the adjustment to HVDC Alternative Route 6-A is not in an area where there are surface waters of special interest.

3.15.5.6.3 Region 6 Water Quality

Table 3.15-26 identifies surface water features within the ROI that do not meet applicable water quality standards based on the surface water's designated uses and, as a result, have been identified as an impaired water in the state's most recent Section 303(d) list. Each of the water segments identified in the table is applicable to the 200-foot-wide representative ROWs as well as the wider ROI.

Table 3.15-26:
Waters with Impaired Quality within the 1,000-Foot-Wide Corridors of the Applicant Proposed Route and HVDC Alternative Routes—Region 6

Water Segment and Watershed	Impaired Uses—Impairment	TMDL Status[1]	Project Components Crossing Impaired Segment
Cache River, AR (Reach 019) Cache watershed (HUC 08020302)	Fisheries—lead impairment	Priority: Low	APR Link 3, ARs 6-A and 6-B
Bayou DeView, AR (Reaches 006 and 007) Cache watershed (HUC 08020302)	Fisheries—sulfate and lead impairments	Priority: Low	APR Link 4, AR 6-A
L'Anguille River, AR (Reach 005) L'Anguille watershed (HUC 08020205)	Fisheries—turbidity, dissolved oxygen, chloride, sulfate, and total dissolved solids impairment Primary Contact—pathogens impairment	Priority: Low Approved TMDL for siltation/turbidity	APR Link 6, AR 6-C

1 TMDL = Total Maximum Daily Load—TMDLs are the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. Once TMDLs have been determined, discharge requirements can be developed that will bring a waterbody back into compliance.
Sources: ADEQ (2014a, 2014b, 2014c), EPA (2013b)

The Region 6 route variation would involve no changes to the list (Table 3.15-25) of impaired waters within the 1,000-foot-wide corridor of the Applicant Proposed Route. Similarly, the adjustment to HVDC Alternative Route 6-A is not in an area where there are impaired waters.

3.15.5.6.4 Region 6 Water Use

In the three counties (Cross, Jackson, and Poinsett counties, Arkansas) that encompass Region 6, groundwater again accounts for the majority of the total water use. Table 3.7-20 shows that the average use of surface water was about 152 million gallons per day in 2010 compared to about 1,790 million gallons per day of groundwater. Surface water, therefore, accounts for about 8 percent of area's total water usage. Total water use (groundwater and surface water) is described in more detail in Section 3.7.5.6.4.

3.15.5.7 Region 7

Region 7 is referred to as the Arkansas Mississippi River Delta and Tennessee Region and includes the Applicant Proposed Route and HVDC Alternative Routes 7-A through 7-D.

Three route variations to the Applicant Proposed Route were developed in Region 7 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.7. The Applicant Proposed Route variations (Link 1, Variation 1; Link 1, Variation 2; and Link 5, Variation 1) are illustrated in Exhibit 1 of Appendix M. The discussion of Region 7 surface water elements that follows includes identification of differences, if any, that would be expected with the route variations as compared to the original Applicant Proposed Route.

3.15.5.7.1 Region 7 Watersheds

The ROI in Region 7 lies within two subregions of the larger Lower Mississippi drainage system: the Lower Mississippi-St. Francis subregion (0802) and the Lower Mississippi-Hatchie subregion (0801). The ROI crosses the Mississippi River and includes a crossing location for the Applicant Proposed Route and a separate crossing location for HVDC Alternative Route 7-A.

At USGS's eight-digit coding level, the ROI lies within three different watersheds as shown in Figure 3.15-1 in Appendix A. Table 3.15-27 lists the applicable watersheds and provides additional detail, including the primary surface water or waters that drain the watershed. Surface waters for the ROI are shown on Figure 3.15-2 in Appendix A.

Table 3.15-27:
Watersheds Crossed by the Applicant Proposed Route and HVDC Alternative Routes—Region 7

USGS HUC Number and Watershed Name	Area Drained (square miles)	Description of Primary Surface Water Feature(s)
08020203, Lower St. Francis	3,579	St. Francis River is the primary drain for this watershed, which stretches from Lake Wappepello (in Missouri) south to where the St. Francis River flows into the Mississippi River.
08010100, Lower Mississippi-Memphis	1,097	Mississippi River is the primary drain for this watershed, which is a narrow watershed running on either side of the river from the Mississippi River's confluence with the Ohio River downstream to the river's convergence with Horn Lake Pass south of Memphis, TN.
08010209, Loosahatchie[1]	742	Loosahatchie River is the primary drain for this water shed. Other creeks drain portions of the watershed and ultimately flow into the Loosahatchie River, which flows into the Mississippi River at the southwestern end of the watershed.

1 The proposed Tennessee converter station would be within the Loosahatchie watershed.
GIS Data Source: USGS (2014a)

As shown in Figure 3.15-1 in Appendix A and described in Table 3.15-27, the ROI crosses three watersheds in Region 7, one is on the western side of the Mississippi River, one is on the eastern side of the river, and the center one straddles the river. The predominant rivers in the first two watersheds (i.e., Lower Mississippi-St. Francis and Lower Mississippi-Memphis) flow toward the south. The Loosahatchie River in the third watershed of the same name flows primarily to the southwest. The three route variations developed for the Applicant Proposed Route in Region 6 would not change the watersheds that would be crossed.

3.15.5.7.2 Region 7 Surface Water Features

Table 3.15-28 lists the total length of perennial streams, intermittent streams, and major waterbodies within the ROI and the 200-foot-wide ROW in Region 7. The table includes the total acreage for reservoirs, lakes, and ponds that occur within the ROI and ROW.

Table 3.15-28:
Miles and Acreage of Surface Water Features within the 1,000-Foot-Wide Corridors (and 200-Foot-Wide Representative ROWs) of the Applicant Proposed Route and HVDC Alternative Routes—Region 7

Route—Proposed and Alternatives[1, 2, 3]	Link 1	Link 2	Link 3	Link 4	Link 5	Region 7 Total
Perennial Streams						
APR (miles)	2.00 (0.34)	0	1.49 (0.13)	0.25 (0)	0.58 (0.07)	4.32 (0.54)
With AR 7-A (miles)	8.95 (1.81)	0	1.49 (0.13)	0.25 (0)	0.58 (0.07)	11.27 (2.01)
With AR 7-B (miles)	2.00 (0.34)	0	0.84 (0.12)		0.58 (0.07)	3.42 (0.53)
With AR 7-C (miles)	2.00 (0.34)	0	2.08 (0.35)			4.08 (0.69)
With AR 7-D (miles)	2.00 (0.34)	0	1.49 (0.13)	1.42 (0.29)		4.91 (0.76)
Intermittent Streams						
APR (miles)	11.52 (2.69)	0.05 (0)	2.35 (0.63)	0.80 (0.15)	3.58 (0.83)	18.30 (4.30)
With AR 7-A (miles)	14.11 (4.69)	0.05 (0)	2.35 (0.63)	0.80 (0.15)	3.58 (0.83)	20.89 (6.30)
With AR 7-B (miles)	11.52 (2.69)	0.05 (0)	2.51 (0.57)		3.58 (0.83)	17.66 (4.09)
With AR 7-C (miles)	11.52 (2.69)	0.05 (0)	9.07 (1.93)			20.64 (4.62)
With AR 7-D (miles)	11.52 (2.69)	0.05 (0)	2.35 (0.63)	4.10 (0.90)		18.02 (4.22)
Major Waterbodies						
APR	0.62 (0.64)	0	0	0	0	0.62 (0.64)
With AR 7-A (miles)	0.68 (0.90)	0	0	0	0	0.68 (0.90)
With AR 7-B (miles)	0.62 (0.64)	0	0		0	0.62 (0.64)
With AR 7-C (miles)	0.62 (0.64)	0	0 (0.01)			0.62 (0.65)
With AR 7-D (miles)	0.62 (0.64)	0	0	0		0.62 (0.64)
Reservoirs, Lakes, and Ponds						
APR (acres)	14.4 (1.5)	0	1.6 (0.1)	0	5.5 (0.8)	21.5 (2.4)
With AR 7-A (acres	27.8 (2.4)	0	1.6 (0.1)	0	5.5 (0.8)	34.9 (3.3)
With AR 7-B (acres	14.4 (1.5))	0	0.7 (0)		5.5 (0.8)	20.6 (2.3)
With AR 7-C (acres	14.4 (1.5)	0	2.2 (0.9)			16.6 (2.4)
With AR 7-D (acres	14.4 (1.5)	0	1.6 (0.1)	2.7 (0)		18.7 (1.6)

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
2 Each region of the Applicant Proposed Route (APR) is divided into links that lie between points, or nodes, where the APR is intersected by alternative routes (ARs). ARs bypass specific links of the APR as shown in the table.
3 For the ARs, the unshaded portion of the rows provides the data for the length of the AR. The shaded portion of the rows provides the data for the balance of the APR, thereby providing perspective across the region.
GIS Data Source: USGS (2014a)

The three Region 7 route variations would involve only minor changes to the surface water features crossed by the 200-foot-wide representative ROW of the Applicant Proposed Route. The ROWs of the variations would have about 0.7 mile more of stream beds (perennial and intermittent). The increase is due to Link 1, Variation 1, which parallels channels running between farm fields. There would be no change in major waterbodies from the original Applicant Proposed Route; Link 1, Variation 2, would cross the same major waterbodies as the original Applicant Proposed Route, but at a slightly different location. The number of other minor waterbodies would decrease by two.

The Tennessee Converter Station Siting Area and AC Interconnection Tie, reduced in size from 743 acres to 218 acres since the Draft EIS, would include 0.21 mile of perennial streams, 1.5 miles of intermittent streams, and no major or other waterbodies (GIS Data Source: USGS 2014a).

3.15.5.7.2.1 Surface Water Features of Special Interest

As described for the watersheds in the ROI for Region 7, the St. Francis, Mississippi, and Loosahatchie rivers are important surface water features in the area from a drainage system standpoint. Table 3.15-29 identifies surface waters within the ROI that have specific federal or state designations of special interest beyond significance as drainage features. The surface waters are presented in a roughly west-to-east order. The water features and designations identified in the table are applicable to the 200-foot-wide ROW as well as the wider ROI.

Table 3.15-29:
Surface Waters of Special Interest within the 1,000-Foot-Wide Corridors of the Applicant Proposed Route and HVDC Alternative Routes—Region 7

Surface Water and Watershed	Designation(s)	Basis/Description	Route/Alternative Affected				
			APR	7-A	7-B	7-C	7-D
St. Francis River, AR Lower St. Francis watershed (HUC 08020203)	Section 10 Navigable Waters of the U.S	Any action that would obstruct or alter a navigable water is prohibited without a USACE permit. APR Link 1 and AR 7-A cross the river.	X L1	X			
Mississippi River, TN Lower Mississippi-Memphis watershed (HUC 08010100)	Section 10 Navigable Waters of the U.S	Any action that would obstruct or alter a navigable water is prohibited without a USACE permit. APR Link 1 and AR 7-A cross the river.	X L1	X			
	Exceptional Tennessee Water	APR Link 1 and AR 7-A cross the river. The river has this designation due to the presence of the federally and state-listed endangered pallid sturgeon (*Scaphirhynchus albus*) and the state-listed threatened blue sucker (*Cycleptus elongatus*).	X L1	X			

L1 = Link 1 of the Applicant Proposed Route in Region 7
Sources: USACE (2014a), TDEC (2013c)

The three Region 7 route variations would involve no changes to the list (Table 3.15-29) of surface waters of special interest within the 1,000-foot-wide corridor of the Applicant Proposed Route.

3.15.5.7.3 Region 7 Water Quality

Table 3.15-30 identifies surface water features within the ROI in Region 7 that do not meet applicable water quality standards based on the surface water's designated uses and, as a result, have been identified as an impaired water in the states' most recent Section 303(d) lists. Each of the water segments identified in the table is applicable to the 200-foot-wide representative ROWs as well as the wider ROI.

Table 3.15-30:
Waters with Impaired Quality within the 1,000-Foot-Wide Corridors of the Applicant Proposed Route and HVDC Alternative Routes—Region 7

Water Segment and Watershed	Impairment Cause—TMDL[1] Priority	Approved TMDLs	Project Components Crossing Impaired Segment
Tyronza River, AR (Reach 909) Lower St. Francis watershed (HUC 08020203)	Turbidity impairment—NA	None	APR Link 1, AR 7-A
Mississippi River, TN (TN08010100001-2000) Lower Mississippi-Memphis watershed (HUC 08010100)	Physical substrate habitat alternations—Low PCBs, dioxin, and chlordane—Not applicable	Approved TMDLs for chlordane, chlordane in fish tissue, dioxin in fish tissue, and PCBs	APR Link 1, AR 7-A
Royster Creek, TN (TN08010209021-0200) Loosahatchie watershed (HUC 08010209)	Total phosphorus—Medium Low dissolved oxygen, physical substrate habitat alternations, loss of biological integrity due to siltation—Low *E. coli*—Not applicable	Approved TMDL for *E. coli*	APR Link 3, ARs 7-B and 7-C
North Fork Creek, TN (TN08010209021-0300 Loosahatchie watershed (HUC 08010209)	Total phosphorus—Medium Low dissolved oxygen, physical substrate habitat alternations, loss of biological integrity due to siltation—Low *E. coli*—Not applicable	Approved TMDL for *E. coli*	APR Links 3 and 4, ARs 7-B and 7-D
Big Creek, TN (TN08010209021-1000) Loosahatchie watershed (HUC 08010209)	Low dissolved oxygen, physical substrate habitat alternations, and loss of biological integrity due to siltation—Low Nitrate + nitrite and total phosphorus—Medium *E. coli*—Not applicable	Approved TMDL for *E. coli*	AR 7-C
Big Creek, TN (TN08010209021-2000) Loosahatchie watershed (HUC 08010209)	Low dissolved oxygen, physical substrate habitat alternations, and loss of biological integrity due to siltation—Low Total phosphorus—Medium *E. coli*—Not applicable	Approved TMDL for *E. coli*	AR 7-C
Big Creek, TN (TN08010209021-3000) Loosahatchie watershed (HUC 08010209)	Low dissolved oxygen, physical substrate habitat alternations, and loss of biological integrity due to siltation—Low Total phosphorus—Medium *E. coli*—Not applicable	Approved TMDL for *E. coli*	APR Link 5, ARs 7-C and 7-D Tennessee Converter Station Siting Area
Big Creek, TN (TN08010209021-4000) Loosahatchie watershed (HUC 08010209)	*E. coli*—High	Approved TMDL for *E. coli*	AR 7-D

1 TMDL = Total Maximum Daily Load—TMDLs are the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. Once TMDLs have been determined, discharge requirements can be developed that will bring a waterbody back into compliance.

APR = Applicant Proposed Route; AR = HVDC Alternative Routes

Sources: ADEQ (2014a, 2014b, 2014c), EPA (2013b), TDEC (2014, 2013b)

The three Region 7 route variations would involve no changes to the list (Table 3.15-30) of impaired waters within the 1,000-foot-wide corridor of the Applicant Proposed Route.

3.15.5.7.4 Region 7 Water Use

The distribution of water use in the four counties (Mississippi and Poinsett counties in Arkansas and Shelby and Tipton counties in Tennessee) that encompass Region 7 again shows groundwater as the predominant source. Table 3.7-22 shows that the average use of surface water was 536 million gallons per day in 2010 compared to 1,440 million gallons per day of groundwater. Surface water, therefore, accounts for about 27 percent of area's total water usage. Total water use (groundwater and surface water) is described in more detail in Section 3.7.5.7.4.

3.15.5.8 Connected Actions

3.15.5.8.1 Wind Energy Generation

Wind energy generation would likely occur within WDZs. The WDZs are shown in Figure 3.15-1 in Appendix A with the designations of Zones A through L. Also shown in the figure are the watersheds in which the WDZs are located and the notable surface waters of the vicinity. Surface waters for the ROI are shown on Figure 3.15-2 in Appendix A.

3.15.5.8.1.1 Watersheds

Because the WDZs are basically located at the western end of the proposed HVDC transmission line, the zones are within many of the same watersheds described for Region 1 in Section 3.15.5.1. All of the zones are within the Lower Cimarron (1104) and North Canadian (1110) subsystems of the larger Arkansas-White-Red drainage system (11). Only the northernmost edge of WDZ-G is within the Lower Cimarron subsystem; the remainder of WDZ-G and the other WDZs are within the North Canadian subsystem. At USGS's eight-digit coding level, the 12 WDZs lie within eight different watersheds as shown in Figure 3.15-1 in Appendix A. Table 3.15-31 lists the applicable watersheds in the order of their HUC numbers, which is roughly in a northwest-to-southeast order. The table provides the land area drained, the primary surface water or waters that drain the watershed, and the WDZs that lie within, or partially within, each of the watersheds (even if only a small portion of the zone is within the watershed). Surface waters for the ROI are shown on Figure 3.15-2 in Appendix A.

Table 3.15-31:
Watersheds Containing Wind Development Zones

USGS HUC Number and Watershed Name	Area Drained (square miles)	Description of Primary Surface Water Features	WDZs within Watershed
11040002, Upper Cimarron	1,750	Cimarron River drains the watershed that extends from the northwest corner of Oklahoma to the northeast into Kansas and its convergence with the North Fork Cimarron River.	G
11040006, Upper Cimarron–Liberal	1,720	Cimarron River drains the watershed that extends from its convergence with the North Fork Cimarron River to the southeast to its convergence with Crooked Creek just inside the north border of Oklahoma.	G
11100101, Upper Beaver	2,732	Beaver (or North Canadian) River drains the watershed that extends from the river's headwaters to its convergence with Goff Creek.	F, G, H
11100102, Middle Beaver	1,356	Beaver River drains the watershed that extends from its convergence with Goff Creek, through Lake Optima, and to the community of Beaver.	A, D, E, F, I, J, K
11100103, Coldwater	1,962	Coldwater and Frisco creeks drain the watershed into Lake Optima.	B, C, D, E, F
11100104, Palo Duro	1,937	Palo Duro Creek drains the watershed into Beaver River.	A, B, D, J, L

Table 3.15-31:
Watersheds Containing Wind Development Zones

USGS HUC Number and Watershed Name	Area Drained (square miles)	Description of Primary Surface Water Features	WDZs within Watershed
11100201, Lower Beaver	1,781	Beaver River, which becomes the North Canadian River, drains the watershed. Several smaller streams converge with the Beaver River within the watershed.	A, J, K
11100202, Upper Wolf	833	Wolf Creek drains the watershed and after running through another watershed joins the Beaver River to form the North Canadian River.	A, L

GIS Data Source: USGS (2014a)

3.15.5.8.1.2 Surface Water Features

Table 3.15-32 lists the total length of perennial streams and intermittent streams and acreage of reservoirs, lakes, and ponds within each of the WDZs. The USGS National Hydrography Dataset used to determine the values in the table also designates an "intermittent" category for reservoirs, lakes, and ponds and, in this instance, the intermittent category was routinely larger than the perennial group. Accordingly, the table provides a breakout for both perennial and intermittent reservoirs, lakes, and ponds. The total area of each WDZ is provided in the table to allow a comparison with the area represented by the water features. A category of "major waterbodies," as included in the preceding descriptions of Regions 1 through 7, is not included in Table 3.15-32. The definition used in this document for a major waterbody (i.e., a surface water with a crossing distance of 100 feet or more—see Section 3.15.4) is not applicable to an area with no specific route or direction.

Table 3.15-32:
Surface Water Features within the Wind Development Zones

Wind Development Zone Designation	Total Acreage of Zone	Streams (miles)		Reservoirs, Lakes, and Ponds (acres)	
		Perennial	Intermittent	Perennial	Intermittent
Zone A	109,747	4.9	103.4	38	1,330
Zone B	125,479	8.0	124.1	164	812
Zone C	161,048	6.4	204.4	125	198
Zone D	69,189	12.7	134.9	57	109
Zone E	47,092	2.6	43.6	25	8
Zone F	112,461	13.0	207.1	24	28
Zone G	187,315	6.8	191.7	12	269
Zone H	116,226	19.9	205.4	8	203
Zone I	105,203	1.7	17.5	17	688
Zone J	92,567	26.2	285.0	123	41
Zone K	92,894	6.3	220.2	60	427
Zone L	165,848	31.6	190.6	650	3,218
Totals		140.1	1,927.8	1,303	8,634

GIS Data Source: USGS (2014a)

It can be seen in Table 3.15-32 that the lengths of intermittent streams far outdistance those of perennial streams in every WDZ. The same can be said with regard to the acres of reservoirs, lakes, and ponds with the exception of WDZs E, F, and J. In each of those three zones, the area of perennial reservoirs, lakes, and ponds is greater than the area of the intermittent features.

3.15.5.8.1.3 Surface Water Features of Special Interest

Surface water features of special interest considered for the WDZs are the same as considered for the region evaluations; that is, the federal, Oklahoma, and Texas surface water designations described in Table 3.15-2. As was described for the watersheds in Table 3.15-31, the Cimarron and Beaver rivers, along with Coldwater, Frisco, Palo Duro, and Wolf creeks are the important surface water features in the area from a drainage system standpoint. Table 3.15-33 identifies surface waters within the WDZs that have specific federal or state designations of special interest beyond significance as drainage features.

Table 3.15-33:
Surface Waters of Special Interest within the Wind Development Zones

Surface Water and Watershed	Designation(s)	Basis for Designation	Affected Wind Development Zone
Beaver River[1], OK Middle Beaver watershed (HUC 11100102) Coldwater Creek[1], OK Coldwater watershed (HUC 11100103)	Area with water of recreational or ecological significance	Optima Wildlife Management Area	Zone D
Wolf Creek, TX Upper Wolf watershed (HUC 11100202)	Ecologically significant river and stream segment	High water quality, exceptional aquatic life, high aesthetic value stream; diverse benthic macroinvertebrate and fish communities	Zone L

1 The portions of Beaver River and Coldwater Creek with this designation are limited to those segments of the streams within the Optima Wildlife Management Area.

Sources: TPWD (2014), Appendix B, Table 1 of OAC 785:45

The designations of surface water of special interest in Table 3.15-33 are both state designations; there are no applicable federal designations. With respect to the Oklahoma designation, only the northern edge of WDZ D extends into the Optima Wildlife Management Area and in Texas, Wolf Creek passes through a relatively small portion of WDZ L, near the zone's northeast limit. In Cimarron County, Oklahoma, the Cimarron and Beaver rivers are both designated Oklahoma High Quality Streams with associated areas of special provision watershed (OWRB 2011a). WDZ G, the only zone in Cimarron County, is located to the east, just outside of the watershed areas for these two high quality streams.

3.15.5.8.1.4 Water Quality

Table 3.15-34 identifies the surface water features within the WDZs that do not meet applicable water quality standards based on the surface water's designated uses and, as a result, have been identified as impaired waters in the states' most recent Section 303(d) lists. As noted in the table, the WDZs in Texas are not located over any impaired surface waters. In Texas, the closest impaired surface water is the Canadian River (TCEQ 2013a, 2013b), which is in a separate watershed to the south of the WDZs, so stormwater runoff from the WDZs would not be expected to flow in the direction of the Texas section of the Canadian River.

Table 3.15-34:
Waters with Impaired Quality within the Wind Development Zones

Water Segment and Watershed	Impaired Uses—Impairment	TMDL Status[1]	Affected WDZ
Beaver River (North Canadian), OK (OK720510000190_00) Upper Beaver watershed (HUC 11100101)	Fish and Wildlife Propagation/Warm Water Aquatic Community—dissolved oxygen impairment	Priority Date: 2020 Approved TMDLs for fecal coliform, E. Coli, and *Enterococcu*s	WDZ-F
Beaver River (North Canadian), OK (OK720500020450_00) Middle Beaver watershed (HUC 11100102)	Agricultural—sulfates, total dissolved solids, and chloride impairments Fish and Wildlife Propagation/Warm Water Aquatic Community—sedimentation/siltation and fishes bioassessments impairments	Priority Date: 2023 Approved TMDLs for fecal coliform, E. Coli, and *Enterococcu*s	WDZ-J
Palo Duro Creek, OK (OK720500020500_00) Palo Duro watershed (HUC 11100104)	Primary Body Contact Recreation—*Enterococcu*s, and *E. coli* impairments Fish and Wildlife Propagation/Warm Water Aquatic Community—dissolved oxygen and selenium impairments Agricultural—sulfates and total dissolved solids impairments	Priority Date: 2023 Approved TMDLs for fecal coliform and total suspended solids	WDZ-J
No Texas impaired waters are within the Wind Development Zones.			

1 TMDL = Total Maximum Daily Load—TMDLs are the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. Once TMDLs have been determined, discharge requirements can be developed that will bring a waterbody back into compliance.

Sources: ODEQ (2014, 2013), EPA (2013b), TCEQ (2013a, 2013b)

3.15.5.8.1.5 Water Use

Table 3.7-26 summarizes the 2010 water use in the six-county area of Beaver, Cimarron, and Texas counties in Oklahoma and Hansford, Ochiltree, and Sherman counties in Texas that encompass the WDZs. As described in the Region 1 discussion (Section 3.15.5.1.4), by far the predominant source of water in the six-county area is groundwater. The average surface water use of about 2.4 million gallons per day is 0.3 percent of the area's total water use of 791 million gallons per day. All of the surface water use in the six-county area is attributed to the categories of irrigation, livestock, and mining. Correspondingly, surface water is not used as a source of drinking water in the area, either for public systems or private domestic systems.

3.15.5.8.2 Optima Substation

The future Optima substation would be on a 160-acres site located just east of the Oklahoma Converter Station and partially within the AC Interconnection Siting Areas. Surface water features in the ROI for the future Optima substation would be as described in the Region 1 discussion above (Section 3.15.5.1) for the Oklahoma Converter Station and AC Interconnection. There is an intermittent stream channel, or channels, in the area of the AC interconnection, but no perennial streams or other waterbodies, including no special interest surface waters or impaired waters.

3.15.5.8.3 TVA Upgrades

The ROI for the direct assignment facilities (which are included in the Applicant Proposed Project) would occur within the Tennessee Converter Station Siting Area and more specifically within the Shelby Substation. The ROI for the network upgrades, and in particular TVA's future 500kV transmission line, cannot be fully determined at this time.

The new 500kV line would be constructed in western Tennessee. The upgrades to existing facilities would mostly be in western and central Tennessee. Upgrades to existing infrastructure would include upgrading terminal equipment at three existing 500kV substations and six existing 161kV substations, making appropriate upgrades to increase heights on 16 existing 161kV transmission lines to increase line ratings, and replacing the conductors on eight existing 161kV transmission lines. Surface waters of special interest in western Tennessee include the Hatchie State Scenic River (flows into the Mississippi River east of HVDC Alternative Route 7-A, more than 10 miles northwest of the Shelby Substation) and in central Tennessee, the Duck and Harpeth State Scenic Rivers. Where possible, general impacts associated with the required TVA upgrades are discussed in the impact sections that follow.

3.15.6 Impacts to Surface Water

3.15.6.1 Methodology

This section addresses potential impacts to surface waters that would be expected from typical construction actions, whether those actions were for construction of converter stations or transmission lines for the Project. The primary areas of concern with regard to surface waters are:

- Potential for runoff or other discharges from construction or support areas to carry sediments or other contaminants to receiving waters
- Changes to runoff rates
- Direct impacts or disturbances to surface water or drainage channels
- Effects on water availability

3.15.6.1.1 Potential for Surface Water Contamination

Soil disturbances typical of construction actions are often associated with increased potential for soil erosion. Eroded materials can be carried by wind or runoff, but primarily runoff, to receiving waters, which can cause these waters to exceed instream water quality standards for turbidity that in turn can cause damage to the waters' natural flora and fauna or make the water unfit for its designated uses. If not contained properly, accidental releases of construction-related hazardous materials may also be carried from the site of a release to receiving waters. In the case of the Project, these hazardous materials would typically consist of fuels and lubricants present in equipment or storage containers at locations where construction activities would occur and at construction staging or storage yards. Additional potential contaminants would be associated with concrete operations, including at temporary concrete batch plants that would be needed for areas too far from commercial batch plants. In any of these locations there would be the potential for contaminants to leak, spill, or otherwise accidently release to the environment. If the released quantity was large enough and it was not cleaned up quickly, it could flow (if liquid) or be carried by runoff to an existing drainage channel and eventually reach surface water. If this were to occur, instream water quality standards could be threatened and downstream uses of the water could be put at risk.

Stormwater control and pollution prevention measures, as well as the construction actions in which they would be integrated, would be managed in accordance with plans and procedures that the Applicant would be required to develop and implement. The construction would require a stormwater discharge permit under the EPA's NPDES program. Each of the states in which construction actions would occur has been given the authority by EPA to implement a state program. Arkansas and Tennessee implement their own state programs pursuant to this authority; Oklahoma and Texas implement their own programs except in Indian Country and for specific discharges (not applicable to the Project) where EPA implements the permitting program for stormwater discharges during construction (EPA 2013a). Each of these states implements its NPDES stormwater discharge permit program through a general permit; referred to here simply as the construction general permit. Common to all of the construction general permits is the requirement for the permit applicant to prepare a SWPPP. Information that must be presented in a SWPPP includes the following (EPA 2014):

- Descriptions and locations of the stormwater control measures to be installed and maintained during construction to minimize erosion and discharge of sediments
- Procedures for inspection, maintenance, and, if necessary, corrective actions for stormwater control measures
- A list of construction site pollutants and locations of all potential pollutant-generating activities
- Descriptions of the procedures to be followed to prevent and respond to spills and leaks of site pollutants
- Identification of all sources of allowable non-stormwater discharges
- Description of staff training applicable to implementation of the SWPPP
- A map or maps showing drainage areas of the work site, before and after major grading, and stormwater discharge locations
- A map or maps showing locations of all potential pollutant-generating activities and stormwater control measures

Measures to prevent spills and leaks of site pollutants may include items such as using secondary containment for onsite fueling tanks or containers; providing cover, containment, and protection for chemicals, liquid products, petroleum products, and other potentially hazardous materials; using spill prevention and control measures when conducting maintenance, fueling, and repair of equipment and vehicles; and providing immediate response to any spill incident. Similarly, the Applicant would develop and follow its own plans to implement these measures as described in Section 2.1.7 to minimize the potential for accidental discharge of hazardous or controlled substances. The elements of the planning, either part of the SWPPP or the SPCCP if developed to include construction, would also minimize the potential for contaminants to leave the site should a discharge occur.

Concrete operations are mentioned separately because they are common to construction actions and involve equipment carrying materials of concern in addition to fuels and lubricants that could become sources of contamination to surface waters if managed improperly or accidentally released. The Applicant would perform washout of concrete trucks and equipment, either at the construction site or at a temporary batch plant, at storage tanks, plastic-lined berms, or some similar containment structure. Captured liquids would not be discharged; rather they would be allowed to evaporate or removed for disposal at an approved off-site location. Dried concrete would similarly be hauled off for proper disposal or recycling, or be broken up and used as clean fill. The Applicant may also bury hardened concrete in on-site embankments in accordance with applicable permit requirements.

It is also anticipated that in some areas equipment and vehicle washing would be required to prevent spread of weeds (removing them from the equipment at or near their source rather than allowing equipment to carry them out of the area). Such actions would generate only a minimal amount of wastewater, but would be done in designated, approved wash stations.

The deepest foundations would be those for the transmission line structures. In most areas of the Project, foundation depths for lattice structures would be about 15 feet and for pole structures the depths would be about 30 feet. Within the Mississippi floodplain, foundation depths generally would be greater: from 17 to 158 feet deep for lattice structures (with most foundation depths not exceeding 40 feet) and from 26 to 115 feet deep for pole structures (with most not exceeding 56 feet) as described in Appendix F. Structure foundations would have to be deeper in the floodplain areas given the expected soil conditions. In the floodplain, pole structures are identified as having a more shallow range of foundations than lattice structures because, due to engineering constraints, the Applicant would need to limit the height of poles in floodplains to 130 feet to minimize the foundation depth (Thomas 2014). Lattice structures would be used exclusively in floodplain locations requiring greater heights than 130 feet. Other than possibly in the Texas and Oklahoma Panhandle regions, these foundation depths could reach the water table in some areas of each region of the Project. As a result, it is expected that at some construction sites, groundwater would have to be pumped from excavations or boreholes to complete foundation construction and the discharge, if mismanaged, could be of concern to area surface waters. In such cases, water would be discharged to vegetated areas through the use of flow control devices (EPM W-8 in Section 3.15.6.1.5).

The Applicant has also identified two types of Project-related materials that would be used as needed in excavations and boreholes: Super Mud™ and high yield bentonite gel, both products of PDSCo. Inc. (Polymer Drilling Systems) of El Dorado, Arkansas. Super Mud™ is described as a synthetic polymer used to create high viscosity slurries for stabilizing excavations. High yield bentonite gel is described as a polymer extended sodium bentonite as described in Appendix F, which is a naturally occurring clay material. The bentonite, in a slurry, is designed for use in drilling applications and acts to stabilize the borehole walls and while it circulates back to the surface, cooling the drill bit and transporting drill cuttings in the process. Because of the potential for these materials to come into contact with groundwater, they are described in more detail in Section 3.7.6.2. After use of either material, disposition of a relatively large volume of slurry would be necessary and discharge to any surface water would be inappropriate. These slurry fluids would be recycled to the extent practicable, but if disposal was necessary, it would be sent offsite. The Applicant may add cement to solidify residual slurry so that the slurry can be disposed in a public landfill. All disposal would be in accordance with applicable federal, state, and local regulations.

Considering the requirements of the construction general permits for stormwater discharges, the measures that the Applicant would implement per its internal plans and procedures, and the limited amount of potentially hazardous materials involved (i.e., the Project would not include large bulk storage operations), it is unlikely that construction activities would result in contaminants, either sediment or chemicals, reaching surface water. This conclusion is applicable to the surface waters of special interest and impaired waters identified in Section 3.15.5 as well as other surface waters. With regard to surface waters of special interest and impaired waters, additional regulatory requirements identified in the subsequent discussions of site-specific impacts would further reduce the potential for adverse impacts.

3.15.6.1.2 Changes to Runoff Rates

Changes to stormwater runoff rates over large areas have the potential to affect water levels in receiving streams, reservoirs, or ponds. If the change is an increase in runoff, it could be associated with flooding around the receiving waters or in upgradient drainage channels. During construction, soils at the sites of the transmission line structures and converter stations would be broken up and loosened for some period of time, either in areas of disturbed soils or in soil stockpiles, and would be expected to have lower runoff rates, than before the disturbance. Higher infiltration rates would mean less water reaching drainage channels and receiving waters. At the same time, the soil in unpaved areas where heavy equipment traveled to, from, or around construction sites and in the temporary staging or storage areas could become more compacted than natural conditions and result in increased runoff. Conditions of loosened soil, however, would be relatively short-term and, for the most part, the disturbed areas would be restored to a pre-disturbance condition once the foundations and structures were in place. With regard to soils that may become compacted as a byproduct of equipment traffic, the Applicant would take measures to prevent serious impacts, to include the use of low ground pressure equipment and, as appropriate, the use of temporary equipment mats (see EPM GE-27 in Section 3.15.6.1.5). If necessary, the Applicant would also undertake soil remediation actions including decompaction, particularly in agricultural areas, to return soils to pre-disturbance conditions (see EPM AG-2 in Section 3.15.6.1.5). As each converter station was constructed, it would represent an area of impervious surfaces and increased runoff, but proper management of the runoff would be part of the facility design. Whether it involved retention or detention ponds, or simply to tie in with an existing municipal stormwater drainage system, the facility design would be required to include a stormwater management approach that did not adversely impact facilities or surface waters in the area. Also, the facilities are not so large that they would involve large increases in the amount of runoff to manage. The relatively small and short-term changes in runoff rates associated with the proposed construction actions would not be expected to cause noticeable changes in the area's existing (natural or man-made) drainage systems or surface waters.

3.15.6.1.3 Direct Impacts or Disturbances to Surface Water or Drainage Channels

Construction actions would occur over a great distance and variety of land types that, as described in Section 3.15.5, contain many streams and drainage channels, some with intermittent flow and others with perennial flow, and other waterbodies. The Applicant would avoid surface waters and their floodplains, to the extent practicable, in siting converter stations and transmission line foundations (EPM GE-9 in Section 3.15.6.1.5); would not construct counterpoise or fiber optic cable trenches across waterbodies (EPM W-6 in Section 3.15.6.1.5); and, in general, would avoid damage to drainage features as practicable. There is sufficient flexibility in the micrositing of facilities away from surface water features and, in the case of transmission lines, in placing structures such that surface waters and drainage features can be spanned by the lines. Therefore, the impact evaluations in this section are based on the assumption that Project facilities, including transmission line structures, would not be constructed in streams (perennial or intermittent) or their channels, or in any lakes, reservoirs, or ponds. The siting of access roads, however, generally does not include the same means of avoidance and, as a result, access roads are components of the Project most likely to require disturbance of drainage features. Since the Project has not yet progressed to the stage of detailed, location-specific design, the manner in which surface waters and drainage features would be crossed or the full extent of existing crossing routes are not yet available. The Applicant has, however, identified four typical crossing methods for access roads if they are necessary. Selection of one of the crossing methods would depend on stream characteristics as well as requirements associated with permits for crossing waters or floodplains (Appendix C). The four types of crossing methods are briefly summarized as follows (see Appendix F):

- Type 1, Drive-Through Crossings—This type of crossing applies to seasonally dry, non-fish-bearing drainages that would require no more than minimal grading or fill to support vehicle travel. Fill material, if needed, would generally consist of commercially available aggregate and the Applicant would limit the quantity used to that needed for safe vehicle travel. The average disturbance for a Type 1 crossing would be about 25 feet along the waterbody.
- Type 2, Ford Crossings—This type of crossing applies to streams (seasonally dry or perennial) with shallow, but defined channels that require grading and stabilization of stream banks and, in some cases, the channel bed to allow vehicle travel. Approaches and, if needed, the streambed would be rock armored with commercially available aggregate or large angular rock (pit run), placed to maintain the dimensions of the natural streambed

and not impede natural flow. The average disturbance for a Type 2 crossing would be about 75 feet along the waterbody.

- Type 3, Culvert—This type of crossing applies to more incised stream channels and with consistent flow regimes sufficient to maintain fishery populations. Typically, the culvert would be designed to be partially buried so that streambed material can be maintained in its bottom. Scour-resistant materials would be installed around the edges of the culvert and a stable travel surface installed across the culvert. The average disturbance for a Type 3 crossing would be about 30 to 60 feet, depending on the channel profile along the waterbody.
- Type 4, Spanning Structure—These bank-to-bank crossing structures apply to higher quality defined perennial stream channels up to a width of about 30 feet. The type of structure designed would depend on the width of the channel. The average disturbance for a Type 4 crossing would be about 30 to 60 feet along the waterbody.

Crossing a drainage feature, no matter the type, would result in impacts to the drainage feature. The extent of those impacts would depend on the nature of the drainage feature and the type of crossing method used. As indicated in the description of crossing types, the higher the quality of the stream, the more elaborate the crossing method that would be expected. In any of the crossing types, however, the intent would be to minimize the length of the drainage feature that would be affected and to maintain flow characteristics through the disturbed section so that effects upstream or downstream would also be minimized. In flowing streams, there could be local impacts to bottom-dwelling aquatic communities, and during construction there would likely be increased turbidity to downstream areas. Increased turbidity would be expected to be short-lived, but depending on the type of crossing, it would likely take longer for bottom communities to recover.

3.15.6.1.4 Effects on Water Availability

Adverse effects on water availability could result if the Project hindered the use of a local surface water source or if the Project's need for water reduced the amount of water available for other existing users. The former situation could result from the Project accidentally causing contamination or physical damage to a stream or even an intake structure so that the water could not be withdrawn. The potential to damage surface water sources would be expected to be limited to access road crossings as was discussed in Section 3.15.6.1.3; the potential for surface water contamination was discussed in Section 3.15.6.1.1.

Water would be needed to support the Project's construction activities, but the activities would not involve major demands for water. The types of water needs expected during construction were described in the groundwater discussion of Section 3.7.6.1.3 and, as noted in that section, the Applicant estimates the Project would require approximately 110 million gallons of water. Construction duration is anticipated to be 36 to 42 months Assuming a 36 month duration, this water demand equates to about 0.1 million gallons per day, which the Applicant plans to obtain from municipal water providers along the transmission line route. The Applicant does not anticipate the need to drill wells to obtain water or to withdraw water directly from surface water sources to support construction actions. The water demand also would be spread out over a large geographic area, so the average demand of 0.1 million gallons per day would be experienced in different areas along the 700-mile route as construction progressed. Construction of the proposed converter stations, however, would be expected to cause their portions of the overall HVDC transmission line route to be associated with a higher percentage of the water demand than those sections with only transmission lines being constructed. As summarized in the average 2010 water use tables in Section 3.7.5, the use of surface water varied from 3 to 1,125 million gallons per day within the seven regions along the HVDC transmission line route. Because water for the Project is expected to come from municipal providers, its source could be groundwater or surface water depending on which part of the route is being worked. The only regions where surface water use is less than 80 million gallons per day are Regions 1 and 2, where public water supplies come entirely from groundwater. Similarly, water to support the Project in these two regions would not be expected to come from surface water sources. In Regions 3 through 7, a water demand of 0.1 million gallons per day over a 36-month construction period is minor compared to quantities of surface water already being used. Water demand associated with the Project is therefore not expected to have noticeable effects on surface water resources beyond those resulting from existing water usage.

3.15.6.1.5 Environmental Protection Measures

The Applicant has developed and would implement a comprehensive list of EPMs to avoid and minimize impacts to surface water. Implementation of these EPMs is assumed throughout the impact analysis that follows for the Project. A complete list of EPMs for the Project is provided in Appendix F. The EPMs associated with surface water are presented below in three general potential impact categories: (1) contamination, (2) runoff rates, and (3) physical impacts. Each EPM is identified by its Applicant-designated reference number.

Practices will be implemented to specifically minimize the potential for release or mismanagement of hazardous materials that could eventually result in surface water contamination. These EPMs include the following:

- GE-1: Clean Line will train personnel on health, safety, and environmental matters. Training will include practices, techniques, and protocols required by federal and state regulations and applicable permits.
- GE-5: Any herbicides used during construction and operations and maintenance will be applied according to label instructions and any federal, state, and local regulations.
- GE-13: Emergency and spill response equipment will be kept on hand during construction.
- GE-14: Clean Line will restrict the refueling and maintenance of vehicles and the storage of fuels and hazardous chemicals within at least 100 feet from wetlands, surface waterbodies, and groundwater wells, or as otherwise required by federal, state, or local regulations.
- GE-21: Clean Line will maintain construction equipment in good working order. Equipment and vehicles that show excessive emissions of exhaust gases and particulates due to poor engine adjustments or other inefficient operating conditions will be repaired or adjusted.
- GE-28 Hazardous materials and chemicals will be transported, stored, and disposed of according to federal, state, or local regulations or permit requirements.
- GE-31: Clean Line will provide sanitary toilets convenient to construction; these will be located greater than 100 feet from any stream or tributary or to any wetland. These facilities will be regularly serviced and maintained; waste disposal will be properly manifested. Employees will be notified of sanitation regulations and will be required to use sanitary facilities.
- W-12: If blasting is required within 150 feet of a spring or groundwater well, Clean Line will conduct preconstruction monitoring of yield and water quality in cooperation with the landowner. In the event of damage, Clean Line will arrange for a temporary water supply through a local supplier until a permanent solution is identified.
- W-14: Clean Line will ensure that there is no off-site discharge of wastewater from temporary batch plant sites.

Practices will be implemented to minimize changes to stormwater runoff rates that could potentially change drainage patterns and runoff quantity or quality. These EPMs include the following:

- GE-3: Clean Line will minimize clearing vegetation within the ROW, consistent with a Transmission Vegetation Management Plan (TVMP) filed with NERC, and applicable federal, state, and local regulations. The TVMP may require additional analysis under NEPA depending on whether and under what conditions DOE decides to participate in the Project.
- GE-6: Clean Line will restrict vehicular travel to the ROW and other established areas within the construction, access, or maintenance easement(s).
- GE-7: Roads not otherwise needed for maintenance and operations will be restored to preconstruction conditions. Restoration practices may include decompacting, recontouring, and re-seeding. Roads needed for maintenance and operations will be retained.
- GE-27: Clean Line will minimize compaction of soils and rutting through appropriate use of construction equipment (e.g., low ground pressure equipment and temporary equipment mats).
- GE-30: Clean Line will minimize the amount of time that any excavations remain open.
- GEO-1: Clean Line will stabilize slopes exposed by its activities to minimize erosion.
- W-3: Clean Line will establish streamside management zones within 50 feet of both sides of intermittent and perennial streams and along margins of bodies of open water where removal of low-lying vegetation is minimized.
- W-7: Clean Line will locate spoil piles from foundation excavations and fiber optic cable trenches outside of streamside management zones.
- W-8: Dewatering will be conducted in a manner designed to prevent soil erosion (e.g., through discharge of water to vegetated areas and/or the use of flow control devices).

Practices will be implemented to minimize direct, physical impacts to surface water features and the potential to restrict the use of a surface water. These EPMs include the following:

- GE-9: Clean Line will avoid and/or minimize damage to drainage features and other improvements such as ditches, culverts, levees, tiles, and terraces; however, if these features or improvements are inadvertently damaged, they will be repaired and/or restored.
- W-1: Clean Line will avoid and/or minimize construction of access roads in special interest waters.
- W-2: Clean Line will identify, avoid, and/or minimize adverse effects to wetlands and waterbodies. Clean Line will not place structure foundations within the Ordinary High Water Mark of Waters of the United States.
- W-5: Clean Line will construct access roads to minimize disruption of natural drainage patterns including perennial, intermittent, and ephemeral streams.
- W-6: Clean Line will not construct counterpoise or fiber optic cable trenches across waterbodies.
- W-15: Clean Line will seek to procure water from municipal water systems where such water supplies are within a reasonable haul distance; any other water required will be obtained through permitted sources or through supply agreements with landowners. (As noted in Section 3.7.6.1.3, the Applicant does not anticipate the need to drill wells to obtain water to support construction actions, but if new wells became necessary to support operational facilities, the Applicant would obtain the necessary approvals and limit withdrawal volumes so as to not adversely affect supplies for other uses.)

3.15.6.2 Impacts Associated with the Applicant Proposed Project

3.15.6.2.1 Converter Stations and AC Interconnection Siting Areas

3.15.6.2.1.1 Construction Impacts

3.15.6.2.1.1.1 Oklahoma Converter Station Siting Area and AC Interconnection Siting Area

Limited surface water features consisting of 1.6 miles of intermittent stream beds, no perennial streams, and no major waterbodies are present within the Oklahoma Converter Station and AC Interconnection Siting Areas. Considering a representative 200-foot-wide ROW for the AC interconnection, the length of intermittent streams enclosed is 0.2 mile. Potential impacts associated with construction of the station and AC interconnection would be the same as those common impacts described in Section 3.15.6.1. Water needed to support construction of the converter station and AC interconnection—although expected to be obtained from a municipal provider—would likely not come from surface water because groundwater is the predominant source of water in Texas County.

3.15.6.2.1.1.2 Tennessee Converter Station Siting Area and AC Interconnection Tie

Limited surface water features consisting of only a few drainage features, including only 0.21 mile of perennial streams, 1.5 miles of intermittent streams, and no major waterbodies are present within the Tennessee Converter Station and AC Interconnection Tie. Potential impacts associated with construction of the station and AC interconnection would be the same as those common impacts described in Section 3.15.6.1. The Applicant would avoid surface waters to the extent practicable in selecting the ultimate construction site for the station. Potential impacts associated with construction of the station and AC interconnection tie would be the same as those common impacts described in Section 3.15.6.1. Water needed to support the construction of the converter station would likely not come from surface water because public water supplies in Shelby County come entirely from groundwater.

3.15.6.2.1.2 Operations and Maintenance Impacts

Operations and maintenance of the Oklahoma and Tennessee converter stations and AC interconnections would not be expected to have any impacts on surface water. There would be no water demand other than the minor amount of drinking water required to support fewer than 15 full-time workers at each station and the station would be connected to the municipal water system and the public water systems in the region use groundwater sources (Tables 3.7-5 and 3.7-22). USACE notes that any water lines that support converter station operation may require permit verification.

3.15.6.2.1.3 Decommissioning Impacts

Decommissioning of converter stations and the associated AC interconnection transmission line or tie would be expected to have impacts similar to those described in Section 3.15.6.1 for common construction activities, i.e., the same types of measures would be required to manage the fuels and lubricants that would be present in equipment and actions to protect stormwater runoff at the site would ensure that contaminants did not reach surface water. Decommissioning actions may require larger equipment than required during typical operation and maintenance activities. As a result, access to some areas may need to be improved or even reestablished and, as during construction, could involve direct disturbances to surface water or drainage channels. Water demand during decommissioning would be limited to that needed for actions such as dust suppression, soil compaction, and possibly re-seeding or landscaping to put the ground back into suitable condition. Water demand would be expected to be less than for construction and would not adversely impact surface water resources.

3.15.6.2.2 AC Collection System

3.15.6.2.2.1 Construction Impacts

As indicated in the discussion of common construction impacts (Section 3.15.6.1), the Applicant would avoid surface waters to the extent practicable in selecting the sites for transmission line structures for any of the AC collection system routes. However, as noted in Section 3.15.6.1.3, access roads may have to cross drainage features. If an access road required a new crossing over any of the impaired streams in any of the regions, or if construction sites were close enough to contribute stormwater runoff to these streams, there would be additional requirements to ensure no adverse impacts to water quality. For example, Oklahoma's NPDES construction general permit includes additional requirements for construction actions that could involve stormwater runoff to impaired waters. These added requirements include an increased frequency for inspections as well as protective measure planning that is specific to the surface water and contaminants of concern (ODEQ 2012). Also common to all of the AC collection system routes, groundwater is the predominant source of water in the area (Table 3.7-6), so water to support construction of any collector line, although expected to be obtained from a municipal provider, would likely not come from surface water.

3.15.6.2.2.1.1 AC Collection System Route E-1

As shown in Table 3.15-5, the 200-foot-wide representative ROW of AC Collection System Route E-1 encompasses 0.23 mile of perennial streams, 1.61 miles of intermittent streams, no major waterbodies, and 0.45 acre of reservoirs, lakes, and ponds. AC Collection System Route E-1 is only one of three AC collection system routes (along with SE-2 and SW-1) to encompass no major waterbodies. AC Collection System Route E-1 also encompasses a section of Palo Duro Creek, which is identified as an Oklahoma impaired water (Table 3.15-6) and additional requirements could be applicable as identified in Section 3.15.6.2.2.1 above. Potential impacts associated with construction of AC Collection System Route E-1 would be the same as those common impacts described in Section 3.15.6.1.

3.15.6.2.2.1.2 AC Collection System Route E-2

The 200-foot-wide ROW of AC Collection System Route E-2 encompasses 0.37 mile of perennial streams, 2.18 miles of intermittent streams, 0.07 mile of major waterbodies, and 0.99 acre of reservoirs, lakes, and ponds (Table 3.15-5). AC Collection System Route E-2 also encompasses a section of Palo Duro Creek, an Oklahoma impaired water (Table 3.15-6) and additional requirements could be applicable as identified in Section 3.15.6.2.2.1 above. Potential impacts associated with construction of the AC Collection System Route E-2 would be the same as those common impacts described in Section 3.15.6.1.

3.15.6.2.2.1.3 AC Collection System Route E-3

The 200-foot-wide ROW of AC Collection System Route E-3 encompasses 0.12 mile of perennial streams, 2.39 miles of intermittent streams, 0.01 mile of major waterbodies, and 0.31 acre of reservoirs, lakes, and ponds (Table 3.15-5). AC Collection System Route E-3 also encompasses a section of Palo Duro Creek, an Oklahoma impaired water (Table 3.15-6) and additional requirements could be applicable as identified in Section 3.15.6.2.2.1 above. Potential impacts associated with construction of AC Collection System Route E-3 would be the same as those common impacts described in Section 3.15.6.1.

3.15.6.2.2.1.4 AC Collection System Route NE-1

The 200-foot-wide ROW of AC Collection System Route NE-1 encompasses 0.41 mile of perennial streams, 0.25 mile of intermittent streams, 0.12 mile of major waterbodies, and no area of reservoirs, lakes, and ponds

(Table 3.15-5). Potential impacts associated with construction of AC Collection System Route NE-1 would be the same as those common impacts described in Section 3.15.6.1.

3.15.6.2.2.1.5 AC Collection System Route NE-2

The 200-foot-wide ROW of AC Collection System Route NE-2 encompasses 0.2 mile of perennial streams, 1.33 miles of intermittent streams, 0.10 mile of major waterbodies, and 1.95 acres of reservoirs, lakes, and ponds (Table 3.15-5). Potential impacts associated with construction of AC Collection System Route NE-2 would be the same as those common impacts described in Section 3.15.6.1.

3.15.6.2.2.1.6 AC Collection System Route NW-1

The 200-foot-wide ROW of AC Collection System Route NW-1 encompasses 0.16 mile of perennial streams, 2.03 miles of intermittent streams, 0.09 mile of major waterbodies, and no area of reservoirs, lakes, and ponds (Table 3.15-5). The AC Collection System Route NW-1 also encompasses a section of the Beaver River, an Oklahoma impaired water (Table 3.15-6) and additional requirements could be applicable as identified in Section 3.15.6.2.2.1 above. Potential impacts associated with construction of AC Collection System Route NW-1 would be the same as those common impacts described in Section 3.15.6.1.

3.15.6.2.2.1.7 AC Collection System Route NW-2

The 200-foot-wide ROW of AC Collection System Route NW-2 encompasses 0.51 mile of perennial streams, 0.95 mile of intermittent streams, 0.18 mile of major waterbodies, and 0.04 acre of reservoirs, lakes, and ponds (Table 3.15-5). The distance of major waterbodies is the highest of any of the AC collection system routes. Potential impacts associated with construction of AC Collection System Route NW-2 would be the same as those common impacts described in Section 3.15.6.1.

3.15.6.2.2.1.8 AC Collection System Route SE-1

The 200-foot-wide ROW of AC Collection System Route SE-1 encompasses 0.42 mile of perennial streams, 2.09 miles of intermittent streams, 0.04 mile of major waterbodies, and 2.61 acres of reservoirs, lakes, and ponds. The area of reservoirs, lakes, and ponds is the highest of any of the AC collection system routes. AC Collection System Route SE-1 also encompasses a section of Palo Duro Creek, an Oklahoma impaired water (Table 5.15-6) and additional requirements could be applicable as identified in Section 3.15.6.2.2.1 above. Potential impacts associated with construction of AC Collection System Route SE-1 would be the same as those common impacts described in Section 3.15.6.1.

3.15.6.2.2.1.9 AC Collection System Route SE-2

The 200-foot-wide corridor of AC Collection System Route SE-2 encompasses no perennial streams, 0.3 miles of intermittent streams, no major waterbodies, and 0.38 acre of reservoirs, lakes, and ponds (Table 3.15-5). The ROW of AC Collection System Route SE-2 is only one of two AC collection system routes encompassing no perennial streams—the length of intermittent streams is the second lowest of any of the routes—and it is only one of three alternatives with no major waterbodies. Potential impacts associated with construction of AC Collection System Route SE-2 would be the same as those common impacts described in Section 3.15.6.1.

3.15.6.2.2.1.10 AC Collection System Route SE-3

The 200-foot-wide ROW of AC Collection System Route SE-3 encompasses 0.37 mile of perennial streams, 2.07 miles of intermittent streams, 0.07 mile of major waterbodies, and 1 acre of reservoirs, lakes, and ponds (Table 3.15-5). AC Collection System Route SE-3 also encompasses a section of Palo Duro Creek, an Oklahoma impaired water (Table 3.15-6), and additional requirements could be applicable as identified in Section 3.15.6.2.2.1 above. SE-3 also encompasses a section of Wolf Creek, which is designated by Texas as a water of high water quality/exceptional aquatic life/high aesthetic value. Texas Surface Water Quality Standards (TAC 30-307) prohibit discharges to Wolf Creek that could lower its water quality such that its designations could not be maintained. Potential impacts associated with construction of AC Collection System Route SE-3 would be the same as those common impacts described in Section 3.15.6.1.

3.15.6.2.2.1.11 AC Collection System Route SW-1

The 200-foot-wide ROW of AC Collection System Route SW-1 encompasses no perennial streams, 0.86 miles of intermittent streams, no major waterbodies, and no area of reservoirs, lakes, and ponds (Table 3.15-5). The ROW of SW-1 is only one of two AC collection system routes encompassing no perennial streams and only one of three routes with no major waterbodies or no area of reservoirs, lakes, and ponds. Potential impacts associated with construction of the AC Collection System Route SW-1 would be the same as those common impacts described in Section 3.15.6.1.

3.15.6.2.2.1.12 AC Collection System Route SW-2

The 200-foot-wide ROW of AC Collection System Route SW-2 encompasses 0.14 mile of perennial streams, 2.91 miles of intermittent streams, 0.08 mile of major waterbodies, and 0.21 acre of reservoirs, lakes, and ponds (Table 3.15-5). The length of intermittent streams is the highest of any of the AC collection system routes. Potential impacts associated with construction of AC Collection System Route SW-2 would be the same as those common impacts described in Section 3.15.6.1.

3.15.6.2.2.1.13 AC Collection System Route W-1

The 200-foot-wide corridor of AC Collection System Route W-1 encompasses 0.17 mile of perennial streams, 1.05 miles of intermittent streams, 0.08 mile of major waterbodies, and 0.49 acre of reservoirs, lakes, and ponds (Table 3.15-5). Potential impacts associated with construction of AC Collection System Route W-1 would be the same as those common impacts described in Section 3.15.6.1.

3.15.6.2.2.2 Operations and Maintenance Impacts

Operations and maintenance of AC collection system routes would not impact surface water. During operations and maintenance, no notable sources of contaminants would be in use other than the typical fuels and lubricants found in vehicles and equipment, herbicides used to maintain ROWs and access roads would be applied in accordance with label instructions and any federal, state, and local regulations to minimize the potential for spreading, and no soil disturbance would occur. Access roads developed during construction would be maintained as needed to support long-term operations and maintenance actions.

3.15.6.2.2.3 Decommissioning Impacts

Decommissioning of AC collection system lines would be expected to have impacts similar to those described in Section 3.15.6.1 for common construction activities, i.e., the same types of measures would be required to manage the fuels and lubricants that would be present in equipment and actions to protect stormwater runoff at the site would ensure that contaminants did not reach surface water. Decommissioning actions may require larger equipment than required during typical operation and maintenance activities. As a result, access to some areas may need to be improved or even reestablished and, as during construction, could involve direct disturbances to surface water or drainage channels. Water demand during decommissioning would be limited to that needed for actions such as dust suppression, soil compaction, and possibly re-seeding or landscaping to put the ground back into suitable condition and would be expected to be less than for construction and would not adversely impact surface water resources.

3.15.6.2.3 HVDC Applicant Proposed Route

3.15.6.2.3.1 Construction Impacts

This section addresses potential impacts from construction of the HVDC transmission line within each of the seven regions of the Applicant Proposed Route. The surface water features described in each region are those located within a 200-foot-wide representative ROW of the Applicant Proposed Route. Surface water features and elements within the ROWs were presented in the regional discussions of Section 3.15.5 along with the information for the 1,000-foot-wide ROI. Changes to impacts due to route variations developed in response to public comments on the Draft EIS are described at the end of the applicable sections.

Common to construction in all of the regions and as described in Section 3.15.6.1.3, the Applicant would avoid surface waters to the extent practicable in selecting the sites for transmission line structures, but access roads may have to cross surface drainage features. If an access road required a new crossing over any of the impaired streams in any of the regions, or if construction sites were close enough to contribute stormwater runoff to these streams, there would be additional requirements to ensure no adverse impacts to water quality. For example, the Oklahoma, Arkansas, and Tennessee general NPDES stormwater construction permits each include additional requirements for construction actions that could involve stormwater runoff to impaired waters as follows:

- Oklahoma's added requirements include an increased frequency for inspections as well as protective measure planning that is specific to the surface water and contaminants of concern (ODEQ 2012).
- Arkansas' added requirements include consideration of additional BMPs to address specific contaminants of concern and additional monitoring to ensure the BMPs are effective (ADEQ 2011).
- Tennessee's added requirements include an increased width of the required buffer zone, design of structures against a greater intensity storm, and specific training requirements for the preparer of the operator's SWPPP (TDWPC 2011).

3.15.6.2.3.1.1 Region 1

As shown in Table 3.15-4, the 200-foot-wide ROW of the Applicant Proposed Route in Region 1 encompasses 0.86 mile of perennial streams, 5.92 miles of intermittent streams, 0.03 mile of major waterbodies, and 9.9 acres of reservoirs, lakes, and ponds. The only federal or state surface water designations of special interest in Region 1 are those identified by the state of Oklahoma as impaired waters. The five impaired waters within the ROW of the Applicant Proposed Route are Palo Duro Creek, Kiowa Creek, Beaver River, Clear Creek, and Otter Creek (Table 3.15-6). With the added requirements if impaired waters were to be affected, potential impacts associated with construction of the Applicant Proposed Route in Region 1 would be the same as those common impacts described in Section 3.15.6.1. Groundwater is the predominant source of water in the four-county area of Region 1, so water to support construction of the transmission line, although expected to be obtained from a municipal provider, would likely not come from surface water.

No route variations were proposed in Region 1.

3.15.6.2.3.1.2 Region 2

The 200-foot-wide ROW of the Applicant Proposed Route in Region 2 encompasses 1.43 miles of perennial streams, 3.75 miles of intermittent streams, 0.01 mile of major waterbodies, and 1.9 acres of reservoirs, lakes, and ponds (Table 3.15-8). Federal or state surface water designations of special interest in Region 2 consist of the Cimarron River, designated as critical habitat by both the USFWS and the state of Oklahoma (Table 3.15-9), and several streams identified by the state of Oklahoma as impaired waters. Four impaired waters occur within the ROW of the Applicant Proposed Route in Region 2: East Griever Creek, Cimarron River, Turkey Creek, and Buffalo Creek (Table 3.15-10). With the added requirements if impaired waters were to be affected, potential impacts associated with construction of the Applicant Proposed Route in Region 2 would be the same as those common impacts described in Section 3.15.6.1. Groundwater is the predominant source of water in the three-county area of Region 2, so water to support construction of the transmission line, although expected to be obtained from a municipal provider, would likely not come from surface water.

Two route variations to the Applicant Proposed Route were developed in Region 2 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.2. The variations are illustrated in Exhibit 1 of Appendix M. The variations would involve no changes to the surface water features within the 200-foot-wide representative ROW of the Applicant Proposed Route and no different waters of special interest or impaired waters are present within the 1,000-foot-wide corridor. The minor route variations in Region 2 of the Applicant Proposed Route would not affect the potential impacts to surface waters associated with construction.

3.15.6.2.3.1.3 Region 3

The 200-foot-wide ROW of the Applicant Proposed Route in Region 3 encompasses 10.45 miles of perennial streams, 7.75 miles of intermittent streams, 0.15 mile of major waterbodies, and 39.5 acres of reservoirs, lakes, and ponds (Table 3.15-12). As indicated in Section 3.15.5.3.2, there are many small dams and reservoirs in areas of Region 3, which have been captured, as applicable, in the acreage of reservoirs, lakes, and ponds and possibly miles of major waterbodies. Because of their relatively small size, it is expected these features would be easily avoided by transmission line structures and access roads. Federal or state surface water designations of special interest in the Region 3 ROW include the source or watershed protection area for Cushing Lake (Table 3.15-13), which is used as a source for drinking water. The ROW only passes through the special provision watershed of Cushing Lake. The Region 3 ROW of the Applicant Proposed Route also encompasses eight streams identified by the state of Oklahoma as impaired waters: Skeleton Creek, Cimarron River, Stillwater Creek, West Spring Creek, Browns Creek, Begger Creek, Salt Creek, and Adams Creek (Table 3.15-14). With the added requirements if impaired waters were to be affected, potential impacts associated with construction of the Applicant Proposed Route in Region 3 would be the same as those common impacts described in Section 3.15.6.1. Groundwater is the predominant source of water in the eight-county area of Region 3, but surface water use is also notable, so water to support construction of the transmission line, although expected to be obtained from a municipal provider, could come from both surface water and groundwater.

Five route variations to the Applicant Proposed Route were developed in Region 3 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.3. The variations are illustrated in Exhibit 1 of Appendix M. The variations would involve minor changes to the surface water features within the 200-foot-wide representative ROW of the Applicant Proposed Route; no different waters of special interest or impaired waters are present within the 1,000-foot-wide corridor. The minor route variations in Region 3 of the Applicant Proposed Route would not affect the potential impacts to surface waters associated with construction.

3.15.6.2.3.1.4 Region 4

As shown in Table 3.15-16, the 200-foot-wide ROW of the Applicant Proposed Route in Region 4 encompasses 3.5 miles of perennial streams, 8.96 miles of intermittent streams, 0.24 mile of major waterbodies, and 16.1 acres of reservoirs, lakes, and ponds. As noted for Region 3, the small dams and reservoirs in the western portion of Region 4 (Section 3.15.5.4.2), are captured, as applicable, in the acreage of reservoirs, lakes, and ponds and possibly miles of major waterbodies and would be easily avoided by transmission line structures and access roads. Region 4 of the transmission line route includes a large number of surface waters with designations of special interest as shown in Table 3.15-17. Rather than attempting to identify each of the surface water features of interest that could be affected by construction, this discussion simply identifies the number of features along the route being discussed and the number of designations involved; Table 3.15-17 can be consulted for additional detail. Federal or state surface water designations of special interest within the ROW of the Applicant Proposed Route in Region 4 includes eight surface waters with a total of 14 designations plus three non-specific source water protection areas. Three of the surface waters (the Arkansas, Lower Illinois, and Mulberry rivers) are designated Section 10 Navigable Waters and, as indicated in Table 3.15-1, any action involving dredging or filling or any other obstruction or alteration of these rivers would require a permit from the USACE; requirements under Section 404 of the CWA would also be applicable. Section 10 Navigable Waters are also addressed in Section 3.19.

As noted in Section 3.15.5.4.2, the Lee Creek Variation within the Applicant Proposed Route avoids the 300-foot buffer zone established around Lee Creek Reservoir by the city of Fort Smith, which is one of the special designations considered in the preceding paragraph.

The ROW of the Applicant Proposed Route also encompasses three streams identified by the state as impaired waters: Sallisaw, Little Sallisaw, and Lee creeks, all in Oklahoma. With the added requirements if impaired waters were to be affected, potential impacts associated with construction of the Applicant Proposed Route in Region 4 would be the same as those common impacts described in Section 3.15.6.1. Surface water is the predominant source of water in the six-county area of Region 4, so water to support construction of the transmission line, although expected to be obtained from a municipal provider, would likely come from surface water.

Seven route variations to the Applicant Proposed Route were developed in Region 4 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.4. The variations are illustrated in Exhibit 1 of Appendix M. The variations would involve minor changes to the surface water features within the 200-foot-wide representative ROW of the Applicant Proposed Route; no different waters of special interest or impaired waters are present within the 1,000-foot-wide corridor. Three streams, however, would be crossed in slightly different locations. The minor route variations in Region 4 of the Applicant Proposed Route would not affect the potential impacts to surface waters associated with construction.

3.15.6.2.3.1.5 Region 5

The 200-foot-wide ROW of the Applicant Proposed Route in Region 5 encompasses 2.16 miles of perennial streams, 9.32 miles of intermittent streams, 0.24 mile of major waterbodies, and 17.3 acres of reservoirs, lakes, and ponds (Table 3.15-20). Federal or state surface water designations of special interest within the ROW of the Region 5 Applicant Proposed Route includes four specific surface waters (Illinois Bayou, Cadron Creek, Little Red River, and White River) with five designations as shown in Table 3.15-21 and two non-specific source water protection areas. Since the White River is designated a Section 10 Navigable Water, any action involving dredging or filling or any other obstruction or alteration of this river would require a permit from the USACE; requirements under Section 404 of the CWA would also be applicable (Table 3.15-1). The ROW of the Applicant Proposed Route in Region 5 also encompasses six streams identified by the state as impaired waters: West Fork Point Remove Creek, East Fork Point Remove Creek, Little Red River, Ten Mile Creek, Glaise Creek, and Departee Creek (Table 3.15-22). With the added requirements if impaired waters were to be affected, potential impacts associated with construction of the Applicant Proposed Route in Region 5 would be the same as those common impacts described in Section 3.15.6.1. Surface water is the predominant source of water in the seven-county area of Region 5, but groundwater use is also notable, so water to support construction of the transmission line, although expected to be obtained from a municipal provider, could come from surface water or groundwater.

Five route variations to the Applicant Proposed Route were developed in Region 5 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.5. The variations are illustrated in Exhibit 1 of Appendix M. The variations would involve minor changes to the surface water features within the 200-foot-wide representative ROW of the Applicant Proposed Route; no different waters of special interest or impaired waters are present within the 1,000-foot-wide corridor. One stream, however, would be crossed in a slightly different location. The minor route variations in Region 5 of the Applicant Proposed Route would not affect the potential impacts to surface waters associated with construction.

3.15.6.2.3.1.6 Region 6

The 200-foot-wide corridor of the Applicant Proposed Route in Region 6 encompasses 0.83 mile of perennial streams, 3.48 miles of intermittent streams, 0.2 mile of major waterbodies, and 5.2 acres of reservoirs, lakes, and ponds (Table 3.15-24). Federal or state surface water designations of special interest within the ROW of the Applicant Proposed Route in Region 6 include only the L'Anguille River, which is on the Nationwide Rivers Inventory (Table 3.15-25). The ROW of the Applicant Proposed Route also encompasses three streams identified by the state as impaired waters: Cache River, Bayou DeView, and L'Anguille River (Table 3.15-26). With the added requirements if impaired waters were to be affected, potential impacts associated with construction of the Applicant Proposed Route in Region 6 would be the same as those common impacts described in Section 3.15.6.1. Groundwater is the predominant source of water used in the three-county area of Region 6, so water to support construction of the transmission line, although expected to be obtained from a municipal provider, would likely not come from surface water.

One route variation to the Applicant Proposed Route was developed in Region 6 in response to public comments on the Draft EIS. The route variation is described in Appendix M and summarized in Section 2.4.2.6. The variation is illustrated in Exhibit 1 of Appendix M. The variation would involve no changes to the surface water features within the 200-foot-wide representative ROW of the Applicant Proposed Route; no different waters of special interest or impaired waters are present within the 1,000-foot-wide corridor. The minor route variation in Region 6 of the Applicant Proposed Route would not affect the potential impacts to surface waters associated with construction.

3.15.6.2.3.1.7 Region 7

The 200-foot-wide ROW of the Applicant Proposed Route in Region 7 encompasses 0.54 mile of perennial streams, 4.3 miles of intermittent streams, 0.64 mile of major waterbodies, and 2.4 acres of reservoirs, lakes, and ponds (Table 3.15-28). Federal or state surface water designations of special interest within the corridor of the Applicant Proposed Route include two surface waters, St. Francis River and Mississippi River, and three designations (Table 3.15-29). Because of the Section 10 Navigable Waters designation on both these rivers, any action involving dredging or filling or any other obstruction or alteration would require a permit from the USACE; requirements under Section 404 of the CWA would also be applicable (Table 3.15-1). The ROW of the Applicant Proposed Route in Region 7 also encompasses one stream in Arkansas and four streams in Tennessee identified as impaired waters: Tyronza River, Mississippi River, Royster Creek, North Fork Creek, and Big Creek (Table 3.15-30). With the added requirements if impaired waters were to be affected, potential impacts associated with construction of the Applicant Proposed Route in Region 7 would be the same as those common impacts described in Section 3.15.6.1. Groundwater is the predominant source of water used in the four-county area of Region 7, but surface water use is notable, so water to support construction of the transmission line, although expected to be obtained from a municipal provider, could come from groundwater and surface water.

Three route variations to the Applicant Proposed Route were developed in Region 7 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.7. The variations are illustrated in Exhibit 1 of Appendix M. The variations would involve minor changes to the surface water features within the 200-foot-wide representative ROW of the Applicant Proposed Route; no different waters of special interest or impaired waters are present within the 1,000-foot-wide corridor. One stream, however, would be crossed in a slightly different location. The minor route variations in Region 7 of the Applicant Proposed Route would not affect the potential impacts to surface waters associated with construction.

3.15.6.2.3.2 Operations and Maintenance Impacts

Operations and maintenance of the HVDC transmission line in Regions 1 through 7, using the Applicant Proposed Route, would not impact surface water. During operations and maintenance, no notable sources of contaminants would be in use other than the typical fuels and lubricants found in vehicles and equipment; herbicides used to maintain ROWs and access roads would be applied in accordance with label instructions and any federal, state, and local regulations to minimize the potential for spreading; no soil disturbance would occur; and water needs would be limited to personal needs of the few workers that would be associated with maintenance of facilities and equipment. Access roads developed during construction would be maintained as needed to support long-term operations and maintenance actions.

3.15.6.2.3.3 Decommissioning Impacts

Decommissioning of HVDC transmission lines would be expected to have impacts similar to those described in Section 3.15.6.1 for common construction activities. The same types of measures would be required to manage the fuels and lubricants that would be present in equipment and actions to protect stormwater runoff at the site would ensure that contaminants did not reach surface water. Decommissioning actions may require larger equipment than required during typical operation and maintenance activities. As a result, access to some areas may need to be improved or even reestablished and, as during construction, could involve direct disturbances to surface water or drainage channels. Water demand during decommissioning would be limited to that needed for actions such as dust suppression, soil compaction, and possibly re-seeding or landscaping to put the ground back into suitable condition. Water demand would be less than for construction and would not adversely impact surface water resources.

3.15.6.3 Impacts Associated with the DOE Alternatives

3.15.6.3.1 Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area

3.15.6.3.1.1 Construction Impacts

The siting area for the Arkansas alternative converter station has been reduced since the Draft EIS, but still contains drainage features, including no perennial streams, 0.63 mile of intermittent streams, no major waterbodies, and 2.6 acres of reservoirs, lakes, and ponds. The 200-foot-wide representative ROW for the AC interconnection line in addition to the area for the new substation at the southern end of the AC Interconnection Siting Area would encompass 0.16 mile of perennial streams, 1.49 miles of intermittent streams, and 1.66 acres of reservoirs, lakes, and ponds. As indicated previously, the Applicant would avoid surface waters to the extent practicable in selecting the ultimate construction site for the station. Potential impacts associated with construction of the station, the AC interconnection line, and substation would be the same as those common impacts described in Section 3.15.6.1. Surface water is the predominant source of water in Pope County, where the siting area is located, so water to support construction of the converter station, interconnection transmission line, and substation would likely come from surface water even though it is expected to be obtained from a municipal provider.

3.15.6.3.1.2 Operations and Maintenance Impacts

Operations and maintenance of the Arkansas converter station basically would be the same as described in Section 3.15.6.2.1.2 for the Oklahoma and Tennessee converter stations. The public water systems in the region predominantly use surface water (Table 3.7-15).

3.15.6.3.1.3 Decommissioning Impacts

Decommissioning of the Arkansas converter station and the associated AC interconnection line and substation would be as described in Section 3.15.6.2.1 for the Oklahoma and Tennessee stations.

3.15.6.3.2 HVDC Alternative Routes

3.15.6.3.2.1 Construction Impacts

This section addresses potential impacts from construction of transmission line along HVDC alternative routes within each of the seven regions of the Project. The surface water features described in each region are those located within a 200-wide representative ROW of the HVDC alternative routes. Surface water features and elements within the ROWs were presented in the regional discussions of Section 3.15.5 along with the information for the corresponding 1,000-foot-wide ROI. Changes to impacts due to route adjustments developed in response to maintain an end-to-end route with variations to the Applicant Proposed Route are described at the end of the applicable sections.

The same considerations described for the Applicant Proposed Route in Section 3.15.6.2.3.1 would be applicable to the HVDC alternative routes. That is, the same considerations of avoiding surface waters to the extent practicable, the potential need for access roads to cross surface drainage features, and the additional stormwater runoff control measures needed if impaired waters could be affected would be applicable to the HVDC alternative routes.

3.15.6.3.2.1.1 Region 1

Table 3.15-4, provides the miles of perennial streams, intermittent streams, and major waterbodies that would be crossed by the 200-foot-wide ROWs of HVDC Alternative Routes 1-A, 1-B, 1-C, and 1-D. Table 3.15-4 also provides the acreage of reservoirs, lakes, and ponds within each of the ROWs. As shown in the table, the ROWs of the HVDC alternative routes would contain the following in comparison to the corresponding links of the Applicant Proposed Route.

- Perennial streams—1-A, 1-B, and 1-C would encompass smaller amounts (by 0.11, 0.2, and 0.1 mile, respectively) and 1-D would encompass the same amount
- Intermittent streams—1-A, 1-B, and 1-C would encompass greater amounts (by 2.69, 0.59, and 0.22 miles, respectively) and 1-D would encompass a smaller amount (by 0.33 mile)
- Major Waterbodies—1-A and 1-C would encompass greater amounts (both by 0.01 mile), 1-B would encompass a smaller amount (by 0.02 mile), and 1-D would encompass the same amount
- Reservoirs, Lakes, and Ponds—1-A, 1-B, 1-C, and 1-D would encompass smaller amounts (by 3.1, 6.1, 6.0, and 0.8 acres, respectively)

No surface waters within the Region 1 ROI have federal or state classifications of special interest other than those identified as having impaired water quality. As shown in Table 3.15-6, Region 1 of the Applicant Proposed Route would contain six surface water segments identified by the state of Oklahoma as having impaired water quality: Palo Duro Creek, Kiowa Creek, Beaver River, Clear Creek, Otter Creek, and Sand Creek. These six impaired waters would also be crossed the corresponding HVDC alternative routes, except that HVDC Alternative Route 1-A would avoid Clear Creek and Otter Creek. However, 1-A would cross an additional impaired water, Sand Creek, which would not be crossed by any of the other Region 1 HVDC transmission line routes.

Groundwater is the predominant source of water in the four-county area of Region 1, so water to support construction of the transmission line, although expected to be obtained from a municipal provider, would likely not come from surface water. Potential impacts associated with construction of an HVDC alternative route in Region 1 would be the same as those common impacts described in Section 3.15.6.1.

3.15.6.3.2.1.2 Region 2

Table 3.15-8, provides the miles of perennial streams, intermittent streams, and major waterbodies that would be crossed by the 200-foot-wide ROWs of HVDC Alternative Routes 2-A and 2-B. Table 3.15-8 also provides the acreage of reservoirs, lakes, and ponds within each of the ROWs. As shown in the table, the ROWs of the HVDC alternative routes would contain the following in comparison to the corresponding links of the Applicant Proposed Route:

- Perennial streams—2-A and 2-B would encompass greater amounts (by 2.03 and 0.38 mile, respectively)
- Intermittent streams—2-A and 2-B would encompass smaller amounts (by 1.22 and 0.6 mile, respectively)
- Major Waterbodies—2-A would encompass a greater amount (by 0.04 mile) and 2-B would encompass the same amount

- Reservoirs, Lakes, and Ponds—2-A and 2-B would encompass greater amounts (by 5.7 and 0.5 acres, respectively)

As shown in Table 3.15-9, the Cimarron River is the only surface water within the Region 2 ROI that has federal or state classifications of special interest other than those identified as having impaired water quality. The Cimarron River, which is within the 200-foot-wide ROW of both the Applicant Proposed Route and HVDC Alternative Route 2-A, has a USFWS designation of critical habitat and an Oklahoma designation as a water of recreational and/or ecological significance. As shown in Table 3.15-10, the Applicant Proposed Route in Region 2 would cross four surface water segments identified by the state of Oklahoma as having impaired water quality: East Griever Creek, Cimarron River, Turkey Creek, and Buffalo Creek. These four also would be crossed by the corresponding HVDC alternative routes. However, 2-A would cross three additional impaired waters; Main Creek, Griever Creek, and Cottonwood Creek, which would not be crossed any of the other Region 2 HVDC transmission line routes.

Groundwater is the predominant source of water in the three-county area of Region 2, so water to support construction of the transmission line, although expected to be obtained from a municipal provider, would likely not come from surface water. Potential impacts associated with construction of an HVDC alternative route in Region 2 would be the same as those common impacts described in Section 3.15.6.1.

3.15.6.3.2.1.3 Region 3

Table 3.15-12 provides the miles of perennial streams, intermittent streams, and major waterbodies that would be crossed by the 200-foot-wide ROW of HVDC Alternative Routes 3-A through 3-E. Table 3.15-12 also provides the acreage of reservoirs, lakes, and ponds within each of the ROWs. As shown in the table, the ROWs of the HVDC alternative routes would contain the following in comparison to the corresponding links of the Applicant Proposed Route:

- Perennial streams—3-A, 3-B, and 3-E would encompass greater amounts (by 0.87, 0.62 and 0.06 mile, respectively) and 3-C and 3-D would encompass smaller amounts (by 1.66 and 1.13 miles, respectively)
- Intermittent streams—3-A and 3-B encompass smaller amounts (both by 0.76 mile) and 3-C, 3-D, and 3-E would encompass greater amounts (by 3.18, 2.27, and 0.74 miles, respectively)
- Major Waterbodies—3-A, 3-B, 3-C, and 3-D would encompass smaller amounts (by 0.02, 0.03, 0.02, and 0.01 mile, respectively) and 3-E would encompass the same amount
- Reservoirs, Lakes, and Ponds—3-A, 3-B, and 3-D would encompass greater amounts (by 5.6, 6.0, and 2.0 acres, respectively) and 3-C and 3-E would encompass smaller amounts (11.9 and 0.2 acres, respectively)

As shown in Table 3.15-13, Lake Carl Blackwell and Cushing Lake are the surface waters within the Region 3 ROI that have federal or state classifications of special interest other than those identified as having impaired water quality. Oklahoma classifies both lakes as special provision watersheds for sensitive public and private water supplies; the state also designates Lake Carl Blackwell as a source water protection area. The special provision watershed of Cushing Lake is within the 200-foot-wide ROW of both the Applicant Proposed Route and the corresponding HVDC Alternative Route (i.e., 3-C) and the watershed of Carl Blackwell is only within the ROWs of HVDC Alternative Routes 3-A and 3-B.

As shown in Table 3.15-14, the Applicant Proposed Route in Region 3 would cross eight streams identified by the state of Oklahoma as impaired waters: Skeleton Creek, Cimarron River, Stillwater Creek, West Spring Creek, Browns

Creek, Begger Creek, Salt Creek, and Adams Creek. Of those eight, HVDC Alternative Routes 3-A and 3-B would avoid Skeleton Creek and 3-C would avoid West Spring Creek and Begger Creek; the other five would be crossed by corresponding alternative routes. However, several of the HVDC alternative routes would cross additional impaired waters that would not be crossed by the Applicant Proposed Route: 3-A/3-B would cross West Beaver Creek, 3-B would cross Stillwater Creek, 3-C would cross Little Deep Fork Creek, and 3-C/3-D would cross Butler Creek.

Groundwater is the predominant source of water in the eight-county area of Region 3, but surface water use is also notable, so water to support construction of the transmission line, although expected to be obtained from a municipal provider, could come from both surface water and groundwater. Potential impacts associated with construction of an HVDC alternative route in Region 3 would be the same as those common impacts described in Section 3.15.6.1.

As described in Appendix M and summarized in Section 2.4.2.3, a route adjustment was developed for HVDC Alternative Route 3-A to maintain an end-to-end route with the Applicant Proposed Route Region 3 Links 1 and 2, Variation 1. The adjustment to HVDC Alternative Route 3-A would involve no change in the surface water features within the 200-foot-wide representative ROW and no different waters of special interest or impaired waters are present within the 1,000-foot-wide corridor. The minor adjustment to HVDC Alternative Route 3-A would not affect the potential impacts associated with construction. The route adjustment is illustrated in Exhibit 1 of Appendix M.

3.15.6.3.2.1.4 Region 4

Table 3.15-16 provides the miles of perennial streams, intermittent streams, and major waterbodies that would be crossed by the 200-foot-wide ROWs of HVDC Alternative Routes 4-A through 4-E. Table 3.15-16 also provides the acreage of reservoirs, lakes, and ponds within each of the ROWs. As shown in the table, the ROWs of the HVDC alternative routes would contain the following in comparison to the corresponding I of the HVDC Applicant Proposed Route:

- Perennial streams—4-A, 4-B, 4-D, and 4-E would encompass smaller amounts (by 0.36, 0.92, 0.62, and 0.37 mile, respectively) and 4-C would encompass a greater amount (by 0.16 mile)
- Intermittent streams—4-A, 4-B, 4-D, and 4-E would encompass greater amounts (by 0.4, 1.17, 0.84 and 0.92 mile, respectively) and 4-C would encompass a smaller amount (by 0.16 mile)
- Major Waterbodies—4-A, 4-B, and 4-D would encompass smaller amounts (by 0.05, 0.06, and 0.08 mile, respectively), and 4-C would encompass the same amount, and 4-E would encompass a greater amount (by 0.08 mile)
- Reservoirs, Lakes, and Ponds—4-A, 4-C, 4-D, and 4-E would encompass greater amounts (by 1.1, 0.5, 0.2, and 4.3 acres, respectively) and 4-B would encompass a smaller amount (by 2.6 acres)

Region 4 of the HVDC transmission line route includes a large number of surface waters with designations of special interest as shown in Table 3.15-17. The table lists 11 named surface water features, many with multiple designations, and 6 non-specific (not publicly available) source water protection areas. Of those table listings, the ROW of the Applicant Proposed Route would encompass eight named surface water features and three non-specific source water protection areas. Compared to features along the Applicant Proposed Route:

- HVDC Alternative Routes 4-A/4-B would avoid two (Briar Creek and Lee Creek Reservoir) but would encompass three (Brushy Creek, Little Lee Creek, and the portion of Lee Creek that is an Oklahoma Scenic River) additional features.

- HVDC Alternative Route 4-A would encompass Webbers Creek.
- HVDC Alternative Route 4-B would encompass Lee Creek where it is an Arkansas extraordinary resource water.
- HVDC Alternative Routes 4-A, 4-B, 4-D would encompass two non-specific source water protection areas.
- HVDC Alternative Route 4-E would encompass a non-specific source water protection area.

HVDC Alternative Route 4-B and the corresponding Link 7 of the Applicant Proposed Route would cross the Mulberry River, which is designated a Section 10 Navigable Water and, as indicated in Table 3.15-1, any action involving dredging or filling or any other obstruction or alteration of these rivers would require a permit from the USACE; requirements under Section 404 of the CWA would also be applicable.

As shown in Table 3.15-18, the Applicant Proposed Route in Region 4 would cross three streams identified by the state of Oklahoma as having impaired water quality: Sallisaw Creek, Little Sallisaw Creek, and Lee Creek. Of those three, each would be crossed by corresponding alternative routes (specifically 4-A and 4-B). HVDC Alternative Routes 4-A and 4-B would also cross an additional impaired stream, Little Lee Creek, that would not be crossed by the Applicant Proposed Route.

Surface water is the predominant source of water in the six-county area of Region 4, so water to support construction of the transmission line, although expected to be obtained from a municipal provider, would likely come from surface water. Potential impacts associated with construction of an HVDC alternative route in Region 4 would be the same as those common impacts described in Section 3.15.6.1.

3.15.6.3.2.1.5 Region 5

Table 3.15-20 provides the miles of perennial streams, intermittent streams, and major waterbodies that would be crossed by the 200-foot-wide ROWs of HVDC Alternative Routes 5-A through 5-F. Table 3.15-20 also provides the acreage of reservoirs, lakes, and ponds within each of the ROWs. As shown in the table, the ROWs of the HVDC alternative routes would contain the following in comparison to the corresponding links of the Applicant Proposed Route:

- Perennial streams—5-A, 5-C, and 5-F would encompass smaller amounts (by 0.18, 0.08, and 0.01 mile, respectively) and 5-B, 5-D, and 5-E would encompass greater amounts (by 0.18, 0.02, and 0.09 mile, respectively)
- Intermittent streams—5-A, 5-B, 5-D, 5-E and 5-F would encompass greater amounts (by 0.33, 2.0, 0.3, 0.99, and 0.46 miles, respectively) and 5-C would encompass a smaller amount (by 0.14 mile)
- Major Waterbodies—5-A, 5-E, and 5-F would encompass the same amount, 5-B and 5-C would encompass greater amounts (by 0.02 and 0.01, respectively), and 5-D would encompass a smaller amount (by 0.01)
- Reservoirs, Lakes, and Ponds—5-A, 5-B, 5-C, 5-D, 5-E, and 5-F would all encompass greater amounts (by 0.4, 3.4, 1.0, 0.4, 3.8, and 2.7 acres, respectively)

As shown in Table 3.15-21, there are six specific surface waters within the Region 5 ROI that have federal or state classifications of special interest and two non-specific (not publicly available) source water protection areas. The ROW of the Applicant Proposed Route would encompass four of specific surface waters (Illinois Bayou, Cadron Creek, Little Red River, and White River) as well as both of the non-specific source water protection areas, and these same items would be encompassed by corresponding HVDC alternative routes. The remaining two specific surface waters in Table 3.15-21 are East Fork Cadron Creek, which would be encompassed by 5-B/5-E/5-F, and Departee

Creek, which would be encompassed by 5-D. HVDC Alternative Route 5-D would cross the White River, which is designated as Section 10 Navigable Waters and, as indicated in Table 3.15-1, any action involving dredging or filling or any other obstruction or alteration of this river would require a permit from the USACE; requirements under Section 404 of the CWA would also be applicable.

Table 3.15-22 identifies the seven Region 5 surface waters identified by the state of Arkansas as having impaired water quality: West Fork Point Remove Creek, East Fork Point Remove Creek, Cypress Creek, Little Red River, Ten Mile Creek, Glaise Creek, and Departee Creek. Of these seven streams, the first six listed would be encompassed by both the Applicant Proposed Route and a corresponding HVDC alternative route. Cypress Creek would be encompassed only by HVDC Alternative Route 5-B.

Surface water is the predominant source of water in the seven-county area of Region 5, but groundwater use is also notable, so water to support construction of the transmission line, although expected to be obtained from a municipal provider, could come from surface water or groundwater. Potential impacts associated with construction of an HVDC alternative route in Region 5 would be the same as those common impacts described in Section 3.15.6.1.

As described in Appendix M and summarized in Section 2.4.2.5, a route adjustment was developed for HVDC Alternative Route 5-B to maintain an end-to-end route with the Applicant Proposed Route Region 5 Links 2 and 3, Variation 1. Another route adjustment was developed for HVDC Alternative Route 5-E to maintain an end-to-end route with the Applicant Proposed Route Region 5 Links 3 and 4, Variation 2. The adjustments to HVDC Alternative Routes 5-B and 5-E would involve no change in the surface water features within the 200-foot-wide representative ROW; no different waters of special interest or impaired waters are present within the 1,000-foot-wide corridor. The minor adjustments in HVDC Alternative Routes 5-B and 5-E would not affect the potential impacts associated with construction. The route adjustments are illustrated in Exhibit 1 of Appendix M.

3.15.6.3.2.1.6 Region 6

Table 3.15-24 provides the miles of perennial streams, intermittent streams, and major waterbodies that would be crossed by the 200-foot-wide ROWs of HVDC Alternative Routes 6-A through 6-D. Table 3.15-24 also provides the acreage of reservoirs, lakes, and ponds within each of the ROWs. As shown in the table, the ROWs of the HVDC alternative routes would contain the following in comparison to the corresponding links of the Applicant Proposed Route:

- Perennial streams—6-A would encompass a smaller amount (by 0.06 mile) and 6-B, 6-C, and 6-D would encompass greater amounts (by 0.02, 0.1, and 0.13 mile, respectively)
- Intermittent streams—6-A would encompass the same amount, 6-B would encompass a smaller amount (by 0.45 mile) and 6-C and 6-D would encompass greater amounts (by 0.02 and 0.14 mile, respectively)
- Major Waterbodies—6-A would encompass the same amount and 6-B, 6-C, and 6-D would encompass smaller amounts (by 0.02, 0.05, and0.04 mile, respectively)
- Reservoirs, Lakes, and Ponds—6-A would encompass a smaller amount (by 1.5 acres), 6-B and 6-C would encompass greater amounts (both by 1.5 acres), and 6-D would encompass the same amount

As shown in Table 3.15-25, the L’Anguille River is the only surface water within the Region 6 ROI that has federal or state classifications of special interest other than those identified as having impaired water quality. The portion of the L’Anguille River that is in the National Rivers Inventory runs south from the Poinsett-Cross county line, so the ROW of HVDC Alternative Route 6-C avoids the designated section of the river. Table 3.15-26 lists the three surface water segments in Region 6 that are identified by the state of Arkansas as having impaired water quality: Cache River, Bayou DeView, and the L'Anguille River. All three of the impaired waters are encompassed by the Applicant Proposed Route and the corresponding HVDC alternative routes.

Groundwater is the predominant source of water used in the three-county area of Region 6, so water to support construction of the transmission line, although expected to be obtained from a municipal provider, would likely not come from surface water. Potential impacts associated with construction of an HVDC alternative route in Region 6 would be the same as those common impacts described in Section 3.15.6.1.

As described in Appendix M and summarized in Section 2.4.2.6, a route adjustment was developed for HVDC Alternative Route 6-A to maintain an end-to-end route with the Applicant Proposed Route Region 6 Link 2, Variation 1. The adjustment to HVDC Alternative Route 6-A would involve no change in the surface water features within the 200-foot-wide representative ROW and no different waters of special interest or impaired waters are present within the 1,000-foot-wide corridor. The minor adjustment to HVDC Alternative Route 6-A would not affect the potential impacts associated with construction. The route adjustment is illustrated in Exhibit 1 of Appendix M.

3.15.6.3.2.1.7 Region 7

Table 3.15-28 provides the miles of perennial streams, intermittent streams, and major waterbodies that would be crossed by the 200-foot-wide ROWs of HVDC Alternative Routes 7-A through 7-D. Table 3.15-28 also provides the acreage of reservoirs, lakes, and ponds within each of the ROWs. As shown in the table, the ROWs of the HVDC alternative routes would contain the following in comparison to the corresponding links of the Applicant Proposed Route:

- Perennial streams—7-A, 7-C, and 7-D would encompass greater amounts (by 1.47, 0.15, and 0.22 miles, respectively) and 7-B would encompass a smaller amount (by 0.01 mile)
- Intermittent streams—7-A and 7-C would encompass greater amounts (by 2.0 and 0.32 miles, respectively), and 7-B and 7-D would encompass smaller amounts (by 0.21 and 0.08 mile, respectively)
- Major Waterbodies—7-A and 7-C would encompass greater amounts (by 0.26 and 0.01 mile, respectively) and 7-B and 7-D would encompass the same amount
- Reservoirs, Lakes, and Ponds—7-A would encompass a greater amount (by 0.9 acre), 7-B and 7-D would encompass smaller amounts (by 0.1 and 0.8 acre, respectively), and 7-C would encompass the same amount

As shown in Table 3.15-29, the St. Francis River and the Mississippi River are the only surface waters within the Region 7 ROI that have federal or state classifications of special interest other than those identified as having impaired water quality. Both rivers would be crossed by HVDC Alternative Route 7-A and Link 1 of the Applicant Proposed Route. Also as shown in Table 3.15-29, both rivers are designated Navigable Waters of the U.S and the Mississippi River is also designated an exceptional Tennessee Water. Because the Region 7 alternatives would cross two surface waters designated as Section 10 Navigable Waters, any action involving dredging or filling or any other obstruction or alteration of these rivers would require a permit from the USACE as indicated in Table 3.15-1; requirements under Section 404 of the CWA would also be applicable.

Table 3.15-30 identifies the five Region 7 surface waters identified by the state of Arkansas or the state of Tennessee as having impaired water quality: Tyronza River in Arkansas; and Mississippi River, Royster Creek, Big Creek, and

North Fork Creek in Tennessee. Also as shown in Table 3.15-30, the state identifies eight different stream segments for these five streams that are within the 200-foot-wide ROWs of the HVDC transmission line routes. Although crossings may be over different segments of the same stream, both the Applicant Proposed Route and corresponding HVDC alternative routes would encompass each stream.

Groundwater is the predominant source of water used in the four-county area of Region 7, but surface water use is notable, so water to support construction of the transmission line, although expected to be obtained from a municipal provider, could come from surface water and groundwater. Potential impacts associated with construction of an HVDC alternative route in Region 7 would be the same as those common impacts described in Section 3.15.6.1.

3.15.6.3.2.2 Operations and Maintenance Impacts

Operations and maintenance of an HVDC transmission line in Regions 1 through 7, using any of the HVDC alternative routes, would not impact surface water. During operations and maintenance, no notable sources of contaminants would be in use other than the typical fuels and lubricants found in vehicles and equipment, herbicides used to maintain ROWs and access roads would be applied in accordance with label instructions and any federal, state, and local regulations to minimize the potential for spreading, no soil disturbance would occur, and water needs would be limited to personal needs of the few workers that would be associated with maintenance of facilities and equipment. Access roads developed during construction would be maintained as needed to support long-term operations and maintenance actions.

3.15.6.3.2.3 Decommissioning Impacts

Decommissioning of HVDC transmission lines with the Applicant Proposed Route or any of the HVDC alternative routes, would be expected to have impacts similar to those described in Section 3.15.6.1 for common construction activities, i.e., the same types of measures would be required to manage the fuel and lubricants that would be present in equipment and actions to protect stormwater runoff at the site would ensure that contaminants did not reach surface water. Decommissioning actions may require larger equipment than required during typical operation and maintenance activities. As a result, access to some areas may need to be improved or even reestablished and, as during construction, could involve direct disturbances to surface water or drainage channels. Water demand during decommissioning would be limited to that needed for actions such as dust suppression, soil compaction, and possibly re-seeding or landscaping to put the ground back into suitable condition. Water demand would be less than for construction and would not adversely impact surface water resources.

3.15.6.4 Best Management Practices

The Applicant has developed a comprehensive list of EPMs that would avoid and minimize impacts to surface water. A complete list of EPMs for the Project is provided in Appendix F; those EPMs that would minimize: (1) the potential for contamination to reach surface water, (2) changes to stormwater runoff or drainage patterns, and (3) direct, physical impacts to surface water features or restrictions on the use of a surface water are summarized in Section 3.15.6.1.5. The EPMs are comprehensive enough to avoid or minimize potential adverse impacts to surface water. DOE has therefore not identified any additional surface-water-related BMPs.

3.15.6.5 Unavoidable Adverse Impacts

Proper construction practices and measures, including those necessary to meet regulatory requirements and those protective measures proposed by the Applicant, should minimize adverse impacts to surface waters. In spite of these measures, adverse impacts to surface water resources, although minor, would still be likely. Construction and operations and maintenance of the Project would require a moderate level of water use, and some access roads would likely traverse through or over stream channels.

Sediment-laden runoff from a construction site could occur and could have adverse effects on a receiving water. The construction general permit for stormwater discharges would minimize the potential for such incidents and would keep potential adverse impacts to these surface waters to a minimum.

3.15.6.6 Irreversible and Irretrievable Commitment of Resources

The Project would involve a commitment of surface water resources, but at least to some extent, those resources would be replenished by cyclic precipitation and snow melt. The commitment of surface water resources would be irreversible in that it would limit, in the short term, future options for use of that resource. Over time, however, the amounts of water used to support construction would be expected to have a negligible effect on surface water resources. In other words, the surface water resource would be renewable or recoverable, so the commitment would not be considered irretrievable.

3.15.6.7 Relationship between Local Short-term Uses and Long-term Productivity

Surface water required to support the Project would represent a new, short-term use of the resource, but would have negligible effect on its long-term productivity. Any alterations to streambeds required by access road construction would have short term impacts on the altered segment of stream, but over time the impacts would be expected to fade as natural flora and fauna reestablished and the impacted stream segments would be small.

3.15.6.8 Impacts from Connected Actions

3.15.6.8.1 Wind Energy Generation

3.15.6.8.1.1 Construction Impacts

Construction of wind farms in the Oklahoma and Texas Panhandle regions would be expected to involve potential impacts to surface waters similar to those described in Section 3.15.6.1 for common construction activities. Sources of contamination, primarily in the form of fuels and lubricants, would be present at construction sites and at associated construction staging and storage yards. Soils in construction areas, access routes, and support areas would be disturbed and, for at least some period of time, would be expected to experience changes in stormwater runoff rates as compared to undisturbed conditions. Construction actions, particularly for access roads, could result in direct disturbances of surface waters or drainage channels. Water needs to support construction activities could affect the availability of surface water resources for other users in the region.

The surface water features that could be affected by construction or that could alter construction approaches due to added requirements are presented in Section 3.15.5.8.1 by WDZ. All of the WDZs contain various lengths of perennial and intermittent streams as well as various areas of reservoirs, lakes, and ponds (Table 3.15-32). Beaver River in WDZ D and Wolf Creek in WDZ L are the only surface water segments of special interest in any of the WDZs (Table 3.15-33). Segments of Beaver River in WDZ-F and -J and a segment of Palo Duro Creek in WDZ J are the only impaired waters in any of the WDZs (Table 3.5-34). Although there are differences in surface water features between the WDZs, DOE has no way of predicting precisely where wind farms might be constructed within the WDZs and, therefore, cannot address whether those features would be of concern to a specific wind farm action. Further, it is estimated that only 20 to 30 percent of any WDZ would actually be included within wind farms and the nature of wind farms is that large areas are required, but only relatively small areas are physically impacted. As a result, wind farm design would be expected to have flexibility on where roads and facilities were placed and what locations, specifically those with environmental concerns, could be avoided. Because of these factors, DOE has not identified potential surface water impacts for individual WDZs; rather the discussion that follows provides more detail on the typical impacts that would be expected from the construction of wind farms within any of the WDZs.

3.15.6.8.1.1.1 Potential for Surface Water Contamination

Construction of even one large wind turbine would involve land disturbance of more than 1 acre (BLM 2005), which is the trigger in both Oklahoma and Texas for requiring a construction general permit for stormwater discharges under the EPA NPDES program as implemented by each state. Accordingly, construction of a wind farm in either state would be subject to the requirements of a construction general permit and the standard permit provisions described in Section 3.15.6.1.2. The future wind farm developer would be required to prepare and implement a SWPPP, which would in turn act to prevent surface water contamination by requiring actions to prevent contaminant releases, including sediment-laden runoff. If a wind farm construction action were to require setup of a temporary concrete batch plant, its operation would also be subject to permit requirements.

Wind farm construction activities could involve foundation depths up to 40 feet if pier foundations are used, but the often-used mat foundations, while requiring more land area, generally do not require excavations of more than 10 feet in depth (DOE 2013). As shown by the water table depths in Table 3.7-23, construction of pier foundations in WDZs in Beaver County, Oklahoma, or in Ochiltree County, Texas, could encounter groundwater, but construction would be unlikely to reach groundwater in the other counties. Construction of mat foundations would be unlikely to encounter groundwater in any of the WDZs. As described in Section 3.15.6.1.2 for the Project, were it necessary to pump groundwater from excavations or boreholes to complete foundation construction, water would likely be discharged to vegetated areas through flow control devices or in some other manner approved by the regulatory agency. Also, excavation of deep foundations could involve additives such as drilling muds or bentonite to help stabilize excavation or borehole walls. These materials would also have to be disposed in accordance with applicable federal, state, and local regulations.

With the wind farm development elements described above, it is expected that construction of the connected action would involve the same minor potential for surface water contamination impacts as described in Section 3.15.6.1.1 for general construction under the Project.

3.15.6.8.1.1.2 Changes to Runoff Rates

As described in Section 3.15.6.1.2 for the Project, soils at connected action construction sites would be broken up, loosened, and stockpiled for some period of time during which such soils would have lower stormwater runoff rates than undisturbed soils. Similarly, soil in some areas could be compacted to improve its stability or simply from equipment traffic and have higher runoff rates as a result. However, such conditions would be expected to be relatively short term, with most soils being restored to a pre-disturbance condition once foundations and structures were in place. Also, disturbed areas would be relatively small in comparison to surrounding areas not disturbed by the connected action; it is estimated that the footprint of all wind farm facilities and structures, including access roads, would be no more than 5 to 10 percent of the total wind farm area (BLM 2005) and could be as low as 1 to 3 percent of the total area (DOE 2013). The total area disturbed during construction would be higher, but the relatively small and short-term changes in runoff rates would not be expected to result in any noticeable changes in the area's existing drainage systems or surface waters.

3.15.6.8.1.1.3 Direct Impacts or Disturbances to Surface Water or Drainage Channels

Since wind farm developments require relatively small amounts of dedicated land (or restated, there are large areas of unused land between individual wind turbines), developers would have the ability to avoid small drainage channels in positioning wind turbines. As a matter of reducing costs and protecting valuable equipment, it is assumed developers would want to avoid locating wind turbines or support facilities in large channels or surface waters, unless for some reason channel relocation was a viable option.

Similar to what was described in Section 3.15.6.1.3 for the construction impacts under the Project, the components of a wind farm most likely to result in disturbance of drainage features would be the access roads. It is reasonable to assume that wind farm developers would want to avoid crossing drainage channels to the extent practicable simply to avoid the associated issues (e.g., risks to equipment, difficulty in maintaining long-term access, potential for added regulatory requirements, and other issues that could add to project costs in the long-term), but in some cases options may be limited. It is also reasonable to assume that wind farm developers would establish some criteria for the manner in which drainage channels would be crossed such as those identified by the Applicant and described in Section 3.15.6.1.3. Also as described in that section, the impacts from putting access roads across drainage channels would depend on the nature of the drainage feature and the type of crossing used. Streams or other surface waters already identified as impaired or designated to be of special value would require more elaborate and protective crossing methods if they could not be avoided.

3.15.6.8.1.1.4 Effects on Water Availability

Water would be needed to support construction of the connected action wind farms. Primary water needs would include use for soil compaction during road, substation, and wind turbine foundation construction; as a component of concrete; and for dust suppression. As shown in Table 3.7-26, the vast majority of water used in the six-county area of the WDZs comes from groundwater. Accordingly, it is assumed that a great majority, if not all, of the water needed to support construction of the connected action wind farms would be from groundwater sources, so the availability of surface waters would not be directly impacted.

Section 3.7.6.8.1 describes the basis for estimating a peak average water demand of about 0.54 million gallons per day for wind farm construction. As described in that section, this water demand would be spread over the 12 WDZs. At any given time, the water demand could be focused in a small number of the zones, but over time the average in any single zone would be expected to be only a fraction of the 0.54 million gallons per day. Although this water demand is only a small portion (0.07 percent) of the total water used in the six-county area in which the WDZs are located, it represents more than one-fifth of the same area's surface water usage. These values highlight the disparity of groundwater usage over surface water usage in the six-county region and the high effects on surface water availability that would be expected if a large portion of the water demand for wind farm construction were to come from surface water. In some situations, heavy groundwater usage can have indirect impacts on surface water by such effects as decreasing spring flows or increasing the portion of surface flow that is lost to infiltration. However, the amount of water that would be needed to support wind farm construction actions would represent such a small portion of the amount of groundwater already used in the area that it would not be expected to result in noticeable changes to existing interrelationships between surface waters and groundwater of the region.

3.15.6.8.1.2 Operations and Maintenance Impacts

Compared to pre-wind farm conditions, long-term operations and maintenance of wind farms in any one of the WDZs would only result in minor changes to stormwater runoff and drainage. As noted in Section 3.15.6.8.1, the footprint of all long-term wind farm facilities and structures would likely be approximately 1 percent of the total wind farm area. Much of this footprint would be expected to be relatively impervious to water and, therefore, involve increased runoff. However, the nature of a wind farm is that the footprint of built-up facilities would be reasonably well dispersed over its entire area. For example, an access road, substation, and control building, if collocated, would likely represent the largest single footprint of built-up area and the wind turbine locations would always be widely dispersed. Added runoff from these dispersed impervious areas would be small and easily managed in the semiarid climate of the Oklahoma and Texas Panhandle regions and would not be expected to cause adverse impacts to existing surface waters.

Operations and maintenance of wind farm facilities would not impact surface water. During operations and maintenance, no notable sources of contaminants would be in use other than the typical fuels and lubricants found in vehicles and equipment, additional stormwater runoff from built-up areas would be dispersed and minor, and water needs would be limited to personal needs of the workers operating and maintaining the wind farm facilities and equipment.

3.15.6.8.1.3 Decommissioning Impacts

Decommissioning of wind farms would be expected to have impacts similar to those described in Section 3.15.6.8.1 and in more detail in Section 3.15.6.1 for common construction activities, i.e., measures would be required to manage the fuel and lubricants that would be present in equipment in a manner protective of stormwater runoff that could then reach surface waters away from the construction sites. Water demand during decommissioning would be limited to that needed for actions such as dust suppression, soil compaction, and possibly re-seeding or landscaping to put the ground back into suitable condition. Water demand would be less than for construction, would likely come from groundwater, and would not adversely impact surface water resources.

3.15.6.8.2 Optima Substation

Surface water impacts from construction of the future Optima substation would be the same as described in Section 3.15.6.2.1 for the Oklahoma Converter Station and AC Interconnection Siting Areas and the common construction impacts described in Section 3.15.6.1. There are few intermittent streams and no perennial streams or major waterbodies in the area proposed for the substation. Impacts during operation and maintenance would be expected to be similar to those described for the Oklahoma Converter Station and AC Interconnection Siting Areas in Section 3.15.6.2.1.1.

3.15.6.8.3 TVA Upgrades

Surface water impacts of concern for the required TVA upgrades, like the Project, are associated with the potential for runoff and receiving water contamination, changes to runoff rates, disturbances to surface water or drainage channels, and effects on water availability as described in Section 3.15.6.1.1. These potential impacts would be limited primarily to the construction phase of the required upgrades and, accordingly, to the construction of a new transmission line.

TVA has indicated that new TVA transmission lines constructed over the last decade have had an average of 3.4 stream crossings per mile of new line. An average of 1.2 stream crossings per mile were forested stream crossings, where forest occurred on one or both affected stream banks. Construction of the new transmission line would be expected to involve the same potential contaminants (primarily fuels and lubricants in equipment) as the Project during construction and implementation of the same type of measures to ensure those contaminants were not released. The construction would be expected to involve relatively minor changes to runoff rates and, to minimize liability and costs, TVA would take precautions to minimize disturbances to surface water and drainage features. Water needs for dust suppression, soil compaction, equipment cleaning, and concrete formulation would be relatively minor and short term. There would be little potential for impacts to surface water during upgrades involving modifications to existing facilities. A possible exception would be if replacement of structures was required as part of the upgrades to existing transmission lines. These type activities could involve new ground disturbances and potential for impacts to surface water similar to those described for typical construction. Operational impacts would be similar to those described above for the Project transmission lines.

3.15.6.9 Impacts Associated with the No Action Alternative

Under the No Action Alternative, DOE assumes for analytical purposes that the Project would not be constructed. Surface water conditions would remain as described in the affected environment descriptions of Section 3.15.5.

Contents

Tables

Figures Presented in Appendix A

3.16 Transportation

This section includes evaluation of existing roadways, railroads, river navigation, and airports/airstrips within the ROI and an evaluation of the potential impacts from specific Project components on transportation amenities. Local bus and emergency routes would be addressed in the more detailed, location-specific Transportation and Traffic Management Plan (see Section 3.16.6.1.2) to be developed prior to construction. Bus and emergency routes are not expected to be prevalent in the Project ROI because the Project traverses areas that are predominantly rural and that have low population densities. Bus and emergency routes are therefore not specifically identified in the affected environment section but are addressed qualitatively in the impacts section.

3.16.1 Regulatory Background

A variety of federal, state, and local agencies administer and regulate roadways and railways. The American Association of State Highway and Transportation Officials (AASHTO) sets standards for construction and operation of interstate and U.S. highways, which are regulated by the FHWA. State departments of transportation are responsible for state highways and routes. County and local roads are controlled by the presiding jurisdiction (cities, counties). Other roads on federal lands are managed by the applicable federal agencies (such as USFS or USACE). Railroad operations are regulated primarily by state commissions. State transportation agencies in the ROI include the Oklahoma Department of Transportation (OKDOT), the Arkansas State Highway and Transportation Department, the Texas Department of Motor Vehicles, the Texas DOT (TXDOT), and the Tennessee DOT (TNDOT). Table 3.16-1 provides a summary of regulatory entities and requirements associated with transportation resources in the area of the Project.

Table 3.16-1:
Regulatory Requirements and Authority Associated with Transportation Resources

Regulatory Entity or Requirement	Key Elements
Roadways	
Encroachment or ROW Permits	Cities, counties, and other public agencies typically require an encroachment permit or similar authorization from the applicable jurisdictional agency at locations where road construction activities would occur within or above the public road ROW. A utility permit (ROW permit or encroachment permit) for state and federal highways must be obtained from the OKDOT for all crossings or encroachment on such highways in Oklahoma, the Arkansas State Highway and Transportation Department, the TXDOT (utility installation request); and the TNDOT Right-of-Way Division Utilities Office. These roadway use permits or similar road use agreements/documents stipulate the party responsible for the repair of damage to roadways and structures caused by a project. The Applicant or its construction contractor must visually document road conditions before and after construction phase and repair road to conditions before construction started or as directed by the applicable state DOT and/or local departments of public works.
Design standards, specifications, and guidelines for roadways (interstate and U.S. highways)	In general, AASHTO and the FHWA define nationwide design standards, specifications, and guidelines for roadways (interstate and U.S. highways) to be used for design and traffic control of roadways. The specific requirements of the permit from the applicable transportation agency are individually determined based on Project and jurisdiction specifics. Permits issued by state and local jurisdictions may include the following requirements: • Identify all roadway locations where special construction techniques such as night construction would be used to minimize impacts to traffic flow. • Develop circulation and detour plans to minimize impacts to local street circulation, which may include the use of signing and flagging to guide vehicles through and/or around the construction zone. • Schedule truck trips outside of peak morning and evening commute hours.

Table 3.16-1:
Regulatory Requirements and Authority Associated with Transportation Resources

Regulatory Entity or Requirement	Key Elements
	• Limit lane closures during peak hours to the extent possible. • Install temporary traffic control devices as specified in the Manual of Uniform Traffic Control Devices for Streets and Highways (FHWA 2009). • Store construction materials only in designated areas.
Oversize and Overweight Permits	Oversize and overweight permits must be obtained from the Oklahoma Department of Public Safety (http://www.dps.state.ok.us/swp/) for roadway travel in Oklahoma, the Arkansas State Highway and Transportation Department (http://www.arkansashighways.com/) for roadway travel in Arkansas, the Texas Department of Motor Vehicles (http://www.txdmv.gov/), and the TNDOT (www.tdot.state.tn.us/). Truck load limits are presented below. Truck Weight and Size Specifications for Oversize/Overweight Vehicles (Texas, Oklahoma, Arkansas, Tennessee) Vehicle Parameters — Specifications Gross Weight — 80,000 pounds for gross vehicle weight 20,000 pounds for single axle weight 34,000 pounds for tandem axle weight[1] Length — 90 feet Width — 8 feet 6 inches Height — 13 feet, 6 inches[2] 1 The tandem axle weight limit is 40,000 pounds in Oklahoma. 2 The height limit is 14 feet in Texas. Sources: AHTD (2011), OKDPS (2014), TNDOT (2003), TXDMV (2014)
National Scenic Byways Program (23 USC § 162) through the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) (Public Law 102-240)	The FHWA is responsible for administering the National Scenic Byways Program (23 USC § 162) through the ISTEA (Public Law 102-240). A scenic byway is a public road with special scenic, historic, recreational, cultural, archaeological, and/or natural qualities that have been recognized as such through legislation or official declaration. ROW acquisition would also be necessary for the crossing of roads that are designated as scenic byways. Federal regulations governing utility use/crossings of a highway ROW note that "[u]tilities provide an essential public service to the general public. Traditionally, as a matter of sound economic public policy and law, utilities have used public road right-of-way for transmitting and distributing their services." 23 CFR 645.209(a). Historic Route 66, Cherokee Hills Byway, Crowley's Ridge Parkway, and the Great River Road National Scenic Byways are crossed by Proposed or Alternative Routes. Additional discussion of scenic byways is included in Section 3.12.
Arkansas Scenic Highways	Arkansas has designated numerous scenic highways through legislative acts that provide a means to further administer and finance such roadways by the Arkansas State Highway and Transportation Department (AHTD 2011). Many of these highways are submitted for consideration as a federal scenic byway. Numerous scenic highways are crossed by the Applicant Proposed Route or HVDC alternative routes. However, additional requirements in terms of traffic controls, ROW acquisition, and heavy vehicle permitting are not indicated beyond what is required for other State highways. Additional discussion of Arkansas scenic highways is included in Section 3.12.
Railroads	
Railroad Operation and Operators	The Oklahoma Corporation Commission Transportation Division, the Arkansas Public Service Commission, and the TNDOT Rail Safety/Regulatory Unit (partners with the Federal Railroad Administration to enforce federal law) oversee railroad operations and operators in their respective states. These entities make public decisions involving railroad safety matters. Specific procedures and standards apply in each state for shared corridor operations and modifications of at-grade crossing. The TXDOT Railroad Division coordinates project development for any projects that affect railroad right-of-way in the state. The Federal Railroad Administration (FRA) was created by the DOT Act of 1966 and its mission is to enable the safe, reliable, and efficient movement of people and goods (FRA 2014).

Table 3.16-1:
Regulatory Requirements and Authority Associated with Transportation Resources

Regulatory Entity or Requirement	Key Elements
NESC (IEEESA 2012)	The NESC (IEEESA 2012) sets policies for practical safeguarding of persons during the installation, operation, or maintenance of electric supply and communication lines and associated equipment. Any railroad/overhead utility crossing interaction would conform to NESC requirements and applicable code requirements. Key requirements include the following four items: 1. Poles or other structures supporting power must be 50 feet from the centerline of main running tracks, centralized traffic control sidings and heavy tonnage spurs. Pole location adjacent to industry tracks must provide at least a 30-foot clearance from the centerline of track when measured at right angles. If located adjacent to curved track, then said clearance must be increased at the rate of 1.5 inches per degree of curved track. 2. Regardless of the voltage, un-guyed poles must be located a minimum distance from the centerline of any track equal to the height of the pole above the ground line plus 10 feet. If guying is required, the guys must be placed in such a manner as to keep the pole from leaning or falling in the direction of the tracks. 3. High voltage poles and structures (345kV and higher) must be located outside the railroad ROW. 4. Crossings must not be installed under or within 500 feet from the end of any railroad bridge or 300 feet from the centerline of any culvert or switch area.
National Transportation Safety Board (NTSB) Office of Railroad, Pipeline and Hazardous Materials	The National Transportation Safety Board (NTSB) Office of Railroad, Pipeline and Hazardous Materials Investigations investigates accidents involving railroads, oil and gas pipelines, and the transportation of hazardous materials (NTSB 2014). On the basis of the investigations conducted by this Office, the NTSB issues safety recommendations to federal and state regulatory agencies, industry and safety standards organizations, carriers and pipeline operators, equipment and container manufacturers, producers and shippers of hazardous materials, and emergency response organizations. The railroad division has the responsibility for railroad accident investigations involving passenger railroads, freight railroads, commuter rail transit systems and other transportation systems operating on a fixed guideway. These accidents typically involve collisions or derailments; some of these accidents lead to the release of hazardous materials.
River Navigation[1]	
USACE Memphis District	The USACE Memphis District is mandated by Congress to keep the Mississippi River open for commercial navigation by obtaining and maintaining a 9-foot-deep and 300-foot-wide channel. About 175 million tons of cargo are transported by barge through the Memphis District's reach (355 miles) of the river each year. The Memphis District is also responsible for maintenance dredging of 10 harbors on the Mississippi River. These harbors serve as vital links to rail and highway transportation systems in the region, helping to deliver products and commodities to and from global markets.
USACE Tulsa District	The USACE Tulsa District is mandated by Congress to keep the McClellan-Kerr Arkansas River Navigation System open for commercial navigation. The system crosses the state of Arkansas into Oklahoma traversing the state until it reaches the confluence of the Arkansas and Verdigris River where the navigation channel follows the Verdigris River terminating 51 miles upstream at the Port of Catoosa, near Tulsa, Oklahoma. The Tulsa District maintains a minimum 9-foot-deep and 250-foot wide channel along the Arkansas River.
Airports and Navigation Aids	
FAA Review Requirements (14 CFR 77.9)	Airports require clear zones for aviation safety. Clear zones vary according to airport activity and the types of aircraft operating at a particular airport. Large airports and military facilities have more extensive requirements than smaller airports and smaller landing strips. Clear zone requirements typically involve a three-dimensional space free of aviation obstacles. In some areas, guy wires, towers, transmission lines, tall buildings, and other possible aviation hazards are marked, lighted, and/or charted based on Federal Aviation Administration (FAA) requirements. FAA requirements also cover an airport's radar, flight control instruments, flight paths, and other fundamental aspects of airport operations and safety. Standards are applied along with customization to address actual conditions at individual airports. Locations where potential air space obstruction hazards would be constructed may require submittal of a Notice of Proposed Construction or Alteration to the FAA based on criteria contained in 14 CFR Part 77, Safe, Efficient Use, and Preservation of the Navigable Airspace. Overhead transmission lines and their

Table 3.16-1:
Regulatory Requirements and Authority Associated with Transportation Resources

Regulatory Entity or Requirement	Key Elements

	supporting structures are subject to these requirements (FAA 2014a). Pursuant to 17 CFR 77.9, any person/organization who intends to sponsor any of the following construction or alterations must file notice with the FAA:
	• Any construction or alteration exceeding 200 feet above ground level
	• Any construction or alteration:
	    o Within 20,000 feet of a public use or military airport which exceeds a 100:1 surface from any point on the runway of each airport with at least one runway more than 3,200 feet
	    o Within 10,000 feet of a public use or military airport which exceeds a 50:1 surface from any point on the runway of each airport with its longest runway no more than 3,200 feet
	    o Within 5,000 feet of a public use heliport which exceeds a 25:1 surface
	• Any highway, railroad or other traverse way whose prescribed adjusted height would exceed the above-noted standards
	• Any construction or alteration located on a public use airport or heliport regardless of height or location
	
	Other FAA requirements for notification include non-height related criteria such as proximity to a navigation facility, encroachment on the airport property, and emission of potential interference frequencies. The FAA notification criteria evaluation tool is available at the following link: https://oeaaa.faa.gov/oeaaa/external/gisTools/gisAction.jsp?action=showNoNoticeRequiredToolForm.

FAA Requirements—Landing Strips and Other Aviation Purposes (14 CFR Part 157)	The applicable FAA regulation for landing strips for agricultural and other aviation purposes is 14 CFR Part 157. These airports may or may not be shown on the FAA sectional charts.
FAA Requirements—Federal Aviation Act of 1958 (Public Law 85-726) (14 CFR Part 77)	Additional requirements are applicable at military sites and within military operating areas and military training routes. Unlike public airports, military operations often include large areas surrounding their airports and operations for testing, training, and other purposes well beyond the military airport areas' landing and takeoff boundaries. These areas are given special airspace designations linked to corresponding military operations. A Section 1101 Air Space Permit is required for air space construction clearance according to the Federal Aviation Act of 1958 (Public Law 85-726) (14 CFR Part 77). The Applicant will address any identified operations and safety issues near military airports that may create unresolved conflicts in military airspace operating areas. Incorporation of design features and implementation of BMPs are expected to lessen the extent of the safety issues to permissible levels. If not, it is currently assumed that any routes with irresolvable issues related to airports or airspace will require additional mitigation to be applied, including the possibility of suggested reroutes.
FAA Navigation Aids	Air navigation aid facilities are used for various purposes including assistance for pilot navigation. An automatic direction finder uses non-directional beacons (NDBs) on the ground to drive a display that shows the direction of the beacon from the aircraft. NDBs continue to be used as a common form of navigation in some areas with relatively few other navigational aids. Very high frequency omnidirectional range (VOR) is a more sophisticated system, and is still the primary air navigation system established for aircraft flying under instrument flight rules (IFR). Air navigation facilities have varied owners and operators including the FAA, the military services, private organizations, individual states and foreign governments. The FAA has the statutory authority via the Federal Aviation Act of 1958 to establish, operate, and maintain air navigation facilities and to prescribe standards for the operation of any of these aids which are used for instrument flight in federally controlled airspace (FAA 2014b). If large structures are in the immediate proximity of these navigation facilities, there is a potential to interfere with the ability of the facilities to transmit signals.

1 USACE river navigation requirements are also addressed in Section 3.15.

3.16.2 Data Sources

The data sources used to analyze transportation resources are described below:

- Data sources used to analyze transportation amenities for the ROI include data for major roads, public roads, roadways, and railroads (GIS Data Sources: BTS 2013; TXDOT 2013; CSA 2007; AHDT 2006a; USCB 2000).
- Annual average daily traffic (AADT) counts for points along roadways within ROIs were obtained from Clean Line (2013, 2014). These AADTs originated from the OKDOT 2012 AADT estimates (OKDOT 2012), the AHDT 2012 AADT (Annual Average Daily Traffic) estimates (AHTD 2012), the TNDOT 2012 AADT estimates (TNDOT 2012), and the TXDOT 2012 AADT estimates (TXDOT 2012).
- A traffic analysis was performed to assess potential traffic impacts during construction of the Project. Detailed data and analysis tables are provided in *Traffic Technical Report for the Plains & Eastern Clean Line* and supplement to the *Traffic Technical Report* (Clean Line 2013).
- The data sources for airports and airstrips (also referred to as airfields) are the Bureau of Transportation Statistics and GIS shape files provided by Clean Line, respectively (GIS Data Sources: BTS 2013a; Clean Line 2013b).
- The data source for navigation aids is FAA's National Flight Database (FAA 2014b).

3.16.3 Region of Influence

3.16.3.1 Region of Influence for the Project

The ROI used to define and evaluate roadway transportation resources and the effects of the Project is a 6-mile area around the Project components. For the transmission line corridors, the 6-mile-wide area extends from each side of the centerline of the Applicant Proposed Route, HVDC alternative routes, and the AC collection system routes (12 miles wide in total). This area defines the ROI surrounding the converter station and AC interconnection siting areas and ensures that local interstate highways, U.S. highways, state highways, and local roads were included in the overall impact evaluation and that the major types of public roadways that may be directly impacted by Project vehicles would be included in the traffic analysis.

Railroads were identified based on the potential encroachment within the ROI defined above. Encroachment refers to areas where railroads and railroad ROWs might be affected because the Project would cross the railroad ROW or be located in close proximity to the Project.

Airports, airstrips, and navigational aids were identified in a 4-mile-wide corridor from the HVDC transmission line and AC collection system transmission line centerlines. A distance of 4 miles is consistent with the FAA safety requirements discussed in Section 3.16.1. Specific mileage from centerlines is also provided as an indicator of the strength and likelihood of potential effects to airports, airstrips, and navigational aids.

Several route variations to the Applicant Proposed Route in Regions 2–7 were developed in response to public comments on the Draft EIS and are described in Appendix M and summarized in Sections 2.4.2.1–2.4.2.7. Assessments of the impacts related to the route variations by Project region, including accompanying HVDC alternative route adjustments, are provided below. The variations are presented graphically in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route and transportation resources would remain consistent within the ROI.

3.16.3.2 Region of Influence for Connected Actions

3.16.3.2.1 Wind Energy Generation

The ROI for evaluation of existing traffic conditions is all public roadways within 6 miles of the AC collection system route centerlines, an area that includes 85 percent of the land area within each of the WDZs. Traffic counts also were evaluated for major highways in an area approximately 12 miles around the WDZs because the WDZs are located in a rural area with low population densities. The WDZs and surrounding communities include rural areas of Oklahoma, Texas, and Kansas. The ROI in the WDZs includes Cimarron and Beaver counties in Texas and Oklahoma, respectively; Sherman, Hansford, and Ochiltree counties in Texas; and southern portions of Baca and Morton counties in Kansas.

3.16.3.2.2 Optima Substation

The transportation ROI for the future Optima Substation includes a 6-mile area surrounding the 160-acre site (Section 3.1), and is entirely included within the Project ROI for Region 1.

3.16.3.2.3 TVA Upgrades

The ROI for the direct assignment facilities (which are included in the Applicant Proposed Project) would occur within the Tennessee Converter Station Siting Area and more specifically within the Shelby Substation. The ROI for the network upgrades, and in particular TVA's future 500kV transmission line, cannot be fully determined at this time. The new 500kV line would be in western Tennessee. The upgrades to existing facilities would mostly be in western and central Tennessee. Upgrades to existing infrastructure would include upgrading terminal equipment at three existing 500kV substations and six existing 161kV substations; making appropriate upgrades to increase heights on 16 existing 161kV transmission lines to increase line ratings, and replacing the conductors on eight existing 161kV transmission lines.

3.16.4 Affected Environment

Several route variations to the Applicant Proposed Route in Regions 2–7 were developed in response to public comments on the Draft EIS and are described in Appendix M and summarized in Sections 2.4.2.1–2.4.2.7. Comparisons in affected environment between the Applicant Proposed Route and the route variations by Project region, including accompanying HVDC alternative route adjustments, are provided below. The variations are presented graphically in Exhibit 1 of Appendix M.

3.16.4.1 Roadways

The roadway network in the ROI includes interstate highways, U.S. highways, state highways, and local roads. Public roadways are classified into Class I two-lane highways, Class II two-lane highways, basic freeway segments, and multi-lane highways as defined below. Class I two-lane highways are highways on which motorists expect to travel at relatively high speeds. These highways are major intercity routes, primary connectors of major traffic generators, daily commuter routes, or major links in state or national highway networks. The roadways serve mostly long-distance trips or provide the connections between facilities that serve long-distance trips (TRB 2010).

Class II two-lane highways are highways where motorists do not necessarily expect to travel at high speeds. These highways function as access routes to Class I highways, serve as scenic or recreational routes (not primary arterials), or pass through rugged terrain where high-speed operation is not possible. These roadways most often serve relatively short trips.

Basic freeway segments are roadway segments outside the influence area of traffic merging and lane-changing caused by the presence of on-ramps and off-ramps.

Multi-lane highways have four to six lanes (including both directions) and posted speed limits that range from 40 to 65 miles per hour. They may be divided by medians, may be undivided, or may have a two-way left turn lane. These roadways are typically located in suburban areas leading to central cities or along high-volume rural corridors connecting two cities or two activity centers that generate a substantial number of daily trips.

The affected environment includes major roadways within the ROI and available information on the existing roadway level of service (LOS), a measure of the quality of service of a roadway. There are six letter designations of LOS from A to F, with LOS-A (free traffic flow with little delay) representing the best roadway operating conditions and LOS F (roadway congestion with long delays) representing the worst operating conditions (TRB 2010). The acceptable LOS for a roadway varies as defined by the federal, state, county, or local agency with jurisdiction over the roadway. According to AASHTO, a LOS-C or better is considered acceptable on rural roadways (AASHTO 2011). Within urban areas, LOS-D generally is considered the minimum acceptable LOS (AASHTO 2011). States have individual requirements and thresholds or criteria regarding decreases in LOS that might trigger the necessity for road capacity improvements for Project construction activities.

General characterization of the current LOS on existing roadways was performed in the Traffic Analysis (Clean Line 2014) for the Project and is summarized in Section 3.16.5. Overall, public roadways in the Project ROI currently operate at an acceptable LOS-C or better as depicted in Figures 3.16-1a through 1f (located in Appendix A). Exceptions are local street segments in Van Buren, Arkansas, in Region 4, and a local street in Searcy, Arkansas, in Region 5 that currently operate at LOS-D. Tables listing all the roadway segments, including local roadways, and related details (i.e., name, segment ID, class, and LOS) in the transportation ROI are provided in the *Traffic Technical Report* and supplement to the *Traffic Technical Report* (Clean Line 2013, 2014).

In addition to LOS, the roadway affected environment is presented in Section 3.16.5 in relation to state and federal roadway crossings and areas of potential ROW encroachment by region. Although the crossing of local and county roadways would also trigger permits, requirements for such crossings or encroachments are generally not as rigorous. The numerous crossings of local and county roadways by Project components are depicted in the maps included on Figure 1.0-2 in Appendix A.

3.16.4.1.1 Construction Haul Roads

Currently, it is anticipated that the materials necessary for construction of the Project would be shipped via major roadways including interstate highways, federal highways, and state highways. More specific haul routes would be identified in a Transportation and Traffic Management Plan. Because haul routes cannot be specifically identified by Project alternative at this point in the planning process, they are not used to further evaluate specific impacts. Once at the appropriate staging area, materials would be moved to designated locations along the HVDC transmission line and other Project components for assembly and installation via existing roads, overland routes, and temporary access roads. Access roads are discussed in Section 2.1.2.4. The road types and typical access road dimensions during construction and operations and maintenance are described in Table 2.1-7. The estimated length (by road type within each state) for access roads associated with HVDC and AC transmission lines (which includes those associated with the fiber optic regeneration sites) is provided in Tables 2.1-8 and 2.1-9, respectively.

The major roadways near each Project component and region are listed in Table 3.16-2. These roads could serve as haul routes during Project construction. The daily commuting routes for construction workers are expected to follow the same roads as the truck haul routes to the construction ROW or temporary staging areas for parking. Improvements to or closure of any roads, intersections, or bridges are not expected to be necessary to accommodate oversized truck deliveries to the Project components. However, if closures were necessary, their durations would be minimized as specified in Section 3.16.6.1.2, and closures would be conducted in accordance with a Transportation and Traffic Management Plan and appropriate state DOT requirements and procedures.

Table 3.16-2:
Potential Primary Haul Roads by Region

Project Region	Interstates/Turnpikes	U.S. Highways	State Highways	Local Roads
Region 1	Nearest: I-40	US-412, US-85, US-270, US-283, US-64, US-183	SH-136, SH-3, SH-23, SH-149, SH-34, SH-46	CR-202, CR-16, CR-14, CR-A
AC Collection System		US-54, US-83, US-412, US-287	SH-95, SH-3, SH-15, SH-207, SH-70, SH-23	CR-14
Oklahoma Converter Station		US-54, US-412	SH-136, SH-3	CR-33, CR-202, CR-282, CR-16
Region 2	Nearest: I-40, I-35	US-64, US-412, US-412, US-281, US-60, US-81	SH-50, SH-34, SH-15, SH-3, SH-45, SH-58, SH-51, SH-8, SH-132	None of particular note
Region 3	I-40, I-35, I-44, Muskogee Turnpike	US-81, US-64, US-177, US-75, US-266, US-63, Alt US-75, US-69, US-62	SH-74, SH-51, SH-18, SH-99, SH-33, SH-48, SH-66, SH-16, SH-72, SH-52, SH-10	None of particular note
Region 4	I-40, Muskogee Turnpike, I-540	US-64, US-59, US-71	SH-82, SH-101, SH-64B, SH-220, SH-22, SH-23, SH-352, SH-96, SH-103, SH-164	CR-76
Region 5	I-40	US-64, US-65, US-67, US-167	SH-7, SH-27, SH-124, SH-164, SH-247, SH-95, SH-9, SH-92, SH-287, SH-336, SH-25, SH-5, SH-36, SH-258, SH-157, SH-16, SH-337, SH-367	None of particular note
Arkansas Converter Station	I-40	US-64	SH-105, SH-124, SH-213, SH-213, SH-247, SH-95, SH-164, SH-7, SH-287, SH-9, SH-7	Buttermilk Road, St. Joe Road
Region 6	I-40, I-55	US-67, US-49, US-63	SH-14, SH-37, SH-18, SH-367, SH-214, SH-145, SH-149, SH-75, SH-163, SH-42	None of particular note
Region 7	I-40, I-55	US-63, US-61, US-51	SH-14, SH-149, SH-75, SH-140, SH-27, SH-178, SH-3, SH-51, SH-77, SH-204, SH-385	Mudville Road
Tennessee Converter Station	I-40, I-55	US-51	SH-385, SH-14, SH-3, SH-51	Mudville Road

GIS Data Sources: BTS (2013), TXDOT (2013), CSA (2007), AHTD (2006a), USCB (2000)

3.16.4.2 Railroads

Numerous railroads are located within the ROI as shown on Figures 3.16-1a through 3.16-1f in Appendix A. Railroads are more specifically discussed in Section 3.16.5 by region.

3.16.4.3 River Navigation

The Project crosses the Arkansas River between Oklahoma and Arkansas (Regions 3 and 4) and the Mississippi River between Arkansas and Tennessee (Region 7). A discussion of River Navigation is provided only for Regions 3, 4, and 7.

3.16.4.4 Airports and Navigational Aids

Airports and airstrips are shown on Figures 3.16-1a through 3.16-1f, in Appendix A and airports within the ROI are listed in Table 3.16-3. Fifty-two airports, airstrips, and heliports are located within the ROI including, 12 public airports, 13 private airports, 20 private airstrips, 3 public heliports, and 4 private heliports. These air travel facilities are more specifically discussed in Section 3.16.5 by region.

Table 3.16-3:
Airports and Airstrips within the ROI

Airport Name	County, State	Type	Private/ Public	Region	Route	Distance from Centerline (miles)
Hooker Municipal Airport	Texas County, OK	Airport	Public	1	AC Collection System Route NE-1	2.6
					AC Collection System Route NE-2	2.8
Guymon Municipal Airport	Texas County, OK	Airport	Public	1	AC Collection System Route NW-1	3.5
Laverne Municipal Airport	Harper County, OK	Airport	Public	1	AR 1-A	1.3
Steinert Lakes	Garfield County, OK	Airport	Private	2	AR 2-B	0.9
					APR	3.2
Okmulgee Regional Airport	Okmulgee County, OK	Airport	Public	3	AR 3-C	2.5
Jones Memorial	Creek County, OK	Airport	Public	3	AR 3-C	1.4
Bristow Hospital	Creek County, OK	Heliport	Public	3	AR 3-C	3.6
HSI	Lincoln County, OK	Heliport	Private	3	AR 3-C	0.3
					APR	0.6
Cushing Municipal Airport	Payne County, OK	Airport	Public	3	APR	0.8
					AR 3-C	2.0
Keefton Emergency Helicopter Service	Muskogee County, OK	Private Airfield	Private	3	APR	0.3
					AR 3-C, AR 3-D	1.5
					AR 3-E	2.3
Davis Field	Muskogee County, OK	Airport	Public	3	APR	3.5
Eagle Creek	Okmulgee County, OK	Airport	Private	3	APR	1.6
Ragwing Acres	Okmulgee County, OK	Airport	Private	3	APR	2.8
Neversweat	Creek County, OK	Airport	Private	3	APR	3.2
Richardson Regional—Campbell Road	Payne County, OK	Heliport	Private	3	APR	3.4
Cushing Regional Hospital	Payne County, OK	Heliport	Private	3	APR	2.5

Table 3.16-3:
Airports and Airstrips within the ROI

Airport Name	County, State	Type	Private/ Public	Region	Route	Distance from Centerline (miles)
Ozark-Franklin County	Franklin County, AR	Airport	Public	4	APR	0.6
					A 4-B	3.7
					AR 4-E	3.9
Crawford Memorial Hospital	Crawford County, AR	Heliport	Private	4	AR 4-C	3.9
Johnson Regional Medical Center	Johnson County, AR	Heliport	Public	4	AR 4-E	3.1
Hospital (unnamed)	Johnson County, AR	Heliport	Public	4	AR 4-E	1.3
					APR	4.0
Clarksville Municipal	Johnson County, AR	Airport	Public	4	AR 4-E	1.1
					APR	3.7
Neversweat Too	Sequoyah County, OK	Airport	Private	4	APR	3.4
Gustafson	Sequoyah County, OK	Airport	Private	4	APR	1.1
Landers Loop	Pope County, AR	Airport	Private	5	APR	2.3
					AR 5-A	2.9
Heifer Creek Ranch	Conway County, AR	Airport	Private	5	AR 5-B	2.8
Brown's	White County, AR	Airport	Private	5	AR 5-B, AR 5-E, AR 5-F	1.8
RAK	Faulkner County, AR	Airport	Private	5	AR 5-B, AR 5-E	2.3
McDonald's Strip	White County, AR	Airport	Private	5	AR 5-B, AR 5-E, AR 5-F	1.2
					APR	3.0
Unnamed	White County, AR	Private Airfield	Private	5	AR 5-B, AR 5-E, AR 5-F	0.5
					APR	3.9
Unnamed	White County, AR	Private Airfield	Private	5	AR 5-B, AR 5-E, AR 5-F	0.2
					APR	2.7
					AR 5-C	2.7
Unnamed	Jackson County, AR	Private Airfield	Private	6	APR	1.8
					AR 6-A	2.0
					AR 6-B	3.7
Unnamed	Jackson County, AR	Private Airfield	Private	6	APR	1.8
					AR 6-A	2.0
					AR 6-C	3.7
Unnamed	Poinsett County, AR	Private Airfield	Private	6	APR	1.5
					AR 6-A	1.5
					AR 6-C	2.2
Temporary Airstrip	Poinsett County, AR	Private Airfield	Private	6	AR 6-A	0.5
					APR	0.7
					AR 6-C	2.2
Unnamed	Poinsett County, AR	Private Airfield	Private	6	AR 6-C	1.3
					APR	1.5
					AR 6-A	2.4

Table 3.16-3:
Airports and Airstrips within the ROI

Airport Name	County, State	Type	Private/ Public	Region	Route	Distance from Centerline (miles)
Unnamed	Poinsett County, AR	Private Airfield	Private	6	APR	0.1
					AR 6-A	1.3
					AR 6-B	1.5
Unnamed	Poinsett County, AR	Private Airfield	Private	6	AR 6-B	1.1
					APR	1.4
					AR 6-A	3.4
Unnamed	Jackson County, AR	Private Airfield	Private	6	AR 6-B	1.2
					APR	2.2
					AR 6-A	4.0
Unnamed	Poinsett, AR	Private Airfield	Private	6	APR	2.4
					AR 6-B	2.5
					AR 6-A	3.9
Unnamed	Poinsett County, AR	Private Airfield	Private	6	APR	3.1
					AR 6-B	3.2
Unnamed	Jackson County, AR	Private Airfield	Private	6	AR 6-B	3.4
Unnamed	Poinsett County, AR	Private Airfield	Private	6	AR 6-C	0.7
					APR	1.3
Unnamed	Poinsett County, AR	Private Airfield	Private	6	AR 6-C	1.1
					APR	3.4
Unnamed	Poinsett County, AR	Private Airfield	Private	6	AR 6-C	1.8
					APR	3.2
Unnamed	Poinsett County, AR	Private Airfield	Private	6	AR 6-C	3.3
Unnamed	Poinsett County, AR	Private Airfield	Private	6	APR	3.2
Marked Tree Municipal Airport	Poinsett County, AR	Airport	Public	7	AR 7-A	1.1
					APR	2.9
Woodbridge Field	Poinsett County, AR	Airport	Private	7	AR 7-A	2.7
Unnamed	Tipton County, TN	Private Airfield	Private	7	AR 7-A	3.6
Millington Regional Jetport	Shelby County, TN	Airport	Public	7	APR	2.1
					AR 7-C, AR 7-D	2.1
					AR 7-B	2.3
Charles W. Baker	Shelby County, TN	Airport	Public	7	AR 7-C	3.5
Ray	Shelby County, TN	Airport	Private	7	AR 7-C, AR 7-D	0.4
Ray	Shelby County, TN	Airport	Private	7	Tennessee Converter Station Siting Area and AC Interconnection Tie	2.2

GIS Data Sources: BTS (2013), Clean Line (2013b)

Navigation aids within 4 miles of the HVDC transmission line centerlines are provided in Table 3.16-4. Navigation aids are only present in the ROI in Regions 3, 4 and 7.

Table 3.16-4:
Navigation Aids within the ROI

Facility	Owner	Region	Route	Distance From Centerline (miles)	Type of Facility/Status
CUH NDB Cushing	City of Cushing	3	AR 3-C	1.9	Nondirectional Radio Beacon/Operational Instrument Flight Rules
CUH NDB Cushing	City of Cushing	3	APR (Link 4)	2.6	Nondirectional Radio Beacon/Operational Instrument Flight Rules
OKM VOR/DME OKMULGEE	FAA	3	AR 3-C	0.8	VOR Distance Measuring Equipment/ Operational Instrument Flight Rules
OKM VOR/DME OKMULGEE	FAA	3	APR (Link 4)	3.0	VOR Distance Measuring Equipment/ Operational Instrument Flight Rules
MKO NDB Muskogee	City of Muskogee	3	APR (Link 6)	1.1	Nondirectional Radio Beacon/ Decommissioned
MKO NDB Muskogee	City of Muskogee	3	APR (Link 5)	1.1	Nondirectional Radio Beacon/ Decommissioned
MKO NDB Muskogee	City of Muskogee	3	AR 3-E	1.1	Nondirectional Radio Beacon/ Decommissioned
MKO NDB Muskogee	City of Muskogee	3	AR 3-C	1.8	Nondirectional Radio Beacon/ Decommissioned
MKO NDB Muskogee	City of Muskogee	3	AR 3-D	1.8	Nondirectional Radio Beacon/ Decommissioned
CZE NDB Clarksville	City of Clarksville	4	AR 4-E	1.35	Nondirectional Radio Beacon/Operational Instrument Flight Rules
CZE NDB Clarksville	City of Clarksville	4	APR (Link 9)	3.9	Nondirectional Radio Beacon/Operational Instrument Flight Rules
MIG NDB Millington	Memphis-Shelby County Airport	7	AR 7-C	3.4	Nondirectional Radio Beacon/Operational Instrument Flight Rules

Source: FAA (2014b)

3.16.5 Regional Description

3.16.5.1 Region 1

No route variations were proposed in Region 1.

3.16.5.1.1 Roadways

Region 1 is primarily rural; small towns are scattered throughout the ROI. Communities in or near the Region 1 ROI include Guymon, Hardesty, Beaver, and Laverne, Oklahoma. Major federal and state highways in the ROI for Region 1 include US-64, US-83, US-183, US-283, US-270, and US-412 and state highways (SH)-23, SH-34, SH-46, SH-94, SH-136, SH-149, and SH-207. The tables provided in the *Traffic Technical Report* and supplement to the *Traffic Technical Report* (Clean Line 2013, 2014) list local roads in the region. Major highways within the ROI for the Oklahoma converter station include SH-136 and SH-207. Major highways in ROI for the AC collection system routes include US-54, US-56, US-64, US-83, and US-412 and SH-15, SH-70, SH-94, SH-95, SH-136, SH-192, and SH-207. Average daily traffic counts (ADTC) are estimated at a maximum of 1,100 on state highways and a maximum of

4,800 for federal and joint federal/state roadways in Region 1 for 2012 (Clean Line 2013, 2014). The major highways, as well as the local roads, in the ROI currently operate at an acceptable average daily LOS-C or better.

3.16.5.1.2 Railroads

The Burlington Northern Santa Fe Railway (BNSF) railroad parallels US 54 in Texas County, Oklahoma, in the ROI in Region 1. A majority of the 13 AC collection system routes would require crossing the railroad. No other operational railroads are located in the ROI in Region 1.

3.16.5.1.3 Airports and Navigation Aids

Three public airports are located in the ROI in Region 1 (Table 3.16-3). Laverne Municipal Airport is located within 1.23 miles of the HVDC Alternative Route 1-A centerline. Hooker Municipal Airport is located 2.56 miles from the centerlines of AC Collection System Routes NE-1 and NE-2. Guymon Municipal Airport is located 3.47 miles from the centerline of AC Collection System Route NW-1. Navigation aids are not located within the ROI in Region 1.

3.16.5.2 Region 2

3.16.5.2.1 Roadways

Region 2 is mostly rural; the largest communities are the towns of Woodward and Fairview, Oklahoma. Major highways in the ROI include US-60/281, US-81, US-183, and US-412; and SH-8, SH-34, SH-34C, SH-50, SH-50B, SH-51, SH-51A, SH-58, SH-74E, SH-132, and SH-183. ADTC are estimated at a maximum of 7,000 on state highways and a maximum of 8,200 for federal and joint federal/state federal and joint federal/state roadways in Region 2 for 2012. Major and local roadways currently operate at an acceptable average daily LOS-B or better in the ROI (Clean Line 2013, 2014). The ROI for the two route variations proposed in Region 2 is generally the same as that of the original Applicant Proposed Route. The route variations are slightly farther from local roadways (see Exhibit 1 of Appendix M).

3.16.5.2.2 Railroads

Railroads in the ROI in Region 2 include (from west to east) the BNSF Railway, the Grainbelt Corporation Railroad, and the Union Pacific Railroad (UPRR). Railroads are located along US-412 in Woodward County, Oklahoma; in a rural region of Major County, Oklahoma; and along US-81 in Garfield County, Oklahoma. The ROI for the two route variations proposed in Region 2 is generally the same as that of the original Applicant Proposed Route. The route variations do not cross railroads.

3.16.5.2.3 Airports and Navigation Aids

One private airstrip, Steinert Lakes, is located within 1 mile from the centerlines of the Applicant Proposed Route and one HVDC alternative route. Navigation aids are not located within the ROI in Region 2. The ROI for the two route variations proposed in Region 2 is generally the same as that of the original Applicant Proposed Route. Link 1, Variation 1, is approximately 0.4 mile closer to one public airport and one private airfield.

3.16.5.3 Region 3

3.16.5.3.1 Roadways

Large communities in the ROI in Region 3 include Stillwater, Cushing, Drumright, and Muskogee. Major highways in the ROI include interstates I-35, I-40 and I-44; US-62, US-64, US- 69, US-75, US-77, US-177, and US-266; SH-10,

SH-16, SH-18, SH-33, SH-48, SH-51, SH-52, SH-56, SH-64, SH-66, SH-72, SH-74, SH-86, SH-99, SH-100, SH-105, SH-108, and SH-162; and the Muskogee Turnpike. ADTC are estimated at a maximum of 16,100 on state highways and a maximum of 19,300 for federal and joint federal/state roadways in Region 3 for 2012. I-35 had a maximum ADTC of 20,300 in 2012; and I-44 had a maximum ADTC of 25,900. Major and local roadways currently operate at an acceptable average daily LOS-C or better in Region 3 (Clean Line 2013, 2014). The ROI for the five route variations proposed in Region 3 is generally the same as that of the original Applicant Proposed Route. Links 1 and 2, Variation 1, is generally farther from local section line roadways (see Exhibit 1 of Appendix M).

3.16.5.3.2 Railroads

Railroads in the ROI in Region 3 include (from west to east) the Stillwater Central Railroad, the BNSF, and the UPRR (in Muskogee County, Oklahoma). The crossings are located near US-77 in Logan County, Oklahoma; near I-44 in Creek County, Oklahoma; near US-75 in Okmulgee County, Oklahoma; and near US-69 in Muskogee County, Oklahoma (or the town of Oktaha, Oklahoma). The ROI for the five route variations proposed in Region 3 is generally the same as that of the original Applicant Proposed Route. The route variations would not cross any railroads.

3.16.5.3.3 River Navigation

The USACE Tulsa District maintains navigation along the Arkansas River at the western Project crossing within Region 3. The ROI for the five route variations proposed in Region 3 is generally the same as that of the original Applicant Proposed Route. The route variations are not located in the vicinity of the Arkansas River crossing.

3.16.5.3.4 Airports and Navigation Aids

Airports and airstrips in the ROI in Region 3 include Cushing Municipal Airport, Jones Memorial, Neversweat airstrip, Ragwind Acres airstrip, Eagle Creek airstrip, Okmulgee Regional Airport, and Davis Field. Heliports in the ROI include Richardson Regional Airport, Bristow Hospital, HSI, Cushing Regional Hospital, and Keefton Emergency Helicopter Service. Link 1, Variation 2, is not located within 1 mile of any airports or airstrips. Link 1 and 2, Variation 1, is located within 1 mile of a private airstrip. One public airport and three private airports and heliports are located in the ROI for Link 4, Variation 1. There is one public airport located in the ROI for Link 5 Variation 2, and this route variation is approximately 0.4 mile closer to this public airport than the original Applicant Proposed Route. Two operational navigation aid facilities are located in the Region 3 ROI including Cushing Non-directional Radio Beacon (CUH NDB) and Okmulgee VHF (very high frequency) Navigational Facility/UHF (ultra high frequency) Standard Distance Measuring Equipment (OKM VOR/DME). One decommissioned navigation facility—Muskogee Non-directional Radio Beacon (MKO NDB)—is located in the ROI.

3.16.5.4 Region 4

3.16.5.4.1 Roadways

Large communities in Region 4 include Sullisaw, Fort Smith, and Clarksville. Major highways in the region include these interstates: I-40 and I-540; US-59, US-60, US- 64, and US-71; SH-10, SH-21, SH-23, SH-59, SH-60, SH-71, SH-82, SH-96, SH-100, SH-101, SH-103, SH-109, SH-123, SH-162, SH-164, SH-186, SH-194, SH-215, SH-219, SH-220, SH-252, SH-255, SH-282, SH-309, SH-315, SH-348, SH-352, SH-359, and SH-924. ADTC are estimated at a maximum of 3,500 on state highways and a maximum of 12,500 for federal and joint federal/state roadways in Region 4 for 2012. I-40 had a maximum ADTC of 40,000 in 2012 in the region and I-540 had a maximum ADTC of 22,000. All public roadways in the region currently operate at an acceptable LOS-C or better except for segments along Fayetteville Road and North Highway 59 in Van Buren, Arkansas, and a segment of nearby I-40 that currently operate at LOS-D. The ROI for the seven route variations proposed in Region 4 is generally the same as that of Applicant Proposed Route Links 3 and 6. Applicant Proposed Route, Link 4, Variation 3 is closer to local roadways (see Exhibit 1 of Appendix M).

3.16.5.4.2 Railroads

Railroads in the ROI in Region 4 include (from west to east) the Kansas City Southern Railroad, the UPRR (in Sequoyah County, Oklahoma), and the Arkansas & Missouri Railroad. The crossings are located near SH-10 in Muskogee County, Oklahoma (or near the town of Marble City in Sequoyah County, Oklahoma); near the town of Sallisaw in Sequoyah County, Oklahoma; near I-540 in Crawford County, Arkansas, and near the town of Mulberry in Crawford County, Arkansas. The ROI for the seven route variations proposed in Region 4 is generally the same as that of the original Applicant Proposed Route. The route variations would not cross any railroads.

3.16.5.4.3 River Navigation

The USACE Tulsa District maintains navigation along the Arkansas River at the eastern Project crossing within Region 4. The ROI for the seven route variations proposed in Region 4 is generally the same as that of the original Applicant Proposed Route. The route variations are not located in the vicinity of the Arkansas River crossing.

3.16.5.4.4 Airports and Navigation Aids

Airports and airstrips in the ROI in Region 4 include an unnamed airstrip near Neversweat Too airstrip, Gustafson airstrip, Ozark-Franklin County Airport, and Clarksville Municipal Airport. Heliports in the ROI include Johnson Regional Medical Center, an unnamed hospital near Clarksville, and Crawford Memorial Hospital. Ozark-Franklin County Airport is less than 1 mile from the Applicant Proposed Route and HVDC Alternative Route 4-B centerlines. One private airport/heliport is located in the ROI for Link 3, Variation 2. One private airstrip is located within 1 mile of the same route variation. One private airport/heliport is located in the ROI for Link 6, Variation 1, and the route variation is slightly closer (<0.1 mile) to the airport/heliport than the original Applicant Proposed Route. One operational navigation aid facility is located in the Region 4 ROI: Clarksville Non-directional Radio Beacon (CZE NDB).

3.16.5.5 Region 5

3.16.5.5.1 Roadways

The larger communities in or near the Region 5 ROI include Dover, Russelville, Damascus, Twin Groves, Greenbriar, Guy, Rose Bud, Heber Springs, and Branch, Arkansas. Major highways in Region 5 include US-65, US-67, US-167, and US-285; SH-5, SH-7, SH-9, SH-14, SH-16, SH-17, SH-25, SH-27, SH-36, SH-87, SH-92, SH-95, SH-105, SH-107, SH-110, SH-124, SH-157, SH-164, SH-213, SH-224, SH-225, SH-247, SH-258, SH-287, SH-305, SH-310, SH-337, SH-356, and SH-367. The Arkansas convertor station and AC interconnect is located in Pope and Conway counties, Arkansas. Major highways in this area include I-40; US-64; and SH-95, SH-105, SH-124, SH-164, SH-213, SH-247, SH-326, and SH-363. ADTC are estimated to be maximums of 11,000 on state highways and 7,600 for federal and joint federal/state roadways in Region 5 for 2012. Public roadways in the region currently operate at an acceptable LOS-C or better except, for a segment along West Race Avenue in Searcy, Arkansas, and near US-67 that currently operates at LOS-D (Clean Line 2013, 2014). The ROI for the five route variations proposed in Region 5 is generally the same as that of the original Applicant Proposed Route. Link 7, Variation 1, is generally located closer to local roadways than the original Applicant Proposed Route (see Exhibit 1 of Appendix M).

3.16.5.5.2 Railroads

The UPRR is in the ROI in Region 5. The crossing is located near SH-367 in Jackson County, Arkansas. The ROI for the five route variations proposed in Region 5 is generally the same as that of the original Applicant Proposed Route. The route variations would not cross any railroads.

3.16.5.5.3 Airports and Navigation Aids

Airstrips in the ROI in Region 5 include Landers Loop airstrip, Heifer Creek Ranch airstrip, Rak airstrip, McDonald's airstrip, two unnamed airstrips, and Brown's airstrip. No public airports or heliports are located in the ROI. One unnamed private airfield is within 0.2 mile of all HVDC transmission line alternatives. One private airport/heliport is located in the ROI for Applicant Proposed Route Link 1, Variation 2. One private airport/heliport is located in the ROI for Applicant Proposed Route Links 3 and 4, Variation 2, and is approximately 0.2 mile farther from the airport/heliport. Navigation aids are not located within the ROI in Region 5.

3.16.5.6 Region 6

3.16.5.6.1 Roadways

Communities within the Region 6 ROI include Newport, Beedeville, Hickory Ridge, Harrisburg, Cherry Valley, and Marked Tree, Arkansas. Major highways in Region 6 include US-49, US-63, US-67; and SH-1, SH-14, SH-17, SH-18, SH-37, SH-42, SH-69, SH-75, SH-145, SH-149, SH-163, SH-193, SH-214, SH-224, SH-367, SH-373, SH-384, and SH-463. ADTC on state highways are estimated at a maximum of 12,000 and reach a maximum of 6,900 for federal and joint federal/state roadways in Region 6 for 2012. Major and local roadways currently operate at an acceptable average daily LOS-C or better in the Region 6 ROI (Clean Line 2013, 2014). The ROI for the single route variation proposed in Region 6 Link 2, Variation 1, is generally the same as that of the original Applicant Proposed Route (see Exhibit 1 of Appendix M).

3.16.5.6.2 Railroads

Railroads in the ROI in Region 6 include three segments of the UPRR. The crossings are located along US-49 in Poinsett County, Arkansas, and near SH-1 in Poinsett and Cross counties, Arkansas. The ROI for the single route variation proposed in Region 6, Link 2, Variation 1, is generally the same as that of the original Applicant Proposed Route. The route variation would not cross any railroads.

3.16.5.6.3 Airports and Navigation Aids

Numerous private airstrips occur in the ROI in Region 6. One private airstrip is 0.1 mile from the centerline of the Applicant Proposed Route; on private airfield is within 0.7 mile of the centerline of HVDC Alternative Route 6-C; and a temporary airstrip is within 0.7 mile of the centerlines of HVDC Alternative Route 6-A and the Applicant Proposed Route. No heliports or navigation aids are located within the ROI in Region 6. Two private airfields are in the ROI for Link 2, Variation 1, which is the same for the original Applicant Proposed Route Link 2.

The Walton Land Company private airstrip is located in Region 6 Applicant Proposed Route, Link 8, near the Region 7 border. DOE and the Applicant considered other route variations, but found no feasible alternative routes for the Project in this area. This airstrip was not previously identified in the Draft EIS.

A BMP has been added to Section 3.16.6.4 that states that the Applicant would perform mitigation to address Project structures in the vicinity of private airstrips. This BMP would require conducting specific flight plan analyses to determine whether interference with private airstrips can be avoided through micrositing within the 1,000-foot-wide corridor, to the extent practicable. If impacts are unavoidable, the Applicant would develop and implement mitigation measures and/or provide compensation in coordination with landowners. The Applicant would apply similar mitigation to private airstrips where Project structures would present a hazard within a 1:20 glide slope from each end of private airfields.

The Applicant has provided a ROW acquisition plan and a Code of Conduct for negotiations with landowners. A copy of this Code of Conduct can be found in comments submitted by the Applicant, which are included in Appendix Q. The Code of Conduct is also available on Clean Line's website at: http://www.plainsandeasterncleanline.com/site/page/code-of-conduct.

3.16.5.7 Region 7

3.16.5.7.1 Roadways

Communities in and near the Region 7 ROI include Marked Tree, Lepanto, Tyronza, Gilmore, and Osceola, Arkansas; and Munford, Gilt Edge, Millington, Atoka, Brighton, Bartlett, Memphis, Lakeland, and Arlington, Tennessee. Major highways in Region 7 include I-55; US-51, US-61, and US-63; and SH-14, SH-42, SH-75, SH-77, SH-87, SH-118, SH-119, SH-135, SH-140, SH-149, SH-181, SH-198, SH-239, SH-297, SH-308, SH-322, SH-385, and SH-463. The Tennessee Converter Station Siting Area and AC Interconnection Tie is located in Shelby County, Tennessee, where the major highways include US-51 and SH-385. ADTC are estimated at maximums of 11,000 on state highways and 23,634 for federal and joint federal/state roadways in the region. I-55 had a maximum ADTC of 19,000 in 2012 in Region 7 for 2012. Major and local roadways currently operate at an acceptable average daily LOS-C or better in the ROI (Clean Line 2013, 2014). The ROI for the three route variations proposed in Region 7 is generally the same as that of original Applicant Proposed Route. Link 1, Variation 1 would have the same general affected environment for roadways; Link 1, Variation 2, is generally located closer to area roadways (see Exhibit 1 of Appendix M); and Link 5, Variation 1, avoids an area of local roadways.

3.16.5.7.2 Railroads

Railroads in the ROI in Region 7 include (from west to east) the BNSF Railroad and the Canadian National Railroad. The crossings are located along US-63 in Poinsett County, Arkansas; along US-61 in Mississippi County, Arkansas; and near US-51 (or near SH-385) in Shelby and Tipton counties, Tennessee. The ROI for the three route variations proposed in Region 7 is generally the same as that of the original Applicant Proposed Route. The route variations would not cross any railroads.

3.16.5.7.3 River Navigation

The USACE Memphis District maintains navigation along the Mississippi River at the Project crossing within Region 7. The ROI for the three route variations proposed in Region 7 is generally the same as that of the original

Applicant Proposed Route. Link 1, Variation 2, located at the western area of the river crossing, would not cause any changes to the ROI in the vicinity of the Mississippi River crossing.

3.16.5.7.4 Airports and Navigation Aids

Airports and airstrips in the ROI in Region 7 include Marked Tree Municipal Airport, Woodbridge Field, an unnamed airstrip, Millington Regional Jetport, and Ray airport. The Marked Tree Municipal Airport is located 1 mile from the HVDC Alternative Route 7-A and Applicant Proposed Route. Ray, a private airstrip, is located 0.4 mile from the centerline of HVDC Alternative Route 7-C. No heliports are located in the ROI. One public airport and one private airport/heliport are located in the ROI for Applicant Proposed Route Link 5, Variation 1. The ROI for the original Applicant Proposed Route is generally the same in relation to the distances to airport facilities. One navigation aid facility is located in the Region 7 ROI: Millington Non-directional Radio Beacon (MIG NDB).

3.16.5.8 Connected Actions

3.16.5.8.1 Wind Energy Generation

3.16.5.8.1.1 Roadways

Table 3.16-5 provides AADT ranges for roadway segments, major highways, and communities in the ROI. Major highways in the ROI include US-56, SH-3 (Oklahoma), US-64, SH-51 (Kansas), US-54, SH-136 (Oklahoma), SH-15 (Texas), US-83, SH-70 (Texas), SH-23 (Oklahoma), and SH-95 (Oklahoma). Maximum ADTC counts in the ROI range from 400 adjacent to WDZ-G to 10,300 in WDZ-A for 2012 (Clean Line 2013, 2014). Major and local roadways currently operate at an acceptable average daily LOS-B or better in the ROI.

Table 3.16-5:
Connected Action—Roadways in WDZ and Wind Energy Generation ROI

WDZ	AADT (maximum for roadway segments in 2012)[1]	Major Federal and State Roadways	Communities
A	10,300	US-83, SH-15, SH-192, SH-143	Perryton, TX
B	2,000	SH-136, SH-207, SH-15, Hansford CR-278	Hardesty, OK
Adjacent to WDZ-B ROI[2]	1,850		Gruver, TX
C	1,500	US-54, US-287, SH-136, SH-15	None
Adjacent to WDZ-C ROI[2]	4,400		Stratford, TX
	6,200		Cactus, TX
	4,100		Sunray, TX
D	2,200	US-412, SH-3, SH-94, SH-136	Hardesty, OK
E	8,600	US-412, SH-136, US-54, SH-3, US-64	Guymon, OK, Hardesty, OK, Optima, OK
F	8,600	US-54, SH-3, US-54, US-412, SH-95, SH-136	Texhoma, TX; Texhoma, OK; Guymon, OK; Goodwell, OK
G	1,400	US-56, SH-3, SH-95, SH-27, US-412, SH-171, US-287, US-385, US-64, SH-325	Kerrick, OK
Adjacent to WDZ-G ROI[2]	5,000		Boise City, OK
	400		Keyes, OK
	2,000		Elkhart, KS
H	1,400	SH-95, SH-3	None

Table 3.16-5:
Connected Action—Roadways in WDZ and Wind Energy Generation ROI

WDZ	AADT (maximum for roadway segments in 2012)[1]	Major Federal and State Roadways	Communities
I	7,600	SH-94, Texas CR 7, US- 54, US- 64	Hooker, OK; Adams, OK; Optima, OK; Turpin, OK;
Adjacent to WDZ-I ROI[2]	6,700		Tyrone, OK
	7,340		Liberal, KS
J	3,300	US-83, SH-3, US-412	Balko, OK; Turpin, OK
Adjacent to WDZ-J ROI[2]	3,100		Beaver, OK
	7,340		Liberal, KS
K	3,300	US-83, SH-3, SH-23, US-270, SH-15	Balko, OK; Perryton TX
Adjacent to WDZ-K ROI[2]	2,900		Booker, TX
	3,100		Beaver, OK
L	4,500	SH-70, SH-15, SH-51, SH-207, SH-23, US-83	Spearman, TX; Waka, TX
Adjacent to WDZ-L ROI[2]	820		Morse, TX

1 Source: Clean Line (2014)
2 Adjacent areas are major highways outside of WDZs generally within 12 miles. Sources: TXDOT (2014), OKDOT (2014), (KSDOT) (2014)

3.16.5.8.1.2 Railroads

Railroads in the WDZ ROIs are listed in Table 3.16-6. In WDZ-A, the Southwest Railroad is located along SH-15 and SH-192 and passes through Perryton, Texas. Two BNSF lines located in WDZ-C both pass through Stratford, Texas. In WDZ-L, the Southwest Railroad is located along SH-15 and passes through Spearman, Texas, along US-287 northwest of the WDZ. In WDZ-E, a BNSF line passes through Guymon, Oklahoma, along US-54 within the ROI northwest of the WDZ. In WDZ-F, the BNSF line passes through Texhoma (Oklahoma and Texas) and Goodwell, Oklahoma, along US-54. In WDZ-G, the CVR line is located along US-56 and passes through Elkhart, Kansas, north of the WDZ boundary. In WDZ-I, the BNSF line passes through Hooker, Oklahoma, along US-54. Southwest Railroad is located 2.61 miles south of WDZ-K and runs along SH-15/SH-192.

Table 3.16-6:
Connected Action—Railroads in WDZ ROIs (within 6 miles of WDZ boundaries)

WDZ	Name	Proximity to WDZ (miles)[1]
A	Southwest	Within WDZ
B	None	NA
C	BNSF	Within WDZ
C	BNSF	0.6
D	None	NA
E	BNSF	1.4
F	BNSF	Within WDZ
G	CVR	Within WDZ
H	None	NA

Table 3.16-6:
Connected Action—Railroads in WDZ ROIs (within 6 miles of WDZ boundaries)

WDZ	Name	Proximity to WDZ (miles)[1]
I	BNSF	Within WDZ
J	None	NA
K	Southwest Railroad	2.6
L	Southwest Railroad	0.8

GIS Data Sources: BTS (2013), TXDOT (2013), CSA (2007), AHTD (2006a), USCB 2000
1 All within 6 miles of the WDZ boundaries.

3.16.5.8.1.3 Airports and Navigation Aids

Airports, airstrips, and navigation aids in the ROI are listed in Table 3.16-7.

Table 3.16-7:
Connected Action—Airports and Navigation Aids in WDZ ROIs

WDZ	Name	Type of Facility	Proximity to WDZ (miles)[1]
A	Perryton Ochiltree County Airport	Public airport	Within WDZ
A	PYX NDB Perryton	Navigation aid. Operational IFR.	0.16
B	Gruver Municipal Airport	Public airport	3.2
C	Stratford Field	Public airport	0.5
D	No facilities	NA	NA
E	Guyman Municipal Airport	Public airport	2.3
E	GUY NDB Guymon	Navigation aid. Operational IFR.	3.7
F	Guyman Municipal Airport	Public airport	1.1
F	GUY NDB Guymon	Navigation aid. Operational IFR.	1.7
F	Municipal Airport (near Texhoma)	Public airport	Within WDZ
G	Elkhart-Morton County Airport	Public airport	2.5
G	EHA NDB Elkhart	Navigation aid. Operational IFR.	2.8
H	No facilities	NA	NA
I	Hooker Municipal Airport	Public airport	Within WDZ
J	No facilities	NA	NA
K	No facilities	NA	NA
L	Major Samuel B Cornelius Field	Military airfield	1.9

GIS Data Sources: BTS (2013), Clean Line (2013b); Source: FAA (2014b)
1 Distances are to closest airport feature, including runways.

3.16.5.8.2 Optima Substation

The future Optima Substation ROI is entirely included in the western area of Region 1 and transportation conditions would be similar to those described in Section 3.16.6.2.1 for the Oklahoma Converter Station Siting Area and the AC collection system routes. Major highways in these areas include US-54, US-56, US-64, US-83, and US-412 and SH-15, SH-70, SH-94, SH-95, SH-136, SH-192, and SH-207. ADTC are estimated at a maximum of 1,100 on state highways and a maximum of 4,800 for federal and joint federal/state roadways for 2012. The major highways, as well as the local roads, currently operate at an acceptable average daily LOS-C or better.

3.16.5.8.3 TVA Upgrades

The ROI for the direct assignment facilities (which are included in the Applicant Proposed Project) would occur within the Tennessee Converter Station Siting Area and more specifically within the Shelby Substation. The ROI for the network upgrades, and in particular TVA's future 500kV transmission line, cannot be fully determined at this time. The new 500kV line would be in western Tennessee. The upgrades to existing facilities would mostly be in western and central Tennessee. Upgrades to existing infrastructure would include upgrading terminal equipment at three existing 500kV substations and six existing 161kV substations, making appropriate upgrades to increase heights on 16 existing 161kV transmission lines to increase line ratings, and replacing the conductors on eight existing 161kV transmission lines. Where possible, general impacts associated with the required TVA upgrades are discussed in the impact sections that follow.

3.16.6 Impacts to Transportation

Impacts to traffic on roadways would include increased traffic during construction activities from workers commuting to the construction sites, as well as increased traffic from the hauling of materials and equipment to the construction sites. Incidental congestion and delay would be expected from the following:

- Slow-moving trucks and construction vehicles
- Vehicle turning movements where construction occurs near and parallel to roadways
- Travel delays and detours associated with transmission line installation in some locations

Temporary travel delays involving major roads (interstate highways, federal highways, and state highways) and railroads may also occur for HVDC or AC line installation at crossings. Shorter duration delays or no delays are anticipated where lines cross narrower roads with lower traffic volumes.

No improvements to public roadways are planned as part of the Applicant Proposed Project or DOE Alternatives.

3.16.6.1 Methodology

3.16.6.1.1 Traffic Impacts

3.16.6.1.1.1 Level of Service

As discussed above (Section 3.16.4.1), impacts to roadway traffic are assessed using the concept of Level of Service (LOS). A qualitative description of LOS is provided in Table 3.16-8. LOS for roadways in the ROI was calculated to assess the potential effects to roadway traffic during construction and operations of the separate components of the Project. These calculations were performed using the standard methods in the Highway Capacity Manual (TRB 2010), and results were used to assess the potential change in LOS from the Project on roadways. Details of the Traffic Analysis calculations are provided in the *Traffic Technical Report* and supplement to the *Traffic Technical Report* (Clean Line 2013, 2014).

Table 3.16-8:
General Description of LOS

LOS	General Description	Motorist Experience
A	Free flow. Traffic flows at or above the posted speed limit and motorists have complete mobility between lanes.	Motorists have a high level of physical and psychological comfort.
B	Reasonably free flow. LOS A speeds are maintained, maneuverability within the traffic stream is slightly restricted.	Motorists still have a high level of physical and psychological comfort.

Table 3.16-8:
General Description of LOS

LOS	General Description	Motorist Experience
C	Stable flow, at or near free flow. Ability to maneuver through lanes is noticeably restricted and lane changes require more driver awareness.	Most experienced drivers are comfortable, roads remain safely below but efficiently close to capacity, and posted speed is maintained.
D	Approaching unstable flow. Speeds slightly decrease as traffic volume is slightly increased.	Freedom to maneuver within the traffic stream is much more limited and driver comfort levels decrease.
E	Unstable flow, operating at capacity. Flow becomes irregular and speed varies rapidly because there are virtually no usable gaps to maneuver in the traffic stream and speeds rarely reach the posted limit.	Any incident will create serious delays. Drivers' level of comfort becomes poor.
F	Forced or breakdown flow. Every vehicle moves in lockstep with the vehicle in front of it, with frequent slowing required.	Travel time cannot be predicted and drivers' level of comfort is poor.

Source: TRB (2010)

To estimate potential changes in LOS from the Project, the Applicant provided anticipated trip generation summarized in Table 3.16-9. Workers, vehicle trips, and the duration of construction activities for the Project are discussed and presented in detail in Sections 2.1.2 and 3.13. The duration of construction for the entire Project would be approximately 36 to 42 months including the initiation of clearing and grading activities through cleanup and restoration tasks. Construction is expected to run concurrently over different areas, and construction within all areas would not occur during the same time. Activities in one segment may be parallel or staggered with activities in other segments. The duration of construction within a 140-mile construction segment is estimated to be 24 months, but disturbance at any one location would be much shorter, depending on localized construction activities and progress. The types of construction vehicles in use at any time would depend on construction activities such as grading, structure construction, access road construction, reclamation, and other activities further described in Section 2.1. Construction vehicle types are summarized in Table 3.16-10 and are broken down by construction activity in the *Traffic Technical Report for the Plains & Eastern Clean Line* and supplement to the *Traffic Technical Report* (Clean Line 2013, 2014). The table provides information on vehicles that would be on roads and also the types of equipment that might be hauled to the site. The hauling information provides information on heavy equipment hauling on roads.

Table 3.16-9:
Summary of Trips During Project Construction

Project Component	Peak Number of Total Daily Trips	Peak Personal (Worker) Trips	Peak Light Construction Vehicle Trips	Peak Heavy Construction Vehicle Trips
HVDC Transmission Line (140-mile segment multi-use areas)	273	54	86	133
AC Collection System	273	54	86	133
HVDC Converter Stations	844	132	250	462
HVDC Transmission Line (140-mile segment multi-use areas), converter station, and AC collection system (simultaneous construction)—Region 1 only	1,390	276	438	676
HVDC Transmission Line (140-mile segment multi-use areas) and converter stations (simultaneous construction) Regions 1, 5, and 7 only	1,117	212	352	553

Source: Appendix F of this EIS.

Table 3.16-10:
Summary of Construction Vehicles/Equipment

Vehicles (on-road light)	Vehicles (on-road heavy)	Vehicles (off-road, to be hauled to construction site)	Other Equipment to be Hauled to Construction Site
Pick-up truck, Truck (1-ton), Utility van, Mechanic's truck, truck (2-ton), splicing truck/van, welder truck, boom lift truck,	Dump truck, Concrete truck, Concrete Pump truck, fuel truck, crane (15-ton boom truck), crane (30-ton), crane (120- to 300-ton), articulated dump truck, road sweeper, water truck, flatbed truck, reel stand truck, steel haul truck, truck (5-ton)	Plate compactor, trencher, excavator mini, 100 Series excavator, vibratory compactor, bobcat/skid loader, forklift (telescopic), lowboy truck, loader backhoe, wheel loader (5 CY), motor grader, bulldozer (100 and 300 Series), scraper, all terrain vehicle, single-drum puller (large), trencher, wagon drill, wire reel trailer, flail mower or Bush hog, crane (rubber-tired), wire puller (small), feller buncher, loader, motor grader, roller compactor, skidder, 3-drum puller (heavy), 3-drum puller (medium), double bull-wheel tensioner (heavy), double bull-wheel tensioner (light), helicopter (small), single-drum puller (large)	Air compressor, generator, construction trailer, chipper, hydra-ax or mulcher

Source: Appendix F of this EIS.

Construction LOS was calculated for each of the roadway segments in the ROI where AADT counts were available (Clean Line 2014). Traffic count data are generally collected and available for federal and state highways, as well as other well-traveled roadways such as county roads and major local roads near communities. Traffic count data are generally not collected or available for lesser-traveled roadways. The analysis does not include the urban street segment category because of variations in how the state DOTs collect AADT data for city streets. In Oklahoma and Arkansas, AADT counts are only collected for select city streets; in Tennessee and Texas, AADT counts are not collected for any city streets. Although urban street segments have the potential to be accessed for construction purposes, major roadways in towns and urban areas throughout the Project are generally accounted for by the other roadway categories that are included in the LOS analysis. Each roadway segment corresponds to an AADT count data point with lengths delimited based on the AADT data.

The traffic analysis estimated the total arriving and departing traffic on a daily basis resulting from construction based on Project trips. The analysis includes the very conservative assumption that each roadway within the ROI could receive the full number of estimated peak daily construction trips. This assumption is implausible because the roadways cannot all receive the full number of trips. The assumption is used as a screening tool to identify roadways where potential effects would be negligible (even under the most conservative trip scenario), and thus to focus on roadway segments with greater potential for impacts. A more detailed traffic analysis is not possible at this stage of the Project because specific commuting and haul routes based on worker residences, material and equipment locations, and construction site destinations would not be identified until the design phase of the Project, when a Transportation Management Plan would be developed. Traffic from construction activities outside the ROI would be much more dispersed, and roadways outside the ROI are unlikely to receive the full number of trips.

The analysis considers simultaneous construction activities within Regions 1, 5, and 7, where the HVDC transmission line and converter stations (Oklahoma, Arkansas, and Tennessee) might be under construction during the same time. The analysis also considers simultaneous construction of the AC collection system and HVDC transmission lines for Region 1. The specific criteria used to assess the LOS for two-lane highways (both Class I and Class II), basic freeway segments, and multi-lane highways are provided in Table 3.16-11. Given the numerous roadways and associated jurisdictions traversed and affected by the Project, the AASHTO minimum LOS for rural and urban areas (C and D, respectively) have been used to evaluate impacts.

Table 3.16-11:
LOS-Criteria Summary

	2-Lane Class I (at 45 mph)	2-Lane Class I (at 45 mph)	2-Lane Class II (at 45 mph)	Basic Freeway Segments (at 70 mph)	Multi-Lane Highway Segments (at 55 mph)
LOS	Avg. Travel Speed (mph)	Percent Time Following	Percent Time Following	Density (cars/mile/lane)	Density (cars/mile/lane)
A	>55	<35	<40	<11	<11
B	>50–55	>35–50	>40–55	>11–18	>11–18
C	>45–50	>50–65	>50–70	>18–26	>18–26
D	>40–45	>65–80	>70–85	>26–35	>26–35
E	<40	>80	>85	>35-41	>35-41

Source: TRB (2010)

3.16.6.1.1.2 Bus and Emergency Routes

Construction traffic has the potential to impact bus and emergency routes for roadways near the construction areas. Public bus routes are expected to be rare in the ROI because most of the Project is located within rural areas without bus routes. Sections 3.16.6.2 and 3.16.6.3 identify more populated areas where the Project could impact bus and emergency routes. Bus and emergency routes would be specifically identified in association with a Transportation and Traffic Management Plan, which also would include measures to avoid or minimize potential impacts to bus routes and emergency vehicle traffic.

3.16.6.1.1.3 Roadway ROW and Railroad

Impacts resulting from roadway and railroad crossings are generally evaluated by identifying the interstates, federal and state highways, and railroads that would be crossed by the Project. Crossings have the potential to involve short-term traffic delays and interruptions, including temporary lane closures in some cases.

Impacts could also occur in areas where the routes are located adjacent to roadways and railroads. Construction activities that take place adjacent to major roadways have the potential to cause temporary adverse impacts to traffic from vehicles entering and leaving the roadway and could involve lane closures.

The Transportation and Traffic Management Plan would include railroad crossing protocols and construction and post-construction practices to avoid vehicle, railroad, and transmission line conflicts. Typically, stoppage of railroad traffic is not required during construction or conductor stringing and tensioning activities. Crossing activities are similar to those for road crossings and typically involve the use of guard structures. Stringing and tensioning activities would be performed in coordination with the appropriate railroad authorities as required.

An analysis of representative transmission line centerlines was performed to identify roadways within 50 feet of the centerlines (see Table 3.16-17 in Section 3.16.6.2.3). The analysis includes the following roadway categories: local, minor arterial/minor collector, principal arterial/major urban collector, county roads, state highways, federal highways, and interstates.

3.16.6.1.1.4 Airport, Airfield, and Navigation Aid

Transmission line structures and lines are a navigation issue and can become a hazard if they are located too close to airport operations or military airspace operating areas. Transmission line construction near an airport presents the potential for new flight safety issues. Effects can occur depending on the proximity between flight paths and transmission line locations, structure and conductor heights, and compliance with applicable requirements. Incorporation of design features and implementation of EPMs are expected to reduce the extent of the safety issues to permissible levels. Any routes with irresolvable issues related to airports or airspace would require FAA review and coordination with specific facilities or entities.

Airports, airfields, and navigation aids within 4 miles of the Applicant Proposed Route and the HVDC alternative routes were identified (see Table 3.16-3 for airports and airstrips). Specific mileage from the representative centerlines is provided to identify potential for conflicts, the triggering of FAA review requirements, or potential impacts to navigation aids.

3.16.6.1.1.5 Roadway Infrastructure

Roadway pavement or other infrastructure might be damaged by heavy vehicles delivering equipment and materials to the site. Specifications and haul routes for oversize/overweight vehicles and equipment would be developed for a Transportation and Traffic Management Plan. Other impacts to roadway infrastructure could include damage from temporary access points. Such damage would be repaired and restored, so the impacts would be temporary. These impacts would be generally common to all alternatives and are therefore not specifically evaluated in terms of the Applicant Proposed Route and HVDC alternative routes.

3.16.6.1.2 EPMs

The Applicant would implement EPMs to avoid or minimize potential impacts resulting from construction, operations and maintenance, and decommissioning of the Project. Prior to construction, the Applicant would develop and implement a Transportation and Traffic Management Plan that would detail the requirements, permits, plans, and mitigation procedures that would be implemented to avoid or minimize potential impacts on transportation infrastructure and traffic conditions.

The Applicant has developed a comprehensive list of EPMs that would avoid or minimize transportation impacts. Implementation of these EPMs is assumed throughout the impact analysis that follows. A complete list of EPMs for the proposed Project is provided in Appendix F*;* those EPMs that would specifically minimize the potential for transportation impacts are listed below:

- LU-2: Clean Line will minimize the frequency and duration of road closures.
- GE-26: When needed, Clean Line will use guard structures, barriers, flaggers, and other traffic controls to minimize traffic delays and road closures.
- GE-8: Access controls (e.g., cattle guards, fences, gates) will be installed, maintained, repaired, replaced, or restored as required by regulation, road authority, or as agreed to by landowner.
- LU-1: Clean Line will work with landowners and operators to ensure that access is maintained as needed to existing operations (e.g., to oil/gas wells, private lands, agricultural areas, pastures, hunting leases).
- LU-4: Clean Line will coordinate with landowners to site access roads and temporary work areas to avoid and/or minimize impacts to existing operations and structures.

- GE-1: Clean Line will train personnel on health, safety, and environmental matters. Training will include practices, techniques, and protocols required by federal and state regulations and applicable permits.
- GE-6: Clean Line will restrict vehicular travel to the ROW and other established areas within the construction, access, or maintenance easement(s).
- GE-7: Roads not otherwise needed for maintenance and operations will be restored to preconstruction conditions. Restoration practices may include decompacting, recontouring, and re-seeding. Roads needed for maintenance and operations will be retained.
- GE-16: Where required by FAA, or in certain areas to protect aviator safety, Clean Line will mark structures and/or conductors and/or shield wires with high-visibility markers (i.e., marker balls or other FAA-approved devices).
- GE-20: Clean Line will conduct construction and scheduled maintenance activities on the facilities during daylight hours, except in rare circumstances that may include, for example, to address emergency or unsafe situations, to avoid adverse environmental effects, to minimize traffic disruptions, or to comply with regulatory or permit requirements.
- GE-22: Clean Line will impose speed limits during construction for access roads (e.g., to reduce dust emissions, for safety reasons, and for protection of wildlife).
- AG-5: Clean Line will work with landowners and/or tenants to consider potential impacts to current aerial spraying or application (i.e., crop dusting) of herbicides, fungicides, pesticides, and fertilizers within or near the transmission ROW. Clean Line will avoid or minimize impacts to aerial spraying practices when routing and siting the transmission line and related infrastructure.

DOE has confirmed that the Applicant recognizes the impact heavy traffic can have on county and local roads and has agreed to minimize the impact of construction vehicles to existing road networks. The Applicant and its construction contractor will work with the state highway authority and county judges and engineers to plan road use during construction. The Applicant has committed to work with each county prior to construction to ensure repair or payment for repair of damage to county or local roads and will coordinate with the county in the event that road upgrades are needed and would pay for such upgrades and improvements. In addition to the ad valorem property tax revenues (or payment in lieu of taxes, where applicable) estimated in Section 3.13, the Applicant has committed to make an infrastructure payment to offset the potential costs of additional county services required during construction. Infrastructure payments will be based on the linear length of the HVDC transmission line constructed in the county. The infrastructure payment will be $7,500 per mile. The Applicant anticipates these one-time payments will be made to counties concurrent with or soon after the commencement of construction activities in the county and expects to make these payments pursuant to an agreement with the county that would specify these payments.

3.16.6.2 Impacts Associated with the Applicant Proposed Project

3.16.6.2.1 Converter Stations and AC Interconnection Siting Areas

Based on the traffic impact analysis (Clean Line 2014), construction of the Oklahoma converter station and AC interconnection is not predicted to result in an LOS decrease for any roadway segments.

Construction of the Tennessee Converter Station Siting area and AC Interconnection Tie (simultaneously with the HVDC transmission line) is predicted to result in a decrease from LOS-A to LOS-B for nine roadway segments; from LOS-B to LOS-C for five roadway segments; and from LOS-C to LOS-D for six roadway segments. With an LOS-B or LOS-C, impacts to roadways would be minimally noticeable to motorists and temporary during construction, and all roadways would continue to operate at an acceptable LOS-C or better. For roadways that are currently operating at LOS-C, a decrease to LOS-D might be unacceptable to specific jurisdictions. The area of the Tennessee Converter Station Siting area and AC Interconnection Tie is more densely populated and urbanized than most other portions of the proposed Project. It is important to note that the decrease from LOS-C to LOS-D is only a one-level drop in operation level and would be minimally noticeable to motorists. In addition, the assumptions made for the traffic analysis are conservative and were intended to identify where there might be potential effects to roadway segments in the ROI. The scenario that peak traffic would be distributed entirely to the roadway segments with resulting decreases to LOS-D is a worst-case scenario; actual impacts to these roadway segments are expected to be less than predicted.

Airports, airstrips, and navigation aids in relation to potential FAA requirements and review are not relevant for the converter stations, except in cases of direct property encroachment, because the converter station structures would not exceed 85 feet in height, well below the 200-foot FAA review trigger, and the direct property encroachment would be avoided. Structures for the AC interconnection tie would be relatively small (gantries or other insulated support structures) and therefore not anticipated to conflict with airports and airstrips.

3.16.6.2.1.1 Construction Impacts

3.16.6.2.1.1.1 Oklahoma Converter Station Siting Area and AC Interconnection Siting Area

All public roadways within the Oklahoma Convertor Station Siting Area currently operate at an acceptable LOS-A. An estimated 1,117 additional construction trips could occur during construction of both the converter station and HVDC transmission line; a maximum of 1,390 trips are estimated under a scenario where the convertor station, AC collection system, and HVDC transmission line are under construction at the same time (Table 3.16-9). Construction trips for the converter station alone, or in conjunction with the HVDC transmission line, are not predicted to result in an LOS decrease for any roadway segments in the siting area ROI.

It is possible that the converter station might require acquisition of Texas CR-202 roadway ROW and require permitting from the county. Based on the assessment of roadway categories where centerlines are within 50 feet of the roadway, 0.04 mile of the Oklahoma converter station AC interconnection is within 50 feet of a principal arterial/major urban collector roadway.

No railroads are located in the Oklahoma Converter Station Siting Area. No airports, airstrips, or navigation aids are located within 4 miles of the siting area.

3.16.6.2.1.1.2 Tennessee Converter Station Siting Area and AC Interconnection Tie

All public roadways within the ROI of the Converter Station Siting area and AC Interconnection Tie currently operate at an acceptable LOS-C or better. As shown in Table 3.16-12, during construction, trips generated from the converter station could result in LOS decreases as described below:

- LOS-A to LOS-B—segments of Mudville Road, Tipton Road, Tracy Road, Rosemark Road, West Union Road, Armour Road, and Sledge Road
- LOS-B to LOS-C—segments of Tipton Road, Brunswick Road, and Rosemark Road
- LOS-C to LOS-D—segments of SH-14 and local roads Munford Avenue, Atoka Idaville Road, Church Street, and Navy Road

Table 3.16-12:
Roadway Segments with LOS Decrease—Tennessee Converter Station Siting Area and AC Interconnection Tie

Roadway	Location	Map ID	Alternatives Impacted	Existing LOS	LOS with Project Construction
Class I					
Munford Avenue	in Munford, TN	474296840	TCS	C	D
Atoka Idaville Road	in Atoka, TN	474297776	TCS	C	D
Tipton Road	south of Munford, TN	474298720	TCS	B	C
Mudville Road	north of Millington, TN	477133599	TCS	A	B
Brunswick Road	northwest of Arlington, TN	477136320	TCS	B	C
Church Street	in Millington, TN	477137273	TCS	C	D
Navy Road	in Millington, TN	477136675	TCS	C	D
Navy Road	in Millington, TN	477136700	TCS	C	D
SH-14	east of Millington, TN	477138707	TCS	C	D
Munford Avenue	in Munford, TN	474296840	TCS and HVDC line	C	D
Atoka Idaville Road	in Atoka, TN	474297776	TCS and HVDC line	C	D
Atoka Idaville Road	east of Atoka, TN	474298172	TCS and HVDC line	B	C
Tipton Road	south of Munford, TN	474298720	TCS and HVDC line	B	C
Mudville Road	north of Millington, TN	477133599	TCS and HVDC line	A	B
Bethuel Road	in Millington, TN	477137092	TCS and HVDC line	B	C
Brunswick Road	northwest of Arlington, TN	477136320	TCS and HVDC line	B	C
Church Street	in Millington, TN	477137273	TCS and HVDC line	C	D
Navy Road	in Millington, TN	477136675	TCS and HVDC line	C	D
Navy Road	in Millington, TN	477136700	TCS and HVDC line	C	D
SH-14	east of Millington, TN	477138707	TCS and HVDC line	C	D
Class II					
Tipton Road	south of Munford, TN	474300336	TCS	A	B
Tracy Road	south of Munford, TN	474301493	TCS	A	B
Rosemark Road	northeast of Millington, TN	477133859	TCS	B	C
Rosemark Road	northeast of Millington, TN	477136190	TCS	A	B
West Union Road	north of Millington, TN	477134688	TCS	A	B
Armour Road	east of Millington	477136908	TCS	A	B
Sledge Road	east of Millington	477140121	TCS	A	B
Portersville Road	south of Brighton, TN	474294203	TCS and HVDC line	A	B
Maple Hill Dr	in Munford, TN	474297087	TCS and HVDC line	A	B
Tipton Road	south of Munford, TN	474300336	TCS and HVDC line	A	B
Tracy Road	south of Munford, TN	474301493	TCS and HVDC line	A	B
Rosemark Road	northeast of Millington, TN	477133859	TCS and HVDC line	B	C
Rosemark Road	east of Millington	477136190	TCS and HVDC line	A	B
West Union Road	north of Millington, TN	477134688	TCS and HVDC line	A	B
Armour Road	east of Millington	477136908	TCS and HVDC line	A	B
Sledge Road	east of Millington	477140121	TCS and HVDC line	A	B

Source: Clean Line (2014)
TCS = Tennessee Converter Station

These impacts to roadways are centered in the areas of Munford, Atoka, and Millington, Tennessee. It is important to note that the decrease from LOS-C to LOS-D is only a one-level drop in operation level, and would be minimally noticeable to motorists. In addition, the assumptions made for the traffic analysis are conservative and were intended to identify where there might be potential effects to roadway segments in the ROI. The scenario that peak traffic would be distributed entirely to the roadway segments with resulting decreases to LOS-D is a worst-case scenario and thus, actual impacts to these roadway segments are expected to be less than predicted.

In the case of both the converter station and HVDC transmission line being under construction in Region 7 at the same time, up to 1,117 construction trips would be generated (Table 3.16-9). For this case, the LOS of four additional public roads would be affected. During construction, trips generated from this scenario are predicted to cause an additional decrease from LOS-A to LOS-B for segments of Portersville Road and Maple Hill Drive, and from B to C for segments of Atoka Idaville Road and Bethuel Road.

With LOS-B and LOS-C, impacts to roadways would be temporary during construction. Although an LOS-D would result in a measurable decrease in roadway operation, the decrease would be temporary and the decrease in operation would be limited to one LOS level. This decrease is not likely to be noticed by motorists.

No portion of the AC Interconnection Siting Area is located within this area based on the assessment of roadway categories where the area is within 50 feet of the roadway.

No railroads are located within the Converter Station Siting area and AC Interconnection Tie . Two airports are located within 4 miles of the converter station siting area—Millington Regional Jetport and Ray Airport. Equipment and buildings associated with the converter station are expected to be less than 85 feet in height and would not require consideration in regards to FAA requirements.

The Converter Station Siting area and AC Interconnection Tie is located within a populated area that might contain bus routes and where emergency routes would be essential to maintain.

3.16.6.2.1.2 Operations and Maintenance Impacts

The operations and maintenance of the converter station and AC interconnection siting areas would require employees, resulting in an incremental increase in localized vehicle trips. The converter station and AC interconnection would be inspected regularly or as necessary using fixed-wing aircraft, helicopters, ground vehicles, all-terrain vehicles, and/or through pedestrian inspection.

Incidental safety impacts could occur in relation to slow-moving Project vehicles on steep roads with limited sight distance required for operations and maintenance of the converter stations or AC interconnection lines, but the travel volumes would be far lower and more distributed over time than those associated with the construction phase These impacts would be associated with normal travel to and from the AC interconnection transmission lines for inspections and repairs.

Based on the number of trips generated during the operational period and their distribution within the roadway network, substantial capacity and congestion impacts are not anticipated. Incidental congestion and delay would be expected from the following: slow-moving trucks and service vehicles and vehicle turning movements where activities occur near and parallel to roadways. Incidental travel time delays are not expected to substantially influence emergency response times or local travel. Access roads not required for facility operations and maintenance would be closed or closed and reclaimed/restored.

Railroad impacts would involve infrequent crossings by construction vehicles and occasional inspections and repairs near railroad tracks. Impacts to railroad operations could occur were a repair needed over an active track, but this is anticipated to be a rare event.

Operations and maintenance of the converter stations or AC interconnection lines would not result in impacts to airports.

3.16.6.2.1.3 Decommissioning Impacts

Impacts during decommissioning of the converter stations and AC interconnection would be similar to those anticipated during construction. EPMs would remain applicable during the decommissioning phase of the Project. The Applicant would be responsible for the decommissioning and reclamation of access roads following abandonment in accordance with the landowner's or appropriate agency's direction. Roadway reclamation would reduce motor vehicle access and return the access road areas back to preconstruction conditions. Temporary access roads may be left intact through mutual agreement of the appropriate landowners and jurisdictional entities.

3.16.6.2.2 AC Collection System

3.16.6.2.2.1 Construction Impacts

All public roadways within 6 miles of the centerline of the ROWs for the AC collection system routes currently operate at an acceptable LOS-B or better. As shown in Table 3.16-13, during construction of the AC collection system, trips added to the ROI could result in a decrease to LOS-B from LOS-A for segments of the following Class I roadways: US-83, US-412, SH-15, and Texas County Highway 28. Impacts to roadways would be temporary during construction.

Table 3.16-13:
Roadway Segments with LOS Decrease—AC Collection System

Roadway Segment	Location	Segment Map ID	Existing LOS	LOS during Project Construction
Class I				
County Highway 28	northeast of Guymon, OK	494361171	A	B
SH-15	near Spearman, OK	444942983	A	B
SH-15	near Spearman, OK	490055417	A	B
SH-15	near Spearman, OK	490055424	A	B
SH-15	near Spearman, OK	490234155	A	B
SH-15	near Spearman, OK	490234211	A	B
SH-70	south of Perryton, OK	490231684	A	B
SH-70	south of Perryton, OK	502121390	A	B
US-412	east of Balko, OK	493084995	A	B
US-412	near Hardesty, OK	494370475	A	B
US-412	near Hardesty, OK	494371189	A	B
US-412	near Hardesty, OK	494371676	A	B
US-412	near Hardesty, OK	494373033	A	B

Table 3.16-13:
Roadway Segments with LOS Decrease—AC Collection System

Roadway Segment	Location	Segment Map ID	Existing LOS	LOS during Project Construction
US-412	near Hardesty, OK	494373352	A	B
US-83	south of Perryton, OK	490233696	A	B

Source: Clean Line (2014)

Table 3.16-14 lists the number of federal and state highway impacts by AC collection system route. Additional discussion for individual alternatives is provided in the sections below.

Table 3.16-14:
AC Collection System Roadway Impacts and Railroad Crossings by Alternative

Alternative	LOS Decrease—Number of U.S. Highways[1]	LOS Decrease—Number of State Highways[1]	Number of U.S. Highways Crossed[2]	Number of State Highways Crossed[2]	Number of Railroad Crossings[2]
E-1	2	3	1	0	0
E-2	2	3	1	0	0
E-3	2	3	1	0	0
NE-1	2	3	2	0	2
NE-2	2	3	0	1	0
NW-1	2	3	2	1	1
NW-2	2	3	0	1	1
SE-1	2	3	0	2	0
SE-2	0	0	0	0	0
SE-3	2	3	0	1	1
SW-1	0	0	0	0	0
SW-2	2	3	0	1	0
W-1	0	0	1	0	1

1 Source: Clean Line (2014)
2 GIS Data Sources: BTS (2013), TXDOT (2013), CSA (2007), AHTD (2006a), USCB (2000)

Table 3.16-15 lists the miles of AC collection system route centerlines within 50 feet of roadways.

Table 3.16-15:
AC Collection System Route Centerlines within 50 feet of Roadways (miles)

Route	Local Roads	Minor Arterials and Minor Collector Roads	Principal Arterials and Major Urban Collectors	State Highways	County Roads
E-1	<0.1	0	<0.1	0	0
E-2	1.1	0.3	0.1	0	0
E-3	5.1	0	3.4	0	0
NE-1	0	0	0	0	0
NE-2	0	0	0	0	0
NW-1	0	0	0	0	0
NW-2	0	0	0	0	0

Table 3.16-15:
AC Collection System Route Centerlines within 50 feet of Roadways (miles)

Route	Local Roads	Minor Arterials and Minor Collector Roads	Principal Arterials and Major Urban Collectors	State Highways	County Roads
SE-1	0.4	0.1	0.1	0.1	3.3
SE-2	0	0	0	0	0.1
SE-3	0.6	0.2	0.1	0.1	12.4
SW-1	0	0	0	0.1	0.2
SW-2	0	0	0	0.1	5.7
W-1	0	0	0	0	0

Source: Clean Line (2014)

The AC Collection System Routes E-1, NE-2, and NW-2 would cross US-412 resulting in a decrease from LOS-A to LOS-B for segments of the following roadways: US-83, US-412, SH-15, and County Highway 28. AC Collection System Routes E-1, NE-2, and NW-2 representative centerlines would not be located within 50 feet of any of the analyzed roadway categories. AC Collection System Routes E-1 and NE-2 would not cross any railroads. The representative centerline of AC Collection System Route NE-2 is located 2.79 miles from Hooker Municipal Airport (Table 3.16-3). Transmission structures for the AC collection system would not exceed 180 feet, so given the relatively flat topography of the area, they would not require an FAA review. AC Collection System Routes NW-1 and NW-2, cross one railroad at US-54; and SE-3, and W-1 also cross one railroad. AC Collection System Route NE-1 has two railroad crossings.

AC Collection System Routes E-2 and E-3 would both cross US-83, resulting in a decrease from LOS-A to LOS-B for segments of the following roadways: US-83, US-412, SH-15 and County Highway 28. AC Collection System Route E-2 is parallel to and within 50 feet of local roadways for approximately 1 mile. AC Collection System Route E-3 would be parallel to and within 50 feet of local roadways for 5 miles, and principal arterials/major urban collector roadways for 3.4 miles.

AC Collection System Routes NE-1 and NE-2 would both cross US-412 and US-54, resulting in a decrease from LOS-A from LOS-B for segments of the following roadways: US-83, US-412, SH-15, and County Highway 28. AC Collection System Routes NE-1 and NW-1 would not be located within 50 feet of any of the analyzed roadway categories. AC Collection System Route NE-1 would cross the railroad along US-54 at two locations. This alternative centerline is located 2.56 miles from Hooker Municipal Airport. AC Collection System Route NW-1 would cross the railroad along US-54. This alternative representative centerline is located 3.47 miles from Guymon Municipal Airport. Transmission structures for AC Collection System Routes NE-1 and NW-1 would not exceed 180 feet, so given the relatively flat topography of the area they would not require an FAA review.

AC Collection System Routes SE-1 and SE-3 would both cross SH-15, resulting in a decrease from LOS-A from LOS-B for segments of the following roadways: US-83, US-412, SH-15, and County Highway 28. Under LOS-B, impacts to roadways would be temporary during construction. AC Collection System Route SE-1 would be parallel to and within 50 feet of county roadways for 3.3 miles and AC Collection System Route SE-3 would be parallel to and within 50 feet of county roadways for 12.4 miles. The close proximity to roadways might result in impacts to roadway ROW and to traffic during construction. Both alternatives cross one railroad near SH-15.

AC Collection System Routes SE-2 and SW-1 would not result in an LOS decrease for segments of any roadways in the ROI. The alternatives would not cross any federal or state highways or railroads.

AC Collection System Route SW-2 would cross SH-15, resulting in a decrease from LOS-A to LOS-B for segments of the following roadways: US-83, US-412, SH-15, SH-207, and County Highway 28. The route is parallel to and within 50 feet of county roadways for 5.7 miles.

The AC Collection System Route W-1 would cross US-54, but not result in an LOS decrease for segments of any roadways in the ROI. The alternative crosses one railroad near US-54.

3.16.6.2.2.2 Operations and Maintenance Impacts

Operations and maintenance of both the AC collection system and HVDC transmission line in Oklahoma would require a total of 32 employees. These 32 new jobs would result in a related increase in population due to family size and also have the potential to induce an additional 83 jobs in Oklahoma and Texas (see Section 3.13). The additional trips that this potential increase in population would generate, including trips from the predicted induced employment, would be negligible in terms of the existing area roadway traffic. None of the routes would result in impacts to railroads or airports/airfields as a result of operations and maintenance of the AC collection system.

Impacts to traffic, roadway capacity and congestion, and railroads would be similar as describe in Section 3.16.6.2.1. Impacts on airports would not change during the operational phase.

3.16.6.2.2.3 Decommissioning Impacts

Impacts during decommissioning would be similar to those described in Section 3.6.6.2.1.

3.16.6.2.3 HVDC Applicant Proposed Route

3.16.6.2.3.1 Construction Impacts

Descriptions of construction impacts (including impacts to LOS) associated with the Applicant Proposed Route are provided by region in the Sections below. Table 3.16-16 provides a roadway impact summary by Project region and a list of roadway and railroad crossings. LOS impacts have been evaluated to describe potential impacts, but note that these are based on conservative assumptions (Section 3.16.6.1).

Table 3.16-16:
Applicant Proposed Route Roadway Impacts and Railroad Crossings by Region

Region[1]	LOS Decrease—Number of Roadway Segments[2]	LOS Decrease to LOS-D or F[2]	Number of U.S. Highways Crossed[3]	Number of State Highways Crossed[3]	Number of Railroad Crossings[3]
1	11	0	5	1	0
2	10	0	3	3	3
3	37	0	8	5	4
4	34	12	4	12	3
5	8	1	3	13	1
6	5	0	1	7	2
7	15	10	4	5	3

1 The values in this table (Regions 2–7) would not be affected by the minor changes that would result from application of the minor route variations and adjustments.
2 Source: Clean Line (2014)
3 Source: OCGI (2012); GIS Data Sources: AHTD (2006a), TXDOT (2013), USCB (2013)

Table 3.16-17 lists the miles by region of Applicant Proposed Route centerlines within 50 feet of roadways.

Table 3.16-17:
Applicant Proposed Route Centerlines within 50 feet of Roadways by Region (miles)

Region[1]	Local Roads	Minor Arterials and Minor Collector Roads	Principal Arterials and Major Urban Collectors	State Highways	County Roads	U.S. Highways	Interstates
Region 1	6.7	0.4	3.4	0	0	0	0
Region 2	19.8	0.2	1.2	0	0	0	0
Region 3	11.3	0.6	2.4	0	0	0	0.1
Region 4	1.4	37.1	0.6	0.6	5.2	0.2	0.4
Region 5	0	0	0	0.9	5.0	0.3	0
Region 6	0	0	0	0.4	10.4	0.1	0
Region 7	2.1	0	0	0.7	4.4	0.4	0.1

1 The values in this table (Regions 2–7) would not be affected by the minor changes that would result from application of the minor route variations and adjustments.
GIS Data Sources: BTS (2013), TXDOT (2013), CSA (2007), AHTD (2006a), USCB (2000)

The FAA standards for tall structures in areas near airports and airstrips apply to structures above 200 feet in height. It is unlikely that any of the transmission structures would be designed to exceed 200 feet, so it is unlikely that the Applicant Proposed Route would result in such impacts to airports and airstrips. However, FAA review requirements are also triggered by proximity and topography in some cases and the potential impacts are discussed below. Construction of the Project is not expected to otherwise impact air transportation.

3.16.6.2.3.1.1 Region 1

The Applicant Proposed Route would cross the following federal and state highways: US-83, US-283, US-270, US-183, US-34, and SH-23. The proximity to roadways might result in impacts to roadway ROW and to traffic. Table 3.16-18 lists LOS impacts in Region 1 for the Applicant Proposed Route. The route does not cross any railroads and the centerline is not located within 4 miles of airports, airfields, or navigation aids.

Table 3.16-18:
Roadways with LOS Decreases for the Applicant Proposed Route—Region 1

Roadway	Location	Map ID	Existing LOS	LOS with Project Construction
Region 1				
US-270	between the SH-23 intersection and intersection with US-283	493085071	A	B
		493085100	A	B
		493085124	A	B
		493085143	A	B
		493085150	A	B
		493085171	A	B

Table 3.16-18:
Roadways with LOS Decreases for the Applicant Proposed Route—Region 1

Roadway	Location	Map ID	Existing LOS	LOS with Project Construction
US-283	between the US-412 intersection and US-64 intersection	493111878	A	B
		493112161	A	B
		493112511	A	B
		493112972	A	B
US-412	between Guymon and Hardesty, OK	494373352	A	B

Source: Clean Line (2014)

3.16.6.2.3.1.2 Region 2

The Applicant Proposed Route would cross the following federal and state highways: SH-15, SH-58, SH-132, US-412, US-281, US-60, and US-81. The representative route centerline is parallel to and within 50 feet of 19.8 miles of local roads and 1.2 miles of principal arterials/major urban collector roads. The proximity to roadways might result in impacts to roadway ROW and to traffic. Table 3.16-19 provides a listing of LOS impacts in Region 2 for the Applicant Proposed Route. The route would cross three railroads in the area. Steinert Lakes private airport is located 3.2 mile from the route centerline (Table 3.16-3). Transmission structures for the Applicant Proposed Route are not expected to exceed 200 feet in height, and the landscape in the area is relatively flat and would not trigger the 1:50 slope ratio limitation, so FAA review requirements are not anticipated. The more populated area of Enid, Oklahoma, might have bus and emergency routes that could be impacted by construction traffic.

Table 3.16-19:
Roadways with LOS Decreases for the Applicant Proposed Route—Region 2

Roadway[1]	Location	Map ID	Existing LOS	LOS with Project Construction
Class I				
SH-51	west of Hennessey, OK	499802732	A	B
East Jack Choate Avenue	In Hennessey, OK	499803699	A	B
SH-51	east of Hennessey	499803873	A	B
SH-58	South of Fairview, OK	499826079	A	B
US-60	north of Seiling, OK	499829895	A	B
South Main Street	in Fairview, OK	499830450	A	B
US-60	in Fairview, OK	499830451	A	B
US-60	north of Seiling, OK	499830588	A	B
Class II				
East Jack Choate Avenue	In Hennessey, OK	499803699	A	B
South Main Street	In Fairview, OK	499830450	A	B

1 The values in this table would not be affected by the minor changes that would result from application of the minor route variations and adjustments.
Source: Clean Line (2014)

Two route variations were developed in Region 2 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.2. The variations are illustrated in Exhibit 1 of Appendix M. In comparison to the original Applicant Proposed Route, Link 1, Variation, 1 has slightly less mileage

(0.01 mile) within 50 feet of roadways, but would be within 4 miles of the Mooreland Municipal Airport. Link 2, Variation 2, would have the same mileage within 50 feet of roadways as the original Applicant Proposed Route.

3.16.6.2.3.1.3 Region 3

The Applicant Proposed Route would cross the following federal and state highways: SH-74, SH-51, SH-18, SH-99, SH-48; US-177, US-75 Alternate, US-75, US-63, US-69; I-35, I-44; and the Muskogee Turnpike. The route centerline is within 50 feet of 11.3 miles of local roads and 2.4 miles of principal arterials/major urban collector roads. Table 3.16-20 provides a list of roadway segments that are predicted to have a decrease in LOS during construction. The Applicant Proposed Route crosses four railroads in Region 3. The eastern boundary of Region 3 (with Region 4) is located at the Arkansas River crossing. There are two highway crossings within the ROI: I-40 and US-64/SH-100. US-64/SH-100 is closer to the Applicant Proposed Route crossing and provides a more direct pathway to the eastern side of the river (within Region 4). This roadway also passes through Webbers Falls and Gore, Oklahoma, where segment LOS decreases are indicated during construction. Traffic impacts to US-64/SH-100 are likely in the area of the river crossing. Although roadway segments in Webbers Falls currently operate at LOS-A, roadway segments in Gore operate at LOS-B and LOS-C.

Five route variations were developed in Region 3 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.3. The variations are illustrated in Exhibit 1 of Appendix M. In comparison to the original Applicant Proposed Route, Link 1, Variation 2, would not have any mileage within 50 feet of roadways and would have one less road crossing. Links 1 and 2, Variation 1, would have slightly more mileage (0.01 mile) within 50 feet of roadways; it should be noted that a route adjustment was made for HVDC Alternative Route 3-A to maintain an end-to-end route with this variation. Link 4, Variation 1, and Link 4, Variation 2, would have the same mileage within 50 feet of roadways and would cross one additional road. Link 5, Variation 2, would have the same mileage within 50 feet of roadways.

Table 3.16-20:
Roadways with LOS Decreases for the Applicant Proposed Route—Region 3

Roadway[1]	Location	Map ID	Existing LOS	LOS with Project Construction
Class I				
East 6th Avenue	east of Stillwater	424886892	B	C
SH-108	in Ripley, OK	424900156	A	B
SH-108	in Ripley, OK	424900277	A	B
North Little Avenue	in Cushing, OK	424901487	B	C
SH-33	between Perkins and Cushing, OK	424902311	B	C
SH-33	between Perkins and Cushing, OK	424902390	B	C
SH-33	between Perkins and Cushing, OK	424902415	B	C
SH-33	between Perkins and Cushing, OK	424902447	B	C
SH-99	southwest of Drumright, OK	425801393	A	B
SH-99	southwest of Drumright, OK	425801863	A	B
SH-99	southwest of Drumright, OK	425806148	A	B
SH-16	northwest of Bristow, OK	428309035	A	B
West 4th Avenue	in Bristow, OK	428311066	B	C
West 4th Avenue	in Bristow, OK	428311068	B	C
East 1st Avenue	in Bristow, OK	428311270	B	C

Table 3.16-20:
Roadways with LOS Decreases for the Applicant Proposed Route—Region 3

Roadway[1]	Location	Map ID	Existing LOS	LOS with Project Construction
South Chestnut Street	in Bristow, OK	428311782	B	C
Alt 75	south of Mounds, OK	428317448	A	B
West Highway 16	north of Slick, OK	428317653	A	B
SH-16	in Slick, OK	428875984	A	B
Alt 75	south of Mounds, OK	439896010	A	B
SH-33	between Perkins and Cushing, OK	439897933	B	C
SH-66	in Bristow, OK	439903008	B	C
US-62	south of Haskell, OK	444814176	A	B
US-64	in Haskell, OK	445475168	B	C
US-64	between Webbers Falls and Gore, OK	499618847	A	B
US-75 Bus	in Beggs, OK	499641185	B	C
US-75 Bus	in Beggs, OK	499641193	B	C
US-75 Bus	in Beggs, OK	499641199	B	C
US-75 Bus	in Beggs, OK	499641228	A	B
US-75 Bus	in Beggs, OK	499641245	A	B
SH-16	in Beggs, OK	499643392	A	B
US-64	in Gore, OK	499683838	B	C
US-64	in Gore, OK	499683842	B	C
SH-10	southeast of Gore, OK	499690169	A	B
SH-100	northeast of Gore, OK	516506775	A	B
SH-100	northeast of Gore, OK	516506777	A	B
US-64	southeast of Gore, OK	516507047	A	B
Class II				
Fairgrounds Road	east of Stillwater	424895827	A	B

1 The values in this table would not be affected by the minor changes that would result from application of the minor route variations and adjustments.

Source: Clean Line (2014)

Two public airfields are within 4 miles of the Applicant Proposed Route centerline: Davis Field Airport is 3.5 miles from the centerline and Cushing Municipal Airport is 0.8 mile from the representative centerline (Table 3.16-3). Four private airports or airfields are located within 4 miles of the Applicant Proposed Route centerline, and three private heliports are located within 4 miles of the centerline. Two of the private airfields or heliports are located within 1 mile of the Applicant Proposed Route centerline. However, most transmission structures for the route are not expected to exceed 200 feet in height, and the landscape in the area is relatively flat so FAA review requirements are not anticipated for those structures. The height of the Arkansas River crossing could range from approximately 130 to 200 feet on the west bank within Region 3 to maintain necessary clearance over the navigable channels. River traffic may be controlled, in coordination with the USACE, during the short time required to span the conductor across the Arkansas River. No airports are located within 4 miles of the crossing area. Three navigation aids are located within 4 miles of the representative route centerline: CUH NDB, OKMVOR/DME, and MKO NDB. All of these navigation aids are located over 1 mile from the representative route centerline, and the route is not expected to cause interference with these facilities.

The more populated areas of Stillwater and Muskogee, Oklahoma, may have bus and emergency routes that could be impacted by construction traffic.

Figure 3.16-1 in Appendix A provides additional details regarding existing roadways; railroads, and airports and airstrips within Region 3.

3.16.6.2.3.1.4 Region 4

The Applicant Proposed Route would cross the following federal and state highways: SH-10, SH-100, SH-82, SH-352, SH-164, SH-103, SH-21, SH-123, US-59, SH-59, I-40, I-540, SH-162, US-64, SH-23, and SH-219. Table 3.16-21 lists roadway segments where the LOS is predicted to decrease during. The Applicant Proposed Route would result in a decrease from LOS-C to LOS-D for several segments. Although an LOS-D would result in a measurable decrease in roadway operations, the decrease would be temporary, and because the decrease is only one LOS level, a significant incremental impact is not expected in relation to existing conditions. At the Arkansas River crossing, the structure heights could range from approximately 180 to 250 feet on the east bank located in Region 4. Region 4 would have the same impacts at the Arkansas River crossing as described above for Region 3.

Table 3.16-21:
Roadways with LOS Decreases for the Applicant Proposed Route—Region 4

Roadway[1]	Location	Map ID	Existing LOS	LOS with Project Construction
Class I				
SH-23	south of Ozark, AR	41455642	B	C
West Commercial Street	in Ozark, AR	41456033	C	D
Ozark Franklin County Airport	in Ozark, AR	425748260	A	B
SH-219	in Ozark, AR	425751612	C	D
Highway 219	north of Ozark, AR	425753499	A	B
North 6th Street	in Van Buren, AR	434179275	A	B
Dora Road	west of Van Buren, AR	443274111	A	B
East Cherokee Avenue	in Sallisaw, OK	495345002	C	D
East Cherokee Avenue	in Sallisaw, OK	495345030	C	D
SH-60	northwest of Alma, AR	496214037	A	B
Highway 282	northeast of Van Buren, AR	496215536	A	B
South Rogers Street	in Clarkesville, AR	496232484	C	D
South Rogers Street	in Clarkesville, AR	496232533	C	D
South Rogers Street	in Clarkesville, AR	496235352	C	D
East Main Street	in Clarkesville, AR	496236784	C	D
West Cherokee Avenue	in Vian, OK	499685764	B	C
South Thornton Street	in Vian, OK	499689658	B	C
East Schley Street	in Vian, OK	499689764	B	C
West Cherokee Avenue	in Sallisaw, OK	499690553	C	D
US-59	in Sallisaw, OK	499691323	C	D
West Cherry Street	in Alma, AR	508287883	A	B
US-64	west of Ozark, AR	508624079	A	B
East Main Street	in Clarkesville, AR	508628771	B	C
SH-123	in Clarkesville, AR	508628790	A	B

Table 3.16-21:
Roadways with LOS Decreases for the Applicant Proposed Route—Region 4

Roadway[1]	Location	Map ID	Existing LOS	LOS with Project Construction
West Main Street	in Clarkesville, AR	510341660	C	D
West Main Street	in Clarkesville, AR	510342226	C	D
US-59	in Sallisaw, OK	510587183	B	C
North 11th Street	in Van Buren, AR	511174296	A	B
Class II				
North 6th Street	in Van Buren, AR	434179275	A	B
Dora Road	west of Van Buren, AR	443274111	A	B
SH-60	northwest of Alma, AR	496214037	A	B
Highway 282	northeast of Van Buren, AR	496215536	A	B
West Cherry Street	in Alma, AR	508287883	A	B
North 11th Street	in Van Buren, AR	511174296	A	B

1 The values in this table would not be affected by the minor changes that would result from application of the minor route variations and adjustments.
Source: Clean Line (2014)

Seven route variations were developed in Region 4 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.4. The variations are illustrated in Exhibit 1 of Appendix M. In comparison to the original Applicant Proposed Link, Link 3, Variation 1, would have the same mileage within 50 feet of roadways. 3, Variation 2, would have slightly more mileage (0.04 mile) within 50 feet of roadways and would avoid two airstrips that are within 1 mile of the original Applicant Proposed Route. This route variation is proposed along with the original Applicant Proposed Route. Link 3, Variation 3, would have 0.02 mile less mileage within 50 feet of roadways. Link 6, Variation 1, would have the same impacts on transportation as the original Applicant Proposed Route. Link 6, Variation 2, would have slightly more mileage (0.08 mile) within 50 feet of roadways. Link 6, Variation 3 would have 0.02 mile less mileage within 50 feet of roadways and would have one less road crossing. Link 9, Variation 1, would have 0.03 less mileage within 50 feet of roadways.

The Applicant Proposed Route crosses three railroads. The Applicant Proposed Route centerline is within approximately 1 mile of one public airport, Ozark-Franklin County Airport (within 0.6 mile) and 3.7 miles from Clarksville Municipal Airport. The Applicant Proposed Route centerline is within 2 miles of a private hospital heliport and within 4 miles of two private airports. However, most transmission structures are not expected to exceed 200 feet in height, and the landscape in the area is relatively flat, so they are unlikely to trigger FAA height or slope ratio limitations. The representative route centerline is 3.9 miles from the CZE NDB navigation aid and is not expected to impact the facility.

The more populated area of Van Buren, Arkansas may have bus and emergency routes that could be impacted by construction traffic.

3.16.6.2.3.1.5 Region 5

The Applicant Proposed Route would cross the following federal and state highways: US-65, US-167, US-67, SH-164, SH-105, SH-124, SH-95, SH-287, SH-107, SH-16, SH-157, SH-87, SH-367, and SH-224. Table 3.16-22 lists roadway segments where the LOS is predicted to decrease during construction. The representative centerline of the

Applicant Proposed Route is within 50 feet of 0.9 mile of state highways and 5 miles of county roads. The proximity to roadways might result in impacts to roadway ROW and traffic.

Table 3.16-22:
Roadways with LOS Decreases for the Applicant Proposed Route—Region 5

Roadway[1]	Location	Map ID	Existing LOS	LOS with Project Construction
Class I				
Little Rock Road	north of Rose Bud, AR	495086707	B	C
Edgemont Road	northeast of Quitman, AR	495087059	A	B
SR 124	northeast of Russellville, AR	496275226	A	B
Heber Springs Road West	south of Heber Springs, AR	515874130	C	D
Highway 9	northwest of Damascus, AR	516208297	A	B
Class II				
Edgemont Road	northeast of Quitman, AR	495087059	A	B
SR 124	east of Dover, AR	496275226	A	B
Highway 9	southwest of Choctaw, AR	516208297	A	B

1 The values in this table would not be affected by the minor changes that would result from application of the minor route variations and adjustments.

Source: Clean Line (2014)

Five route variations were developed in Region 5 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.5. The variations are illustrated in Exhibit 1 of Appendix M. In comparison to the Applicant Proposed Route, Link 1, Variation 2, would have slightly more mileage (0.05 mile) within 50 feet of roadways and would have one additional road crossing. Link 2, Variation 2, would have slightly more mileage (<0.1 mile) within 50 feet of roadways and would cross 2 less roadways. Links 2 and 3, Variation 1, would have slightly more mileage (0.01 mile) within 50 feet of roadways. It should be noted that a route adjustment was made for HVDC Alternative Route 5-B to maintain continuity with the variation. Links 3 and 4, Variation 2, would have the same mileage within 50 feet of roadways and would have one additional road crossing. It should be noted that a route adjustment was made for HVDC Alternative Route 5-E to maintain continuity with the variation. Link 7, Variation 1, would have the same mileage within 50 feet of roadways.

The Applicant Proposed Route crosses one railroad near US-67. The Applicant Proposed Route centerline is located 1 to 3 miles from one private airport and two private airstrips. Transmission structures for the route are not expected to exceed 200 feet in height and slope ratios in relation to the airports would not exceed 1:50, so FAA review requirements are not anticipated.

3.16.6.2.3.1.6 Region 6

The Applicant Proposed Route would cross the following federal and state highways: US-49, SH-17, SH-145, SH-37, SH-214, SH-1, SH-163, and SH-75. The crossings would require ROW permits. Table 3.16-23 lists roadway segments where the LOS is predicted to decrease during construction. The route centerline is within 50 feet of 10.4 miles of county roads. The proximity to roadways might result in impacts to roadway ROW and traffic.

Table 3.16-23:
Roadways with LOS Decreases for the Applicant Proposed Route—Region 6

Roadway[1]	Location	Map ID	Existing LOS	LOS with Project Construction
Class I				
Highway 14 East	south of Newport, AR	41848771	A	B
SH-14	east of Marked Tree, AR	445617713	A	B
Highway 1	south of Cherry Valley, AR	495221858	B	C
SH-14	north of Newport, AR	500360708	A	B
Class II				
SH-14	north of Newport, AR	500360708	A	B

1 The values in this table would not be affected by the minor changes that would result from application of the minor route variations and adjustments.

Source: Clean Line (2014)

One route variation was developed in Region 6 after the publication of the Draft EIS. The route variation is described in Appendix M and summarized in Section 2.4.2.6. The variation is illustrated in Exhibit 1 of Appendix M. In comparison to the original Applicant Proposed Route, Link 2, Variation 1, would have slightly less mileage (0.09 mile) within 50 feet of roadways than the original Applicant Proposed Route. It should be noted that a route adjustment was made for HVDC Alternative Route 6-A to maintain continuity with the variation.

The Applicant Proposed Route crosses two railroads: one near SH-1 and one near US-49. The Applicant Proposed Route centerline is 0.1 mile to 3.4 miles from 14 private airfields. Transmission structures for the route are not expected to exceed 200 feet in height and slope ratios in relation to the airports/airfields would not exceed 1:50, so FAA review requirements are not anticipated.

The height of the transmission structures at the Mississippi River crossing could reach approximately 350 feet on the west bank within Region 6 to maintain necessary clearance over the navigable channels.

3.16.6.2.3.1.7 Region 7

The Applicant Proposed Route would cross the following federal and state highways: US-63, US-61, US-51/SH-3, SH-149, SH-322, SH-308, SH-77, and I-55. Table 3.16-24 lists roadway segments where the LOS is predicted to decrease during construction of the proposed Project, including general locations. The route centerline is within 50 feet of 2.1 miles of local roads and 4.4 miles of county roads.

Three route variations were developed in Region 7 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.7. The variations are illustrated in Exhibit 1 of Appendix M. In comparison to the original Applicant Proposed Route, Link 1, Variation 1, would have slightly less mileage (<0.1) within 50 feet of roadways. Link 1, Variation 2, would encounter 0.06 mile less mileage within 50 feet of roadways, and would cross one additional road, but it would cross one less interstate/U.S./state highway. ,Link 5, Variation 1, would encounter the same mileage within 50 feet of roadways.

Table 3.16-24:
Roadways with LOS Decreases for the Applicant Proposed Route—Region 7

Roadway[1]	Location	Map ID	Existing LOS	LOS with Project Construction
Class I				
US-63	in Gilmore, AR	385533228	C	D
Munford Avenue	in Munford, TN	474296840	C	D
Kimbrough Avenue	in Munford, TN	474297271	B	C
Atoka Idaville Road	in Atoka, TN	474297776	C	D
Navy Road	in Millington, TN	477136664	C	D
Navy Road	in Millington, TN	477136700	C	D
Armour Road	east of Millington, TN	477136908	A	B
Church Street	in Millington, TN	477137273	C	D
Raleigh Millington Road	in Millington, TN	477137862	C	D
SH-14	east of Millington, TN	477138707	C	D
Singleton Pkwy	in Millington, TN	477140029	C	D
Sledge Road	east of Millington, TN	477140121	A	B
Highway 63	in Gilmore, AR	507380920	C	D
Class II				
Armour Road	east of Millington, TN	477136908	A	B
Sledge Road	east of Millington, TN	477140121	A	B

1 The values in this table would not be affected by the minor changes that would result from application of the minor route variations and adjustments.
Source: Clean Line (2014)

The Applicant Proposed Route would cross the Mississippi River in Region 7. Only two highways cross the river near the proposed Project: I-40/US-64 and I-55/US-61. These highways are located in the urban areas of West Memphis, Arkansas, on the western side of the river, and in Memphis, Tennessee, on the eastern side of the river, and they are not located in the 6-mile ROI. The AADTs on these interstate highways near the river crossing range from 54,725 to 58,389. AADTs along I-40 farther east in the city of Memphis increase to more than 80,000. The 1,117 trips associated with construction of the converter station and the HVDC transmission line (Table 3.16-9) could increase the AADT on these highways by about 2 percent. This increase would not be significant for either highway over a 24-hour period.

The Applicant Proposed Route crosses three railroads: one near US-63, one near US-61, and one near US-51. The Applicant Proposed Route is within 2.5 miles of the Marked Tree Municipal Airport. Based on a 50:1 surface extending from the runway of this airport and structure heights that are not expected to exceed 200 feet, FAA notification would not be required. The Applicant Proposed Route is within 2 miles of the Millington Regional Jetport. Based on a 100:1 surface extending from the runway of this airport and potential structure heights, transmission line structures are likely to be subject to FAA review. The Applicant has and intends to continue to coordinate with the City of Millington and the FAA in the implementation of solutions to ensure continued safe airport operations. The Applicant intends to complete and submit Form 7460-1 (Notice of Proposed Construction or Alteration) to initiate FAA review as required for all structures that meet the criteria under 17 CFR Part 77.

The transmission structure height at the Mississippi River crossing might reach 350 feet to maintain necessary clearance over the navigable channels. River traffic may be controlled, in coordination with the USACE, during the short time required to span the conductor across the Mississippi River. However, no airports are located within 4 miles of the crossing area.

The greater metropolitan area of Memphis, Tennessee, may have bus and emergency routes that could be impacted by construction traffic. Bus and emergency routes would be identified in a Transportation and Traffic Management Plan described in Section 3.16.6.1.2. The plan would also include specific measures to avoid and mitigate potential impacts to bus routes and emergency vehicle traffic.

3.16.6.2.3.2 Operations and Maintenance Impacts

Operations and maintenance of the HVDC transmission line in Arkansas would require a total of 10 employees. These 10 new jobs would result in related increased population associated with family members and have the potential to induce an additional 15 jobs (see Section 3.13) in Arkansas. The additional trips from this potential increase in population, including trips from the predicted induced employment, would be negligible in terms of the existing area roadway traffic.

The additional trips that would result from the very slight potential increase in the local population as a result of 32 new jobs over the entire state of Oklahoma (for both the AC collection system and the HVDC transmission line), 10 jobs in the state of Arkansas, and 15 jobs in the state of Tennessee during operations and maintenance of the HVDC transmission line, including trips from potential induced employment, would not be noticeable in terms of the existing area roadway traffic.

The general types of impacts to traffic, roadway capacity and congestion, and railroads would be similar to those described in Section 3.16.6.2.1.2. River traffic would not be impacted. Impacts on airports would not change during the operational phase.

3.16.6.2.3.3 Decommissioning Impacts

Impacts during decommissioning would be similar to those described in Section 3.6.6.2.1.

3.16.6.3 Impacts Associated with the DOE Alternatives

3.16.6.3.1 Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area

3.16.6.3.1.1 Construction Impacts

All roadways currently operate at an acceptable LOS-C or better within the ROI. As shown in Table 3.16-25, during construction, trips generated from the converter station could result in a decrease to LOS-B from LOS-A for several segments of roadway. All roadways would continue to operate at an acceptable LOS-C or better in the converter station siting area.

Table 3.16-25:
Roadway Segments with LOS Decrease—Arkansas Converter Station Siting Area and AC Interconnection Siting Area

Roadway	Location	Map ID	Alternatives Impacted	Existing LOS	LOS with Project Construction
Class I					
US-64	east of Atkins, AR	496274975	ACS	A	B
US-64	east of Atkins, AR	496274975	ACS and HVDC line	A	B
SH-247	north of Atkins, AR	496275121	ACS and HVDC line	A	B
Class II					
Avenue Two Southeast	in Atkins, AR	496274854	ACS	A	B
SH-105 North	south of Hector, AR	496276184	ACS	A	B
SH-124	northeast of Russellville, AR	496275352	ACS	A	B
SH-124	northeast of Russellville, AR	496275226	ACS	A	B
SH-124	northeast of Russellville, AR	496275226	ACS and HVDC line	A	B
Avenue Two Southeast	in Atkins, AR	496274854	ACS and HVDC line	A	B
SH-105 North	south of Hector, AR	496276184	ACS and HVDC line	A	B
SH-105 North	north of Atkins, AR	496275339	ACS and HVDC line	A	B
SH-124	northeast of Russellville, AR	496275352	ACS and HVDC line	A	B
SH-124	northeast of Russellville, AR	496275226	ACS and HVDC line	A	B

Source: Clean Line (2014)

SH-124 and SH-247 are located within the Arkansas Converter Station Siting Area. Based on the assessment of roadway categories where centerlines are within 50 feet of the roadway, 0.17 mile of the AC interconnect centerline is within 50 feet of a county roadway.

No railroads are located within the Arkansas Converter Station Siting Area, and no airports, airstrips, or navigation aids are located within 4 miles of the siting area.

The Arkansas converter station will require a new substation at the point where the 500kV AC interconnection line taps the existing Arkansas Nuclear One-Pleasant Hill 500kV line. The substation is expected to generate a small amount of additional local traffic during construction, and traffic impacts would be slight and temporary.

3.16.6.3.1.2 Operations and Maintenance Impacts

An estimated 15 workers would be employed that could lead to an additional overall population increase of 45 persons in the local area. The additional trips from this increase in population, including trips from the predicted induced employment of 22 persons (see Section 3.13), would be negligible in terms of the existing area roadway traffic.

3.16.6.3.1.3 Decommissioning Impacts

Impacts during decommissioning would be similar to those described in Section 3.6.6.2.1.

3.16.6.3.2 HVDC Alternative Routes

3.16.6.3.2.1 Construction Impacts

Construction impacts to the transportation system under the HVDC alternative routes are discussed below by region. LOS impacts have been evaluated to describe potential impacts, but note that these are based on conservative assumptions (Section 3.16.6.1.1).

The number of railroad crossings would generally be the same for all of the alternatives because the HVDC transmission line would generally traverse the same area in each region, although the actual crossing locations would vary somewhat by HVDC alternative route.

The FAA standards for tall structures in areas near airports and airstrips apply to structures above 200 feet in height. It is unlikely that any of the transmission structures would be designed to exceed 200 feet, so it is unlikely that any of the alternatives would result in such impacts to airports and airstrips. Potential impacts to airports and airstrips, however, are discussed below and considered conservative. Construction of the proposed Project is not expected to otherwise impact air transportation.

3.16.6.3.2.1.1 Region 1

During construction of the HVDC transmission line, trips added to the analysis area are predicted to result in an LOS decrease to LOS-B from LOS-A for segments of the following roadways: US-412, US-270, and US-283. Table 3.16-26 provides an overview of impacts to roadway segments by HVDC alternative route.

Table 3.16-26:
Roadways with LOS Decreases—Region 1

Roadway	Location	Map ID	Alternatives Impacted	Existing LOS	LOS with Project Construction
US-412	West of the SH-23 intersection	493084995	AR 1-B, 1-C	A	B
US-270	between the SH-23 intersection and intersection with US-283	493085071	AR 1-B, 1-C, 1-D, APR	A	B
		493085100	AR 1-D, APR	A	B
		493085124	AR 1-D, APR	A	B
		493085143	AR 1-D, APR	A	B
		493085150	AR 1-D, APR	A	B
		493085171	AR 1-D, APR	A	B
US-283	between the US-412 intersection and US-64 intersection	493111123	AR 1-A	A	B
		493111878	AR 1-A, 1-D, APR	A	B
		493112161	AR 1-A, 1-D, APR	A	B
		493112511	AR 1-A, 1-D, APR	A	B
		493112972	AR 1-A, 1-D, APR	A	B
US-412	between Guymon and Hardesty, OK	494370475	AR 1-A, 1-C	A	B
		494371189	AR 1-A, 1-C	A	B
		494371676	AR 1-A, 1-B, 1-C	A	B
		494373033	AR 1-A, 1-B, 1-C	A	B
		494373352	AR 1-A, 1-B, 1-C, APR	A	B

Source: Clean Line (2014)

Table 3.16-27 provides a summary of potential impacts from the Region 1 HVDC alternative routes. None of the routes would cross any railroads. Although slight local variations would occur for specific alternatives, the overall impacts to traffic from the proposed Project are expected to be similar in relation to the Applicant Proposed Route.

Table 3.16-27:
HVDC Transmission Line Roadway Impacts and Railroad Crossings by HVDC Alternative Routes—Region 1

Alternative	LOS Decrease—Number of Roadway Segments[1]	LOS Decrease —Number of Segments Not Present with APR[1 2)]	Number of U.S. Highways Crossed[3]	Number of State Highways Crossed[3]	Number of Railroad Crossings[3]
1-A	10	5	4	2	0
1-B	5	3	1	0	0
1-C	7	5	1	0	0
1-D	10	0	1	0	0

NA Not applicable
1 Source: Clean Line (2014)
2 This column is based on an assessment of the comparable APR links for each HVDC Alternative route and indicates where there are additional roadway segments that are predicted for a LOS decrease.
3 Source: OCGI (2012); GIS Data Sources: AHTD (2006a), TXDOT (2013), USCB (2013)

As shown in Table 3.16-28, HVDC alternative routes have a greater number of miles within 50 feet of roadways than the comparable links of the Applicant Proposed Route.

Table 3.16-28:
Centerline within 50 Feet of Roadways—Region 1

Route	Local Roads (miles)[1]	Minor Arterials and Minor Collector Roads (miles)[1]	Principal Arterials and Major Urban Collectors (miles)[1]	State Highways (miles)[2]	County Roads (miles)[1]	U.S. Highways (miles)[2]	Interstates (miles)[2]
AR 1-A (Corresponds with APR Links 4, 5)	12.8	0.2	11.2	0	0	0	0
AR 1-B (Corresponds with APR Link 2)	5.4	0.1	1.4	0	0	0	0
AR 1-C (Corresponds with APR Link 2)	2.8	0.1	1.3	0	0	0	0
AR 1-D (Link 4)	7.2	0.1	0.3	0	0	0	0
APR Link 1	0	0	0	0	0	0	0
APR Link 2	2.1	0.3	2.7	0	0	0	0
APR Link 3	0	0	0	0	0	0	0
APR Link 4	1.0	0.1	0.3	0	0	0	0
APR Link 5	3.5	0.1	0.4	0	0	0	0

1 GIS Data Sources: TXDOT (2013), CSA (2007)
2 GIS Data Sources: BTS (2013)

The LOS of five roadway segments may decrease for the HVDC alternative routes beyond the Applicant Proposed Route, so a small potential exists for increased construction impacts on LOS in comparison to the Applicant Proposed Route within this area.

While the centerline for HVDC Alternative Route 1-A is located 1.3 miles from the Laverne Municipal Airport (Table 3.16-3), its transmission structures are not expected to exceed 200 feet in height, and the landscape in the area is relatively flat, so FAA review requirements are not anticipated. HVDC Alternative Routes 1-B, 1-C, and 1-D centerlines are not located within 4 miles of airports, airfields, or navigation aids.

3.16.6.3.2.1.2 Region 2

Table 3.16-29 provides a list of roadway segments in Region 2 where there are predicted decreases in LOS related to construction. During construction of the HVDC transmission line, trips added to the ROI are indicated to result in a decrease to LOS-B from LOS-A for segments of the following federal and state roadways: US-412, US-60, and SH-51, SH-58, and SH-8.

Table 3.16-29:
Roadways with LOS Decreases—Region 2

Roadway	Location	Map ID	Alternatives Impacted	Existing LOS	LOS with Project Construction
Class I					
SH-51	west of Hennessey, OK	499802732	APR	A	B
East Jack Choate Avenue	in Hennessey, OK	499803699	APR	A	B
SH-51	east of Hennessey	499803873	AR 2-B, APR	A	B
US-412	between US-281 and US-60/SH8	499825530	AR 2-A	A	B
US-412	between US-281 and US-60/SH8	499825532	AR 2-A	A	B
US-412	between US-281 and US-60/SH8	499825533	AR 2-A	A	B
US-412	between US-281 and US-60/SH8	499825643	AR 2-A	A	B
US-412	between US-281 and US-60/SH8	499825708	AR 2-A	A	B
US-412	between US-281 and US-60/SH8	499825716	AR 2-A	A	B
US-412	between US-281 and US-60/SH8	499825717	AR 2-A	A	B
SH-58	south of Fairview, OK	499826079	APR	A	B
SH-8	in Cleo Springs, OK	499827457	AR 2-A	A	B
SH-58	south of Ringwood, OK	499828846	AR 2-A	A	B
US-60	north of Seiling, OK	499829895	APR	A	B
US-412	between US-281 and US-60/SH8	499830219	AR 2-A	A	B
US-412	between US-281 and US-60/SH8	499830222	AR 2-A	A	B
US-412	between US-281 and US-60/SH8	499830228	AR 2-A	A	B
US-412	between US-281 and US-60/SH8	499830320	AR 2-A	A	B
US-412	between US-281 and US-60/SH8	499830387	AR 2-A	A	B
US-412	between US-281 and US-60/SH8	499830399	AR 2-A	A	B
South Main Street	in Fairview, OK	499830450	APR	A	B
US-60	in Fairview, OK	499830451	APR	A	B
US-60	north of Seiling, OK	499830588	APR	A	B
US-412	between US-281 and US-60/SH-8	499830616	AR 2-A	A	B

Table 3.16-29:
Roadways with LOS Decreases—Region 2

Roadway	Location	Map ID	Alternatives Impacted	Existing LOS	LOS with Project Construction
Class II					
East Jack Choate Avenue	in Hennessey, OK	499803699	APR	A	B
North 3rd Street	in Cleo Springs, OK	499829882	AR 2-A	A	B
South Main Street	in Fairview, OK	499830450	APR	A	B

Source: Clean Line (2014)

Table 3.16-30 provides a summary overview of impacts to roadway segments by alternative. The Applicant Proposed Route crosses three railroads and HVDC route alternatives cross two railroads in Region 2. Railroads are located along US-412 in Woodward County, Oklahoma; in a rural region of Major County, Oklahoma; and along US-81 in Garfield County, Oklahoma.

Table 3.16-30:
HVDC Transmission Line Roadway Impacts and Railroad Crossings by HVDC Alternative Routes—Region 2

Alternative	LOS Decrease—Number of Roadway Segments[1]	LOS Decrease—Number of Segments Not Present with APR[1,2]	Number of U.S. Highways Crossed[3]	Number of State Highways Crossed[3]	Railroad Crossings[3]
2-A	17	17	3	1	0
2-B	1	0	1	1	2

1 Source: Clean Line (2014)
2 This column is based on an assessment of the comparable APR links for each alternative segment and indicates where there are additional roadway segments that are predicted for a LOS decrease.
3 Source: OCGI (2012); GIS Data Sources: AHTD (2006a), TXDOT (2013), USCB (2013)

As shown in Table 3.16-31, HVDC Alternative Route 2-B centerline has fewer miles within 50 feet of roadways than corresponding Applicant Proposed Route Link 3.

Table 3.16-31:
Centerline within 50 feet of Roadways—Region 2

Route	Local Roads (miles)[1]	Minor Arterials and Minor Collector Roads (miles)[1]	Principal Arterials and Major Urban Collectors (miles)[1]	State Highways (miles)[2]	County Roads (miles)[1]	U.S. Highways (miles)[2]	Interstates (miles)[2]
AR 2-A (Corresponds with APR Link 2)	1.3	0.1	1.8	0	0	0	0
AR 2-B (Corresponds with APR Link 3)	2.1	0	0.3	0	0	0	0
APR Link 1	0.5	0	0.9	0	0	0	0
APR Link 2	1.7	0.2	0.8	0	0	0	0
APR Link 3	17.6	0	0.3	0	0	0	0

1 GIS Data Sources: TXDOT (2013), CSA (2007)
2 GIS Data Source: BTS (2013)

The more populated area of Enid, Oklahoma, may have bus and emergency routes that could be impacted by construction traffic.

Under LOS-B, impacts to roadways for HVDC Alternative Routes 2-A and 2-B would be temporary during construction. Although slight local variations would occur for specific HVDC alternative routes, the overall impacts to traffic from the proposed Project are expected to be similar in relation to the Applicant Proposed Route.

Mileages for HVDC Alternatives 2-A and 2-B are much less than the 17.6 miles of the corresponding Applicant Proposed Route link, so the impacts would be expected to be much less than the Applicant Proposed Route.

HVDC Alternative Route 2-A does not cross any railroads. No airports, airfields, or navigation aids are located within 4 miles of the route. HVDC Alternative Route 2-B crosses two railroads: one near EO550 Road and one near US-81. HVDC Alternative Route 2-B is located within 1 mile of the Steinert Lakes private airport (Table 3.16-3).

3.16.6.3.2.1.3 Region 3

Table 3.16-32 provides a list of roadway segments that are predicted to have a decrease in LOS during construction. During construction of the HVDC transmission line, trips added to the ROI could result in a decrease to LOS-B from LOS-A and to LOS-C from LOS-B for some segments.

Table 3.16-32:
Roadways with LOS Decreases—Region 3

Roadway[1]	Location	Map ID	Alternatives Impacted	Existing LOS	LOS with Project Construction
Class I					
S Highway 48	south of Bristow, OK	9852388	AR 3-C	A	B
East 6th Avenue	east of Stillwater	424886892	AR 3-B, APR	B	C
SH-108	in Ripley, OK	424900156	AR 3-B, 3-C, APR	A	B
SH-108	in Ripley, OK	424900277	AR 3-B, 3-C, APR	A	B
North Little Avenue	in Cushing, OK	424901487	AR 3-C, APR	B	C
SH-33	between Perkins and Cushing, OK	424902311	AR 3-B, 3-C, APR	B	C
SH-33	between Perkins and Cushing, OK	424902390	AR 3-B, 3-C, APR	B	C
SH-33	between Perkins and Cushing, OK	424902415	AR 3-B, 3-C, APR	B	C
SH-33	between Perkins and Cushing, OK	424902447	AR 3-B, 3-C, APR	B	C
SH-99	southwest of Drumright, OK	425801393	AR 3-C, APR	A	B
SH-99	southwest of Drumright, OK	425801863	AR 3-C, APR	A	B
SH-99	southwest of Drumright, OK	425806148	AR 3-C, APR	A	B
SH-16	northwest of Bristow, OK	428309035	AR 3-C, APR	A	B
West 4th Avenue	in Bristow, OK	428311066	AR 3-C, APR	B	C
West 4th Avenue	in Bristow, OK	428311068	AR 3-C, APR	B	C
East 1st Avenue	in Bristow, OK	428311270	AR 3-C, APR	B	C
South Chestnut Street	in Bristow, OK	428311782	AR 3-C, APR	B	C
SH-66	between Stroud and Depew, OK	428313405	AR 3-C	A	B
Alt 75	south of Mounds, OK	428317448	APR	A	B
West Highway 16	north of Slick, OK	428317653	AR 3-C, APR	A	B

Table 3.16-32:
Roadways with LOS Decreases—Region 3

Roadway[1]	Location	Map ID	Alternatives Impacted	Existing LOS	LOS with Project Construction
SH-16	in Slick, OK	428875984	AR 3-C, APR	A	B
Alt 75	south of Mounds, OK	439896010	APR	A	B
SH-33	between Perkins and Cushing, OK	439897933	AR 3-B, 3-C, APR	B	C
SH-66	in Bristow, OK	439903008	AR 3-C, APR	B	C
US-62	south of Haskell, OK	444814176	AR 3-C, 3-D, APR	A	B
US-64	in Haskell, OK	445475168	APR	B	C
US-64	between Webbers Falls and Gore, OK	499618847	AR 3-C, 3-D, 3-E, APR	A	B
North Hughes Avenue	in Morris, OK	499640718	AR 3-C	A	B
US-75 Bus	in Beggs, OK	499641185	AR 3-C, APR	B	C
US-75 Bus	in Beggs, OK	499641193	AR 3-C, APR	B	C
US-75 Bus	in Beggs, OK	499641199	AR 3-C, APR	B	C
US-75 Bus	in Beggs, OK	499641228	AR 3-C, APR	A	B
US-75 Bus	in Beggs, OK	499641245	AR 3-C, APR	A	B
SH-16	in Beggs, OK	499643392	AR 3-C, APR	A	B
US-64	in Gore, OK	499683838	AR 3-C, 3-D, 3-E, APR	B	C
US-64	in Gore, OK	499683842	AR 3-C, 3-D, 3-E, APR	B	C
SH-10	southeast of Gore, OK	499690169	AR 3-C, 3-D, 3-E, APR	A	B
SH-100	northeast of Gore, OK	516506775	APR	A	B
SH-100	northeast of Gore, OK	516506777	AR 3-C, 3-D, 3-E	A	B
US-64	southeast of Gore, OK	516507047	AR 3-C, 3-D, 3-E, APR	A	B
Class II					
Fairgrounds Road	east of Stillwater	424895827	AR 3-B, 3-C, APR	A	B

1 The values in this table would not be affected by the minor changes that would result from application of the minor route variations and adjustments.

Source: Clean Line (2014)

Table 3.16-33 provides an overview of impacts to roadway segments by alternative. Although slight local variations would occur for specific alternatives, the overall impacts to traffic from the proposed Project are expected to be similar for all alternatives.

Table 3.16-33:
HVDC Transmission Line Roadway Impacts and Railroad Crossings by HVDC Alternative Routes—Region 3[1]

Alternative[1]	LOS Decrease—Number of Roadway Segments[2]	LOS Decrease—Number of Segments Not Present with APR[2,3]	Number of U.S. Highways Crossed[4]	Number of State Highways Crossed[4]	Number of Railroads Crossed[4]
3-A	0	0	2	2	1
3-B	9	0	3	2	1
3-C	35	3	6	7	3
3-D	7	1	4	1	1
3-E	6	1	1	0	0

1 The values in this table would not be affected by the minor changes that would result from application of the minor route variations and adjustments.
2 Source: Clean Line (2014)
3 This column is based on an assessment of the comparable APR links for each HVDC alternative route and indicates where there are additional roadway segments that are predicted for a LOS decrease.
4 Source: OCGI (2012); GIS Data Sources: AHTD (2006a), TXDOT (2013), USCB (2013)

As shown in Table 3.16-34, HVDC Alternative Routes 3-A and 3-B centerlines have fewer miles within 50 feet of roadways than the corresponding Applicant Proposed Link 1.

Table 3.16-34:
Centerline within 50 feet of Roadways—Region 3

Route[1]	Local Roads (miles)[2]	Minor Arterials and Minor Collector Roads (miles)[2]	Principal Arterials and Major Urban Collectors (miles)[2]	State Highways (miles)[3]	County Roads (miles)[2]	U.S. Highways (miles)[3]	Interstates (miles)[3]
AR 3-A (Corresponds with APR Link 1)	1.9	0.1	0.5	0	0	0	0.1
AR 3-B (Corresponds with APR Link 1)	2.3	0.1	0.6	0	0	0	0.1
AR 3-C (Corresponds with APR Links 4, 5)	5.2	0.1	1.5	0	0	0	0.1
AR 3-D (Corresponds with APR Links 2, 3)	1.7	0	0.6	0	0	0	0
AR 3-E (Corresponds with APR Link 5)	0.4	0	0.3	0	0	0	0
APR Link 1	6.1	0.1	0.4	0	0	0	0.1
APR Link 2	0.1	0.1	0.1	0	0	0	0
APR Link 3	0.2	0	0.1	0	0	0	0
APR Link 4	3.6	0.4	1.0	0	0	0	0.1
APR Link 5	1.0	0	0.5	0	0	0	0
APR Link 6	0.5	0	0.4	0	0	0	0

1 The values in this table would not be affected by the minor changes that would result from application of the minor route variations and adjustments.
2 GIS Data Sources: TXDOT (2013), CSA (2007)
3 GIS Data Source: BTS (2013)

The more populated areas of Stillwater and Muskogee, Oklahoma, may have bus and emergency routes that could be impacted by construction traffic.

HVDC Alternative Route 3-A would not individually result in an LOS decrease for any roadway segments in Region 3. 3-B would have decreases to LOS-B from LOS-A and to LOS-C from LOS-B. 3-C would have decreases to LOS-B from LOS-A and to LOS-C from LOS-B. These decreases are similar to the roadway segment decreases predicted for the Applicant Proposed Route.

HVDC Alternative Route 3-C would result in the LOS decrease of three additional roadway segments beyond the number of roadway segments predicted for the Applicant Proposed Route in the comparable area. 3-D would result in LOS decrease for one additional roadway segment beyond the number of roadway segments predicted for the Applicant Proposed Route. 3-E would result in the LOS decrease of one additional roadway segment beyond the number of roadway segments predicted for the Applicant Proposed Route. Therefore, the potential exists for increased construction impacts with HVDC Alternative Routes 3-C, 3-D, and 3-E for decreases in LOS in comparison to the Applicant Proposed Route. However, under LOS-B and LOS-C, impacts to roadways would be temporary during construction.

The Applicant Proposed Route would be parallel to and within 50 feet of 6.1 miles of local roads. HVDC Alternative 3-A mileage would be 1.9 miles. HVDC Alternative 3-B mileage would be 2.3 miles. HVDC Alternative 3-C mileage would be 5.2 miles. HVDC Alternative Route 3-D would be 1.7 miles. HVDC Alternative 3-D mileage would be less than 1 mile. These mileages are less than or comparable to the associated Applicant Proposed Route links and the impacts would be temporary during construction.

HVDC Alternative Routes 3-C, 3-D, and 3-E transmission structures would not be expected to exceed 200 feet in height, and the landscape in the area is relatively flat, so FAA review requirements are not anticipated. The exception would be for HVDC Alternative 3-E at the Arkansas River crossing where the height on the west bank could range from approximately 130 to 200 feet to maintain necessary clearance over the navigable channels. River traffic may be controlled, in coordination with the USACE, during the short time required to span the conductor across the Arkansas River under HVDC Alternative Routes 3-C, 3-D, or 3-E, and Applicant Proposed Route Link 6. However, no airports are located within 4 miles of the crossing area.

A route adjustment was developed for HVDC Alternative Route 3-A to maintain continuity with Applicant Proposed Route Link 1, Variation 1, and Links 1 and 2, Variation 1. Compared to the original HVDC alternative route, the route adjustment would have slightly more mileage (0.01 mile) within 50 feet of roadways and the centerline is not located within 1 mile of any private airstrips or heliports. The route adjustment is illustrated in Exhibit 1 of Appendix M.

3.16.6.3.2.1.4 Region 4

Table 3.16-35 lists roadway segments where the LOS is predicted to decrease during construction of the Project. During construction of the HVDC transmission line, trips added to the ROI could result in a decrease to LOS-B from LOS-A, to LOS-C from LOS-B, and to LOS-D from LOS-C for some segments. Most of the LOS-D roadway segments are located in Clarkesville, Arkansas. Although an LOS-D would result in a decrease in roadway operation, the decrease would be temporary and would be minimally noticeable by motorists.

Table 3.16-35:
Roadways with LOS Decreases—Region 4

Roadway	Location	Map ID	Alternatives Impacted	Existing LOS	LOS with Project Construction
Class I					
SH-23	south of Ozark, AR	41455642	AR 4-E, APR	B	C
West Commercial Street	in Ozark, AR	41456033	AR 4-B, 4-E, APR	C	D
Ozark Franklin County Airport	in Ozark, AR	425748260	AR 4-B, 4-E, APR	A	B
SH-219	in Ozark, AR	425751612	AR 4-B, 4-E, APR	C	D
Highway 219	north of Ozark, AR	425753499	AR 4-B, 4-E, APR	A	B
North 6th Street	in Van Buren, AR	434179275	APR	A	B
Dora Road	west of Van Buren, AR	443274111	APR	A	B
East Cherokee Avenue	in Sallisaw, OK	495345002	APR	C	D
East Cherokee Avenue	in Sallisaw, OK	495345030	APR	C	D
SH-60	northwest of Alma, AR	496214037	APR	A	B
North Highway 71	north of Alma, AR	496214633	AR 4-A, 4-B, 4-D	B	C
Highway 282	northeast of Van Buren, AR	496215536	APR	A	B
South Rogers Street	in Clarkesville, AR	496232484	AR 4-E, APR	C	D
South Rogers Street	in Clarkesville, AR	496232533	AR 4-E, APR	C	D
South Rogers Street	in Clarkesville, AR	496235352	AR 4-E, APR	C	D
East Main Street	in Clarkesville, AR	496236784	AR 4-E, APR	C	D
US-64	in Webbers Falls, OK	499618847	AR 4-B	A	B
US-64	in Gore, OK	499683838	AR 4-B	B	C
US-64	in Gore, OK	499683842	AR 4-B	B	C
West Cherokee Avenue	in Vian, OK	499685764	AR 4-A, APR	B	C
US-59	northeast of Sallisaw, OK	499686807	AR 4-A, 4-B	A	B
South Thornton Street	in Vian, OK	499689658	AR 4-A, 4-B, APR	B	C
East Schley Street	in Vian, OK	499689764	AR 4-A, 4-B, APR	B	C
West Cherokee Avenue	in Sallisaw, OK	499690553	APR	C	D
US-59	in Sallisaw, OK	499691323	APR	C	D
West Cherry Street	in Alma, AR	508287883	APR	A	B
US-64	west of Ozark, AR	508624079	AR 4-B, APR	A	B
East Main Street	in Clarkesville, AR	508628771	AR 4-E, APR	B	C
SH-123	in Clarkesville, AR	508628790	AR 4-E, APR	A	B
West Main Street	in Clarkesville, AR	510341660	AR 4-E, APR	C	D
West Main Street	in Clarkesville, AR	510342226	AR 4-E, APR	C	D
US-59	in Sallisaw, OK	510587183	APR	B	C
North 11th Street	in Van Buren, AR	511174296	APR	A	B
US-64	southeast of Gore, OK	516507047	AR 4-B	A	B
Class II					
North 6th Street	in Van Buren, AR	434179275	AR 4-C, 4-D, APR	A	B
Dora Road	west of Van Buren, AR	443274111	AR 4-C, 4-D, APR	A	B
SH-60	northwest of Alma, AR	496214037	AR 4-A, 4-B, 4-C, 4-D, APR	A	B
Highway 282	northeast of Van Buren, AR	496215536	AR 4-A, 4-C, 4-D, APR	A	B
SH-10	northwest of Gore, OK	499622510	AR 4-B	A	B
SH-10	northwest of Gore, OK	499691530	AR 4-B	A	B

Table 3.16-35:
Roadways with LOS Decreases—Region 4

Roadway	Location	Map ID	Alternatives Impacted	Existing LOS	LOS with Project Construction
West Cherry Street	in Alma, AR	508287883	AR 4-A, 4-B, 4-D, APR	A	B
North 11th Street	in Van Buren, AR	511174296	AR 4-C, 4-D, APR	A	B

Source: Clean Line (2014)

Table 3.16-36 provides an overview of impacts to roadway segments by alternative. Although slight local variations would occur for specific alternatives, the overall impacts to traffic from the Project are expected to be similar for all alternatives.

The more populated area of Van Buren, Arkansas, may have bus and emergency routes that could be impacted by construction traffic.

Figure 3.16-1 in Appendix A provides additional details regarding existing roadways, railroads, and airports and airstrips within Region 4. Additional discussion for individual alternatives is provided in the sections below.

Table 3.16-36:
HVDC Transmission Line Roadway Impacts and Railroad Crossings by HVDC Alternative Routes—Region 4

Alternative	LOS Decrease—Number of Roadway Segments[1]	LOS Decrease—Number of Segments Not Present with APR[1, 2]	LOS Decrease to LOS-D or F[1]	Number of U.S. Highways Crossed[3]	Number of State Highways Crossed[3]	Number of Railroads Crossed[3]
AR 4-A	8	1	0	3	6	2
AR 4-B	17	8	2	3	9	2
AR 4-C	5	0	0	0	1	0
AR 4-D	7	1	0	2	5	1
AR 4-E	13	0	8	2	6	0

1 Source: Clean Line (2014)
2 This column is based on an assessment of the comparable APR links for each HVDC alternative route and indicates where there are additional roadway segments that are predicted for a LOS decrease.
3 Source: OCGI (2012); GIS Data Sources: AHTD (2006a), TXDOT (2013), USCB (2013)

Table 3.16-37 shows the centerline mileage within 50 feet of roadways for the HVDC alternative routes and the corresponding links of the Applicant Proposed Route.

HVDC Alternative Route 4-A would result in one decrease to LOC-C greater than the roadway segment decreases predicted for the Applicant Proposed Route. HVDC Alternative Route 4-B would result in a decrease from LOS-B to LOS-C; 4-C would result in a decrease from LOS-A from LOS-B; 4-D would result in a decrease from LOS-A to LOS-B and LOS-B to LOS-C; 4-E would result in a decrease from LOS-A from LOS-B, LOS-B to LOS-C, and LOS-C to LOS-D.

Table 3.16-37:
Centerline within 50 Feet of Roadways—Region 4

Route	Local Roads[1] (miles)	Minor Arterials and Minor Collector Roads[1] (miles)	Principal Arterials and Major Urban Collectors[1] (miles)	State Highways[2] (miles)	County Roads[1] (miles)	U.S. Highways[2] (miles)	Interstates[2] (miles)
AR 4-A (Corresponds with APR Links 3, 4, 5, 6)	1.0	0	0.4	0.3	1.4	0.1	0.1
AR 4-B (Corresponds with APR Links 2, 3, 4, 5, 6, 7, 8)	0.9	0	0.3	0.4	3.9	0.2	0.1
AR 4-C (Corresponds with APR Link 5)	0	0	0	0.1	0.2	0	0
AR 4-D (Corresponds with APR Links 4, 5, 6)	0	0	0	0.2	1.4	0.1	0.1
AR 4-E (Corresponds with APR Links 8, 9)	0.2	0	0	0.4	4.2	0	0.1
APR (Link 1)	0.4	0.1	0.2	0	0	0	0
APR (Link 2)	0.2	0	0	0	0	0	0
APR (Link 3)	0.6	0.1	0.4	0	0.2	0	0
APR (Link 4)	0	0	0	0	0.1	0	0
APR (Link 5)	0	0	0	0.1	0.1	0	0
APR (Link 6)	0.2	0	0	0.2	1.8	0.1	0.4
APR (Link 7)	0	0	0	0.1	0.7	0	0
APR (Link 8)	0	0	0	0	0	0.1	0
APR (Link 9)	0	0	0	0.3	2.7	0	0

1 GIS Data Sources: AHTD (2006a), CSA (2007)
2 GIS Data Source: BTS (2013), USCB (2000)

HVDC Alternative Route 4-A mileage would be 1.0 mile on local roads and 1.4 miles on county roads. HVDC Alternative Route 4-B mileage would be 0.9 mile for local roads and 3.9 miles for county roads. HVDC Alternative Route 4-C mileage would be less than 1 mile. HVDC Alternative Route D mileage would be 1.4 miles. The mileages for HVDC Alternative Routes 4-A, 4-B, 4-C, and 4-D would be comparable to the mileage of the corresponding Applicant Proposed Route links. HVDC Alternative 4-E mileage would be 4.2 miles, and this mileage is greater than the mileage of the corresponding Applicant Proposed Route links.

HVDC Alternative Routes 4-A, 4-B would cross two railroads, one near Marble City, Oklahoma, and one near I-540, and would require easements. HVDC Alternative Route 4-C would cross one railroad near I-540. HVDC Alternative Route 4-D would cross two railroads, one near Marble City, Oklahoma, and one near I-540, and would require easements. HVDC Alternative Route 4-E would not cross any railroads.

HVDC Alternative Route 4-A centerline is not located within 4 miles of any airports, airfields, or navigation aids. HVDC Alternative Route 4-B centerline is located 3.72 miles from the Ozark-Franklin County Airport (Table 3.16-3). This distance is considerably greater than the Applicant Proposed Route. HVDC Alternative Route 4-C centerline is located 3.9 miles from a private hospital heliport (Table 3.16-3). HVDC Alternative Route 4-D centerline is not located within 4 miles of any airports, airfields, or navigation aids. HVDC Alternative Route 4-E centerline is located within about 1 mile of the Clarksville Municipal Airport and is 3.9 miles from the Ozark-Franklin County Airport and within 4 miles of two public heliports. HVDC Alternative 4-E centerline is located 1.3 miles from the CZE NDB Clarksville navigation aid and is not expected to cause interference with the facility. Transmission structures for HVDC Alternative Routes 4-B, 4-C, and 4-E are not expected to exceed 200 feet in height, and the landscape in the area is relatively flat, so FAA review requirements are not anticipated. None of the HVDC Alternative Routes in Region 4 would span the Mississippi Region.

3.16.6.3.2.1.5 Region 5

Table 3.16-38 lists roadway segments where the LOS is predicted to decrease during construction. During construction of the HVDC transmission line, trips added to the ROI are predicted to result in a decrease from LOS-A to LOS-B for segments of the following roadways: SH-14, Edgemont Road, SR 124, Highway 9, and Blackland Road. During construction of the HVDC transmission line, trips added to the ROI are predicted to result in a decrease from LOS-B to LOS-C for segments of Little Rock Road. Under LOS-B and LOS-C, impacts to roadways would be temporary during construction.

During construction of the HVDC transmission line, trips added to the analysis area are predicted to result in a decrease from LOS-C to LOS-D for segments of Heber Springs Road W located northwest of Damascus, Arkansas.

Table 3.16-38:
Roadways with LOS Decreases—Region 5

Roadway[1]	Location	Map ID	Alternatives Impacted	Existing LOS	LOS with Project Construction
Class I					
SH-14	near the intersection with US-67	444973582	AR 5-D	A	B
Little Rock Road	north of Rose Bud, AR	495086707	AR 5-B, 5-E, 5-F, APR	B	C
Edgemont Road	northeast of Quitman, AR	495087059	APR	A	B
SR 124	northeast of Russellville, AR	496275226	APR	A	B
Heber Springs Road W	south of Heber Springs, AR	515874130	APR	C	D
Highway 9	northwest of Damascus, AR	516208297	APR	A	B
Class II					
Blackland Road	in Pleasant Plains, AR	447212101	AR 5-D	A	B
Edgemont Road	northeast of Quitman, AR	495087059	APR	A	B
SR 124	east of Dover, AR	496275226	AR 5-A, APR	A	B
Highway 9	southwest of Choctaw, AR	516208297	AR 5-B, APR	A	B

1 The values in this table would not be affected by the minor changes that would result from application of the minor route variations and adjustments.
Source: Clean Line (2014)

Table 3.16-39 provides an overview of impacts to roadway segments by alternative. Although slight local variations would occur for specific alternatives, the overall impacts to traffic from the Project are expected to be similar in relation to the Applicant Proposed Route. Additional discussion for individual alternatives is provided in the sections below.

Table 3.16-39:
HVDC Transmission Line Roadway Impacts and Railroad Crossings by HVDC Alternative Routes—Region 5

Alternative[1]	LOS Decrease—Number of Roadway Segments[2]	LOS Decrease—Number of Segments Not Present with APR[2,3]	LOS Decrease to LOS-D or F[2]	Number of U.S. Highways Crossed[4]	Number of State Highways Crossed[4]	Number of Railroads Crossed[4]
AR 5-A	1	0	0	0	1	0
AR 5-B	2	0	0	1	10	0
AR 5-C	0	0	0	0	2	0
AR 5-D	2	2	0	2	2	1
AR 5-E	1	0	0	0	6	0
AR 5-F	1	0	0	0	3	0

1 The values in this table would not be affected by the small changes that would result from application of the minor route variations and adjustments.
2 Source: Clean Line (2014)
3 This column is based on an assessment of the comparable APR links for each HVDC alternative route and indicates where there are additional roadway segments that are predicted for a LOS decrease.
4 Source: OCGI (2012); GIS Data Sources: AHTD (2006a), TXDOT (2013), USCB (2013)

Table 3.16-40 shows the centerline mileage within 50 feet of roadways for the HVDC alternative routes and the Applicant Proposed Route.

Table 3.16-40:
Centerline within 50 Feet of Roadways—Region 5

Route[1]	Local Roads[2] (miles)	Minor Arterials and Minor Collector Roads[2] (miles)	Principal Arterials and Major Urban Collectors[2] (miles)	State Highways[3] (miles)	County Roads[2] (miles)	U.S. Highways[3] (miles)	Interstates[3] (miles)
AR 5-A (Corresponds with APR Link 1)	0	0	0	0.1	1.0	0	0
AR 5-B (Corresponds with APR Links 3, 4, 5, 6)	0.2	0	0	0.6	3.7	0.1	0
AR 5-C (Corresponds with APR Links 6, 7)	0	0	0	0.1	0.5	0	0
AR 5-D (Corresponds with APR Links 4, 5, 6)	0	0	0	0.1	1.7	0.2	0
AR 5-E (Corresponds with APR Link 9)	0	0	0	0.3	1.7	0	0
AR 5-F (Corresponds with APR Links 5, 6)	0	0	0	0.1	1.4	0	0
APR Link 1	0	0	0	0.1	0.8	0	0
APR Link 2	0	0	0	0.1	0.3	0	0
APR Link 3	0	0	0	0.3	2.3	0.1	0
APR Link 4	0	0	0	0.2	0.4	0	0
APR Link 5	0	0	0	0	1.1	0	0
APR Link 6	0	0	0	0.1	0.1	0	0
APR Link 7	0	0	0	0.1	0.3	0	0

Table 3.16-40:
Centerline within 50 Feet of Roadways—Region 5

Route[1]	Local Roads[2] (miles)	Minor Arterials and Minor Collector Roads[2] (miles)	Principal Arterials and Major Urban Collectors[2] (miles)	State Highways[3] (miles)	County Roads[2] (miles)	U.S. Highways[3] (miles)	Interstates[3] (miles)
APR Link 8	0	0	0	0	0.1	0	0
APR Link 9	0	0	0	0.2	1.8	0.2	0

1 The values in this table would not be affected by the minor changes that would result from application of the minor route variations and adjustments.
2 GIS Data Sources: AHTD (2006a), USCB (2000)
3 GIS Data Source: BTS (2013)

HVDC Alternative Route 5-A would result a decrease from LOS-A to LOS-B. 5-B would result in a decrease from LOS-A to LOS-B and LOS-B to LOS-C. 5-C would not result in an LOS decrease for any roadway segments in Region 5. 5-D would result in a decrease from LOS-A to LOS-B and would also result in two LOS decreases that are not predicted for the Applicant Proposed Route, so the potential exists for this alternative to have greater effects on traffic than the Applicant Proposed Route. 5-E would result in a decrease from LOS-B to LOS-C. 5-F would result in decreases from LOS-B from LOS-C and LOS-C to LOS-D.

HVDC Alternative Route 5-A mileage would be 1 mile. 5-B would mileage would be 3.7 miles 5-C mileage would be less than 1 mile. 5-D mileage would be 1.7 miles. 5-E mileage would be 1.7 miles. 5-F mileage would be 1.4 miles. These mileages are comparable to the mileage of the corresponding Applicant Proposed Route links.

HVDC Alternative Routes 5-A, 5-B, 5-C 5-E, and 5-F do not cross any railroads. HVDC Alternative Route 5-D would cross one railroad near SH-367.

HVDC Alternative Route 5-A centerline is located 2.89 miles from a private airport (Table 3.16-3). Transmission structures for the alternative are not expected to exceed 200 feet in height and slope ratios in relation to the airport would not exceed 1:100. HVDC Alternative Route 5-B centerline is located within about 0.5 mile of two private airfields and within 1.2 to 2.8 miles of four private airports. HVDC Alternative Route 5-C centerline is located 2.7 miles from one private airfield. Transmission structures for HVDC Alternative Routes 4-B and 4-C are not expected to exceed 200 feet in height and slope ratios in relation to the airfield would not exceed 1:50. HVDC Alternative Route 5-D centerline is not located within 4 miles of any airports, airfields, or navigation aids. 5-E centerline is located within about 0.5 mile of two private airfields, and within 1.2 to 2.3 miles of 3 private airports. 5-F centerline is located within about 0.5 mile of two private airfields and within 1.2 to 1.8 miles of 2 private airports. Transmission structures for the alternative are not expected to exceed 200 feet in height and slope ratios in relation to the airports/airfields would not exceed 1:50, so FAA review requirements are not anticipated for any of these alternatives.

A route adjustment was developed for HVDC Alternative Route 5-B to maintain continuity with Applicant Proposed Route Links 2 and 3, Variation 1. The variation would have the same transportation impacts as the original HVDC alternative route. The route adjustment is illustrated in Exhibit 1 of Appendix M.

A route adjustment was developed for HVDC Alternative Route 5-E to maintain continuity with Applicant Proposed Route Links 3 and 4, Variation 2. The variation would have the same mileage within 50 feet of roadways as the original HVDC alternative route. The route adjustment is illustrated in Exhibit 1 of Appendix M.

3.16.6.3.2.1.6 Region 6

Table 3.16-41 lists roadway segments where the LOS is predicted to decrease during construction. During construction of the HVDC transmission line, trips added to the ROI are predicted to result in a decrease from LOS-A to LOS-B for segments of the following roadways: Highway 14 E, SH-14, and Air Base Road. During construction of the HVDC transmission line, trips added to the 6-mile ROI could result in a decrease from LOS-B to LOS-C for segments of Highway 1. During construction of the HVDC transmission line, there are no roadway segments predicted to result in a decrease from LOS-C to LOS-D in the 6-mile ROI for Region 6.

Table 3.16-41:
Roadways with LOS Decreases—Region 6

Roadway[1]	Location	Map ID	Alternatives Impacted	Existing LOS	LOS with Project Construction
Class I					
Highway 14 E	south of Newport, AR	41848771	AR 6-A, 6-B, APR	A	B
SH-14	east of Marked Tree, AR	445617713	AR 6-C, 6-D, APR	A	B
Highway 1	south of Cherry Valley, AR	495221858	APR	B	C
SH-14	north of Newport, AR	500360708	APR	A	B
Class II					
SH-14	north of Newport, AR	500360708	APR	A	B
Air Base Road	in Newport, AR	500363489	AR 6-B	A	B

1 The values in this table would not be affected by the minor changes that would result from application of the minor route variations and adjustments.
Source: Clean Line (2014)

Table 3.16-42 provides an overview of impacts to roadway segments by alternative. Although slight local variations would occur for specific alternatives, the overall impacts to traffic from the Project are expected to be similar in relation to the Applicant Proposed Route. Additional discussion for individual alternatives is provided in the sections below.

Table 3.16-42:
HVDC Transmission Line Roadway Impacts and Railroad Crossings by HVDC Alternative Routes—Region 6

Alternative[1]	LOS Decrease—Number of Roadway Segments[2]	LOS Decrease—Number of Segments Not Present with APR[2,3]	Number of U.S. Highways Crossed[4]	Number of State Highways Crossed[4]	Number of Railroads Crossed[4]
AR 6-A	1	0	1	2	1
AR 6-B	2	1	0	3	0
AR 6-C	1	0	0	3	1
AR 6-D	1	0	0	0	0

1 The values in this table would not be affected by the minor changes that would result from application of the minor route variations and adjustments.
2 Source: Clean Line (2014)
3 This column is based on an assessment of the comparable APR links for each HVDC alternative route and indicates where there are additional roadway segments that are predicted for a LOS decrease.
4 Source: OCGI (2012); GIS Data Sources: AHTD (2006a), TXDOT (2013), USCB (2013)

Table 3.16-43 shows the centerline mileage within 50 feet of roadways for the HVDC alternative routes and the corresponding links of the Applicant Proposed Route.

Table 3.16-43:
Centerline within 50 Feet of Roadways—Region 6

Route[1]	Local Roads[2] (miles)	Minor Arterials and Minor Collector Roads[2] (miles)	Principal Arterials and Major Urban Collectors[2] (miles)	State Highways[3] (miles)	County Roads[2] (miles)	U.S. Highways[3] (miles)	Interstates[3] (miles)
AR 6-A (Corresponds with APR Links 2, 3, 4)	0	0	0	0.1	1.7	0.1	0
AR 6-B (Corresponds with APR Link 3)	0	0	0	1.5	1.2	0	0
AR 6-C (Corresponds with APR Links 6, 7)	0	0	0	0.2	4.3	0	0
AR 6-D (Corresponds with APR Link 7)	0	0	0	0	0.3	0	0
APR Link 1	0	0	0	0.1	0.7	0	0
APR Link 2	0	0	0	0	0.1	0	0
APR Link 3	0	0	0	0.1	3.5	0	0
APR Link 4	0	0	0	0.1	0.4	0.1	0
APR Link 5	0	0	0	0	0.3	0	0
APR Link 6	0	0	0	0.1	4.3	0	0
APR Link 7	0	0	0	0	0.8	0	0
APR Link 8	0	0	0	0.1	0.3	0	0

1 The values in this table would not be affected by the minor changes that would result from application of the minor route variations and adjustments.
2 GIS Data Sources: AHTD (2006a), USCB (2000)
3 GIS Data Source: BTS (2013)

HVDC Alternative Route 6-A would result in a decrease from LOS-A to LOS-B and LOS-C to LOS-D. HVDC Alternative Route 6-B would result in a decrease from LOS-A to LOS-B, and for this route, one LOS decrease is predicted that is not predicted for the Applicant Proposed Route. HVDC Alternative Route 6-C would result in the decrease from LOS-A to LOS-B. 6-D would result in a decrease from LOS-A to LOS-B.

HVDC Alternative Route 6-A mileage would be 1.7 miles for county roads. 6-B mileage would be 1.2 miles for county roads and 1.5 miles for state highways. HVDC Alternative Route 6-D mileage would be less than 0.3 mile for local roads (county roads) and this mileage is less than the mileage of the corresponding Applicant Proposed Route links.

HVDC Alternative Route 6-A would cross one railroad near US-49. HVDC Alternative Route 6-B does not cross any railroads. HVDC Alternative Route 6-C would cross one railroad near SH-1. HVDC Alternative Route 6-D does not cross any railroads.

The HVDC Alternative Route 6-A centerline is located from 1.3 to 4.0 miles from nine private airfields. The HVDC Alternative Route 6-B centerline is located from 1.1 to 3.7 miles from seven private airfields. The HVDC Alternative Route 6-C centerline is located from 0.7 to 3.7 miles from eight private airfields. Transmission structures for the alternative are not expected to exceed 200 feet in height and slope ratios in relation to the airports/airfields would not exceed 1:50. FAA review requirements are therefore not anticipated. The HVDC Alternative Route 6-D centerline is not located within 4 miles of any airport, airfield, or navigation aid.

A route adjustment was developed for HVDC Alternative Route 6-A to maintain continuity with Applicant Proposed Route Link 1, Variation 1, and Link 2, Variation 1. The variation would have the same transportation impacts as the original HVDC alternative route. The route adjustment is illustrated in Exhibit 1 of Appendix M.

3.16.6.3.2.1.7 Region 7

Table 3.16-44 lists roadway segments where the LOS is predicted to decrease during construction of the Project.

Table 3.16-44:
Roadways with LOS Decreases—Region 7

Roadway	Location	Map ID	Alternatives Impacted	Existing LOS	LOS with Project Construction
Class I					
US-63	in Gilmore, AR	385533228	APR	C	D
Munford Avenue	in Munford, TN	474296840	AR 7-C, 7-D, APR	C	D
Kimbrough Avenue	in Munford, TN	474297271	AR 7-C, 7-D, APR	B	C
Atoka Idaville Road	in Atoka, TN	474297776	AR 7-C, 7-D, APR	C	D
Navy Road	in Millington, TN	477136664	AR 7-B, 7-C, 7-D, APR	C	D
Navy Road	in Millington, TN	477136700	AR 7-B, 7-C, 7-D, APR	C	D
Armour Road	east of Millington, TN	477136908	APR	A	B
Church Street	in Millington, TN	477137273	AR 7-B, 7-C, 7-D, APR	C	D
Raleigh Millington Road	in Millington, TN	477137862	AR 7-B, 7-C, 7-D, APR	C	D
SH-14	east of Millington, TN	477138707	AR 7-C, 7-D, APR	C	D
Singleton Pkwy	in Millington, TN	477140029	AR 7-B, 7-C, APR	C	D
Sledge Road	east of Millington, TN	477140121	APR	A	B
SH-14	southeast of Millington, TN	477143261	AR 7-C	C	D
Raleigh Millington Road	north edge of Memphis, TN	477144537	AR 7-C	C	D
Raleigh Millington Road	in north Memphis, TN	477147467	AR 7-C	C	D
US-61	south of Osceola, AR	496260011	AR 7-A	A	B
West Semmes Avenue	in Osceola, AR	496261166	AR 7-A	A	B
South Ermen Lane	in Osceola, AR	496267109	AR 7-A	B	C
Highway 63	in Gilmore, AR	507380920	APR	C	D
Class II					
Armour Road	east of Millington, TN	477136908	AR 7-B, 7-C, 7-D, APR	A	B
Sledge Road	east of Millington, TN	477140121	AR 7-C, 7-D, APR	A	B
Germantown Road	northeast of Bartlett, TN	477147065	AR 7-C	B	C
SH-135	in Lepanto, AR	495126627	AR 7-A	A	B

Source: Clean Line (2014)

Table 3.16-45 provides an overview of impacts to roadway segments by alternative. Additional discussion for individual alternatives is provided in the sections below.

The greater metropolitan area of Memphis, Tennessee, may have bus and emergency routes that could be impacted by construction traffic.

Table 3.16-45:
HVDC Transmission Line Roadway Impacts and Railroad Crossings by HVDC Alternative Routes—Region 7

Alternative	LOS Decrease—Number of Roadway Segments[1]	LOS Decrease—Number of Segments Not Present with APR[1, 2]	LOS Decrease to LOS-D or F[1]	Number of U.S. Highways Crossed[3]	Number of State Highways Crossed[3]	Number of Railroads Crossed[3]
AR 7-A	4	4	0	3	6	2
AR 7-B	6	0	4	0	0	0
AR 7-C	15	4	11	1	3	1
AR 7-D	10	0	7	1	0	1

1 Source: Clean Line (2014)
2 This column is based on an assessment of the comparable APR links for each HVDC alternative route and indicates where there are additional roadway segments that are predicted for a LOS decrease.
3 Source: OCGI (2012); GIS Data Sources: AHTD (2006a), TXDOT (2013), USCB (2013)

Table 3.16-46 shows the centerline mileages within 50 feet of roadways for the HVDC alternative routes and the corresponding links of the Applicant Proposed Route.

Table 3.16-46:
Centerline within 50 Feet of Roadways—Region 7

Route	Local Roads[1] (miles)	Minor Arterials and Minor Collector Roads[1] (miles)	Principal Arterials and Major Urban Collectors[1] (miles)	State Highways[2] (miles)	County Roads[1] (miles)	U.S. Highways[2] (miles)	Interstates[2] (miles)
AR 7-A (Corresponds with APR Link 1)	1.1	0	0	1.1	2.8	0.2	0.1
AR 7-B (Corresponds with APR Links 3, 4)	1.5	0	0	0	0	0	0
AR 7-C (Corresponds with APR Links 3, 4, 5)	1.8	0	0	0.3	0	0.1	0.1
AR 7-D (Corresponds with APR Links 4, 5)	0.4	0	0	0.1	0	0	0
APR Link 1	0.1	0	0	0.6	4.4	0.2	0.1
APR Link 2	1.0	0	0	0	0	0	0
APR Link 3	0.4	0	0	0	0	0	0
APR Link 4	0.1	0	0	0	0	0	0
APR Link 5	0.6	0	0	0.2	0	0.2	0

1 GIS Data Sources: AHTD (2006a), USCB (2000)
2 GIS Data Source: BTS (2013)

HVDC Alternative Route 7-A would result in a decrease from LOS-A to LOS-B and a decrease from LOS-B to LOS-C. There are two LOS decreases for this route that are not predicted for the Applicant Proposed Route. HVDC

Alternative Route 7-B would result in a decrease from LOS-A to LOS-B, from LOS-B to LOS-C, and from LOS-C to LOS-D. 7-C would result in a decrease from LOS-A to LOS-B, from LOS-B to LOS-C, and from LOS-C to LOS-D. This route has a greater number of LOS-C to LOS-D decreases than the Applicant Proposed Route. 7-D would result in a decrease from LOS-A to LOS-B, LOS-B to LOS-C, and LOS-C to LOS-D.

HVDC Alternative Route 7-A mileages would be 2.8 miles for county roads,1.1 miles for local roads, and 1.1 miles for state highways. The proximity of the route to these roadways might require roadway ROW permits and has the potential to impact traffic in these areas. 7-B mileage would be 1.5 miles for local roads and this mileage in combination is comparable to the mileage of the corresponding Applicant Proposed Route link. HVDC 7-C mileage would be 1.8 miles for local roads, and the proximity of the route to the roadway might require roadway ROW permits and has the potential to impact traffic in the roadway area during construction.

HVDC Alternative Route 7-A would cross two railroads, one near US-63 and one near US-61. 7-B would cross one railroad near US-51 North. 7-C would cross one railroad near US-51 North. 7-D would cross one railroad near US-51 North.

HVDC Alternative Route 7-A centerline would be located about 1 mile from the Marked Tree Municipal Airport and from 2 to 4 miles from a private airfield and a private airport (Table 3.16-3). Most transmission structures for the alternative are not expected to exceed 200 feet in height and slope ratios in relation to the airports/airfields would not exceed 1:50. However, the structure height at the Mississippi River crossing might reach 350 feet to maintain necessary clearance over the navigable channels and there is one private airport located approximately 3.6 miles from the south river crossing point for Route 7-A. Depending on the final design height of the transmission line, FAA review could be required for the alternative for the structures located at the river crossing. River traffic may be controlled, in coordination with the USACE, during the short time required to span the conductor across the Mississippi River under HVDC Alternative Route 7-A or Applicant Proposed Route Link 1. HVDC Alternative Route 7-B centerline is located 2.3 miles from the Millington Regional Jetport. Transmission structures for the alternative are not expected to exceed 200 feet in height and slope ratios in relation to the airports/airfields would not exceed 1:50.

HVDC Alternative Route 7-C centerline is located 2.1 miles from the Millington Regional Jetport and 3.5 miles from the Charles W. Baker Airport. The Ray private airport is located 0.4 mile from the Route 7-C centerline. Transmission structures for the alternative are not expected to exceed 200 feet in height and slope ratios in relation to the airports/airfields would not exceed 1:50. The HVDC Alternative 7-C representative centerline is located 3.4 miles from the MIG NDB Millington navigation aid and is not expected to cause interference with the facility. The 7-D centerline would be located about 2 miles from the Millington Regional Jetport and is located 0.4 mile from a private airport. Transmission structures are likely to be subject to FAA review due to their proximity to the Millington Regional Jetport.

3.16.6.3.2.2 Operations and Maintenance Impacts

Impacts during operations and maintenance would be similar to those described in Section 3.16.6.1.

3.16.6.3.2.3 Decommissioning Impacts

Impacts during decommissioning would be similar to those described in Section 3.6.6.2.1.

3.16.6.4 Best Management Practices

BMPs that could be implemented to reduce potential impacts to transportation are identified below:

- Accommodate existing and programmed, approved, and/or funded transportation facility projects to the extent practicable into the final Project design, and coordinate with appropriate jurisdictions to avoid or minimize disruptions to trails, streets, or drainage/irrigation structures.
- In identified areas of traffic impact, conflicts between the Project traffic and background traffic such as movements of normal heavy trucks (dump trucks, concrete trucks, standard size tractor-trailers or flatbeds, etc.) would be minimized by scheduling (essential deliveries only) to the extent practicable during peak traffic hours/times and scheduling remaining heavy truck trips during off-peak traffic hours/times.
- To the extent practicable, staging activities and parking of equipment and vehicles will occur primarily within private ROW on private land.
- The Applicant would implement a Communications Plan described in Section 3.1.2.

The Applicant would perform mitigation to address Project structures in the vicinity of private airstrips. This BMP would require conducting specific flight plan analyses to determine whether interference with private airstrips can be avoided through micrositing within the 1,000-foot-wide corridor to the extent practicable. If impacts are unavoidable, the Applicant would develop and implement mitigation measures and/or provide compensation, in coordination with landowners. The Applicant would apply similar mitigation to private airstrips where Project structures would present a hazard within a 1:20 glide slope from each end of private airfields.

3.16.6.5 Unavoidable Adverse Impacts

Impacts to traffic and roadway infrastructure would be avoided or minimized by meeting regulatory or jurisdictional requirements and implementing EPMs and BMPs. Despite these measures, unavoidable and temporary adverse impacts to local traffic would occur during construction on roadways where materials and equipment are hauled to construction areas. Construction activities associated with the crossing of roadways and railroads and potential encroachment along roadway ROW would also result in unavoidable temporary impacts to roadways and traffic.

3.16.6.6 Irreversible and Irretrievable Commitment of Resources

As a result of increased traffic associated with construction of the Project, a portion of the local roadway network capacity would be lost during the construction period. This loss would be irretrievable but short-term. The use of non-renewable resources and resources that cannot be recycled would occur as a result of access roadway construction. This use of these resources would be irreversible.

3.16.6.7 Relationship between Local Short-term Uses and Long-term Productivity

The Project would increase the short-term uses of the local roadway network during construction but would have no impact on long-term productivity because roadways would be returned to their original condition and travel conditions would neither improve nor deteriorate during the operational life of the Project.

3.16.6.8 Impacts from Connected Actions

3.16.6.8.1 Wind Energy Generation

3.16.6.8.1.1 Construction

Estimated trips associated with three scenarios for wind farm construction within the WDZs are provided in Table 3.16-47. These three scenarios are not intended to represent an actual construction timeframe for the wind farm, but have been created to represent a range of the most conservative conditions for the traffic analysis. The traffic analysis uses trips associated with the scenario where nineteen 100MW wind farms are constructed within 1 year. This scenario includes 2,185 trips per day during construction of the 19 wind farms as documented in Appendix F. Construction of the 19 wind farms is considered a very conservative (maximum) construction scenario for a 1-year period because the design, permitting, and land acquisition process for such construction would be expected to stagger the construction of the wind farms over a period of greater than one year. Information for the scenario in which 38 wind farms and the AC collection system are under construction within 1 year is also presented as an improbable estimate of the upper limit of traffic impacts. It is much more likely that the 38 wind farms would be constructed over a period of 2 or more years due to the individual wind farm requirements for permitting, design, and land acquisition processes.

Table 3.16-47:
Connected Action—Trip Assumptions During Construction

Wind Farm Project	Trips per Day
One 100MW Wind Farm	
Workers	95
Delivery Trucks	20
Nineteen 100MW Wind Farms Constructed in 1 year, Total Trips (workers and delivery)	2,185
Thirty-eight 100MW Wind Farms Constructed in 1 year, Total Trips (workers and delivery)	4,370
Thirty-eight 100MW Wind Farms Constructed in 1 year along with AC Collection System Construction, Total Trips	4,643

Source: Clean Line (2013)

Major and local roadways in the WDZ ROI that could be affected by wind farm construction currently operate at an average daily LOS-B or better. LOS levels for most roadway segments in the WDZs would decrease from LOS-A to LOS-B during construction of the nineteen 100MW wind farms. No roadway segments in WDZ-B, -C, -G, and -H currently operate below LOS-A, and no roadway segments in these WDZs would decrease to LOS-C during wind farm construction. Table 3.16-48 provides a list of roadway segments with LOS-B to LOS-C decreases for the nineteen 100MW wind farm scenario in Table 3.16-48. Under LOS-B and LOS-C, impacts to roadways would be temporary during construction. Two roadway segments in the area of Perryton, Texas, are predicted to decrease by two LOS levels from LOS-A to LOS-C in the area of WDZ-A and -L. One roadway segment in the area of Spearman, Texas, is predicted to decrease by two LOS levels from LOS-A to LOS-C in the area of WDZ-L.

Table 3.16-48:
Roadways with LOS Decreases with Construction of 19 Wind Farms

MAP_ID	Roadway Segment	Location	WDZ	Existing LOS	LOS During Construction
444942827	State Hwy 15	Southwest of Perryton, TX	A, L	B	C
490233987	State Hwy 15	Northeast of Perryton, TX	A, K	B	C
444942983	State Hwy 15	Near Spearman, TX	L	A	C
502121390	State Hwy 70	South of Perryton, TX	A, L	A	C
490231684	State Hwy 70	South of Perryton, TX	L	A	C
507147928	US Hwy 83	South of Perryton, TX	A, L	B	C
493082833	US Hwy 83	North of Perryton, TX	J	B	C
493085008	US Hwy 83	North of Perryton, TX	J, K	B	C
490234026	N Main St	In Perryton, TX	A	B	C
494367614	N Main St	Guymon, OK	E, F	B	C
494367999	N Main St	Guymon, OK	E, F	B	C
494368599	S Main St	Guymon, OK	E, F	B	C
494356087	County Hwy 7	Near Hooker, OK	I	B	C
494364275	County Hwy 26	North of Guymon, OK	E, F	B	C
494365439	US Hwy 64	Near Guymon, OK	E, F	B	C
494369668	US Hwy 412	Northwest of Hardesty, OK	D, E, I	B	C
494369047	US Hwy 412	Near Guymon, OK	E, F	B	C
494369051	US Hwy 412	East of Guymon, OK	E, F	B	C
494369131	US Hwy 412	East of Guymon, OK	E	B	C
494369156	US Hwy 412	East of Guymon, OK	E	B	C
494368312	US Hwy 412	Near Guymon, OK	E, F	B	C
494368630	US Hwy 412	Near Guymon, OK	E, F	B	C
494368843	US Hwy 412	Near Guymon, OK	E	B	C
493084936	US Hwy 412	Northeast of Perryton, TX	J, K	B	C
493084941	US Hwy 412	Northeast of Perryton, TX	J, K	B	C
493084980	US Hwy 412	North of Perryton, TX	J, K	B	C

Source: Clean Line (2014)

LOS would not decrease below LOS-C even in the unlikely scenario where 38 wind farms and the AC collection system are under construction during 1 year, which further supports the conclusion that impacts during construction would be temporary.

Numerous local, state, and federal roads and highways are within the WDZs (see Table 3.16-5) and many are likely to be crossed by wind farm components including access roads, underground collection cables, and generation tie lines. Railroads are also present in the WDZs as listed in Table 3.16-6. Railroads are located within WDZ-A, -C, -F, -G, and -I. Airports and airstrips in the WDZ ROI are listed in Table 3.16-7. Airports are located in WDZ-A, -F, and -I. One navigation aid is located within WDZ-A. No airports or navigation aids are located within 4 miles of WDZ-D, -H, -J, and -K. Wind turbines, including turbine blade tips can reach a height of up to 420 feet. FAA lighting requirements would apply to the wind turbines. In addition, these heights would require careful selection of specific turbine sites to avoid potential conflicts with airports and military airspace. In some cases, FAA notification requirements might be triggered.

3.16.6.8.1.2 Operation and Maintenance

As discussed in Section 3.13, operations and maintenance of the wind capacity build-out of 4,000MW would require 177 to 303 operations workers. Assuming an average family size of 3, the full build-out scenario is expected to result in a population increase of from 530 to 909. The population is anticipated to be spread among Sherman, Hansford, and Ochiltree counties in Texas; and Cimarron, Texas, and Beaver counties in Oklahoma; as well as surrounding counties in Texas, Oklahoma, and Kansas. If these people were spread evenly across the six-county area where the wind farms would be located, 152 people could potentially reside in each county. If these 152 people generated 456 additional round trips per day (a conservative estimate of three round trips per person), based on previous construction traffic analysis results, no roadway segments would incur a LOS decrease below LOS-C. Under LOS-B and LOS-C, impacts to traffic would be minimally noticeable to motorists. In addition, such trips would occur during limited times associated with peak daily commutes to and from the wind farms by workers from their homes; sporadic equipment and material deliveries, and localized maintenance activities at each wind farm. Indirect impacts to roadways would occur with typical local residential trips and family member commuting not directly associated with the wind farm operation.

3.16.6.8.1.3 Decommissioning

Decommissioning of a wind farm would involve removal and recycling of materials from turbines, electrical infrastructure, buildings, access roads, and foundations. Traffic from these activities likely would be similar to that for construction activities. The timeframe for decommissioning of a wind farm would depend on numerous factors such as the continued functioning of the power delivery infrastructure and economic factors associated with the wind farm. Wind farms might be re-powered with new equipment over the years. A scenario where all of the wind farms would be decommissioned at the same time is unlikely; decommissioning would more likely take place over many years. Therefore impacts to transportation associated with decommissioning are anticipated to be much less than those during construction.

3.16.6.8.2 Optima Substation

Impacts to transportation resources from the future Optima Substation would be similar to those described in Section 3.16.6.2.1 for the Oklahoma Converter Station Siting Area and the AC collection system. All public roadways within 6 miles of the Oklahoma Convertor Station Siting Area currently operate at an acceptable LOS-A. The future Optima Substation would involve less than the assumed additional construction trips estimated during construction of the converter station and the AC collection system where these are being constructed at the same time. Construction trips for the converter station alone, or in conjunction with the AC collection system, are not predicted to result in an LOS decrease for any roadway segments in the siting area ROI (see the Traffic Technical Report and supplement to the *Traffic Technical Report* [Clean Line 2013, 2014]).

No railroads are located at the future Optima Substation site. No airports, airstrips, or navigation aids are located within 4 miles of the future Optima Substation site.

3.16.6.8.3 TVA Upgrades

The potential impacts to transportation from the required TVA upgrades could increase traffic as workers commute to work sites and construction vehicles haul materials and equipment, and could result in incidental congestion and delays. Construction-related traffic impacts are more likely to occur during construction of the new transmission line than during upgrades of existing substations or transmission lines. Evaluations for the Project typically resulted in a LOS decrease of one level and in some cases resulted in no decrease in LOS. The required upgrades, including construction of the new transmission line, would not be expected to result in localized changes in LOS because compared to the Project, they would involve similar though substantially reduced construction activities. The specific localized impacts to towns near the proposed TVA upgrades (including the new electric transmission line) would depend on the likely commuter and haul routes that would be taken during project construction and the existing levels of congestion on those routes.

3.16.6.9 Impacts Associated with the No Action Alternative

Under the No Action Alternative, DOE assumes for analytical purposes that the Project would not be constructed. Therefore, no impacts to transportation including impacts from additional traffic, interruption of traffic, roadway ROW encroachment, or requirements for new easement from railroads would result from the Project.

Contents

Tables

Figures Presented in Appendix A

This page intentionally left blank.

3.17 Vegetation Communities and Special Status Plant Species

3.17.1 Regulatory Background

Protection and management of vegetation communities and special status plan species occurs under a number of federal and state statutes, regulations and programs. Key legal authorities and programs of relevance to these resources are summarized in Table 3.17-1. For the purposes of this EIS, noxious weeds are considered to be a subset of the overall invasive plant species that may exist and exert an influence on economics or the environment. Weeds designated as legally noxious by federal, state, or county governments include plant species that are harmful to public health, recreational activities, agriculture, wildlife species and habitat, and properties (BLM 2010).

Table 3.17-1:
Legal Authorities and Programs Associated with Vegetation Management

Statute/Regulation/Agency	Key Elements
Federal	
Endangered Species Act (7 USC § 136; 16 USC § 1531)	The ESA is designed to protect critically imperiled species and the habitats in which they are found. The law requires federal agencies to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of listed species or result in adverse modification to designated critical habitat. Under Section 7(a)(2) of the ESA, a federal agency is required to consult with the USFWS where a proposed federal agency action is determined to likely adversely affect a listed species or designated critical habitat.
Plant Protection Act of 2000 (7 USC § 7701 *et seq.*)	Under the Plant Protection Act of 2000, which repealed and superseded the Federal Noxious Weed Act of 1974 (7 USC § 2801 *et seq.*), the federal government lists 137 regulated noxious weeds. States typically have their own noxious weed lists and county weed control boards or districts that monitor weed infestations and provide guidance on weed control.
Executive Order 13112, "Invasive Species"	EO 13112 (February 3, 1999; 2564 FR 6183, February 3, 1999) establishes the National Invasive Species Council, made up of 13 departments and agencies, to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause.
Oklahoma	
State of Oklahoma—Threatened and endangered plant species	The state of Oklahoma does not maintain a state list of threatened and endangered plant species with commensurate regulatory protections.
Oklahoma Noxious Weed Law and Rules—Section 3-220, Title 35, Chapter 30, Subchapter 34	A designated Oklahoma State University extension agent or the Department Agriculture determines the most appropriate treatment, control, or eradication method available to treat infestations (ODA 2000).
Oklahoma Natural Heritage Program (ONHP)	The ONHP maintains a tracking list of rare plants in the state. It includes approximately 548 species of plants. Accounts for each species include description, life history, habitat preference, distribution, causes of decline, recovery needs, field-identification characters, an illustration, and a map of current and historical sites (ONHP 2014).
Arkansas	
Plant Act of 1917 (Arkansas Statutes 77-101–77-116)	The act establishes the Arkansas State Plant Board. The Board is required to remain informed of the varieties of insect pests, diseases, and noxious weeds, the origin, locality, nature and appearance thereof, the manner in which they are disseminated, and approved methods of treatment and eradication (Arkansas Plant Board 1993).
Circular 10: Regulations on the Sale of Planting Seed in Arkansas, Arkansas State Plant Board (Arkansas Code Annotated 2-16-207 and 2-16-209)	The circular describes the requirements for licensing, reporting, and labeling of seeds, including sampling and analyzing, fees and services, and prohibitions (Arkansas Plant Board 2014a).
Arkansas State Plant Board—Noxious Weed List	The state of Arkansas maintains a list of 25 plants listed as noxious. (Arkansas Plant Board 2014b)
Arkansas Natural Heritage Commission	The ANHC maintains up-to-date and comprehensive information concerning plant species and high-quality natural communities for the state of Arkansas in a System of Natural Areas. Along

Table 3.17-1:
Legal Authorities and Programs Associated with Vegetation Management

Statute/Regulation/Agency	Key Elements
	with conservation of remnants of the original natural landscape, lands within the System of Natural Areas provide vital habitat for imperiled plant and animal species. ANHC has a tracking list for state rare plants that includes approximately 544 total species. (ANHC 2014)
Tennessee	
Tennessee Department of Agriculture (TDA) Division of Plant Industries, Pest Plant Regulations (Chapter 0080-6-24)	The regulations list 14 pest plants that are injurious to the agricultural, horticultural, silvicultural, or other interests of the state (TDA 2007).
Tennessee Department of Environment and Conservation (TDEC), Rare Plant Protection and Conservation Regulations (Chapter 0400-06-02)	These regulations provide for the implementation of The Rare Plant Protection and Conservation Act, which requires persons to obtain written permission from a landowner or manager before knowingly removing or destroying state-listed endangered plant species and requires nursery farmers to be licensed to sell state-listed endangered species (TDEC 2008).
Tennessee Natural Heritage Program (TNHP)—Rare Plant List	The Rare Plant Protection and Conservation Act of 1985 allows the Division of Natural Areas, Tennessee Natural Heritage Program to enter into agreements with other agencies to conserve rare plants. It also requires persons to obtain written permission from a landowner or manager before knowingly removing or destroying state-listed endangered plant species. The Tennessee Natural Heritage Commission website has a tracking list with approximately 531 total rare plant species for the state (TDEC 2014).
Texas	
Endangered, Threatened, and Protected Native Plants (Texas Administrative Code (TAC) 31-69.1–69.9	The regulations list laws regarding threatened and endangered native plant species.
Texas Parks and Wildlife Code, Wildlife and Plant Conservation, Chapter 88	The regulation establishes TPWD and identifies procedures for identifying, studying, and protecting endangered, threatened, or protected plants.
Texas Department of Agriculture, Noxious Weed List (TAC 4-19.300(a))	The state of Texas maintains a list of 29 plants listed as noxious (http://www.texasinvasives.org/plant_database/tda_results.php).

3.17.2 Data Sources

The data sources used for Vegetation Communities in this EIS are listed in Table 3.17-2. All sources are listed in Chapter 6.

Table 3.17-2:
Sources of Vegetation Community Data

Vegetation	Data Sources
Cover Types and Dominant Species	EPA Level I (EPA 2012) and III Ecoregions (GIS Data Source: EPA 2010) 2011 National Land Cover Database (GIS Data Source: Jin et al. 2013) NRCS Plants Database (USDA 2013) Flora of North America (eFlora 2013)
Special Status Plant Species	USFWS Endangered Species Program Threatened and Endangered Species Range Maps ((http://www.fws.gov/endangered/map/index.html)) USFWS Critical Habitat Portal (http://ecos.fws.gov/crithab/) Oklahoma Natural Heritage Inventory (http://www.oknaturalheritage.ou.edu/) Arkansas Natural Heritage Commission (http://www.naturalheritage.com/) Tennessee Department of Environment and Conservation Natural Heritage Inventory Program (http://www.tn.gov/environment/natural-areas/natural-heritage-inventory-program.shtml) Texas Parks and Wildlife Department Natural Diversity Database (http://www.tpwd.state.tx.us/huntwild/wild/wildlife_diversity/txndd/)

Table 3.17-2:
Sources of Vegetation Community Data

Vegetation	Data Sources
Designated Plant Conservation Areas	USGS National Gap Analysis Program Protected area Database (http://gapanalysis.usgs.gov/padus/data/) The Nature Conservancy Lands and Waters Dataset (http://maps.tnc.org/gis_data.html) Arkansas Natural Heritage Commission, Species Focal Areas (http://www.naturalheritage.com/) ANHC Areas of Conservation Interest (http://www.naturalheritage.com/)
Wetlands and Riparian Areas	National Wetlands Inventory—USFWS (http://www.fws.gov/wetlands/)
Listed Noxious Weeds	Oklahoma State Department of Agriculture, Plant Industry and Consumer Services Division Noxious Weed Information (http://www.oda.state.ok.us/cps-weed.htm) Arkansas State Plant Board Noxious Weed Information (Arkansas Plant Board 2014b) Tennessee Department of Agriculture Noxious Weed Information (http://www.invasive.org/species/list.cfm?id=58) Texas Department of Agriculture Noxious Weed Information (http://www.texasinvasives.org/plant_database/tda_results.php)

3.17.3 Region of Influence

For vegetation communities and special status plant species, the ROI for the Project and connected actions is the same as described in Section 3.1.1.

3.17.4 Affected Environment

The ROI crosses many ecosystems that support diverse vegetation communities. Section 3.17.5 describes existing vegetation communities by Project region (1 through 7), including the dominant vegetation types and dominant plant species as well as special status plant species, designated conservation or habitat protection areas, and listed noxious weed species that may occur within the ROI. Land cover is described in detail in Section 3.10 and contains tables that show land cover by Project region and component.

Several route variations to the Applicant Proposed Route in Regions 2–7 were developed in response to public comments on the Draft EIS and are described in Appendix M and summarized in Sections 2.4.2.1–2.4.2.7. The variations are presented graphically in Exhibit 1 of Appendix M.

3.17.5 Regional Description

The descriptions of vegetation presented below were developed from information provided by the EPA for the Level III and IV ecoregions and the National Land Cover Database (NLCD) (Table 3.17-3).

Project Regions 1 through 3 are located within the Great Plains Level I ecoregion. Project Regions 4 through 7 are located within the Eastern Temperate Forests Level I ecoregion (EPA 2012). Level I ecoregions are further divided into Level II, Level III, and Level IV ecoregions to describe the more defined ecosystem boundaries that are often nested within broader ecological hierarchies. Level III and Level IV ecoregions within the ROI are identified and described in Table 3.17-3. Figure 3.17-1 (located in Appendix A) is a depiction of Level IV ecoregions mapped over the entire breadth of the Project.

Table 3.17-3:
EPA Level III and IV Ecoregions by State and Region/Project Component

Level III Ecoregion	Level IV Ecoregion	State(s)	Region/Project Component
High Plains	Canadian/Cimarron High Plains	Oklahoma and Texas	Region 1, AC Collection System
Southwestern Tablelands	Canadian/Cimarron Breaks		Region 1, Oklahoma Converter Station Siting Area and AC Interconnection Siting Area
Central Great Plains	Rolling Red Hills	Oklahoma	Regions 1 and 2
	Pleistocene Sand Dunes		Regions 1 and 2
	Gypsum Hills		Region 2
	Prairie Tableland		Regions 2 and 3
	Cross Timbers Transition		Region 3
Cross Timbers	Northern Cross Timbers	Oklahoma	Region 3
Central Irregular Plains	Osage Cuestas		Region 3
Boston Mountains	Lower Boston Mountains	Oklahoma and Arkansas	Regions 3 and 4
Arkansas Valley	Arkansas Valley Plains	Oklahoma and Arkansas	Region 4
	Arkansas Valley Hills	Arkansas	Regions 4 and 5, Arkansas Converter Station Alternative Siting Area
	Arkansas River Floodplain		Region 4
Mississippi Alluvial Plain	Western Lowlands Holocene Meander Belts		Regions 5 and 6
	Western Lowlands Pleistocene Valley Trains		Region 6
	St. Francis Lowlands		Region 6
	Northern Holocene Meander Belts	Arkansas and Tennessee	Region 7
	Northern Pleistocene Valley Trains	Arkansas	Region 7
	Northern Backswamps	Arkansas	Region 7
Mississippi Valley Loess Plains	Bluff Hills	Arkansas and Tennessee	Regions 6 and 7, Tennessee Converter Station Siting Area
	Loess Plains	Tennessee	Region 7, Tennessee Converter Station Siting Area

Sources: Griffith et al. (1998, 2004), Woods et al. (2004, 2005); GIS Data Source: EPA (2010)

Annual precipitation ranges from about 16 inches in the Oklahoma Panhandle region to about 45–50 inches in eastern Oklahoma, across Arkansas to the Mississippi Valley region on the east end of the Project. The gradient of precipitation greatly influences the land cover types and vegetation in the ecoregions from the High Plains and Southwestern Tablelands in the Oklahoma and northern Texas Panhandles to the Mississippi Alluvial Plain and Mississippi Valley Loess Plains in Arkansas and Tennessee (Tyrl et. al 2002). The grassland/herbaceous cover type is dominated by shortgrass and, to a lesser extent, midgrass prairie species in the semi-arid parts of Regions 1 and 2. As precipitation increases across Oklahoma (Regions 3 and 4), the species composition changes to more mixed grass prairie (midgrasses) and then to tall grass species through central and eastern Oklahoma and across Arkansas. Shrub/scrub cover types are more common in the more semi-arid western regions of the Project and decrease in abundance across Oklahoma as forest types become more common with increased precipitation. In Region 1 and parts of Region 2, shrubland areas of sand sagebrush (*Artemisia filifolia*) and shinnery oak (*Quercus* *harvardii*) are common. Farther east in the Project area, shrubland areas may be associated with early successional stages of either human or naturally disturbed areas.

Table 3.10-3 in the Land Use section of this EIS summarizes the percentage of each USGS 2011 NLCD classification within the ROI. Forest cover types (evergreen, deciduous, and mixed) occur along the entire Project but are most abundant in higher precipitation areas in the Cross Timbers, Central Irregular Plains, Boston Mountains, Arkansas Valley, Mississippi Alluvial Plain, Mississippi Valley Loess Plains ecoregions in Regions 3 through 7. Forested areas in the western semi-arid regions are limited to deciduous forests in floodplains or small areas of upland evergreen forests of pinyon-juniper woodlands. Across central Oklahoma, forested cover types become common and are composed largely of oaks in the Cross Timbers. In eastern Oklahoma, Arkansas, and western Tennessee, the forested cover types transition to deciduous forest of oaks, hickories, and other broadleaf trees and mixed forest of deciduous trees and evergreen trees such as short-leaf pine. Smaller evergreen forest of short-leaf pine also occurs on escarpments and drier south slopes. Cultivated cover types include cultivated crops or pasture/hay. Cultivated crops also vary across the Project with the precipitation gradient. Cultivated crops in the drier, western part of the Project are most likely to be dryland farms or irrigated fields (e.g., center-pivot). As precipitation increases to the east, irrigation becomes less important. Crops vary, but typically include annual species such as corn, soybeans, rice, cotton, and wheat. Several land cover types are classified as developed with different levels of development intensity. These areas typically contain a matrix of vegetation interspersed with human development (i.e., residential, commercial, and industrial). The type of vegetation within the developed cover type would reflect the location along the precipitation gradient and the potential vegetation that could occur there based on precipitation. Wetlands cover types occur throughout the ROI and may either be woody or emergent wetlands. Woody wetlands occur where forests or shrubs grow in soils periodically saturated with or covered by water. Vegetation in emergent wetlands is dominated by perennial herbaceous species.

3.17.5.1 Region 1

3.17.5.1.1 Ecoregional Descriptions

Region 1 is referred to as the Oklahoma Panhandle Region and includes the Applicant Proposed Route and HVDC Alternative Routes 1-A through 1-D, the AC collection system, and the Oklahoma Converter Station and AC Interconnection Siting Area. Region 1 is the most arid of the Project, and annual precipitation ranges from less than 16 inches to about 24 inches. The ROI in Region 1 largely crosses areas consisting of agriculture (including center-pivot irrigation) and open pasture interspersed with well fields. The land is flat and dry, and has few narrow riparian corridors associated with streams and rivers, such as Palo Duro Creek. East of Hollow N1150 Road, topography becomes more noticeable in areas. Small plateaus are even present between Oklahoma Route 46 and U.S. Route 183. The shrub/scrub cover type consists of semi-arid species such as sand sagebrush and shinnery oak. The grassland/herbaceous cover type consists primarily of shortgrass prairie species (blue grama [*Bouteloua gracilis*], buffalograss [*Buchloë dactyloides*], fringed sage [*Artemisia frigida*]) with some midgrasses (sideoats grama [*Bouteloua curtipendula*], western wheatgrass [*Pascopyrum smithii*], little bluestem [*Schizachyrium scoparium*]) as precipitation increases to the east. Forested cover types are limited in Region 1 and typically consists of deciduous forests (plains cottonwoods [*Populus deltoides* ssp. *monolifera*] and willows, such as peach-leaved willow [*Salix amygdaloides*]) in floodplains or small areas of pinyon-juniper woodland.

No route variations were proposed in Region 1.

3.17.5.1.2 Special Status Plants

No federal or state threatened or endangered plants are known to occur in the ROI for the Applicant Proposed Route, the HVDC alternative routes, or the Oklahoma Converter Station Siting Area in Region 1 (USFWS 2013a, 2014; ODWC 2013).

3.17.5.1.3 Noxious Weeds

Region 1 is located in the states of Oklahoma and Texas. Oklahoma has three listed noxious weeds: musk thistle (*Carduus nutans*), Scotch thistle (*Onopordum acanthium*), and Canada thistle (*Cirsium arvense*). Desktop analysis has not yielded data with which to establish magnitude of occurrence for these three listed noxious weeds within the ROI (ODA 2000; CISEH 2014). In addition, field reconnaissance has not been undertaken to substantiate the actual presence or absence of these three species in the ROI.

Twenty-seven plant species are designated as noxious weeds in the state of Texas (see Texas Administrative Code Title 4, Chapter 19). Two of these noxious species are confirmed to occur within Ochiltree County, Texas (field bindweed [*Convolvulus arvensis*]) and saltcedar [*Tamarix* spp.]). Field bindweed is also confirmed from both Sherman and Hansford counties, Texas. In addition to the two listed noxious weeds, a large number of other invasive plant species are confirmed for the three county area in north Texas where various portions of the AC collection system may be sited. Desktop analysis has not yielded data with which to establish magnitude of occurrence for state listed noxious weeds confirmed in the Texas counties where the various AC collection routes have been identified (CISEH 2014). In addition, field reconnaissance has not been undertaken to substantiate the actual presence or absence of listed noxious weeds in the various ROIs for the AC collection system.

3.17.5.2 Region 2

3.17.5.2.1 Ecoregional Descriptions

Region 2 is referred to as the Oklahoma Central Great Plains Region and includes the Applicant Proposed Route and HVDC Alternative Routes 2-A and 2-B. Annual precipitation in Region 2 ranges from about 24 to 32 inches. In Region 2, the ROI largely crosses areas consisting of agriculture and open pasture interspersed with well fields. Near Mooreland, Oklahoma, lands appear wetter where they are associated with the North Canadian River. From Oklahoma Route 50 south and east to the location that the ROI passes north of Canton Lake, forested areas are interspersed with open pasturelands and well fields. Between the city of Fairview and the town of Isabella, Oklahoma, land use changes to agriculture; however, east of Isabella, lands associated with the Cimarron River and floodplain are wetter and interspersed with forested tracts. The grassland/herbaceous cover type that is common in the ROI in Region 2 contains some short grass species, but more midgrasses and tall grass species (big bluestem [*Andropogon gerardii*], switchgrass [*Panicum virgatum*], Indiangrass [*Sorghastrum nutans*], and little bluestem) are present farther east. Region 2 also contains larger areas of deciduous and evergreen forest than did the more arid Region 1, including the western part of the Cross Timbers ecoregion.

Two route variations to the Applicant Proposed Route were developed in Region 2 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.2. The variations are illustrated in Exhibit 1 of Appendix M. Link 1, Variation 1, would feature 261 acres of grassland/herbaceous land cover and 11 acres of urban/developed land. Applicant Proposed Route Link 2, Variation 2 would have 845 acres of cultivated crops and 288 acres of grassland/herbaceous land cover.

3.17.5.2.2 Special Status Plants

No federal or state threatened or endangered plants are confirmed in the ROI for the Applicant Proposed Route or the HVDC alternative routes in Region 2 (USFWS 2013a, 2014; ODWC 2013).

3.17.5.2.3 Noxious Weeds

Oklahoma has three listed noxious weeds, as discussed under Region 1. Desktop analysis has not confirmed the magnitude of occurrence for these three species in the ROI. Field reconnaissance would be required to substantiate quantities and spatial distribution of these species within the ROI for the Project.

3.17.5.3 Region 3

3.17.5.3.1 Ecoregional Descriptions

Region 3 is referred to as the Oklahoma Cross Timbers Region and includes the Applicant Proposed Route and HVDC Alternative Routes 3-A through 3-E. Annual precipitation in Region 3 ranges from 32 inches in the west to about 44 inches in Muskogee County, Oklahoma. In Region 3, the ROI crosses areas consisting of agriculture and pastureland and small forested areas associated with creeks. East of Oklahoma Route 74, the land cover becomes wetter, with multiple waterbodies, including Otter Creek and Beaver Creek, and more forested areas associated with these creeks. East of Interstate 35, the ROI becomes more interspersed with forested lands and waterbodies, with a larger tract of forested area present southwest of Stillwater, Oklahoma. The ROI traverses the Cimarron River, associated tributaries, floodplains, and wetlands. East of the Cimarron River, the ROI becomes more densely forested, though not in contiguous tracts, as the forested and riparian areas are intermixed with shrub and pasture lands, as well as developed cities such as Bristow, Beggs, and Okmulgee, Oklahoma. East of Okmulgee, to Muskogee, the ROI traverses open pasture lands interspersed with oil well pads. The Cross Timbers Region contains larger areas of oak forest (deciduous forest) interspersed with grassland/herbaceous cover that is composed of mostly tall grass prairie species such as big bluestem, switchgrass, Indiangrass, and little bluestem. These two cover types, along with cultivated crops and pasture/hay, compose much of the vegetation in Region 3.

Five route variations to the Applicant Proposed Route were developed in Region 3 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.3. The variations are illustrated in Exhibit 1 of Appendix M. Link 1, Variation 2, would feature 320 acres of grassland/herbaceous cover and 112 acres of forest cover. Links 1 and 2, Variation 1, would have 269 acres of grassland/herbaceous cover, and 28 acres of forested land. It should be noted that a route adjustment was made for HVDC Alternative Route 3-A to maintain an end-to-end route with the Links 1 and 2 variations. This route adjustment yielded 61 acres of grassland/herbaceous land cover and 3 acres of forested land. Link 4, Variation 1, would have 105 acres of grassland/herbaceous land cover type and 6 acres of forested land. Link 4, Variation 2, would have 84 acres of grassland/hay land cover plus 30 acres of forested land. Applicant Proposed Route Link 5, Variation 2, would have 128 acres of pasture/hay land cover, and 106 acres of grasslands.

3.17.5.3.2 Special Status Plants

No federal or state threatened or endangered plants are known to occur in the ROI for the Applicant Proposed Route or the HVDC alternative routes in Region 3 (USFWS 2013a, 2014; ODWC 2013).

3.17.5.3.3 Noxious Weeds

Oklahoma has three listed noxious weeds as discussed under Region 1. Musk thistle is confirmed for Payne, Lincoln, Creek, and Okmulgee counties, which the ROI traverses.

3.17.5.4 Region 4

3.17.5.4.1 Ecoregional Descriptions

Region 4 is referred to as the Arkansas River Valley Region and includes the Applicant Proposed Route, including the Lee Creek Variation, and HVDC Alternative Routes 4-A through 4-E. Average annual precipitation in Region 4 varies from 44 inches in eastern Oklahoma to about 50 inches in Arkansas. In Region 4, the ROI crosses the Arkansas and Illinois rivers in Oklahoma, both of which have extensive tracts of forested lands. Through Sequoyah County, the northern portion of the ROI traverses larger tracts of forested areas, while the southern portion traverses lightly developed areas and pasture lands.

In Arkansas, land cover in Region 4 varies from north to south, with large tracts of forest common in the north, while there are more developed areas to the south associated with the city of Fort Smith. This difference between the northern and southern portions of the ROI continues through Franklin and Johnson counties. East of Clarksville, Arkansas, the ROI becomes more densely forested as it continues into Pope County.

Forested cover types are prevalent in Region 4; deciduous forest (oak-hickory) is the most common. Evergreen forests with pines are common in some locations. Grassland/herbaceous cover types are less prevalent than in the drier regions in Oklahoma but where present contain predominately tallgrass prairie species. Pasture/hay cover types are relatively abundant in this region and contain domestic forage species and some native species.

Seven route variations to the Applicant Proposed Route were developed in Region 4 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.4. The variations are illustrated in Exhibit 1 of Appendix M. Link 3, Variation 1, would involve 217 acres of pasture/hay land cover and 27 acres of forested lands. Link 3, Variation 2, features 387 acres of pasture/hay land cover and 368 acres of forested land cover. Link 3, Variation 3, would have 96 acres of pasture/hay land cover and 298 acres of forested lands. Link 6, Variation 1, would have 60 acres of pasture/hay land cover and 74 acres of forested land cover. Link 6, Variation 2, would feature 191 acres of pasture/hay and 79 acres of cultivated crops. Link 6, Variation 3, would have 15 acres of pasture/hay land cover and 92 acres of forested land cover.

3.17.5.4.2 Special Status Plants

No federal or state threatened or endangered plants are known to occur in the ROI for the Applicant Proposed Route or the HVDC alternative routes within the portion of Region 4 within the state of Oklahoma (USFWS 2013a, 2014; ODWC 2013). Arkansas has a voluntary Endangered Species Protection Program with bulletins for each county. Special status plant species potentially occurring in the ROI for the Applicant Proposed Route and the HVDC alternative routes in Region 4 in Arkansas are listed in Table 3.17-4.

Table 3.17-4:
State and Federally Designated Threatened and Endangered Plants Potentially Occurring in the ROI in Region 4 (by County)

Common Name	Scientific Name	Listing Status	Counties of Occurrence in the Region
Alabama snow-wreath	*Neviusia alabamensis*	ST	Pope
Appalachian filmy fern	*Trichomanes boschianum*	ST	Johnson
Bicknell's sedge	*Carex opaca*	SE	Franklin
Interrupted fern	*Osmunda claytoniana*	ST	Pope
Open-ground Whitlow-grass	*Draba aprica*	ST	Pope
Ovate-leaf catchfly	*Silene ovata*	ST	Crawford, Pope
Small-head pipewort	*Eriocaulon koernickianum*	SE	Franklin, Johnson, Pope
Tinytim	*Geocarpon minimum*	FT/SE	Franklin
Whorled dropseed	*Sporobolus pyramidatus*	ST	Franklin

FT = Federally Threatened SE = State Endangered ST = State Threatened
Source: ANHC (2014b)

The federally listed species tinytim (*Geocarpon minimum*) has confirmed elemental occurrence in Franklin County, Arkansas; however, no portions of the ROI have been specifically surveyed for this species, so its presence in the ROI is not confirmed. Tinytim is also listed as state endangered. Tinytim is typically found in eroded areas in saline soil prairies, called "slicks." Slicks are bare soils that occur over sandstone, and they are naturally high in sodium and magnesium. Slicks are ephemeral and can fluctuate greatly from year to year, causing tinytim populations to increase or decrease (Pittman 1993; ANHC 2011). To date, tinytim has not been found on any sandstone glades in Arkansas. Although the Ozark Highlands of Arkansas contain many sandstone glades that appear superficially similar to the tinytim-supporting glades of Missouri, no known sandstone glades are confirmed in Arkansas with the same mode of formation and chemical composition as the Missouri channel sand glades. All of the currently known Arkansas tinytim sites occur on saline soil prairies (NatureServe 2013). Factors that cause disturbances to natural plant successional phases are contributing to this species' decline. Threats include cattle grazing in and around sandstone-glade or saline soil prairie habitat, complete conversion of saline soil prairies, and off-road vehicular traffic (DeLay et al. 1993), although the current role of erosional disturbance is debatable. Other reasons given for this species' decline are climate change and changes in site-specific hydrology (USFWS 2009).

The state-threatened species, Alabama snow-wreath (*Neviusia alabamensis)*, has confirmed elemental occurrence in Pope County in Region 4 and also Conway and Faulkner County in Region 5. Alabama snow-wreath is a 3- to 6-foot-tall deciduous, thicket-forming shrub with bright green leaves. It is a clonal species that rarely reproduces by seeds. It may be found in forested bluffs, talus slopes, and streambanks on a variety of geologic substrates, soil types, and aspects, and under open- to completely closed-canopy conditions. Most typical habitat may be within forested areas on thin soil over limestone that is moist for part of the year (seasonal streambeds, margins of sinkholes, riverbluffs) (ANHC 2014b). It is most vulnerable to timber harvesting and other forms of disturbance.

The Appalachian filmy fern (*Trichomanes boschianum*) is a state listed threatened species in Arkansas and has confirmed elemental occurrence in Johnson County in Region 4 and Cleburne County in Region 5. Its presence within the ROI for the Applicant Proposed Route or the HVDC alternative routes cannot be confirmed without species specific surveys in these areas. The Appalachian filmy fern has a very limited distribution. The habitat for this species consists of places where humidity is constantly high and temperatures tend to be moderate throughout the year. This includes deep recesses and cracks in cliffs and rock shelters, and on boulders along streams or in deep narrow hollows. Appalachian filmy fern is usually found on sandstone or conglomerate, but can be on other non-calcareous rocks (Taylor 2014).

Bicknell's sedge (*Carex opaca*) is a state listed endangered plant species that has confirmed elemental occurrence in Franklin County in Region 4, Faulkner County in Region 5, and Poinsett County in Regions 6 and 7. Its presence within the ROI for the Applicant Proposed Route or the HVDC alternative routes cannot be confirmed without species specific surveys in these areas. Bicknell's sedge is a large (3-foot-tall) perennial sedge that grows in dense clumps. Its primary habitats are moist depressions, drainages, and swales in wet or mesic prairie; it also colonizes roadside ditches and railroad ROWs and often occurs on heavy, clayey soils. Habitat conversion and alteration of hydrologic regimes are primary threats as these habitats (wet or mesic prairie) lend themselves to alternative use.

The interrupted fern (*Osmunda claytonia*) is a state threatened species in Arkansas with confirmed elemental occurrence in Pope County in Regions 4 and 5. Its presence within the ROI for the Applicant Proposed Route or the HVDC alternative routes cannot be confirmed without species specific surveys in these areas. This fern species is distributed through eastern Canada and is rare but occurs in many states in the eastern and central United States. It is ranked as critically imperiled in Arkansas, which indicates that there are five or fewer known occurrences in the state (NatureServe 2014a; Meades et al. 2000).

Open-ground Whitlow-grass (*Draba aprica*) is an Arkansas state listed threatened species with confirmed elemental occurrence in Pope County in Regions 4 and 5 and in Faulkner County in Region 5. Its presence within the ROI for the Applicant Proposed Route or the HVDC Alternative Routes cannot be confirmed without species specific surveys in these areas. Open-ground Whitlow-grass is an annual, herbaceous plant, up to one foot tall, with dense clusters of small, white flowers. In Arkansas, populations tend to occur in barrens or glades on very thin soil (approximately 1.5-inch-tall), often on rocky glade/barren margins; sites include shale barrens. Loss of glade habitat is a threat to the species.

The ovate-leaf catchfly (*Silene ovata*) is an Arkansas state threatened plant species that has confirmed elemental occurrence from Crawford and Pope counties in Region 4 of the Project and Pope, Conway, Van Buren, and Cleburne counties in Region 5. Its presence within the ROI for the Applicant Proposed Route or the HVDC alternative routes cannot be confirmed without species specific surveys in these areas. The ovate-leaf catchfly is a state listed endangered species in Tennessee and is reported from Shelby County in Region 7. Ovate-leaf catchfly is a perennial herb approximately 2 to 6 inches tall, with opposite leaves that are rare throughout its range. It occurs in a variety of open or forested sandy or pebbly habitats including floodplains. Threats include logging, grazing (deer and feral hogs), trampling, road construction, and ROW maintenance. Soil disturbance is likely to have a negative effect on this species due to the resultant erosion.

The small-head pipewort (*Eriocaulon koernickianum*) is a state-listed endangered plant species. It is a small annual with a leafless flowering stem, approximately 2 to 3 inches tall, arising from a tuft of grass-like leaves. It has confirmed elemental occurrence in Arkansas in Franklin, Johnson, and Pope counties in Region 4 and Pope, Conway, and Van Buren counties in Region 5. Its presence within the ROI for the Applicant Proposed Route or the HVDC alternative routes cannot be confirmed without species specific surveys in these areas. In the western part of its range, including Arkansas, the small-head pipewort is found in or near sandy, permanently moist to wet acidic seepage areas, particularly upland sandstone glade seeps and sandy hillside seeps; in hillside seepage bogs, particularly the less densely vegetated, sandy bog margins; and (rarely) in wet prairies. Plants tend to occur in sparsely vegetated areas rather than among dense vegetation; the species is considered intolerant of shade and is probably early successional. Habitat loss resulting from wetland draining is a serious threat. Natural disturbances, such as periodic fire, are necessary to ensure this species' persistence via removal of competing vegetation.

Whorled dropseed (*Sporobolus pyramidatus*) is a grass species listed as threatened in the state of Arkansas. It has confirmed elemental occurrence from Franklin County in Region 4. Its presence within the ROI for the Applicant Proposed Route or the HVDC alternative routes cannot be confirmed without species specific surveys in these areas. Whorled dropseed is a warm season, tufted perennial grass typically growing from 4–19 inches in height. It grows in open, disturbed sites on sandy, saline and alkaline soil types. Its distribution includes Kansas to Colorado, south Texas, Louisiana, and Arizona, and in southern Florida (NRCS 2014). Whorled dropseed has a conservation rank in Arkansas of S2, which means the species is thought to have 6 to 20 element occurrences within the state (NatureServe 2014b; Kartesz 1999).

American ginseng (*Panax quinquefolius*) is not listed as federally threatened or endangered under the Endangered Species Act (ESA), nor is it a state-listed threatened or endangered species in Arkansas. However, this species does have commercial value, and as such, the state of Arkansas does require licensing and regulation for persons engaged in harvesting the plant. Additionally, the USFWS regulates the export of American ginseng under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (USFWS 2015).

3.17.5.4.3 Noxious Weeds

Region 4 straddles the border between Oklahoma and Arkansas. Oklahoma has three listed noxious weeds, as discussed under Region 1, of which only musk thistle is confirmed in Sequoyah County, Oklahoma (Region 4). The ROI does traverse this county.

Thirty-eight noxious weeds are listed for Arkansas. Seventeen of the state-listed noxious weeds are confirmed in the four counties crossed by the ROI in Region 4 (Table 3.17-5).

Table 3.17-5:
Arkansas Listed Noxious Weeds-Region 4 (by County crossed within the ROI)

Common Name	Scientific Name	Crawford	Franklin	Johnson	Pope
Balloonvine	*Cardiospermum halicacabum*	X			
Banyardgrass	*Echinochloa crus-galli*		X		X
Bermudagrass	*Cynodon dactylon*	X	X	X	X
Buckthorn plantain	*Plantago lanceolata*	X	X	X	
Cheatgrass (Chess)	*Bromus racemosus*		X		
Cheatgrass (Chess)	*Bromus secalinus*		X	X	X
Corncockle	*Agrostemma githago*		X		X
Dock	*Rumex* spp.	X	X	X	X
Field bindweed	*Convolvulus arevensis*	X			X
Hedge bindweed	*Calystegia sepium*		X	X	
Johnsongrass	*Sorghum halepense*	X	X	X	X
Morning glory	*Ipomoea* spp.		X	X	X
Nutgrass	*Cyperus rotundus*		X		
Thistle	*Carduus* spp.			X	

Table 3.17-5:
Arkansas Listed Noxious Weeds-Region 4 (by County crossed within the ROI)

Common Name	Scientific Name	Crawford	Franklin	Johnson	Pope
Thistle	*Cirsium* spp.		X		
Thistle	*Silybum* spp.		X		
Wild onion and/or garlic	*Allium* spp.				X

Sources: Arkansas Plant Board (2014b), CISEH (2014)

3.17.5.5 Region 5

3.17.5.5.1 Ecoregional Descriptions

Region 5 is referred to as the Central Arkansas Region and includes the Applicant Proposed Route and HVDC Alternative Routes 5-A through 5-F. Annual precipitation in Region 5 is approximately 50 inches. Forested cover types are common in Region 5 and include deciduous (oak-hickory), mixed (oak-pine), and evergreen (pine). The pasture/hay cover type also is prevalent throughout the ROI. Grassland/herbaceous land cover types are not as common in Region 5 but comprise mostly tall grass species. In Region 5, the ROI traverses forested areas that are interspersed with waterways, such as the Illinois Bayou, and open pasture lands. From Route 105 to Route 95, the ROI traverses large tracts of forested lands and riparian corridors. As Region 5 continues through Conway, Van Buren, Faulkner, Cleburne, and White counties, the ROI consists of an evenly distributed mosaic of forested lands and open lands. In White County, the ROI crosses the Little Red River and its relatively wide riparian corridor. As the ROI continues northeast and into Jackson County, there are large contiguous tracts of forested lands, as well as areas of agriculture and pasture land. An abrupt change in land cover is evident near U.S. Route 67. To the west of U.S. Route 67, lands are largely forested, while to the east, as the ROI enters the floodplain of the White River, land use shifts to agricultural uses, with sparse forested areas that are associated with small creeks.

Five route variations to the Applicant Proposed Route were developed in Region 5 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.5. The variations are illustrated in Exhibit 1 of Appendix M. Link 1, Variation 2, would have 36 acres of pasture/hay and 295 acres of forest. Link 2, Variation 2, would have 58 acres of forest land and 8 acres of total agricultural and open lands, and more forested land than the ROI for Applicant Proposed Route Link 2. Links 2 and 3, Variation 1, would have 10 acres of grassland/herbaceous cover and 237 acres of forest. It should be noted that a route adjustment was made for HVDC Alternative Route 5-B to maintain an end-to-end route with Links 2 and 3, Variation 1. The route adjustment for HVDC Alternative Route 5-B features 18 acres of pasture/hay and 105 acres of forested lands. Links 3 and 4, Variation 2, would have 91 acres of pasture/hay and 362 acres of forest lands. It should be noted that a route adjustment was made for HVDC Alternative Route 5-E to maintain an end-to-end route with this proposed variation. The HVDC route adjustment for Alternative Route 5-E would have 16 acres of pasture/hay and 58 acres of forested land. Link 7, Variation 1, would feature 59 acres of pasture/hay and 52 acres of forest.

3.17.5.5.2 Special Status Plants

Special status plant species potentially occurring in the ROI in Region 5 in Arkansas are listed in Table 3.17-6.

Table 3.17-6:
State and Federally Designated Threatened and Endangered Plants Potentially Occurring in the ROI in Region 5 (by County)

Common Name	Scientific Name	Listing Status	Counties of Occurrence in the Region
Alabama snow-wreath	*Neviusia alabamensis*	ST	Pope, Faulkner
Appalachian filmy fern	*Trichomanes boschianum*	ST	Cleburne
Bicknell's sedge	*Carex opaca*	SE	Faulkner
Dwarf bristle fern	*Trichomanes petersii*	ST	Pope, Conway
French's shooting-star	*Primula frenchii*	ST	Cleburne
Interrupted fern	*Osmunda claytoniana*	ST	Pope
Open-ground Whitlow-grass	*Draba aprica*	ST	Pope, Faulkner
Ovate-leaf catchfly	*Silene ovata*	ST	Pope, Conway, Van Buren, Cleburne
Pondberry	*Lindera melissifolia*	FE/SE	Jackson, Poinsett
Purple fringeless orchid	*Platanthera peramoena*	ST	Faulkner, White
Small-head pipewort	*Eriocaulon koernickianum*	SE	Pope, Conway, Van Buren
Southern tubercled orchid	*Platanthera flava*	ST	Conway
Tall cinquefoil	*Drymocallis arguta*	ST	Faulkner

Key: FE = Federally Endangered SE = State Endangered ST = State Threatened
Source: ANHC (2014b)

Many of the Arkansas state listed plant species that occur in Region 5 also occur in Region 4. Those species are discussed in Section 3.17.5.4 under Region 4 special status plants. The species that do not occur in the regions previously discussed are described here.

The federally endangered plant species pondberry (*Lindera melissifolia*) has confirmed element occurrence in Jackson and Poinsett counties, Arkansas, but no species-specific surveys have been undertaken to document the presence or absence within the ROI in Regions 5, 6, or 7. Pondberry is a strongly aromatic shrub that grows in seasonally flooded wetlands and along the margins of ponds, depressions, and bogs (eFlora 2013; Devall et al. 2001). Exact census counts of this species are lacking; however, Arkansas has confirmed 10 populations (DeLay et al. 1993). The state of Arkansas has protected areas, known as "Natural Areas," for pondberry within two counties crossed by the ROI. Swifton Sand Ponds Natural Area is located in Jackson County, and St. Francis Sunken Lands Natural Area is located in Poinsett County (ANHC 2009). Neither of these locations, however, is within the ROI.

Some populations of pondberry can appear quite large, but they may in fact be groupings of clones that produce numerous stems (Devall et al. 2001); this characteristic could add to the pondberry's vulnerability. Pondberry has been rarely confirmed historically. This plant has been adversely affected by logging, wetland drainage, road construction, and habitat conversion (Pittman 1993). Other threats include over-spray of herbicides from adjacent agricultural operations and pollution of ponds by pesticides and fertilizers associated with farming practices (LDWF 2013).

Dwarf bristle fern (*Trichomanes petersii*), listed by the state of Arkansas as threatened, is a rare mat-forming fern resembling a moss with leaves that vary in size from approximately 0.2 inch to 1 inch in length. The dwarf bristle fern inhabits moist, sheltered rocks, predominantly sandstones, where the surrounding air is perpetually moist. In Region 5, the dwarf bristle fern is known from Pope and Conway counties.

French's shooting-star (*Primula frenchii*) is a state listed threatened plant species in Arkansas that occurs in Cleburne County in Region 5. French's shooting-star is a perennial herbaceous species that typically grows as a pioneer species, protected beneath sandstone overhangs, preferring north and east-facing exposures. The species grows in habitats that yield little competition from other plant species, often growing alone in bare soil. In Arkansas, it is found occasionally in large numbers in areas that have not been impacted by timber management. Removal of large shade trees negatively affects the species.

The purple fringeless orchid (*Platanthera peramoena*) is listed as threatened in the state of Arkansas and occurs in Faulkner and White counties in Region 5. It grows in moist forests, woodlands, meadows, and thickets, as well as in marshes and swamps. The purple fringeless orchid appears to benefit from natural disturbances that reduce overhead tree canopies and results in more light. The species has a restricted habitat, making it especially vulnerable to land-use conversion, habitat fragmentation, and forest management practices.

The southern tubercled orchid (*Platanthera flava*) is a state threatened species in Arkansas and occurs in Conway County in Region 5. The southern tubercled orchid occurs on sandy silt alluvium and rotting logs in bottomland (floodplain) forest and wet thickets. It also occurs in wet-mesic prairies and wet meadows. This species is threatened by habitat loss, especially in floodplain forests and wet prairies. The primary threat to the southern tubercled orchid is the destruction of wetland habitat through development, logging, drainage, beaver activity, and other hydrologic alterations. Also threatening to this species are over-collection of orchids, excessive grazing, and successional overgrowth of habitats by woody species.

Tall cinquefoil (*Drymocallis arguta*) is member of the rose family that is listed as threatened by the state of Arkansas. The species is reported from Faulkner County in Region 5. The herbaceous species can reach 3 feet in height. Little information is available for tall cinquefoil in Arkansas but in other locations is considered a prairie species on well-developed soils. Habitat conversion and disturbance is a potential threat.

American ginseng (*Panax quinquefolius*) is not listed as federally threatened or endangered under the Endangered Species Act (ESA), nor is it a state-listed threatened or endangered species in Arkansas. However, this species does have commercial value, and as such, the state of Arkansas does require licensing and regulation for persons engaged in harvesting the plant. Additionally, the USFWS regulates the export of American ginseng under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (USFWS 2015).

3.17.5.5.3 Noxious Weeds

Arkansas has 43 listed noxious weeds. Sixteen of the 43 state-listed noxious weeds are confirmed to occur in the seven counties crossed by the ROI in Region 5 (Table 3.17-7).

Table 3.17-7:
Arkansas-Listed Noxious Weeds-Region 5 (by County Crossed within the ROI)

Common Name	Scientific Name	Pope	Conway	Van Buren	Faulkner	Cleburne	White	Jackson
Balloonvine	*Cardiospermum halicacabum*				X			
Banyardgrass	*Echinochloa crus-galli*	X			X			X
Bermudagrass	*Cynodon dactylon*	X	X		X	X		
Buckthorn plantain	*Plantago lanceolata*			X	X	X	X	
Cheatgrass (Chess)	*Bromus secalinus*	X	X		X			
Corncockle	*Agrostemma githago*	X	X		X			
Crotalaria	*Crotalaria* spp.							X
Dock	*Rumex* spp.	X	X	X	X	X		
Field bindweed	*Convolvulus arevensis*	X			X		X	
Hedge bindweed	*Calystegia sepium*							X
Johnsongrass	*Sorghum halepense*	X	X		X	X	X	X
Morning glory	*Ipomoea* spp.	X	X		X	X		
Nutgrass	*Cyperus rotundus*				X			
Thistle	*Carduus* spp.							
Thistle	*Cirsium* spp.		X	X		X		
Wild onion and/or garlic	*Allium* spp.	X			X	X		

Sources: Arkansas Plant Board (2014b), CISEH (2013)

3.17.5.6 Region 6

3.17.5.6.1 Ecoregional Descriptions

Region 6 is referred to as the Cache River and Crowley's Ridge Region and includes the Applicant Proposed Route and HVDC Alternative Routes 6-A through 6-D. Annual precipitation in Region 6 is approximately 50 inches. Region 6 occurs almost entirely within the Mississippi Alluvial Plain ecoregion. This ecoregion is fairly level and therefore provides good agricultural land. Agricultural crops (e.g., rice [*Oryza sativa*], soybeans [*Glycine max*], cotton [*Gossypium* spp.], corn [*Zea mays*], and wheat [*Triticum aestivum*]) represent a major cover type with Region 6. Because of the high precipitation levels, forest types that are present include deciduous and mixed types interspersed among the agricultural land or along riparian corridors. The western portion of the ROI is similar to the eastern end and consists of agriculture land with sloughs and narrow riparian corridors that continue to Route 37. In Region 6, the ROI traverses the Cache River, including its densely forested riparian corridor and associated wetlands. Immediately after traversing the forested areas of the Cache River, land use abruptly changes to agriculture and pasture lands and transitions to small forested areas that intersect Crowley's Ridge, which is densely forested with deciduous species (oak-hickory). Crowley's Ridge is a remnant elevated plain covered in loess soils and is part of the Mississippi Valley Loess Plains ecoregion. East of Crowley's Ridge, the ROI consists of agriculture and open land. Because Region 6 is located in the Mississippi Alluvial Plain ecoregion with a relatively high water table, woody wetlands, areas dominated by hydrophytic tree species with periodically saturated soils or standing water, also are more common.

One route variation was developed to the Applicant Proposed Route in Region 6 in response to public comments on the Draft EIS. The route variation is described in Appendix M and summarized in Section 2.4.2.6. The variation is illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to land cover within the ROI. Link 2, Variation 1, would have 274 acres of cultivated crop lands and 6 acres of urban/developed lands. It should be noted that a route adjustment was made for HVDC Alternative Route 6-A to maintain an end-to-end route with Link 2, Variation 1. The route adjustment for HVDC Alternative Route 6-A would have 1,574 acres of cultivated crops and 62 acres of urban/developed lands compared with the original HVDC Alternative Route 6-A.

3.17.5.6.2 Special Status Plants

Bicknells's sedge and pondberry, described under Regions 4 and 5 respectively, have documented element occurrence in Jackson and Poinsett counties, Arkansas (Table 3.17-8). No species-specific surveys have been conducted for these two species within the Applicant Proposed Route or the HVDC alternative routes in the ROI in Region 6. These two species also have documented element occurrence in previously discussed regions of the Project.

Table 3.17-8:
State and Federally Designated Threatened and Endangered Plants Potentially Occurring in the ROI in Region 6 (by County)

Common Name	Scientific Name	Listing Status	Counties of Occurrence in the Region
Bicknell's sedge	*Carex opaca*	SE	Poinsett
Pondberry	*Lindera melissifolia*	FE/SE	Jackson, Poinsett

Key: FE = Federally Endangered SE = State Endangered
Source: ANHC (2014a)

American ginseng (*Panax quinquefolius*) is not listed as federally threatened or endangered under the Endangered Species Act (ESA), nor is it a state-listed threatened or endangered species in Arkansas. However, this species does have commercial value, and as such, the state of Arkansas does require licensing and regulation for persons engaged in harvesting the plant. Additionally, the USFWS regulates the export of American ginseng under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (USFWS 2015).

3.17.5.6.3 Noxious Weeds

Arkansas has 43 designated noxious weeds. Fifteen of the 43 state-listed noxious weeds are confirmed to occur in the three counties crossed by the ROI in Region 6 (Table 3.17-9).

Table 3.17-9:
Arkansas-Listed Noxious Weeds—Region 6 (by County crossed within the ROI)

Common Name	Scientific Name	Poinsett	Mississippi	Cross
Balloonvine	*Cardiospermum halicacabum*		X	
Banyardgrass	*Echinochloa crus-galli*	X	X	
Bermudagrass	*Cynodon dactylon*	X		X
Buckthorn plantain	*Plantago lanceolata*			
Cheatgrass (Chess)	*Bromus secalinus*	X		
Corncockle	*Agrostemma githago*	X		
Dock	*Rumex* spp.	X		X

Table 3.17-9:
Arkansas-Listed Noxious Weeds—Region 6 (by County crossed within the ROI)

Common Name	Scientific Name	Poinsett	Mississippi	Cross
Field bindweed	*Convolvulus arevensis*		X	X
Hedge bindweed	*Calystegia sepium*	X		
Johnsongrass	*Sorghum halepense*	X	X	
Morning glory	*Ipomoea* spp.		X	
Thistle	*Carduus* spp.		X	
Thistle	*Cirsium* spp.		X	
Thistle	*Salsola* spp.		X	
Wild onion/garlic	*Allium* spp.		X	X

Sources: Arkansas Plant Board (2014b), CISEH (2014)

3.17.5.7 Region 7

3.17.5.7.1 Ecoregional Descriptions

Region 7 is referred to as the Arkansas Mississippi River Delta and Tennessee Region and includes the Applicant Proposed Route, HVDC Alternative Routes 7-A through 7-D, and the Tennessee Converter Station Siting Area and AC Interconnection Tie. The majority of the ROI in Arkansas consists of Mississippi River floodplain (Mississippi Alluvial Plain ecoregion), which is predominantly used for agricultural crops (e.g., rice, soybeans, and cotton). Annual precipitation is about 50 inches. The Project crosses the Mississippi River in Region 7. Immediately adjacent to the river is riparian forest. Woody wetlands are also relatively common in the region because of the high water table and precipitation, but they are patchy in distribution, so the routes may vary in the amount of wetlands within the ROI. Shrub/scrub cover types also may be more prevalent in Region 7 and in many cases may represent woody successional communities in areas that have been disturbed by human activities or periodic flooding. The eastern end of Region 7, where the Project terminates, is in Tennessee and occurs in the Mississippi Valley Loess Plains ecoregion. Vegetation is a mixture of cultivated land (crops and pasture/hay) and forests (deciduous and mixed).

Three route variations to the Applicant Proposed Route were developed in Region 7 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.7. The variations are illustrated in Exhibit 1 of Appendix M. Link 1, Variation 1, would feature 98 acres of cultivated crops. Link 1, Variation 2, would have 402 acres of cultivated crop lands and 21 acres of urban/developed lands Link 5, Variation 1, would have 56 acres of cultivated crops and 27 acres of forested lands.

3.17.5.7.2 Special Status Plants

Two special status plant species, Bicknell's sedge and pondberry, have documented element occurrence in Poinsett County in Arkansas (Table 3.17-10). Pondberry was discussed in detail in Region 5 and Bicknell's sedge was discussed in Section 3.17.5.4 for Region 4.

Table 3.17-10:
State and Federally Designated Threatened and Endangered Plants Potentially Occurring in the ROI in Region 7—Arkansas

Common Name	Scientific Name	Listing Status	Counties of Occurrence in the Region
Bicknell's sedge	*Carex opaca*	SE	Poinsett
Pondberry	*Lindera melissifolia*	FE/SE	Poinsett

FE = Federally Endangered SE = State Endangered
Source: ANHC (2014a)

No plants designated as threatened or endangered under the ESA occur in the portion of the ROI for the Applicant Proposed Route or the HVDC alternative routes in Region 7 in Tennessee (USFWS 2013a, 2013b, 2013c, 2014). State-designated plant species have been confirmed in Shelby and Tipton counties, Tennessee (TDEC 2014). Table 3.17-11 identifies these special status plant species and documents the counties in Tennessee in which they occur.

Table 3.17-11:
State-Listed Threatened and Endangered Plants Potentially Occurring in the ROI in Region 7—Tennessee

Common Name	Scientific Name	Listing Status	Shelby County	Tipton County
Copper iris	*Iris fulva*	ST	X	
Earleaved false-foxglove	*Agalinis auriculata*	SE		X
Nodding rattlesnake-root	*Prenanathes crepidinea*	SE	X	X
Ovate-leaf catchfly	*Silene ovata*	SE	X	
Red starvine	*Schisandra glabra*	ST	X	X
Sweetbay magnolia	*Magnolia virginiana*	ST	X	

SE = State Endangered, ST = State Threatened
Source: TDEC (2014)

No species-specific field surveys for pondberry or any state-listed species in Arkansas or Tennessee have been undertaken to date within the ROI for the Applicant Proposed Route or the HVDC alternative routes in Region 7.

Copper iris (*Iris fulva*) is a state threatened species in Tennessee and has documented element occurrence in Shelby County, Tennessee. The copper iris is a perennial plant that grows from a rhizome. Habitats include wetlands and bottomland forests. Primary threats include habitat conversions and alteration of wetland hydrology.

The earleaved false-foxglove (*Agalinis auriculata*) is an annual herbaceous plant up to approximately 36 inches tall. It occurs primarily in mesic to dry prairies, fallow fields, tallgrass prairies, prairie-like glades and barrens. It is listed as endangered by the state of Tennessee and has been reported in Tipton County in Region 7 of the Project. Tennessee's Rare Plant Protection and Conservation Act requires persons to obtain written permission from a landowner or manager before knowingly removing or destroying state-listed endangered plant species. Primary threats for this species include habitat conversion, repeated mowing, and succession to woody species.

Nodding rattlesnake-root (*Prenanathes crepidinea*) is considered a state endangered plant species in Tennessee and reported from Shelby County in Region 7. It is a herbaceous perennial plant that is associated with wooded floodplains. Primary threats include changes to stream hydrology, logging of floodplain forests, and conversion to agriculture.

Red starvine (*Schisandra glabra*) is a twining, woody vine with deciduous leaves and occurs in locations in western Tennessee along loess bluffs in counties bordering the Mississippi River, including Shelby County in Region 7 of the Project. Red starvine is considered a threatened species by the state of Tennessee. Primary habitat includes moist woods in bottomlands or in the bluffs along creeks and rivers in sandy-silt-loam soils. Threats include competition from non-native invasive species such as Japanese honeysuckle, land use conversions, and forest management practices.

The sweetbay magnolia (*Magnolia virginiana*) is classified as a threatened species by the state of Tennessee, although it is relatively common in other regions in the eastern and southern United States. It is typically a shrub or small tree, evergreen to partly deciduous. The sweetbay magnolia has been reported in Shelby County in Region 7. The species is most common in wet woods, swamps, bogs, and floodplains. Primary threats include land use conversions and alteration of hydrology regimes.

American ginseng (*Panax quinquefolius*) is not listed as federally threatened or endangered under the Endangered Species Act (ESA), nor is it a state-listed threatened or endangered species in Tennessee. However, this species does have commercial value, and as such, the state of Tennessee does require licensing and regulation for persons engaged in harvesting the plant. Additionally, the USFWS regulates the export of American ginseng under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (USFWS 2015).

3.17.5.7.3 Noxious Weeds

Tennessee has 14 designated noxious weed species (TDA 2007). Of this total, seven species are confirmed from counties crossed by the ROI (CISEH 2014). Table 3.17-12 presents the Tennessee noxious weed county occurrences.

Table 3.17-12:
Tennessee-Listed Noxious Weeds-Region 7 (by County crossed within the ROI)

Common Name	Scientific Name	Tipton	Shelby
Amur honeysuckle	*Lonicera maackii*		X
Autumn olive	*Elaeagnus umbellata*		X
Chinese privet	*Ligustrum sinense*	X	X
European privet	*Ligustrum vulgare*		X
Mimosa	*Albizia julibrissisn*	X	X
Multiflora rose	*Rosa multiflora*	X	X
Thorny olive	*Elaeagnus pungens*		X

Sources: TDA (2007), CISEH (2014)

3.17.5.8 Connected Actions

3.17.5.8.1 Wind Energy Generation

The land cover in each WDZ is summarized in Section 3.10. The ecoregional description and dominant vegetation types within the WDZs are the same as that of Region 1.

3.17.5.8.2 Optima Substation

The future Optima Substation would be constructed on approximately 160 acres partially within the area identified on Figure 2.1-3 in Appendix A as the AC Interconnection Siting Area. The land cover in the future Optima substation location is primarily grassland herbaceous, with some shrub/scrub and developed, open space. There are no structures or existing infrastructure on the 160-acre site, although there are roads and an operating wind farm nearby. Irrigated cropland is also in the vicinity.

3.17.5.8.3 TVA Upgrades

The ROI for the direct assignment facilities (which are included in the Applicant Proposed Project) would occur within the Tennessee Converter Station Siting Area and more specifically within the Shelby Substation. The ROI for the network upgrades, and in particular TVA's future 500kV transmission line, cannot be fully determined at this time. The new 500kV line would be in western Tennessee. The upgrades to existing facilities would mostly be in western and central Tennessee. Upgrades to existing infrastructure would include upgrading terminal equipment at three existing 500kV substations and six 161kV substations, making appropriate upgrades to increase heights on 16 existing 161kV transmission lines to increase line ratings, and replacing the conductors on eight existing 161kV transmission lines. Where possible, general impacts associated with the required TVA upgrades are discussed in the sections that follow.

3.17.6 Impacts to Vegetation Communities and Special Status Plant Species

3.17.6.1 Methodology

3.17.6.1.1 Impact Calculations

Vegetation communities and special status plant species are assessed for impacts based upon the current understanding of Project construction detail, standard operations and maintenance details, and possible scenarios for decommissioning. This assessment quantifies impacts to vegetation resources using estimated facility dimensions and associated land requirements by Project component as defined in Chapter 2 and Appendix F. The analysis conservatively assumes that the typical width of the ROW—200 feet—would be cleared of existing vegetation during the construction of the transmission line. All values for acreage of impacts have been rounded to the nearest tenth of an acre.

3.17.6.1.2 Construction Impacts

Construction-related impacts to vegetation communities and special status plant species may be temporary, short-term, or long-term. The elements of the construction process that may cause impacts to vegetation communities and special status plant species include, but are not necessarily limited to, the following activities:

- Clearing and grading
- Placement of structural foundations
- Access road construction
- Excavation for grounding wires, fiber optic regeneration cables, and transmission line structural foundations
- Blasting
- Herbicide use
- Hazardous materials handling

In terms of duration of impacts, the potential for temporary or short-term impacts to vegetation communities and special status plant species from construction activities include:

- The mechanical damage to vegetation by heavy machinery.
- The compaction of soils on temporary construction laydown yards or temporary access roads, thereby reducing the soil's water-holding capacity and inhibiting plant growth.
- The alteration of hydrology from access road construction, which could affect plant growth. Impacts could be positive or negative depending on the type and duration of alteration.
- The contamination of vegetation from herbicide drift or runoff, and from accidental spills of hazardous substances, such as fuels and lubricants. These impacts may stunt plant growth or inhibit the onset of growth.

The potential long-term impacts to vegetation communities and special status plant species from Project construction include:

- Removal of vegetation by excavation for structure foundations.
- Removal of vegetation during construction of access roads.
- Long-term conversion of forests and shrublands to herbaceous cover type within the transmission ROW; this impact includes the effects of habitat fragmentation such as reduced gene flow, susceptibility to blow-down, and competition by invasive species.
- Introduction of invasive species from construction equipment or spread of existing invasive species on newly cleared land. Invasive species can compete with native vegetation and could result in long-term change to vegetation community diversity and structure.

A more detailed discussion of the potential impacts to vegetation communities and special status plant species from specific construction activities and the corresponding proposed avoidance and minimization measures are discussed in the following sections. Unless otherwise specified, the discussion of impacts provided below is common to all components of the Project, including converter stations and AC interconnections, the HVDC transmission line, AC collection system transmission lines, access roads, multi-use construction yards and other temporary construction areas, and communications sites. In cases where a specific component's impact may vary, additional detail is provided to distinguish between components.

3.17.6.1.2.1 Clearing and Grading

The analysis conservatively assumes that construction within the typical width of the ROW—200 feet—would disturb existing vegetation either by removing it or by causing mechanical damage to it during the construction process. Grading, on the other hand, is expected to be much more focused in scope. Grading activities would likely take place at specific construction sites for structure foundations along some portion of the Project access road system, and at the converter station sites. Direct impacts would include removal of vegetation, mechanical damage to vegetation, the potential modification of plant community structure (e.g., removal of trees or shrubs and conversion to grassland/herbaceous land cover), and indirect impacts from compaction of soils and the resulting potential for increased erosion. Specific impacts are discussed below.

3.17.6.1.2.1.1 Removal of Vegetation

The removal of vegetation, as described in this section, includes blading or digging to physically remove plants, and also mechanical damage to plants that results in loss of vigor or death (e.g., crushing of above- and belowground biomass as heavy machinery or other equipment moves over the surface or is stored on the surface). Removal of vegetation can be either direct short-term or long-term impacts, depending on the vegetation cleared, and it would occur during clearing and grading activities. Removal of vegetation may be partial (e.g., aboveground tissue only) or complete. Vegetation removal can impact community structure and composition as well as alter soil moisture content and nutrient chemistry; however, impacts depend on the type and amount of vegetation removed and the rate of regeneration after construction. To reduce impacts from vegetation removal, the Applicant would minimize clearing of vegetation within the ROW (EPM GE-3) and would clearly demarcate (EPM FVW-3) and avoid or minimize impacts to environmentally sensitive vegetation (EPM FVW-1).

The greatest amount of localized vegetation removal would occur at the converter station sites, which would be long term in duration. Desktop analysis has not confirmed any special status plant species within the Oklahoma Converter Station Siting Area. The Oklahoma Converter Station Siting Area is predominately introduced vegetation. Similarly, the Tennessee Converter Station Siting Area is half cultivated cropland and half wooded areas, and no confirmed special status plant species are within this siting area based on desktop analysis. The ROI for the Arkansas Converter Station Alternative Siting Area includes the Cherokee WMA, but this WMA would not be considered a candidate for converter station siting. Wooded areas are present within the Arkansas Converter Station Alternative Siting Area, but much of the area has been cleared for pasture. Therefore, with the implementation of EPMs GE-6, FVW-1, and FVW-3, impacts from vegetation clearing at the converter station sites would be limited in size and would not involve the removal of environmentally sensitive plant species.

In contrast to the more localized vegetation removal at the converter station siting areas, vegetation removal at HVDC or AC structure footprints, along access roads, and in conjunction with temporary workspaces would be dispersed over a larger area. Although vegetation removal at structure footprints and along access roads would likely be long-term, vegetation along the remainder of the ROW and temporary access roads would be allowed to grow back to within certain parameters (i.e., height thresholds for transmission line safety). Conversion of forest along the transmission line ROWs would be considered a long-term impact, while clearing of forested areas for temporary work spaces would be considered a long-term impact. Where access occurs using overland driving instead of via existing improved or constructed roads, vegetation could be crushed, and although root materials would remain intact, allowing the vegetation to regenerate, this could also lead to the spread of invasive plants and noxious weed species, as discussed below. Therefore, the Applicant would restrict vehicular travel to the ROW and other established areas (EPM GE-6) to reduce this impact. Considering the dispersal of impacts over a larger region, these long-term impacts are considered to be minor.

3.17.6.1.2.1.1.1 Erosion

Removal of vegetation exposes topsoil to water and wind erosion. Removal of vegetation during Project construction could result in local erosion. Erosion can then cause increase runoff that removes downgradient vegetation or that causes sediment deposition over existing downgradient vegetation. Additionally, erosion could alter existing drainage patterns and affect vegetation resources that are not normally located in areas of flow. Minimizing vegetation removal, per EPM GE-3, would reduce the extent of erosion. In addition, the Applicant would develop and implement an SWPPP to ensure that both direct and indirect impacts related to erosion are minimized.

3.17.6.1.2.1.1.2 Fragmentation

Removal of vegetation during construction of the Project could result in habitat fragmentation. Habitat fragmentation is the physical separation of larger blocks of habitat into smaller blocks with newly created edge exposed. This fragmentation effect can occur naturally, or it can result from manmade actions. There is some degree of existing habitat fragmentation created by previous development that includes roads, oil and gas pipelines, and transmission lines that are already influencing the landscapes over which this Project would be built. Impacts resulting from vegetation removal within grassland and shrub communities, outside the footprint of the Project facilities and structures, would be short-term and less likely to contribute to long-term habitat loss, fragmentation, and degradation because these communities would be allowed to reestablish themselves following construction.

Habitat fragmentation in forested ecosystems is more visible, and its impact may be more pronounced. The construction of ROW corridors through forested tracts would create new, long edge habitats, susceptible to invasion by noxious weeds and other non-native vegetation species. As previously stated, the Applicant would minimize clearing of vegetation (EPM GE-3); however, if overstory vegetation were removed within forested ecosystems, these areas would not be allowed to reestablish following construction within the ROW due to the need to maintain the ROW for operational safety and system reliability, which would contribute to long-term habitat loss, fragmentation, and degradation. Forested vegetation could also be removed during construction in select tensioning and pulling sites, at temporary workspaces, and for temporary access roads. This vegetation would be allowed to reestablish following construction, but the recovery time would likely result in this activity being a long-term impact to vegetation resources.

3.17.6.1.2.1.1.3 Edge Effects

As described in the previous subsection, vegetation removal during the construction phase may result in habitat fragmentation, which exposes or creates new “edge” habitat, especially pronounced in forested areas. The creation of edge effects could increase competition among plant species due to changes in microclimate (e.g., increased light levels, decreased humidity, increased wind effects, etc.). This indirect impact would be long-term; however, per EPM FVW-1, the Applicant would avoid and/or minimize impacts on environmentally sensitive vegetation such that edge effects would be reduced.

3.17.6.1.2.1.1.4 Noxious Weeds

Invasive plant species and state listed noxious weeds occur within many counties in the ROI. The direct impact of removing vegetation can lead to the indirect impact of establishment of invasive plant species and listed noxious weeds, which can impact habitat quality by replacing native species. Replacement of native species, in turn, can lead to increased erosion, changes in soil nutrients, and lowering of existing wildlife habitat values.

Vegetation removal and soil disturbance during the construction phase of the Project would create disturbed substrates ideally suited to noxious weed establishment. EPMs GE-3 and FVW-2 (minimization of the spread of invasive species and noxious weeds) would reduce this impact. Additionally, construction vehicles and materials could disperse invasive plant seeds, resulting in their spreading and/or establishment in areas that may not have previously contained any invasive species. However, as stated above, restricting vehicular travel to the ROW and other established areas, per EPM GE-6, would also help to reduce this impact.

The Applicant would identify and implement measures to control and minimize the spread of non-native invasive species and noxious weeds based upon EPM FVW-2.

3.17.6.1.2.1.1.5 Soil Compaction

Construction of the Project would require the use of heavy equipment, which could cause soil compaction within the ROW and along access roads. Soil compaction could occur throughout the entire ROW for the ROI. Compaction of soils reduces pore space and soil aeration, decreasing soil permeability, thereby increasing runoff and altering water flow. This can alter vegetative communities and their ability to reestablish following construction. The Applicant would minimize compaction through appropriate use of construction equipment (EPM GE-27) and would develop and implement a restoration plan that would describe post-construction activities to reclaim disturbed areas not required for the operations and maintenance activities.

3.17.6.1.2.1.1.6 Herbicide Use

The Applicant would likely apply herbicides selectively to stumps and low-growing brush during clearing of the ROW. There would be mortality of targeted plant species that need to be removed. There would also be the potential for this type of activity to include accidental herbicide overspray and drift. Such an occurrence may cause adverse toxic effects to non-targeted terrestrial and aquatic vegetation, depending upon the type of herbicide used and the concentration. Impacts to non-targeted individual plants may be severe enough to cause mortality, whereas overall plant community impact may be localized and much less severe. To minimize potential impacts during construction, the Applicant would apply herbicides according to all label instructions and any federal, state, and local regulations (EPM GE-5).

3.17.6.1.2.1.1.7 Fuel and Lubricant Handling

Accidental spills of harmful fuels and lubricants used during construction could have unintended direct impacts on vegetation. Materials present during construction that could harm or cause mortality to vegetation include fuels, lubricants, antifreeze, detergents, paints, solvents, herbicides, and potentially other toxic fluids. In addition to the direct impact to the vegetation, cleanup of spills could also require the removal and disposal of vegetation. The Applicant would develop and implement an SPCCP to prevent, control, and clean up spills. The Applicant would keep emergency and spill response equipment on hand during construction (EPM GE-13) and would restrict the refueling and maintenance of vehicles and the storage of fuels and hazardous chemicals from within at least 100 feet of wetlands and waterbodies (EPM GE-14). These measures would ensure that any inadvertent spills would be cleaned up promptly and that impacts, including the potential for loss of vigor or mortality to plants, would be kept to a minimum.

3.17.6.1.2.2 Vegetation Cover Types of Special Concern

This section specifically discusses potential impacts from the Project’s construction phase to vegetation cover types of special concern, including vegetation communities in designated conservation areas or sensitive habitats identified in the ROI. The potential impacts to vegetation in wetlands and riparian areas are discussed in Section 3.19.

In general, the potential Project impacts from construction of the HVDC and AC transmission lines to special vegetation cover types would be similar to those discussed for general vegetation cover types. While the siting area for the Arkansas Converter Station Alternative does include the Cherokee WMA, the Applicant would specifically site this station outside the boundary of the WMA. Neither the Oklahoma nor the Tennessee converter station siting areas contain vegetation of special concern. As a result, no impacts to special status plant species are anticipated. Discussion of the potential construction impacts to vegetation communities within CRP lands are described under agricultural resources (Section 3.2).

3.17.6.1.2.2.1 Special Status Plant Species

Special status plant species are provided with special protection due to their rarity, uniqueness, and/or sensitivity. The USFWS has identified two federally protected plant species with potential to occur in the ROI. These two species are tinytim, which is federally listed as threatened, and pondberry, which is federally listed as endangered. Additional state-recognized special status plants may occur along the HVDC transmission line in Arkansas and Tennessee (as described for special status plants within Section 3.17.5).

Potential impacts to special status plant species from construction of the Project may include direct impacts from crushing by equipment or removal of federally or state-listed threatened or endangered plant species when clearing vegetation, and indirect impacts resulting from soil compaction from heavy construction equipment, which could inhibit water absorption and indirectly impact plant species survival. There may also be an increased potential for invasive plants and noxious weeds to encroach upon areas with special status plant species, causing short- and potentially long-term impacts to the plant communities in which the special status plants live. The use of herbicides to control noxious weed species could have the unwanted side effect of loss of non-target species, such as special status plants. Some potential for habitat fragmentation and edge effects exists in some plant communities in which special status plants may be found. Habitat fragmentation can lead to reduced gene flow within and between plant populations, reducing reproductive success for special status plants. Edge effects associated with habitat fragmentation can lead to special status plant species being outcompeted by early seral-stage plants that thrive in the edge environments. The edge position may also expose special status plants to more harsh or adverse microclimate conditions, reducing vigor or causing mortality.

The Applicant would plan and carry out special status plant surveys prior to any construction activities as necessary and appropriate. The Applicant would (EPMs FVW-1 and FVW-3) identify and clearly mark special status plant species such that impacts would be avoided and/or minimized to the maximum extent possible. The Applicant's Revegetation Plan would address the details of revegetating plant communities identified to contain special status plant species (EPMs FVW-1 and FVW-3).

3.17.6.1.3 Environmental Protection Measures

The Applicant has developed a comprehensive list of EPMs that would cover the measures necessary to avoid and minimize impacts to vegetation communities. Implementation of these EPMs is assumed throughout the impact analysis that follows for the Project. A complete list of EPMs for the Project is provided in Appendix F; those EPMs that would specifically minimize the potential for impact on vegetation and special status plant species are list below:

General EPMs relating to vegetation resources include the following:

- GE-3: Clean Line will minimize clearing vegetation within the ROW, consistent with a Transmission Vegetation Management Plan (TVMP) filed with NERC, and applicable federal, state, and local regulations. The TVMP may require additional analysis under NEPA depending on whether and under what conditions DOE decides to participate in the Project.
- GE-4: Vegetation removed during clearing will be disposed of according to federal, state, and local regulations.
- GE-5: Any herbicides used during construction and operations and maintenance will be applied according to label instructions and any federal, state, and local regulations.
- GE-6: Clean Line will restrict vehicular travel to the ROW and other established areas within the construction, access or maintenance easement(s).
- GE-7: Roads not otherwise needed for maintenance and operations will be restored to preconstruction conditions. Restoration practices may include decompacting, recontouring, and re-seeding. Roads needed for maintenance and operations will be retained.

Vegetation-specific EPMs included the following:

- FVW-1: Clean Line will identify environmentally sensitive vegetation (e.g., wetlands, protected plant species, riparian areas, large contiguous tracts of native prairie) and avoid and/or minimize impacts to these areas.
- FVW-2: Clean Line will identify and implement measures to control and minimize the spread of non-native invasive species and noxious weeds.
- FVW-3: Clean Line will clearly demarcate boundaries of environmentally sensitive areas during construction to increase visibility to construction crews.
- FVW-5: If construction occurs during important time periods (e.g., breeding, migration, etc.) or at close distances to environmentally sensitive areas with vegetation, wildlife, or aquatic resources, Clean Line will consult with USFWS and/or other resource agencies for guidance on seasonal and/or spatial restrictions designed to avoid and/or minimize adverse effects.

The Applicant would also develop and implement the following plans to avoid or minimize impacts to vegetation resources from construction, operations and maintenance, and/or decommissioning, as appropriate:

- Restoration Plan: This plan would describe post-construction activities to reclaim disturbed areas. This plan should include information on integrated weed management to identify current noxious weed infestations, treat those areas during construction, and periodically monitor and continue treatment of infestations as needed.
- Transmission Vegetation Management Plan (TVMP): This plan would describe how the Applicant would conduct work on its ROW to prevent outages due to vegetation. The TVMP may require additional analysis under NEPA depending on whether and under what conditions DOE decides to participate in the Project.

3.17.6.1.4 Operations and Maintenance Impacts

This section discusses potential impacts to vegetation resources associated with the operations and maintenance of Project converter stations and interconnects, HVDC and AC transmission lines, access roads, and fiber optic regeneration stations.

Operations and maintenance activities could impact vegetation resources, including special vegetation cover types, special status plant species, and noxious weeds. Potential impacts would include periodic maintenance of vegetation, soil compaction, introduction or spread of noxious weeds, and fire risk.

3.17.6.1.4.1 Vegetation Maintenance

The Applicant would maintain a 150- to 200-foot-wide typical ROW during operations and maintenance. Trees and brush would be periodically trimmed or removed within the ROW. Vegetation in the transmission ROW would be limited to low-growing vegetation to prevent interference with or damage to transmission lines. Vegetation management would be conducted as necessary to ensure compliance with NESC clearance requirements. The frequency of vegetation maintenance relates to the growth rates of the vegetation found within and near the ROW. More rapidly growing vegetation would require more frequent maintenance. In addition to vegetation maintenance of the ROW, minor trimming of woody vegetation may be required along access roads that are maintained for operations and maintenance activities. Maintenance activities are likely to result in periodic trampling of herbaceous vegetation. Maintenance vehicles would utilize established access roads to the extent practicable. Limited vegetation clearing could occur during Project operations and maintenance for any necessary repairs required for Project components. Impacts from vegetation clearing would be similar to those outlined for the construction phase.

Pursuant to NERC Reliability Standard FAC-003-2, prior to operation, the Applicant would create and implement a documented vegetation management strategy for the Project's permanent ROW to prevent vegetation-caused outages on the transmission system. The Applicant would develop a Vegetation Management Program (Vegetation Program) that will provide the framework for implementing treatments prescribed in the Project's Transmission Vegetation Management Plan (TVMP). The TVMP may require additional analysis under NEPA depending on whether and under what conditions DOE decides to participate in the Project.

The Vegetation Program will be based on established principles of Integrated Vegetation Management (IVM) for promoting and managing sustainable plant communities within transmission line ROWs that are compatible with safe, reliable operations and maintenance of the Project. The Project Description (Section 4.4 of Appendix F) describes how the Applicant will use management objectives described in the Vegetation Program to inform the Project's TVMP. The TVMP will define site-specific standards and action thresholds, measurable objectives and metrics; and prescribe controls or treatment options to achieve defined management objectives that support the Vegetation Program's overall goals of maintaining desirable plant communities and system reliability.

During development of the TVMP, the Applicant would solicit input from landowners or tenants (or other land managers as appropriate) as a key step when evaluating and selecting site-specific control methods for the TVMP. To accomplish this, the Applicant will utilize information obtained from landowners, tenants, and/or managers about specific land uses within their parcels to select control methods that best achieve the ROW management objectives at a specific site and address landowners' concerns. The Applicant would also work with landowners to clarify expectations for management objectives and to communicate the need for, benefits of, and scientific principles of IVM.

The Vegetation Program's goals, broad management objectives, and periodic progress reports are intended to be available and accessible to the general public or interested stakeholders upon request and/or through a project or corporate website. Opportunities for accessing these resources may include public or community education materials focused on IVM's objectives and its benefits. Consistent with common utility practice, the TVMP is a detailed plan and living document that will contain site-specific treatment measures that will be coordinated with a landowner. The TVMP may contain sensitive information that could be considered Critical Energy Infrastructure Information (as defined by FERC Order 630) and or personally-identifiable Information (such as name, address, or property maps) for landowners, and therefore general circulation may be limited in whole or in part.

3.17.6.1.4.2 Soil Compaction

Soil compaction during operations and maintenance of the Project could occur from inspection and maintenance vehicles. Impacts from soil compaction would be similar in nature, but less likely to occur in the same volume when compared to those outlined for the construction phase. Maintenance vehicles would stay on established access roads to the extent practicable, thereby minimizing additional soil compaction. The Applicant would minimize compaction of soils and rutting (EPM GE-27).

3.17.6.1.4.3 Introduction/Spread of Noxious Weeds

The periodic use of maintenance and inspection vehicles over a period of many years would increase the likelihood of introduction and spread of invasive plant species, including noxious weeds. This potential would be heightened after the initial construction phase when habitats such as forested tracts are newly fragmented and susceptible to invasion by noxious weeds. The threat would be lessened during operations through careful adherence to EPMs, including FVW-2.

3.17.6.1.4.4 Fire Risk

The operations and maintenance of an active electric transmission system presents an inherent fire risk. The greatest potential would result from uncontrolled growth of vegetation either within the ROW under live wires, or vegetation outside of the ROW, that could fall into energized lines. Uncontrolled wildfire could cause mortality to both the vegetation adjacent to the ROW and to vegetation resources located at greater distances, depending on several variables. Wildfires are a threat to all vegetation cover types, but especially damaging to forested ecosystems. The duration, intensity, and spatial extent of the impacts would vary according to the ambient conditions of local climate and of the vegetation itself.

Vegetation management would be conducted as necessary to ensure compliance with NERC clearance requirements. The frequency of vegetation maintenance relates to the growth rates of vegetation found within and near the ROW. More rapidly growing vegetation requires more frequent maintenance. The Applicant would develop and implement a TVMP describing vegetation maintenance schemes that specifically seek to minimize fire risk. The TVMP may require additional analysis under NEPA depending on whether and under what conditions DOE decides to participate in the Project.

3.17.6.1.5 Decommissioning Impacts

There is potential for the decommissioning of the Project to impact vegetation communities and special status plant species. Prior to any decommissioning activities, the Applicant would develop a Decommissioning Plan, for review and approval by appropriate state and federal resource agencies.

The Applicant would follow the same general and resource-specific EPMs during decommissioning that would be implemented during the construction and operations and maintenance phases of the Project. These measures would help to avoid and/or minimize impacts on vegetation communities and special status plant species.

At the end of the useful life of the facilities, decommissioning activities may include replacement of vegetation lost during construction. Potential impacts to vegetation communities and special status plant species during decommissioning are estimated to be similar to, but of less duration and severity, compared with the construction phase of the Project. It is assumed that the ROW would be allowed to revert back to pre-construction conditions, relieving the effects of habitat fragmentation, reducing or eliminating vehicle traffic and the issue of soil compaction, and reducing the threat of wildfire caused by transmission lines or maintenance vehicles in the ROW.

3.17.6.2 Impacts Associated with the Applicant Proposed Project

This section describes the potential impacts from the Project that would be common to the converter stations, AC interconnection, AC collection system, and Applicant Proposed Route. Impacts from the construction, operations and maintenance, and decommissioning phases of the Project are discussed separately by Project component.

3.17.6.2.1 Converter Stations and AC Interconnection Siting Areas

3.17.6.2.1.1 Construction Impacts

3.17.6.2.1.1.1 Oklahoma Converter Station Siting Area and Associated AC Interconnection Siting Area

The dominant vegetation for the siting area for the Oklahoma converter station is grassland and herbaceous cover (605 acres). Construction impacts for the Oklahoma Converter Station Siting Area and Associated AC Interconnection Siting Area were calculated using estimated facility dimensions and associated land requirements as described in Section 3.17.6.1. Construction of a single converter station is estimated to take 32 months. It is yet to be determined how many tubular (impact of 0.001 acre each), H-frame (impact of 0.002 acre each), and fiber optic (impact of 0.009 acre per control building) structures and how many tensioning areas outside the ROW (impact of 2.58 acres each) would be needed. The discussion below focuses on impacts related to the transmission lines; the lattice structures, which are assumed to be the primary structures used; and the tensioning area inside the 200-foot-wide representative ROW.

Forty-five to 60 acres of land would be cleared and graded for the station facility footprint, plus an additional 5 to 10 acres of land for the overall construction. The clearing and grading of the 45–60 acres would produce a long-term impact and the clearing, grading, and use of the additional 5–10 acres would produce a short-term impact. The latter would be revegetated using guidance within the Project's Restoration Plan. In addition, one 35-foot-wide by 1-mile-long all weather access road would be needed. Clearing and grading activities for the road would cause approximately 4 acres of long-term impact to current vegetation.

A maximum 200-foot-wide by 3-mile-long interconnection ROW would result in approximately 65.5 acres of long-term impacts, including the initial clearing of the existing vegetation. The structural footprint for the lattice structures would be 28 feet by 28 feet, equaling 784 square feet (0.02 acre) of vegetation removal. The maximum number of lattice structures would be 21, or less than 1 acre of long-term impact to vegetation.

Approximately four tensioning or pulling sites, 150 feet wide by 600 feet long, also would be required within the ROW, although it is estimated that 1 acre of the total will be located outside the ROW (2.0 acres each, minus 1 acre, for a total of 7 acres). Tensioning or pulling sites would be located partially outside the ROW at locations where the line turns more than 8 degrees, estimated at 1 acre.

Approximately 74 acres would be required for the Oklahoma converter station (including access road) and approximately 19 acres would be required for the Oklahoma AC interconnection during construction.

3.17.6.2.1.1.2 Tennessee Converter Station Siting Area and AC Interconnection Tie

The dominant vegetation for the 218 acre siting area for the Tennessee converter station includes cultivated crop lands (71 acres or 33 percent), pasture/hay (67 acres or 31 percent), and cultivated crops (44 acres or 20 percent).

Approximately 74 acres would be required for the Tennessee converter station (including access road). This acreage would be cleared and graded for the station facility. The clearing and grading of the 74 acres would produce a long-term impact. It is anticipated that any temporary construction areas would be contained within the footprint of the Tennessee converter station and the Shelby Substation. Any temporary impacts would be revegetated using guidance within the Project's Restoration Plan.

The AC interconnection tie to the Shelby Substation would be contained entirely within the converter station footprint and the Shelby Substation footprint and therefore not impact any additional vegetation.

3.17.6.2.1.2 Operations and Maintenance Impacts

3.17.6.2.1.2.1 Oklahoma Converter Station Siting Area and Associated AC Interconnection Siting Area

Vegetation removed during the construction of the converter station would not be replaced during the operations phase of the Project. Similarly, vegetation removed during the construction of the converter station access road would not be replaced during the operations and maintenance phase of the Project. Vegetation within the ROW of the AC interconnection would be maintained during the operations and maintenance phase of the Project in compliance with the TVMP. The TVMP may require additional analysis under NEPA depending on whether and under what conditions DOE decides to participate in the Project. The projected acreage of vegetation to maintain in the ROW is 65.5 acres.

3.17.6.2.1.2.2 Tennessee Converter Station Siting Area and Associated AC Interconnection Tie

Vegetation removed during the construction of the converter station would not be replaced during the operations phase of the Project. Similarly, vegetation removed during the construction of the converter station access road would not be replaced during the operations and maintenance phase of the Project.

3.17.6.2.1.3 Decommissioning Impacts

The decommissioning impacts related to the Project would be similar in nature to the set of temporary impacts resulting from initial construction of the Project. These temporary impacts would involve use of construction machinery at each of the two converter stations (i.e., Oklahoma and Tennessee). The specific acreages for the footprints of the two converter stations total a projected maximum of 120 acres that would be reclaimed and revegetated according to the details that would be written into the Decommissioning Plan. The total ROW acreage projected to be temporarily impacted again during decommissioning of the two sites would equal a maximum value of 70.3 acres. It is likely these temporary impacts would only be crushing or matting of some portion of the overall ROW at each of the two sites, and the vegetation would naturally recover. For those areas that are more severely impacted, reseeding with native vegetation species may be required according to the Decommissioning Plan.

3.17.6.2.2 AC Collection System

3.17.6.2.2.1 Construction Impacts

The AC collection system would consist of four to six 345kV lines, each extending up to 40 miles from the Oklahoma Converter Station. Within the 150–200-foot-wide ROW for each transmission line, an assembly area for the pole structures (whether lattice, tubular, or H frame, the assembly area footprint is the same) would be required. Each assembly area would be 150 feet wide by 150 feet long (0.5 acre) and five to seven assembly areas per mile would be required. Assuming 30 miles of AC collection lines, the total acreage of assembly areas would range between 765 and 1,071 acres. Total disturbance from the construction of access roads (inside and outside the ROW) for the AC collection system would be approximately 301 miles, or 669 acres.

Approximately six fiber optic regeneration sites would be required for the AC collection system. Each fiber optic regeneration site would be approximately 100 feet by 100 feet, with a fenced area of approximately 75 feet by 75 feet. The regeneration equipment would be enclosed in a small control building made of either metal or concrete, approximately 12 feet by 32 feet by 9 feet tall. An access road and power supply to the site would be required, but the same road would be used to access the transmission line, so those access road impacts are included in the impacts for the transmission line. Typically, these sites would be adjacent to or within 750 feet of the ROW. A total of approximately 3 acres of undeveloped land would be converted to a utility use for the six fiber optic regeneration sites anticipated to be required for the entire AC collection system.

Temporary work areas that would be required during construction include wire splicing sites and tensioning or pulling sites. One wire splicing site 100 feet by 100 feet (0.2 acre) would be required every 2 miles; assuming 150 sites, these would total 30 acres. A tensioning or pulling site 150 feet wide by 600 feet long (2 acres) would be required at least every 18,000 feet; assuming a total of 200 sites and 25 percent of these (50 sites) are located within the ROW, these would total 100 acres.

Assuming that the remaining 75 percent (150) of the tensioning or pulling sites would be located outside the ROW, they would add an additional 300 acres.

Additional temporary construction areas that would be required outside the ROW include multi-use construction yards and fly yards.

Multi-use construction yards would each be approximately 25 acres in size and would be located approximately 25 miles apart and typically within 10 miles of the ROW. Assuming the AC collection system requires approximately 15 multi-use construction yards, the total footprint would be 375 acres for all 15 yards. Fly yards would each require 10 to 15 acres each and would be located at approximately 5-mile intervals along the ROW and typically within 10 miles of the ROW. Assuming a total of 60 fly yards, 15 of which would be located within multi-use construction yards, 45 fly yards would have a total footprint of 450 to 675 acres. In total, approximately 3,223 acres would be required for the construction of the AC collection system, although construction would only occur in particular construction segments for a limited time.

Impacts would include temporary mowing and long-term removal of vegetation. Additional impacts to vegetation would be consistent with those described in Section 3.17.6.1.3. The duration of construction for the complete AC collection system will be approximately 24 months from mobilization to restoration. The land cover in the AC collection system representative ROW, by route, is summarized in Table 3.17-13. For each route, it is assumed that the entire acreage within the ROW would be temporarily disturbed during construction, although construction would not occur along the entire length of a route at the same time.

This page intentionally left blank.

Table 3.17-13:
Land Cover in the AC Collection System Representative ROW by Route

		Barren Land (Rock/Sand/Clay)	Cultivated Crops	Developed, High Intensity	Developed, Low Intensity	Developed, Medium Intensity	Developed, Open Space	Emergent Herbaceous Wetlands	Grassland/ Herbaceous	Open Water	Shrub/ Scrub	Woody Wetlands	Total
E-1	Acres	0.0	48.8	0.0	0.6	0.0	32.8	0.0	574.2	0.0	50.9	0.7	708.0
	Percent	0.0	76.9	0.0	0.1	0.0	4.6	0.0	81.1	0.0	7.2	0.1	100.0
E-2	Acres	0.0	280	0.0	0.5	0.0	26.3	0.0	572.8	0.0	74.5	1.8	974.4
	Percent	0.0	30.7	0.0	0.1	0.0	2.7	0.0	58.8	0.0	7.6	0.2	100.0
E-3	Acres	0.0	105.2	0.0	0.9	0.0	174.0	0.0	650.3	0.0	47.1	0.0	977.5
	Percent	0.0	10.8	0.0	0.1	0.0	17.8	0.0	66.5	0.0	4.8	0.0	100.0
NE-1	Acres	0.0	247.2	0.0	7.3	0.5	141.7	1.2	291.1	0.0	40.7	0.0	729.8
	Percent	0.0	33.9	0.0	1.0	0.1	19.4	0.2	39.9	0.0	5.6	0.0	100.0
NE-2	Acres	0.5	50.2	0.0	0.8	0.0	103.8	0.0	450.2	0.0	32.1	0.0	637.4
	Percent	0.1	7.9	0.0	0.1	0.0	16.3	0.0	70.6	0.0	45.0	0.0	100.0
NW-1	Acres	0.0	85.0	0.0	15.1	0.0	540.2	0.0	609.5	0.0	15.6	0.0	1,265.4
	Percent	0.0	6.7	0.0	1.2	0.0	42.7	0.0	48.2	0.0	1.2	0.0	100.0
NW-2	Acres	0.0	410.9	0.0	6.2	0.5	292.0	0.0	629.3	0.0	26.1	0.0	1,365.0
	Percent	0.0	30.1	0.0	0.5	0.0	21.4	0.0	46.1	0.0	1.9	0.0	100.0
SE-1	Acres	0.0	340.0	0.0	0.2	0.0	64.2	0.0	513.2	1.9	59.4	0.0	979.4
	Percent	0.0	34.7	0.0	0.0	0.0	6.6	0.0	52.4	0.2	6.1	0.0	100.0
SE-2	Acres	0.0	130.6	0.0	0.0	0.0	20.6	0.0	169.9	0.0	4.4	0.0	325.4
	Percent	0.0	40.1	0.0	0.0	0.0	6.3	0.0	52.2	0.0	1.3	0.0	100.0
SE-3	Acres	0.0	483.9	0.0	10.9	0.0	71.8	0.0	565.7	0.0	59.6	1.8	1,193.6
	Percent	0.0	40.5	0.0	0.9	0.0	6.0	0.0	47.4	0.0	5.0	0.1	100.0
SW-1	Acres	0.0	0.0	0.0	0.7	0.0	9.5	0.0	312.8	0.0	2.6	0.0	325.6
	Percent	0.0	0.0	0.0	0.2	0.0	2.9	0.0	96.1	0.0	0.8	0.0	100.0
SW-2	Acres	0.0	33.6	0.0	1.5	0.0	122.7	0.0	733.0	0.0	10.6	0.0	901.4
	Percent	0.0	3.7	0.0	0.2	0.0	13.6	0.0	81.3	0.0	1.2	0.0	100.0
W-1	Acres	0.0	47.2	0.0	1.8	1.1	69.4	0.0	377.0	0.0	11.5	0.0	507.8
	Percent	0.0	9.3	0.0	0.4	0.2	13.7	0.0	74.2	0.0	2.3	0.0	100.0

This page intentionally left blank.

3.17.6.2.2.2 Operations and Maintenance Impacts

3.17.6.2.2.2.1 Route E-1

The ROW for AC Collection System Route E-1 is dominated by grassland/herbaceous land cover (542.7 acres). This route does not feature any forested cover types in the ROW, but does cross 50.9 acres of shrub/scrub land cover. The operations and maintenance for AC Collection System Route E-1 may involve some degree of trimming and/or mowing in the ROW, but with no real change to the dominant cover types. The TVMP would govern the degree of maintenance that is required in the shrub-scrub cover type.

3.17.6.2.2.2.2 Route E-2

Grassland/herbaceous land cover is the dominant land cover type (574.2 acres) in the ROW for AC Collection System Route E-2. There are also 298.6 acres of cultivated crops land cover in the ROW. Both land cover types may have some trimming or mowing impacts from operations and maintenance of the Project with no change to the dominant cover type. No forested cover type is present in the 200-foot-wide ROW for AC Collection System Route E-2. There are 74.5 acres of shrub/scrub cover in the ROW that may require trimming and/or mowing over the operational life of the Project. This impact would not likely cause a change to cover type.

3.17.6.2.2.2.3 Route E-3

The ROW for AC Collection System Route E-3 is dominated by grassland/herbaceous land cover type (650.3 acres). It is unlikely that the operations or maintenance of the line would impact this land cover type or cause other adverse effects. No forested land cover is present in the ROW for AC Collection System Route E-3. Shrub/scrub land cover equals approximately 47.1 acres in the ROW and may require some degree of trimming or mowing during operations and maintenance with no change likely to the dominant cover type.

3.17.6.2.2.2.4 Route NE-1

AC Collection System Route NE-1 is almost equally dominated by cultivated crops (247.2 acres) and by grassland/herbaceous land cover (291.1 acres) in the ROW. Both land cover types may have impacts from trimming or mowing during operations and maintenance of the Project ROW with no change to the dominant cover type. No forested land cover is present in the ROW for AC Collection System Route NE-1. There are approximately 40.7 acres of shrub-scrub land cover in the ROW that may require trimming and/or mowing over the operational life of the Project. This impact would not likely cause a change to cover type.

3.17.6.2.2.2.5 Route NE-2

Grassland/herbaceous land cover is the dominant land cover type (450.2 acres) in the ROW for AC Collection System Route NE-2. The grassland/herbaceous land cover may have trimming and mowing impacts during operations and maintenance of the Project with no change to the dominant cover type. There is no forested land cover in the ROW for AC Collection System Route NE-2. There are 32.1 acres of shrub/scrub that may require trimming and/or mowing over the operational life of the Project. This impact would not likely cause a change to cover type.

3.17.6.2.2.2.6 Route NW-1

Grassland/herbaceous land cover is the dominant land cover type (609.5 acres) in the ROW for AC Collection System Route NW-1. There are also 540.2 acres of developed open space land cover in the ROW. The grassland/herbaceous land cover may have trimming and mowing impacts during operations and maintenance of the Project with no change to the dominant cover type. No forested land cover is present in the ROW for AC Collection System Route NW-1. There are 15.6 acres of shrub/scrub vegetation that may require trimming and/or mowing over the operational life of the Project. This impact would not likely result in a change to cover type.

3.17.6.2.2.2.7 Route NW-2

Grassland/herbaceous land cover (629.3 acres) is the dominant land cover type in the ROW for AC Collection System Route NW-2. There are also 410.9 acres of cultivated crops land cover in the ROI. Both the grassland/herbaceous and cultivated crop land cover may have trimming and mowing impacts during operations and maintenance of the Project with no change to the dominant cover type. No forested land cover is present in the ROW for AC Collection System Route NW-2. There are approximately 26.1 acres of shrub/scrub land cover that may require trimming and/or mowing over the operational life of the Project. This impact would not likely result in a change to cover type.

3.17.6.2.2.2.8 Route SE-1

Grassland/herbaceous land cover is the dominant land cover type (513.2 acres) in the ROW for AC Collection System Route SE-1. There are also 340.0 acres of cultivated crops land cover in the ROW. Both the grassland/herbaceous and cultivated crop land cover may have trimming and mowing impacts during operations and maintenance of the Project with no change to the dominant cover type. No forested land cover is present in the ROW for AC Collection System Route SE-1. Fifty-nine acres of shrub/scrub land cover located within the ROW may require trimming and/or mowing over the operational life of the Project. This impact would not likely result in a change to cover type.

3.17.6.2.2.2.9 Route SE-2

Grassland/herbaceous land cover is the dominant land cover type (169.9 acres) in the ROW for AC Collection System Route SE-2. There are also 130.6 acres of cultivated crops land cover in the ROW. Both the grassland/herbaceous and cultivated crops land cover may have trimming and mowing impacts during operations and maintenance of the Project with no change to the dominant cover type. No forested land cover is present in the ROW for AC Collection System Route SE-2. There are approximately 4.4 acres of shrub/scrub land cover that may require trimming and/or mowing over the operational life of the Project. This impact would not likely result in a change to cover type.

3.17.6.2.2.2.10 Route SE-3

Grassland/herbaceous land cover is the dominant land cover type (565.7 acres) in the ROW for AC Collection System Route SE-3. There are also 483.9 acres of cultivated crops land cover in the ROW. Both the grassland/herbaceous and cultivated crop land cover may have trimming and mowing impacts during operations and maintenance of the Project with no change to the dominant cover type. No forested land cover is present in the ROW for AC Collection System Route SE-3. There are 59.6 acres of shrub/scrub land cover that may require trimming and/or mowing over the operational life of the Project. This impact would not likely result in a change to cover type. Approximately 14 acres of wetlands may be present in the ROW for AC Collection System Route SE-3.

3.17.6.2.2.2.11 Route SW-1

Grassland/herbaceous land cover is the dominant land cover type (312.8 acres) in the ROW for AC Collection System Route SW-1. This land cover may have trimming and mowing impacts during operations and maintenance of the Project with no change to the dominant cover type. No forested land cover is present in the ROW for AC Collection System Route SW-1. There are 2.6 acres of shrub/scrub land cover that may require trimming and/or mowing over the operational life of the Project. This impact would not likely result in a change to cover type.

3.17.6.2.2.2.12 Route SW-2

Grassland/herbaceous land cover is the dominant land cover type (733.0 acres) in the ROW for AC Collection System Route SW-2. There are also 122.7 acres of developed open space in the ROW. Both the grassland/herbaceous and the open space land cover may have trimming and mowing impacts during operations and maintenance of the Project with no change to the dominant cover type. No forested land cover is present in the ROW for AC Collection System Route SW-2. There are approximately 10.6 acres of shrub/scrub land cover that may require trimming and/or mowing over the operational life of the Project. This impact would not likely result in a change to cover type.

3.17.6.2.2.2.13 Route W-1

Grassland/herbaceous land cover is the dominant land cover type (377.0 acres) in the ROW for AC Collection System Route W-1. The grassland/herbaceous land cover may have trimming and mowing impacts during operations and maintenance of the Project with no change to the dominant cover type. No forested land cover is present in the ROW for AC Collection System Route W-1. There are approximately 11.5 acres of shrub/scrub land cover that may require trimming and/or mowing over the operational life of the Project. This impact would not likely result in a change to cover type.

3.17.6.2.2.3 Decommissioning Impacts

The decommissioning impacts related to the AC collection system would be similar in nature to the set of temporary impacts resulting from initial construction. These temporary impacts would result from use of construction machinery at the various alternative AC collection system sites of infrastructure (e.g., the lattice structures, tubular structures, H-frame structures, and fiber optic infrastructure) to remove aboveground material, and foundation material where required. Use of construction machinery would have the potential to crush or remove vegetation (primarily in grasslands or croplands), but these areas would be reseeded following removal of infrastructure. No long-term effects are judged to be likely from the decommissioning phase of the AC collection system. Revegetation would be guided by the Project's Decommissioning Plan.

3.17.6.2.3 HVDC Applicant Proposed Route

3.17.6.2.3.1 Construction Impacts

Construction impacts for the Applicant Proposed Route were calculated using estimated facility dimensions and associated land requirements as described in Section 3.17.6.1, Chapter 2, and Appendix F. It is yet to be determined how many lattice crossing (impact of 0.11 acre each), monopole (impact of 0.001 acre each), guyed (impact of 0.001 acre each), and fiber optic (impact of 0.009 acre per control building) structures and how many tensioning areas outside the ROW (impact of 3.44 acres each) would be needed. The discussion below focuses on impacts related to the representative 200-foot-wide ROW for the transmission lines. These impacts would result from initial clearing of the ROW. This would include both potential removal of vegetation and mechanical damage to vegetation. There would be placement of foundations for the lattice structures (which are assumed to be the primary structures used) and which would involve approximately six structures per mile on average, with 0.02 acres of impact per structural foundation set. This impact would be long-term in duration. Additional impacts to vegetation in the ROW would be consistent with those described in Section 3.17.6.1.2.The placement of the transmission line would involve tensioning areas inside the 200-foot-wide representative ROW (average of one tensioning site per two miles of transmission line). Tensioning impacts are estimated to be temporary in duration and might include trimming or mowing of vegetation, and/or crushing of existing vegetation by heavy machinery. The land requirements for the Applicant Proposed Route in Regions 1–7 are summarized in Table 3.17-14. Changes to impacts due to route variations and adjustments developed in response to public comments on the Draft EIS are described at the end of applicable sections.

Table 3.17-14:
Total Temporary and Long-Term Construction Impact Acreage for the Applicant Proposed Route—200-Foot-Wide Representative ROW

Regional Description	Potential Impact Acreage Within ROW
Region 1	
Initial ROW Clearing (115.5 miles in length)	2,825.2 acres
Lattice Structural Foundations/693 structures	13.9 acres
Region 2	
Initial ROW Clearing (106 miles in length)	2,588.1 acres
Lattice Structural Foundations (636 structures)	13 acres
Region 3	
Initial ROW Clearing (161.7 miles in length)	3,949.1 acres
Lattice Structural Foundations (970 structures)	19.4 acres
Region 4	
Initial ROW Clearing (126.3 miles in length)	3,087.6 acres
Lattice Structural Foundations (758 structures)	15.2 acres
Lee Creek Variation in Region 4	
Initial ROW Clearing (3.4 miles in length)	84.4 acres
Lattice Structural Foundations (20 structures)	0.4 acres
Region 5	
Initial ROW Clearing (112.8 miles in length)	2,759.5 acres
Lattice Structural Foundations (677 structures)	13.5 acres
Region 6	
Initial ROW Clearing (54.4 miles in length)	1,331.9 acres
Lattice Structural Foundations (326 structures)	6.5 acres
Region 7	
Initial ROW Clearing (42.8 miles in length)	1,048.0 acres
Lattice Structural Foundations (256 structures)	5.1 acres

The duration of construction is expected to be approximately 36 to 42 months for the entire Project, although the duration of construction for a single HVDC segment is anticipated to be approximately 24 months from mobilization to restoration.

Acreages of land cover types, by region (1 through 7), are included in Tables 3.10-15 through 3.10-21 Section 3.10 of the EIS. Additionally, descriptions of route variations to the Applicant Proposed Route, and the associated acreages of land cover types in those route variations, are described in detail in Sections 3.10.6.2.3.1.1 through 3.10.6.2.3.1.7.

3.17.6.2.3.2 Operations and Maintenance Impacts

Impacts from operations and maintenance of the Applicant Proposed Route would be similar to those from the AC collection system routes (see Section 3.17.6.2). These impacts may result from some degree of trimming and/or mowing in the ROW, with no real change to the dominant cover types. Within the transmission line ROW (200 feet wide by 720 miles long), only the transmission structures, fiber optic regeneration sites, and access roads would remain. For lattice structures, the operational footprint would be four to six structures per mile, and each foundation would measure 28 feet by 28 feet (less than 0.02 acre). Assuming 720 miles of lattice structures, the operational footprint would be 86 acres. Each structure would be 120 to 200 feet tall. For monopole structures, the operational footprint would be five to seven structures per mile, each with a foundation of 7 feet by 7 feet (approximately 0.001 acre), up to 5 acres total. Each structure would be 120 to 160 feet tall. Lattice crossing structures, which would be required in limited situations, would each have a structural footprint of 55 feet by 55 feet (approximately 0.07 acre) and each structure would be 200 to 300 feet tall. Guyed structures would also be required in limited situations, and would each have a structural footprint (not including guy wires) of 7 feet by 7 feet (0.001 acre) and each structure would be 120 to 200 feet tall.

The estimated four fiber optic regeneration sites would remain, each consisting of a fenced area 75 feet wide by 75 feet long (0.13 acre) including a control building 12 feet by 32 feet. The estimated operational footprint for all four sites is 0.8 acre. A permanent access road to the fenced area, a power supply to the control building, and a backup power generator and fuel supply would also remain.

It is anticipated that all existing roads and existing roads with repairs/improvements would be retained for operations and maintenance of the Project. It is estimated that approximately 75 percent of the new overland roads with no improvements and 90 percent of the new overland roads with clearing and new bladed roads would be retained for operations and maintenance access. New overland roads that are utilized for operations and maintenance would result in long-term removal of vegetation. These roads would be up to 20 feet wide and would total an estimated 1,851 acres. Access roads that are not needed for operations and maintenance of the Project would be restored (EPM GE-7).

In total, approximately 1,938 acres would be required for the operation of the HVDC transmission line, including 86 acres for the structures, 1,851 acres for the roads, and 0.8 acre for the fiber optic regeneration sites. All other land in the ROW would be allowed to recover and return to its previously dominant vegetation types, with the exception of forested lands and shrublands, which would be maintained according to the TVMP. Vegetation within the wire zone would be limited to low-growing herbaceous vegetation including grasses, forbs, and short-stature shrubs in those locations where the conductor is 50 feet or less from the ground. Tall shrubs and short trees would be permitted in the border zone (i.e., to the edge of the ROW). Tree-trimming and brush removal would be conducted as needed to maintain the vegetation within the ROW.

During operations and maintenance of the Applicant Proposed Route, the transmission line would be inspected regularly and as necessary using fixed-wing aircraft, helicopters, ground vehicles, and/or personnel on foot. Maintenance would be performed as needed. Maintenance activities would generally be smaller in scale and more localized than construction activities. Maintenance activities would cause long-term impacts to forested land cover, and may cause temporary impacts within the ROW to crops and other vegetation; the areas of impacts are summarized in Table 3.17-15.

Table 3.17-15:
Total Long-Term Operations and Maintenance Impact Areas for the Applicant Proposed Route—200-Foot-Wide Representative ROW

Applicant Proposed Route	Total Length of Route/Acres of Potential Vegetation Impact Within the ROW	Forested Land Cover Within ROW
Region 1		
APR Links 1–5	115.5 miles/2,825.2 acres	< 1 acre
Region 2		
APR Links 1–3	106.0 miles/2,588.1 acres	252.9 acres
Region 3		
APR Links 1–6	161.7 miles/3,949.1 acres	1,145.4 acres
Region 4		
APR Links 1–9	126.3 miles/3,087.6 acres	1,333.5 acres
Region 5		
APR Links 1–9	112.8 miles/2,759.5 acres	1,556.2 acres
Region 6		
APR Links 1–8	54.4 miles/1,331.9 acres	96.5 acres
Region 7		
APR Links 1–5	42.8 miles/1,048.0 acres	81.8 acres
Totals	719.5 miles/17,589.4 acres	4,466.3 acres

3.17.6.2.3.2.1 Region 1

The majority of land cover within the ROW for Region 1 is grassland/herbaceous (1,742.3 acres) and cultivated crops (748.8 acres). Less than 1 acre of the ROW for the Applicant Proposed Route in Region 1 contains forested lands, so very little trimming of trees is anticipated.

3.17.6.2.3.2.2 Region 2

Region 2 is dominated by grassland/herbaceous land cover (1,299.9 acres) and cultivated crop land cover (788.0 acres) within the ROW. Forested lands account for approximately 252.9 acres of cover within the ROW for this region, including evergreen, deciduous, and mixed forest types. The routine operations and maintenance for the Project would result in long-term impacts to some portion of these forested lands as governed by the TVMP.

3.17.6.2.3.2.3 Region 3

Region 3 operations and maintenance would occur in a ROW dominated by grassland/herbaceous vegetation (1,339.5 acres) and 1,145.4 acres of deciduous and evergreen land cover types. The routine operations and maintenance for the Project would result in long-term impacts to some portion of these forested lands as governed by the TVMP.

3.17.6.2.3.2.4 Region 4

Region 4 is dominated by pasture/hay land cover type (1,436.1 acres). This land cover type would likely require very little vegetation maintenance during the operational life of the Project. However, there are 1,333.5 acres of deciduous, evergreen, and mixed forest cover types in the ROW of Region 4. The routine operations and maintenance for the Project would result in long-term impacts to some portion of these forested lands as governed by the TVMP.

3.17.6.2.3.2.5 Region 5

Region 5 operations and maintenance would occur on lands dominated by deciduous forest (810.8 acres in the ROW) land cover. There are 1,556.2 total acres of deciduous, evergreen, and mixed forest cover types in the Region 5 ROW. The routine operations and maintenance for the Project would result in long-term impacts to some portion of these forested lands as governed by the TVMP.

3.17.6.2.3.2.6 Region 6

Region 6 operations and maintenance would occur on lands dominated by cultivated crops (1,056.5 acres) land cover. Very little impact is anticipated from operations and maintenance activities with regard to this cover type. Forested lands within the ROW for Region 6 are limited to 88.8 acres of deciduous forest and 7.7 acres of mixed forest land cover. The routine operations and maintenance for the Project would result in long-term impacts to some portion of these forested lands as governed by the TVMP.

3.17.6.2.3.2.7 Region 7

Region 7 operations and maintenance would occur on lands dominated by cultivated crops (691.8 acres). Little to no impact would result from operations and maintenance of the Project on this land cover type. The ROW for Region 7 has approximately 81.8 acres of deciduous, evergreen, and mixed forest land cover types. The routine operations and maintenance for the Project would result in long-term impacts to some portion of these forested lands as governed by the TVMP.

3.17.6.2.3.3 Decommissioning Impacts

The decommissioning impacts related to the Applicant Proposed Route would be similar in nature to the set of temporary impacts resulting from initial construction of the HVDC transmission line. These temporary impacts would result from use of construction machinery at the various sites of infrastructure (e.g., the lattice structures, lattice crossing structures, monopole structures, guyed structures, and fiber optic infrastructure) to remove aboveground material, and foundation material where required. Use of construction machinery would have the potential to crush or remove vegetation, but no long-term effects are judged to be likely from the decommissioning phase of the Project. Revegetation would be guided by the Project's Decommissioning Plan.

3.17.6.3 Impacts Associated with the DOE Alternatives

3.17.6.3.1 Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area

3.17.6.3.1.1 Construction Impacts

Construction impacts for the Arkansas Converter Station Siting Area and associated AC Interconnection Siting Area were calculated using estimated facility dimensions and associated land requirements as described in Chapter 2 and Appendix F. The dominant land cover types at the Arkansas Converter Station Siting Area are deciduous forest (71 acres), followed by pasture/hay lands (67 acres), and cultivated crops (44 acres). There are also 12 acres of woody wetlands within the siting area.

Twenty to 35 acres of land would be cleared and graded for the station facility footprint, plus an additional 5 to 10 acres of land for the overall construction. The clearing and grading of the 20–35 acres would produce a long-term impact and the clearing, grading, and use of the additional 5–10 acres would produce a short-term impact. The latter would be revegetated using guidance within the Project's Restoration Plan. In addition, one 35-foot-wide by 1-mile-long all weather access road would be needed. Clearing and grading activities for the road would cause approximately 4 acres of removal of current vegetation.

Construction of the related Project facilities for the Arkansas converter station and interconnection facility would result in the following impacts to vegetation:

- Transmission line ROW: A maximum 200-foot-wide by 5-mile-long ROW would result in 121 acres of long-term impacts to vegetation via clearing and grading activities. The AC Interconnection Siting Area contains 72 percent (478 acres) hay and pastureland and 11 percent (76 acres) evergreen forest.
- Lattice Structures: The maximum number of lattice structures would be 35, and this would equal approximately 1 acre of long-term impact to vegetation.
- Tubular Pole Structures: The maximum number of tubular pole structures would be 35, and this would equal less than 1 acre of long-term impact to vegetation.
- Substation Site: A 25–35-acre site would be required to construct a substation for the interconnection to an existing 500kV transmission line. An additional 5-acre area would be required during construction, resulting in a potential for 45 total acres of impact. The substation site is mostly grassland with some forested areas.

3.17.6.3.1.2 Operations and Maintenance Impacts

Vegetation removed during the construction of the converter station would not be replaced during the operations phase of the Project. Similarly, vegetation removed during the construction of the converter station access road would not be replaced during the operations and maintenance phase of the Project. Vegetation within the ROW of the AC interconnection would be maintained during the operations and maintenance phase of this Project in compliance with the TVMP. The projected acreage of vegetation to maintain in the ROW is 121 acres. Vegetation removed for the substation site would not be replaced except for about 5 acres required only during construction.

3.17.6.3.1.3 Decommissioning Impacts

The decommissioning impacts related to the Arkansas converter station and associated facilities would be similar in nature to the set of temporary impacts resulting from initial construction. These temporary impacts would involve use of construction machinery at the converter station site, as well as the ROW area that would have been used for AC interconnection. The specific acreage for the footprint of the converter station totals a projected maximum of 60 acres which would be reclaimed and revegetated according to the details that would be written into the Decommissioning Plan.

3.17.6.3.2 HVDC Alternative Routes

3.17.6.3.2.1 Construction Impacts

Construction impacts for the HVDC alternative routes were calculated using estimated facility dimensions and associated land requirements as described in Chapter 2 and Appendix F. It is yet to be determined how many lattice structures (impact of 0.11 acre each), monopoles (impact of 0.001 acre each), guyed structures (impact of 0.001 acre each), and fiber optic (impact of 0.009 acre per control building) structures, and how many tensioning areas outside the ROW (impact of 3.44 acres each) would be needed. Predicted impacts to vegetation in the ROW would be consistent with those described in Section 3.17.6.1.2. The land requirements for the HVDC alternative routes and the Applicant Proposed Route in Regions 1–7 are summarized in Table 3.17-16. The table also includes the acreage of potential vegetation impacts in the ROW, and the acres of potential forest impacts within the ROW.

Table 3.17-16:
Land Requirements for the HVDC Alternative Routes and the Applicant Proposed Route in Regions 1–7

Alternative	Length of Route/Acres of Potential Vegetation Impact Within ROW/Predominant Land Cover/Acres of Potential Forest Impact Within ROW[1]	# of Lattice Structures/Acres of Potential Vegetation Impact Within ROW
Region 1		
AR 1-A	123.0 miles/3,003.1 acres/grassland and herbaceous cover/4.7 acres	738 structures/14.8 acres
APR Links 2–5	113.6 miles/2,777.7 acres/grassland and herbaceous cover/0.1 acres	682 structures/13.6 acres
AR 1-B	51.8 miles/1,268.4 acres/grassland and herbaceous cover/0.0 acres	311 structures/6.2 acres
APR Links 2–3	53.8 miles/1,316.0 acres/grassland and herbaceous cover/0.0 acres	323 structures/6.5 acres
AR 1-C	52.0 miles/1,272.5 acres/grassland and herbaceous cover/0.0 acres	312 structures/6.2 acres
APR Links 2–3	53.8 miles/1,316.0 acres/grassland and herbaceous cover/0.0 acres	323 structures/6.5 acres
AR 1-D	33.5 miles/819.2 acres grassland and herbaceous cover/0.0 acres	201 structures/4.0 acres
APR Links 3-4	33.6 miles/822.8 acres grassland and herbaceous cover/0.0 acres	202 structures/4.0 acres
Region 2		
AR 2-A	57.2 miles/1,396.3 acres/grassland and cultivated crops/144.5 acres	343 structures/6.9 acres
APR Link 2	54.4 miles/1,330.7 acres/grassland and cultivated crops/231.5 acres	326 structures/6.5 acres
AR 2-B	29.8 miles/727.7 acres/cultivated crops and grassland/16.6 acres	179 structures/3.6 acres
APR Link 3	31.2 miles/763.6 acres/cultivated crops and grassland/15.9 acres	187 structures/3.7 acres
Region 3		
AR 3-A	37.6 miles/919.1 acres/grassland, deciduous forest, and cultivated crops/194.3 acres	226 structures/4.5 acres
APR Link 1	40.0 miles/977.1 acres/grassland, deciduous forest, and cultivated crops/236.5 acres	240 structures/4.8 acres
AR 3-B	47.7 miles/1,166.6 acres/grassland, deciduous forest, and cultivated crops/229.0 acres	286 structures/5.7 acres
APR Links 1–3	49.9 miles/1,220.6 acres/grassland, deciduous forest, and cultivated crops/293.7 acres	299 structures/6.0 acres
AR 3-C	121.6 miles/2,967.5 acres/grassland, deciduous forest, and pasture/hay/878.3 acres	730 structures/14.6 acres
APR Links 3–6	118.6 miles/2,895.2 acres/pasture/hay, deciduous forest, and grassland/901.9 acres	712 structures/14.2 acres
AR 3-D	39.3 miles/958.8 acres/pasture/hay, deciduous forest, and grassland/185.0 acres	236 structures/4.7 acres
APR Links 5, 6	35.1 miles/856.8 acres/pasture/hay, grassland, and deciduous forest/167.4 acres	211 structures/4.2 acres
AR 3-E	8.5 miles/207.8 acres/pasture/hay, deciduous forest, and grassland/74.1 acres	51 structures/1.0 acre
APR Link 6	7.7 miles/189.7 acres/deciduous forest, pasture/hay, and grassland/80.8 acres	46 structures/0.9 acre
Region 4		
AR 4-A	58.4 miles/1,426.1 acres/deciduous forest and pasture/hay/749.1 acres	350 structures/7.0 acres
APR Links 3–6	60.4 miles/1,475.7 acres/pasture/hay and deciduous forest/521.6 acres	362 structures/7.2 acres
AR 4-B	78.6 miles/1,919.8 acres/deciduous forest and pasture/hay/1,239.4 acres	472 structures/9.4 acres
APR Links 2–8	81.3 miles/1,987.9 acres/pasture/hay and deciduous forest/758.4 acres	488 structures/9.8 acres
AR 4-C	3.4 miles/82.6 acres/deciduous forest and pasture/hay/56.8 acres	20 structures/0.4 acre
APR Link 5	2.2 miles/53.4 acres/deciduous forest and pasture/hay/35.1 acres	13 structures/0.3 acre
AR 4-D	25.3 miles/617.6 acres/pasture/hay and deciduous forest/276.6 acres	152 structures/3.0 acres
APR Links 4–6	25.4 miles/619.1 acres/pasture/hay and deciduous forest/157.1 acres	152 structures/3.0 acres

Table 3.17-16:
Land Requirements for the HVDC Alternative Routes and the Applicant Proposed Route in Regions 1–7

Alternative	Length of Route/Acres of Potential Vegetation Impact Within ROW/Predominant Land Cover/Acres of Potential Forest Impact Within ROW[1]	# of Lattice Structures/Acres of Potential Vegetation Impact Within ROW
AR 4-E	36.7 miles/897.2 acres/pasture/hay and evergreen and deciduous forest/394.1 acres	220 structures/4.4 acres
APR Links 8–9	38.7 miles/946.7 acres/pasture/hay and evergreen and deciduous forest/464.6 acres	232 structures/4.6 acres
Region 5		
AR 5-A	12.6 miles/308.5 acres/evergreen and deciduous forest/226.6 acres	76 structures/1.5 acres
APR Link 1	12.3 miles/300.1 acres/evergreen and deciduous forest/224.0 acres	74 structures/1.5 acre
AR 5-B	71.0 miles/1,732.3 acres/pasture/hay and mixed forest/804.2 acres	426 structures/8.5 acres
APR Links 3–6	67.1 miles/1,641.6 acres/pasture/hay and mixed forest/880.6 acres	403 structures/8.1 acres
AR 5-C	9.2 miles/224.6 acres/deciduous forest, pasture/hay, and mixed forest/135.5 acres	55 structures/1.1 acre
APR Links 6–7	9.4 miles/229.9 acres/deciduous forest, pasture/hay, and mixed forest/138.6 acres	56 structures/1.1 acre
AR 5-D	21.7 miles/529.6 acres/deciduous forest, cultivated crops, and mixed forest/338.4 acres	130 structures/2.6 acres
APR Link 9	20.5 miles/499.9 acres/cultivated crops, deciduous forest, and pasture/hay/199.6 acres	123 structures/2.5 acres
AR 5-E	36.3 miles/885.1 acres/pasture/hay and mixed forest/395.0 acres	218 structure/4.4 acres
APR Links 4–6	33.1 miles/811.1 acres/pasture/hay and mixed forest/386.9 acres	199 structures/4.0 acres
AR 5-F	22.3 miles/544.5 acres/pasture/hay and deciduous forest/270.4 acres	134 structures/2.7 acres
APR Links 5–6	18.7 miles/459.1 acres/pasture/hay and deciduous forest/266.5 acres	112 structures/2.2 acres
Region 6		
AR 6-A	16.2 miles/395.7 acres/cultivated crops/0.0 acres	97 structures/1.9 acres
APR Links 2, 3, 4	17.7 miles/432.8 acres/cultivated crops/0.1 acre	106 structures/2.1 acres
AR 6-B	14.1 miles/343.7 acres/cultivated crops/0.0 acres	85 structures/1.7 acres
APR Link 3	9.6 miles/235.7 acres/cultivated crops/0.1 acre	58 structures/1.2 acre
AR 6-C	23.1 miles/565.6 acres/cultivated crops/52.5 acres	139 structures/2.8 acres
APR Links 6–7	24.8 miles/606.5 acres/cultivated crops/95.0 acres	149 structures/3.0 acres
AR 6-D	9.2 miles/223.6 acres/cultivated crops/4.0 acres	55 structures/1.1 acre
APR Link 7	8.6 miles/209.4 acres/cultivated crops/1.7 acres	52 structures/1.0 acre
Region 7		
AR 7-A	43.2 miles/1,052.0 acres/cultivated crops/0.5 acre	259 structures/5.2 acres
APR Link 1	28.6 miles/697.7 acres/cultivated crops/0.7 acre	172 structures/3.4 acres
AR 7-B	8.6 miles/209.9 acres/cultivated crops, deciduous forest, and shrub/scrub/43.6 acres	52 structures/1.0 acre
APR Links 3–4	8.4 miles/205.1 acres/cultivated crops, deciduous forest, and shrub/scrub/53.5 acres	50 structures/1.0 acre
AR 7-C	23.8 miles/578.6 acres/cultivated crops, pasture/hay, and deciduous forest/62.4 acres	143 structures/2.9 acre
APR Links 3–5	13.2 miles/323.5 acres/cultivated crops, deciduous forest, and scrub/shrub/81.0 acres	79 structures/1.6 acres
AR 7-D	6.5 miles/159.5 acres/cultivated crops and pasture/hay/16.1 acres	39 structures/0.8 acre
APR Links 4–5	6.4 miles/157.0 acres/cultivated crops, pasture/hay, and deciduous forest/27.5 acres	38 structures/0.8 acre

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments

Descriptions of route adjustments to HVDC Alternative Routes 3A, 5B, 5E, and 6A, with their associated acreages of land cover types crossed by the adjustment, are described in detail in Section 3.10.6.3.2.1.3.1, Section 3.10.6.3.2.1.5.2, Section 3.10.6.3.2.1.5.5, and Section 3.10.6.3.2.1.6.1, respectively.

3.17.6.3.2.2 Operations and Maintenance Impacts

Impacts from operations and maintenance of the HVDC alternative routes would be similar to those from the Applicant Proposed Route (see Section 3.17.6.2.3). No long-term impacts are described for access roads because the location of access roads has not yet been determined. Maintenance activities would cause long-term impacts to pre-construction forested land cover. Some forested lands (including evergreen forests, hardwood forests, and mixed forests) would need to be cut and maintained according to the TVMP and would not be allowed to regrow for line safety and integrity reasons. There may also be temporary impacts within the ROW to crops and other vegetation. Grasslands/herbaceous, cultivated crops, and other low-profile land covers may have trimming and mowing impacts during operations and maintenance of the Project. The land area for long-term impacts to forested land cover are summarized in the Table 3.17-16, including a comparison of impacts to the Applicant Proposed Route, by region. These long-term impacts may include the pruning or removal of shrubs and trees, where necessary according to the TVMP. In the table, total forested land cover includes the sum of deciduous, evergreen, and mixed forest cover types.

3.17.6.3.2.3 Decommissioning Impacts

The decommissioning impacts relative to the alternative routes would be similar in nature to the set of temporary impacts resulting from initial construction. These temporary impacts would result from use of construction machinery at the various sites of infrastructure (e.g., the lattice structures, lattice crossing structures, monopole structures, guyed structures, and fiber optic infrastructure) to remove aboveground material, and foundation material where required. Use of construction machinery would have the potential to crush or remove vegetation, but no long-term effects are judged to be likely from the decommissioning phase of the Project. Revegetation would be guided by the Project’s Decommissioning Plan.

3.17.6.4 Best Management Practices

A complete list of EPMs for the Project is provided in Appendix F; those EPMs that would specifically lead to the avoidance or minimization of potential impacts on vegetation communities are summarized in Section 3.17.6.1. The Applicant would consider the development of site-specific BMPs that may be necessary after consultation with appropriate federal and state agencies.

3.17.6.5 Unavoidable Adverse Impacts

Unavoidable adverse impacts to vegetation and special status plant species from the Project may include the following:

- Removal of vegetation in the footprints of new transmission line support structures, access roads, regulator stations, and other associated infrastructure
- Conversion of structural types of vegetation (e.g., forest conversion to grassland or forest to low-stature shrublands)
- Changes to plant species diversity with the general trend likely to be a diminishment of vegetation species diversity in disturbed areas
- Potential lower yields in croplands that are disturbed during construction and operations and maintenance

3.17.6.6 Irreversible and Irretrievable Commitment of Resources

A commitment of resources is irreversible when its primary and secondary impacts limit the future options for a resource. An irretrievable commitment refers to the use or consumption of a resource that is neither renewable nor recoverable for use by future generations.

Both short- and long-term disturbance to vegetation would be minimized through appropriate application of the Project's Restoration Plan. Once the Project has been decommissioned, there is potential for all of the approximately 2,598 acres of vegetation to be recovered. Therefore, it is predicted that there would be no irreversible or irretrievable commitment of vegetation resources.

3.17.6.7 Relationship Between Local Short-term Uses and Long-Term Productivity

Removal of vegetation, mechanical damage to vegetation, and reduced plant water availability due to compaction of soils are all potential local short-term use effects on vegetation that could result from construction of the Project. The short-term impacts would be minimized through the use of multiple EPMs incorporated into the Project. The impact of short-term uses on long-term productivity to vegetation resources would be limited to those areas where (1) structural foundations are left in place until decommissioning, or (2) instances where vegetation structure is altered from forested to herbaceous structural types. In this second specific case, the functions of wildlife habitat maintenance, biodiversity, and recreational opportunities could be diminished. The EPMs listed in Section 3.19.6.1 should limit these changes in long-term productivity.

3.17.6.8 Impacts from Connected Actions

3.17.6.8.1 Wind Energy Generation

Although site-specific layouts of wind energy generation facilities in the 12 WDZs have yet to be designed or proposed, impacts from these potential wind energy generation facilities on vegetation communities were evaluated using the methodology described in Section 3.17.6.1.

Based on the maximum capacity of the Project and information from wind energy developers, it is estimated that 20-30 percent of the potentially suitable land, or between 216,400 and 324,600 acres, would actually be developed for wind energy facilities using transmission capacity from the Project.

It is estimated that during the construction phase approximately 2 percent of land within a wind energy facility is affected (Denholm et al. 2009). Assuming up to 30 percent build-out of the WDZs, up to 6,492 acres would be temporarily disturbed during construction. This would include the construction of access roads, turbine pads and foundations, underground collection lines, collector substation, and often a generation tie line. An operations and maintenance building and at least one or two meteorological towers are also typically included.

During the operations and maintenance phase of wind energy facilities, approximately 1 percent or less of the land would be affected. Once construction has been completed, temporary construction areas would revert to their previous uses. Only turbines, access roads, generation tie-lines (if necessary), substations, and operations and maintenance buildings would remain. This would equate to approximately 3,246 acres. Existing land uses, including agricultural croplands, would be expected to return to almost all areas of the facilities, unless deemed incompatible with the operations of a wind farm.

Temporary impacts during construction may result from increased dust entrainment that can settle on surrounding vegetation causing a reduction in photosynthetic capability of plants. It is also likely that there would be mowing or potential removal of vegetation in ROWs for generation tie-lines, access roads, and electrical collection lines that are placed underground. Long-term impacts may result to vegetation where it is removed to facilitate construction of substation facilities.

Impacts to pasture and cultivated crops may also occur during construction in the WDZs. Construction may temporarily prevent the existing uses in the construction area, including growing crops. Wind energy developers typically coordinate with landowners to minimize impacts to agricultural operations, such as timing construction to begin after crops are harvested; and specifying types of seed to use during revegetation. The land cover distribution for the 12 WDZs is presented in Table 3.10-12 in Section 3.10.

Wind lease agreements typically include provisions to minimize the losses, including minimizing soil compaction and revegetating temporary work areas. In addition, the agreements typically stipulate compensation for landowners for any losses of crops, landscaping, and trees. Once construction has been completed, agricultural operations would be able to continue in most of the wind farm. Agricultural activities such as cultivating crops are generally permitted up to the wind turbine pads, so only a very minimal area of existing agricultural land would be removed from production. Access roads may change the configuration of fields for crops.

3.17.6.8.2 Optima Substation

The future Optima Substation is anticipated to be constructed on 160 acres of currently undeveloped land near an operating wind energy facility. The land cover of the site is primarily grassland/herbaceous. Vegetation within this area would be expected to be removed for the construction of the substation. Impacts associated with removal of vegetation are described in Section 3.17.6.1.2. No special status plant species have documented elemental occurrences within the substation site.

3.17.6.8.3 TVA Upgrades

Much of the following discussion is relevant for the new 500kV transmission line, or for certain upgrades associated with the 161kV transmission lines. The required TVA upgrades to existing facilities (including existing transmission lines and existing substations) should have minimal impact on vegetation resources and, except for potential access roads, would not involve vegetation removal outside existing ROWs or developed substation sites. The construction, operation, and maintenance of the new 500kV transmission line would have impacts similar to the Project although on a smaller scale. These impacts may include mechanical damage and/or removal of vegetation by heavy machinery, reduced water-holding capacity and inhibition of plant growth, due to compaction of soils, introduction of invasive species from construction equipment or spread of existing invasive species on newly cleared land, alteration of hydrology during road construction, which could affect plant growth, long-term conversion of forested and shrublands to herbaceous cover type within ROWs, and contamination from herbicide drift or runoff or from accidental spills of fuels or lubricants that could stunt plant growth or inhibit the onset of growth.

Many construction-related impacts would be short-term, but vegetation loss in areas of new structures and access roads would be long-term. On average, the construction of new TVA transmission lines during the last decade has resulted in the removal of 5.6 acres of forest per mile of new line. During operations, vegetation would reestablish on most disturbed areas; in ROWs for the new electric transmission line vegetation would be managed so maintenance activities would not be affected, especially in any forested areas where trees could restrict access or affect operations if allowed to reestablish. Depending on the locations of the required TVA upgrades, federally protected plant species and state-recognized special status plants may occur. Special status plant species could be impacted the same as other vegetation unless, as is planned for the Project, plant surveys are carried out prior to construction activities and TVA marks special status species and avoid them as practicable.

3.17.6.9 Impacts Associated with the No Action Alternative

Under the No Action Alternative, DOE assumes for analytical purposes that the Project would not be constructed. No impacts on vegetation or special status plant species on private, federal, state, or tribal lands, or their corresponding land management policies and regulations would occur. The existing diversity, structure, and function of vegetation within the ROW would be expected to continue to evolve under the influence of natural processes such as succession and as a result of other human-related disturbances.

Contents

Tables

Figures Presented in Appendix A

This page intentionally left blank.

3.18 Visual Resources

This section describes the affected environment and assesses the impact of the Project on visual resources, which are defined as visible features of the landscape (e.g., land, water, vegetation, animals, structures, and other features) (BLM 2010).

The methodology used to identify and assess the potential impacts of the Project on visual resources is based on the Bureau of Land Management (BLM) Visual Resource Management (VRM) inventory and contrast rating systems although the Project does not cross lands administered by the BLM. The BLM VRM system provides a systematic approach for evaluating the potential changes to visual resources that may result from the Project. The major concepts of the BLM VRM methodologies that this visual resource analysis follows are described below:

- Establish an understanding of the existing visual character and qualities of the landscape environment of the Project area
- Determine areas from which the Project would be visible
- Estimate the visual expectations and response of the viewers to visual changes resulting from the Project
- Identify the visual contrast resulting from changes to the existing landscape character and qualities in the Project area as a result of the Project

The overall visual resource assessment methodology is graphically shown in a flowchart in Figure 3.18-1 (located in Appendix A). The methodologies for conducting the visual resources inventory and impact assessment are described in more detail in Sections 3.18.4 and Section 3.18.6, respectively.

3.18.1 Regulatory Background

Goals, objectives, policies, implementation strategies, and guidance for visual resources are typically contained in resource management plans, and comprehensive plans. Regulations and guidance documents that focused the analysis presented in this section are identified in Table 3.18-1.

Table 3.18-1:
Visual Laws and Regulations Applicable to the Project

Statute/Regulation	Agency	Applicability to the Project
Federal		
National Environmental Policy Act of 1969, as amended (NEPA)	Council of Environmental Quality (CEQ)	The CEQ implementing regulations for NEPA require that EISs (including DEISs) discuss the environmental consequences to aesthetic resources (40 CFR 1508.8). Aesthetic resources under NEPA include park lands, wild and scenic rivers and other ecologically critical areas that may be affected by major federal actions that may include activities entirely or partially financed, assisted, conducted, or approved by federal agencies. NEPA's focus is on the environment of the area(s) to be affected by the alternatives under consideration. In December 2012, DOE published the NOI to prepare an EIS to analyze the potential environmental impacts of the Project. Several of the scoping comments received in response to this NOI addressed potential effects of the Project on specific aesthetic resources including impacts on scenic vistas such as Gloss Mountain and the Mississippi River, Ozark Mountains, Ozark National Forest, Trail of Tears, Honey Springs Battlefield/State Park, scenic highways, and National Scenic Byways.

Table 3.18-1:
Visual Laws and Regulations Applicable to the Project

Statute/Regulation	Agency	Applicability to the Project
Federal Land Policy and Management Act of 1976 (FLPMA) (43 USC § 1701 et. seq.)	National Forest Service (NFS)	FLPMA was enacted for the purpose of establishing a unified, comprehensive, and systematic approach to managing and preserving public lands in way that protects "the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archaeological values." In the context of FLPMA, public lands consist of federally-owned lands (i.e., BLM, NPS, and USFS lands). The following sections of FLPMA are applicable to visual resources: Section 102 (a)(8). States that "…the public lands be managed in a manner that will protect the quality of the …scenic…values…" Section 103(c). Identifies "scenic values" as one of the resources for which public land should be managed. Section 505(a). Requires that "Each right-of-way shall contain terms and conditions which will…minimize damage to the scenic and aesthetic values…" HVDC Alternative Route 4-B crosses the Ozark-St. Francis National Forest (Figure 3.10-1 in Appendix A). The Ozark-St. Francis National Forests Revised Land and Resource Management Plan was updated in 2005 to provide a framework for managing the forests' natural resources by establishing long-range goals and management areas with specific objectives. The Land and Resource Management Plan identifies the following scenery management priorities (USFS 2005a): • Maintain or enhance the visual character of the forests by using the USFS Scenery Management System (SMS) to achieve Scenic Integrity Objectives (SIO) • Manage landscapes and built elements in order to achieve scenic integrity objectives • Promote the planning and improvement of infrastructure along scenic travel routes. Use the best environmental design practices to harmonize changes in the landscape and to advance environmentally sustainable design solutions • Restore landscapes to reduce visual effects of nonconforming features • Manage scenic restoration to be consistent with other management area objectives • Maintain the integrity of the expansive, natural landscapes, and traditional cultural features that provide the distinctive character of places Maintain the character of key places in order to maintain their valued attributes.
National Historic Preservation Act of 1966, as amended (NHPA) (16 USC § 470 et seq.) (implementing regulations at 36 CFR 800.5)		The NHPA includes language protecting the visual integrity of sites listed or eligible for the NRHP: "Examples of adverse effects…include…introduction of visual, atmospheric, or audible elements that diminish the integrity of the property's significant historic features…" (36 CFR 800.5). Visual resources protected by the NHPA are discussed in Section 3.9.6.
The National Trails System Act (16 USC § 1241)	National Park Service (NPS)	National Trails were established under the National Trail System Act of 1968 (16 USC §§ 1241–51), designating and protecting national scenic trails, national historic trails, and national recreational trails. National trails are administered by the BLM, NPS, and USFS. These agencies provide coordination and oversight for the entire length of a trail. However, because these trails traverse both public and private lands as well as lands controlled by various agencies, on-site management activities are performed by the jurisdictional agency, the state, or the landowner (16 USC §§ 1241–51, as amended 2009). Portions of the Applicant Proposed Route and HVDC Alternative Routes 4-A, 4-B, 4-C, 4-D, 4-E, and 7-A in Regions 4 and 7 cross the Trail of Tears. The Trail of Tears in Region 4 is a multi-branched linear resource management corridor and was used during the forced relocation of Native American peoples indigenous to the

Table 3.18-1:
Visual Laws and Regulations Applicable to the Project

Statute/Regulation	Agency	Applicability to the Project
		southeastern United States to Indian Territory (now Oklahoma) in the 1830s. Greatly expanded in 2009, the Trail of Tears National Historic Trail consists of several separate branches that cross, and in one case terminate in, Arkansas. The ROI for the Project (see Section 3.18.3) intersects the branch of the Trail of Tears now called the Bell-Drane Route between western Crawford County and south-central Johnson County. Generally following the old Little Rock-to-Fort Gibson Road up the northern side of the Arkansas Valley as far west as Fort Smith, this trail segment is typically described as approximating the present route of U.S. Route 64. From the vicinity of Fort Smith, the Bell-Drane Route turns north and approximates State Route 59 to Evansville, in southwestern Washington County near the Arkansas-Oklahoma line. The NPS does not exercise regulatory authority over any portion of Trail of Tears crossed by the Project. The role of the NPS is to lead a group of federal, state, local, non-governmental, and private stakeholders with interests in the identification, preservation, interpretation, and promotion of the Trail of Tears National Historic Trail and associated properties.
National Scenic Byways Program (23 USC § 162) Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA; Public Law 102-240).	The Federal Highway Administration (FHA)	A scenic byway is a public road with special scenic, historic, recreational, cultural, archaeological, and/or natural qualities that have been recognized as such through legislation or official declaration. Easements associated with scenic byway ROWs may prohibit construction of transmission structures or other structures that degrade the scenic quality of the road. The National Scenic Byways Program establishes the framework for identifying and managing highways that have "outstanding scenic, historic, cultural, natural, recreational, and archaeological qualities." Additionally, the FHWA's May 18, 1995, interim policy (60 FR 26759, May 18, 1995 [FHWA Docket No. 95-15]) sets forth the procedures for the designation of certain roads as National Scenic Byways or All-American Roads by the U.S. Secretary of Transportation. The interim policy also requires the preparation of a corridor management plan to provide guidance for the conservation and enhancement of the byways' intrinsic qualities.
State		
Oklahoma Scenic Rivers Act (Oklahoma Statute 82-1451–1471)	Oklahoma Water Resources Board (OWRB)	In Oklahoma, state scenic rivers were established under the Oklahoma Scenic Rivers Act designating certain free-flowing rivers that possess unique natural scenic beauty and outdoor recreational values for the benefit of present and future inhabitants of the state. The intent of this act is to preserve state-designated scenic rivers in their natural scenic state. There are five streams protected under the program in Oklahoma, including Lee Creek and Little Lee Creek. No other rivers designated under the Oklahoma Scenic Rivers Act occur within the ROI.
Arkansas Natural and Scenic Rivers Act (Arkansas Code Annotated 15-23-301)	Arkansas	In Arkansas, state scenic rivers are established under the Arkansas Natural and Scenic Rivers System Act, designating certain rivers of the state that possess "outstanding natural, scenic, educational, geological, recreational, historical, fish and wildlife, scientific, and cultural values of great present and future benefit to the people". The intent of this act is to balance the alterations of man and the protection of the natural landscape along certain rivers. The act establishes a process for designating and managing state-designated scenic rivers.
Scenic Highway Designations (Arkansas Code Annotated 27-67-203)	Arkansas Highway Commission	State-designated scenic highways are established under the Arkansas Code Title 27-67-203. Byways are nominated for scenic status and are officially designated by the State General Assembly (AHTD 2007). For a highway to be declared scenic, a group interested in preserving the scenic, cultural, recreational, and historic qualities of the route must be created. Once a scenic highway has been designated, the Arkansas State Highway, Transportation Department, and respective counties must place appropriate signs indicating these highways have been designated; however, the state does not identify additional regulations for protecting state-designated scenic highways.

Table 3.18-1:
Visual Laws and Regulations Applicable to the Project

Statute/Regulation	Agency	Applicability to the Project
Tennessee Scenic Rivers Act (Tennessee Administrative Code 11-13)	Tennessee Department of Environment and Conservation—Division of Natural Areas	In Tennessee, state scenic rivers are established under the Tennessee Scenic Rivers Act of 1968, designating certain rivers that “possess outstanding scenic, recreational, geological, fish and wildlife, botanical, historical, archaeological, and other scientific values of great present and future benefit to the people” as scenic rivers. This act establishes three classes of scenic rivers and the management requirements for each classification, including permitted land uses. The intent of this act is to protect scenic, historic, archaeological, and scientific features of state-designated scenic rivers, regardless of classification.
Tennessee Scenic Highway System Act of 1971 (Tennessee Administrative Code 54-17)	Tennessee Department of Transportation (TNDOT)	The Tennessee Scenic Highway System Act of 1971 establishes the criteria to designate, recover, and conserve natural scenic beauty along designated scenic highways, and preserve routes of historical significance. This act recommends designation of specific highways, and provides strategies for promoting the scenic highway system.

3.18.2 Data Sources

Potential visual resources were identified through a desktop analysis of readily available information, research, and reports; information received directly from regulatory agencies and other stakeholders during the DOE scoping process and stakeholder outreach; and data obtained through GIS databases. Table 3.18-2 lists the GIS databases that were used to compile visual resource data. GIS source data included federal, state, and municipal governments, and non-governmental organizations.

Table 3.18-2:
Summary of GIS Data Sources

Information/Resources	Data Sources	Region of Influence Extent of Data Collection[1]
Existing Visual Character of the Landscape		
Land Type, including Forest, Grassland, Barren (rock/sand/clay)	GIS Data Sources: Jin et al. (2013), Tetra Tech (2014b)	Within 15 miles
Water, including state-identified as Outstanding, Exceptional, or Extraordinary Resource Waters, or other state-specific designations that may relate to aesthetics or recreational use	Oklahoma Water Resource Board Appendix B Waters (High Quality Waters) Outstanding Resource Waters (Extraordinary Resource Waters, Natural and Scenic Waterways) (ADEQ 2012) Tennessee Division of Water Pollution Control Exceptional Tennessee Waters and Outstanding National Resource Waters (TDEC 2013) Texas Water Development Board High Water Quality/Exceptional Aquatic Life/High Aesthetic Value Designated Streams (GIS Data Source: TWDB 2013)	Within 15 miles
Digital Elevation Data	GIS Data Sources: USGS (1999), Tetra Tech (2014b)	Within 15 miles
Land Use (Developed, Residential, Agriculture, Parks, Roads, Railroads)	GIS Data Sources: Jin et al. (2013), Clean Line (2013a)	Within 15 miles
Potential Visual Resources/Viewpoints		
National Wild and Scenic Rivers	GIS Data Source: IWSRCC (1999), National Wild and Scenic Rivers dataset	Within 15 miles

Table 3.18-2:
Summary of GIS Data Sources

Information/Resources	Data Sources	Region of Influence Extent of Data Collection[1]
Schools	GIS Data Sources: Clean Line (2013a, 2013b); Tetra Tech (2014a)	Within 3 miles
Churches	GIS Data Sources: Clean Line (2013a, 2013b), Tetra Tech (2014a)	Within 3 miles
Cemeteries	GIS Data Sources: Clean Line (2013a, 2013b), Tetra Tech (2014a), ESRI (2013)	Within 3 miles
Federal Lands and Wilderness Areas	USFWS (2012), ESRI (2010); GIS Data Sources: ESRI (2013), USFS (2014a, 2014b, 2014c)	Within 15 miles
State Parks (Oklahoma Tourism and Recreation Department, Arkansas Department of Parks and Tourism, Tennessee Department of Environment and Conservation [TDEC], Division of Parks and Conservation, and Texas Parks and Wildlife Department [TPWD])	ESRI (2010), TDEC (2011), TPWD (2011); GIS Data Source: AHTD (2006c)	Within 15 miles
State-Owned WMAs (owned by ODWC, AGFC, Tennessee Wildlife Resources Agency, and TPWD)	GIS Data Sources: OSU (2003), AGFC (2005) (ongoing), TWRA (2007)	Within 15 miles
Arkansas WMAs (leased by AGFC)	AGFC (2013)	Within 3 miles
Cities and Town Boundaries	ESRI (2010)	Within 3 miles
County, City, and Town owned Lands that are managed for conservation or recreation	ESRI (2010); DOE Scoping Comments (Appendix E)	Within 3 miles
Scenic Byways and Trails	GIS Data Sources: NPS (2013), Clean Line (2013f)	Within 15 miles
National Register of Historic Places Sites	GIS Data Source: NPS (2013)	Within 3 miles
Residential Structures	GIS Data Sources: Tetra Tech (2014), Clean Line (2013a, 2013b)	Within 0.5 mile on either side of the referenced centerline of the Applicant Proposed Route and HVDC Alternative Routes).

1 Measured from representative centerlines of transmission line routes or the boundary of the converter station siting areas.

Structures within 0.5 mile of the transmission line routes were digitized and categorized from aerial photography, and a structure data layer was created (GIS Data Sources: Clean Line 2013a, 2013b; Tetra Tech 2014a). These data were field verified and updated accordingly. Aerial reconnaissance was also conducted following development of the Applicant Proposed Route and HVDC alternative routes.to verify the feasibility of the routes. Additional structures noted during the aerial reconnaissance were also included in the structure inventory.

In addition to the desktop research and initial field reconnaissance, field investigation at Key Observation Point (KOP) locations was conducted in February and March 2014 to assess contrast and visual impacts and provide photographs for visual simulations.

3.18.3 Region of Influence

3.18.3.1 Region of Influence for the Project

The ROI for visual resources was established through a combination of field reconnaissance and in consideration of the BLM distance zones. For the purpose of this analysis, a 1,000-foot-wide corridor was identified by Clean Line (Clean Line 2013). A representative ROW (a 200-foot-wide corridor associated with the transmission lines) was created within this 1,000-foot-wide corridor. Although theoretically the transmission line and associated ROW could be located anywhere within these corridors, it would be difficult to assess the transmission line from an infinite number of possibilities. Assessment of the line from the center of the corridors (referenced centerline), therefore, provides consistency throughout the assessment. The ROI for visual resources for the transmission line is defined as 6 miles (3 miles on either side of the referenced centerline of the Applicant Proposed Route, HVDC alternative routes, AC interconnection lines, and AC collection system). The reference centerlines are located within the 1,000-foot-wide corridor (which is the “standard” ROI for the Applicant Proposed Route and HVDC alternative routes) and within the center of each corridor identified for the AC interconnection routes and AC collection system. The ROI for visual resources also includes the converter station siting areas and the interconnection siting areas and a 3-mile buffer from the boundaries of those siting areas.

These visual resource ROIs encompass the 3 miles on either side of the reference centerline for the transmission lines and from the boundary of the converter station siting areas, encompasses the foreground/middleground (FG/MG) as defined by the BLM VRM system. In the FG/MG, Project components might be viewed in detail. Some viewing locations may occur outside the defined ROI (between 3 and 15 miles) and may include areas such as communities, scenic vistas from a national or state park, trails, etc. that were identified during agency consultation and/or the public scoping process.

Based on the foregoing, the ROI for visual resources is as follows:

- Applicant Proposed Project
  - Oklahoma Converter Station Siting Area: A 620-acre siting area and a 3-mile buffer from the boundary of the siting area in Texas County, Oklahoma.
  - Texas County AC Interconnection Siting Area: A 3-mile buffer from the boundary of an approximate 870-acre corridor.
  - AC Collection System Corridors: Six miles (3 miles either side) of the referenced centerline (explained above). The referenced centerlines for the AC Collection System are located in the center of thirteen 2-mile-wide corridors in Oklahoma (Beaver, Cimarron, and Texas counties) and Texas (Hansford, Ochiltree, and Sherman counties).
  - Tennessee Converter Station Siting Area: A 220-acre siting area and a 3-mile buffer from the boundary of the siting area in Shelby County, Tennessee.
  - Applicant Proposed Route: Six miles (3 miles either side) of the referenced centerline (explained above).
- DOE Alternatives
  - Arkansas Converter Station Alternative Siting Area: A 20,000-acre siting area and a 3-mile buffer from the boundary of the siting area in Pope County, Arkansas.
  - Arkansas Converter Station Alternative AC Interconnection Siting Area: Six miles (3 miles either side) of the referenced centerline. The referenced centerline is located in the center of a 2-mile-wide corridor.

- o HVDC alternative routes: Six miles (3 miles either side) of the referenced centerline (explained above).
  Region of Influence for Connected Actions

3.18.3.1.1 Wind Energy Generation

The WDZs are areas that have been identified within a 40-mile radius of the Oklahoma Converter Station Siting Area with adequate wind resources and within which future development of wind energy facilities could occur. The ROI for wind energy generation has been set at 30 miles from the boundary of each WDZ. The ROI for wind energy generation includes approximately 1,700 square miles, or 1,385,000 acres in Oklahoma (Beaver, Cimarron, and Texas counties) and Texas (Hansford, Ochiltree, and Sherman counties). Sensitive visual resources in the ROI for WDZs G, H, and I also include communities in Kansas.

3.18.3.1.2 Optima Substation

The ROI for the future Optima Substation includes a 3-mile buffer around the boundary of the substation site. The future Optima Substation would be constructed within 160 acres and is located approximately 2.3 miles east of the Oklahoma Converter Station Siting Area in Texas County, Oklahoma.

3.18.3.1.3 TVA Upgrades

The ROI for the direct assignment facilities (which are included in the Applicant Proposed Project) would occur within the Tennessee Converter Station Siting Area and more specifically within the Shelby Substation. The ROI for the network upgrades, and in particular TVA's future 500kV transmission line, cannot be fully determined at this time. The new 500kV line would be constructed in western Tennessee. The upgrades to existing facilities would mostly be in western and central Tennessee. Upgrades to existing infrastructure would include upgrading terminal equipment at three existing 500kV substations and six existing 161kV substations, making appropriate upgrades to increase heights on 16 existing 161kV transmission lines to increase line ratings, and replacing the conductors on eight existing 161kV transmission lines. The new 500kV transmission line would be in the Mississippi Valley Loess Plains region described in Section 3.18.4.8.

3.18.4 Affected Environment

The affected environment includes the visual resources described for the ROI in Regions 1 through 7. The methodology for conducting the visual resources inventory is graphically shown in a flowchart in Figure 3.18-2 in Appendix A.

To inventory and characterize the affected environment for visual resources, scenery and viewing locations, including KOPs, were considered. The following tasks were undertaken to inventory visual resources in the ROI:

- Documentation of existing landform, vegetation, and water features (scenery) at the regional scale (see the ecoregion description in Sections 3.18.4.1 through 3.18.4.10) and at the Project-specific scale (see regional description Sections 3.18.5.1 through 3.18.5.7)
- Identification of viewing locations including KOPs (viewing locations)

Scenery

Scenery is the aggregate of features that give character to the landscape (BLM 1984). Landscapes encompass varying levels of landform, vegetation, existence of water, color, scarcity, adjacent scenery, and cultural modifications. Cultural modifications are defined as human modifications to the landscape. All of these elements combine to form landscape character (BLM 2010). The existing landscape character provides the context for assessing the effects of changes to the landscape caused by the Project. Regional-level landscape character creates a sense of place and describes the generalized visual image of a specific geographic area. To assess impacts to the landscape's visual character, it is important to establish the context for the visual environment at both a regional level and at a project-specific level.

Regional Level Scenery

EPA Level III ecoregions were used to develop a description of the existing landscape character in Regions 1 through 7 (EPA 2012). Ecoregions provide an appropriate foundation for describing visual character at the regional level because they are defined based on elements similar to those used in the BLM's VRM for inventorying and assessing scenic quality (BLM 2010). These factors include physiographic elements of landform, vegetation, water, and cultural modifications. Level III ecoregions that cross the Project ROI include the Arkansas Valley, Boston Mountains, Central Great Plains, Central Irregular Plains, Cross Timbers, High Plains, Mississippi Alluvial Plain, Mississippi Valley Loess Plains, Ozark Highlands, and Southwestern Tablelands. Level III ecoregions are depicted in Figure 3.17-1 in Appendix A and detailed descriptions are provided in Sections 3.18.4.1 through 3.18.4.10.

Project-Specific Level Scenery

An inventory of the existing landscape character within the ROI was conducted to provide the context for assessing the effects of changes to the landscape at a level of detail consistent with the scale and dimensions of the Project and gain a broad understanding of the types of landscapes potentially crossed by the Project. The factors used to describe the visual character of the Level III ecoregions (topography, vegetation, water, and cultural modifications) were reviewed in further detail within the ROI and mapped using GIS. The factors were ranked and combined into 3 categories that were determined based on the frequency of occurrence of the factor in the Project area and the anticipated impacts to each type:

- Distinct—Landscapes where characteristic features of landform, water, and vegetation are distinctive or unique in the context of the surrounding areas. These features occur infrequently within the ROI and are typically associated with intact natural landscapes with minimal cultural modifications.
- Common—Landscapes where characteristic features of landform, water, and vegetation occur frequently within the ROI. These features are typically associated with croplands and rangelands with cultural modifications limited primarily to rural residential structures and ancillary facilities associated with farms (e.g., barns, silos, fences).
- Developed—Landscapes with a greater occurrence of cultural modifications than the surrounding areas. Cultural modifications in the landscape include roads, buildings (residential, commercial, industrial), utility lines, and other infrastructure and are typically associated with villages, towns, and cities.

To map the three categories within the ROI the landscape factors (topography, vegetation, water, and cultural modifications) were assigned a numeric value based on the criteria included in Table 3.18-3.

Table 3.18-3:
Landscape Category Inventory and Evaluation Rating

Landscape Inventory Factor	Rating Criteria and Score		
Landform	Terrain with slopes 26 percent or greater. High vertical relief as expressed in prominent hills, mountains, cliffs, or rock outcrops; or severe surface variation or highly eroded formations. Terrain features which are dominant or are exceptional. Score 5	Terrain with slopes ranging from 11-25 percent. Hills, canyons, ravines, or terrain with interesting erosional patterns. Terrain features that are interesting but not dominant or exceptional. Score 3	Terrain with slopes ranging from 0 to 10 percent. Flat gently rolling terrain with few or no interesting landscape features. Score 1
Vegetation	Forests, wetlands and National Forest lands. Exhibit a variety of vegetation types and are relatively untouched, natural/intact landscapes. Score 5	Crops/pasturelands. Vegetation types which occur most often in the landscape. Variety of vegetation is limited to only one or two major types. Score 3	Developed and barren land. Vegetation is either absent due to development or little or no variety of vegetation types. Score 1
Water	Lakes, reservoirs, and rivers. Features that are present and are a dominant factor in the landscape. Score 8 (derived from combination of landform, vegetation, and cultural modification rankings)	None	None
Cultural Modifications	Protected/scenic lands, parks, and trails. Cultural modifications add favorably to visual variety while promoting visual harmony. Cultural modifications may include picnic areas, trailheads, boat launches, trails and trail signage. Score 2	Cultural modifications add little or no visual variety to the area; and introduce no discordant elements. Score 0	Developed lands. Cultural modifications dominate the landscape; and may include moderate and high-density residential, commercial and/or industrial development or infrastructure such as roadways and utilities. Score -4

The sum of the numeric values for these factors determines the landscape category. Lands categorized as Distinct received a score of 9 or more, lands categorized as Common received a score of 3 to 8, and Developed lands received a score of 2 or less. Landscape categories are depicted in Figure 3.18-3 in Appendix A.

KOPs are viewing locations that are representative of visually sensitive areas used to assess visual impacts. The description of landscape categories from each KOP focuses on the view from the KOP out over the landscape; therefore, a KOP may be located within a certain landscape category but the view might be towards another. For example, a KOP located in a town would be in a landscape categorized as Developed, but the view from the KOP could be a landscape categorized as Common. Descriptions of the landscape category for each KOP are included in Sections 3.18.5.1 through 3.18.5.7.

Visual Sensitivity

BLM defines visual sensitivity as a measure of viewer concern for the scenic resource and potential changes to the resource. The level of viewer concern relates to the importance of maintaining the scenic quality or viewshed from a specific viewing location; and varies for different viewers or groups of viewers depending on viewer activities (Clean

Line 2014). For example, scenic routes are typically associated with viewers who have a high degree of concern for maintaining the scenic quality or viewshed because the landscape setting is a key component to the scenic designation. In contrast, viewing locations associated with a state route would have a lower sensitivity because viewers travel at a higher rate of speed and concern for aesthetics is generally secondary to commuting.

Viewing locations are defined as public and private areas (including KOPs) within the landscape where the Project could be visible, and where concern for changes to the landscape exists. Viewing locations are typically associated with residences, travel routes, and recreation areas; however, other viewers can have concern for changes to the landscape and include public facilities, such as schools and religious institutions and resorts. DOE and Clean Line identified viewing locations within the ROI through a desktop analysis of relevant, publicly available information and GIS databases. Additional viewing locations were identified outside the ROI and included viewing locations identified during agency consultation, stakeholder meetings, or public scoping (Clean Line 2014). These additional viewing locations were included in the visual analysis.

Visual sensitivity for each identified viewing location was based on the following factors: (1) volume of use, (2) frequency of views (i.e., how often the view is experienced), and (3) viewing duration.

Key Observation Points

KOPs represent a critical or representative viewpoint within or along an identified viewing location, used to assess visual impacts of a proposed project. A process for ranking all potential visual resources was developed to help select the most appropriate KOPs to complete the visual impact analysis. The process for ranking visual resources to identify KOPs involved the following steps:

- Identifying all visual resources in the ROI.
- Ranking visual resources using the KOP ranking criteria and formula described below, including resources identified through agency consultation, public scoping, or stakeholder outreach (Clean Line 2014).
- Selecting visual resources with values ranging from moderate high to high (Clean Line 2014).
- Reviewing Google Earth aerial imagery in combination with Google Earth Streetview and line-of-site tools (i.e., using .kmz files) to identify more precise locations of the selected visual resources, evaluate their potential visibility, and identify the best typical or representative views, as well as views from sensitive resources. Using these tools and professional judgment, the list of resources was narrowed to identify the best potential KOPs for field investigations (Clean Line 2014).

DOE and Clean Line identified KOPs for the Project from the list of visual resources by applying the following selection criteria:

- Visibility: If any portion of the Project is potentially visible from the KOP based on terrain.
- Distance: If the Project would potentially be visible within FG or MG distance zones (i.e., within 3 miles) of the KOP. The Project may be visible in the BG distance zone for some unique KOPs that receive high use and have high visual sensitivity and/or were identified during scoping or public or stakeholder outreach (e.g., an overlook at a state park within 15 miles of the Project).
- Visual Sensitivity: If the KOP is identified to have moderate–high visual sensitivity (Clean Line 2014).

KOPs are depicted in Figures 3.18-3 in Appendix A. To document the existing conditions of the landscape viewed from the selected KOPs consistently, inventory forms were used for KOPs on federal, state, and private lands (see Visual Contrast Rating Worksheets in Appendix K).

3.18.4.1 Arkansas Valley

The Arkansas Valley ecoregion is characterized by undulating plains with scattered hills, open low mountains, ridges, cuesta, and level to undulating floodplains and terraces associated with the Arkansas River. The broad floodplain valley of the Arkansas River includes low terraces, meander scars, oxbows, swales and natural levees. This ecoregion also contains perennial and intermittent streams and several large reservoirs and lakes. Elevations range from 100 to 1,500 feet AMSL. Vegetation types consist of oak savanna and oak-hickory-pine forests with maple, beech, elm and red cedar in upland areas. Dense deciduous forests occupy broad areas along streams and within floodplains and consist largely of bottomland oaks, sycamore, sweetgum, willow, eastern cottonwood, green ash and elm. Cultural features in this ecoregion consist primarily of croplands and pasturelands. Cropland occurs extensively in floodplain areas and consists largely of soybeans, grain sorghum, wheat, alfalfa, and corn. Poultry and livestock farming also occur within this ecoregion. Other cultural modifications include coal mining, natural gas production facilities, distribution and high-voltage transmission lines, paved and unpaved roadways, scattered rural residences, and farms and associated appurtenances (e.g., barns, silos, fences, other out buildings, etc.).

The ROI in Regions 4 and 5 crosses the Arkansas Valley ecoregion (Figure 3.17-1 in Appendix A).

3.18.4.2 Boston Mountains

The Boston Mountains ecoregion is characterized by low rugged mountains typically capped by sandstone, high rounded hills, and deeply dissected mountainous plateaus. Outcrops are common within this ecoregion. The area contains a high density of intermittent and perennial streams, several of which are designated as wild and scenic. Elevations range from 475 to 1,700 feet AMSL. Vegetation types consist primarily of oak-hickory forests with shortleaf pine and red cedar found in many lower areas. On north-facing slopes and in ravines, dominant vegetation includes sugar maple, beech, red oak, basswood and hickory. Bottomlands contain riparian hardwood forests dominated by birch, sycamore, cottonwood, elm, and willow. This region is sparsely populated and recreation and forestry are the primary land uses. The Ozark National Forest occupies much of this ecoregion and logging and recreation are common activities. Livestock farming, pastures and hayland occupy some of the flatter areas. Croplands are rare within this ecoregion. Other cultural modifications include electric distribution lines, paved and unpaved roads, and rural residences.

The ROI in Regions 4 and 5 crosses the Boston Mountains ecoregion (Figure 3.17-1 in Appendix A).

3.18.4.3 Central Great Plains

The Central Great Plains ecoregion is characterized by broad alluvial valleys, level to gently rolling plains, dissected gently to steeply rolling hills, ravines, low escarpments, and some sand dunes. Water is generally limited to ephemeral and intermittent streams, often with incised channels, that occur in the area. Some larger rivers with braided sandy channels also cross the ecoregion including Beaver River/North Canadian River and Cimarron River. Elevations range from 750 to 2,700 feet AMSL. Much of the vegetation within this ecoregion has been converted to croplands. Natural vegetation that occurs within the ecoregion includes scattered grasslands consisting of short-, mixed-, and tallgrass prairie; oak savanna and eastern red cedar in some upland areas; and cottonwood, willow, walnut, ash, and elm in scattered riparian areas. Cultural features in this ecoregion consist mostly of dryland and irrigated croplands, including corn, grain sorghum, alfalfa, and cotton. Other cultural modifications common to this ecoregion include natural gas and oil fields, distribution and high-voltage transmission lines, paved and unpaved roadways, scattered rural residences, and farms and associated appurtenances.

The ROI in Regions 1, 2, and 3 crosses the Central Great Plains ecoregion (Figure 3.17-1 in Appendix A).

3.18.4.4 Central Irregular Plains

The Central Irregular Plains ecoregion is characterized by rolling and irregular plains with intermittent low hills and cuestas, which are ridges with a steep face on one side (usually on the eastern side) and a gentle slope on the other. Perennial streams are common within this ecoregion and in some areas many are channelized. Some larger streams, reservoirs, and rivers, such as the Arkansas River, occur in this ecoregion. Elevations range from 500 to 1,050 feet AMSL. Vegetation types consist of tall grass prairie with oak-hickory woodlands in upland and more rugged areas. Wooded riparian areas occur in wet bottomlands and consist largely of box elder, maple, oak, cottonwood, willow, walnut, pecan, hackberry, elm, and sycamore. Cultural features in this ecoregion consist of a mosaic of cropland, woodland, and grassland. Croplands consist largely of wheat, soybeans, grain sorghum, and alfalfa. Other cultural modifications include oil and gas and coal mining production facilities, distribution and high-voltage transmission lines, paved and unpaved roadways, scattered rural residences, and farms and associated appurtenances.

The ROI in Region 3 crosses the Central Irregular Plains ecoregion (Figure 3.17-1 in Appendix A).

3.18.4.5 Cross Timbers

The Cross Timbers ecoregion is characterized by gently rolling hills with some ridges and ledges. Small perennial streams are common and in some areas many are channelized. Some larger streams, reservoirs, and lakes also occur within this ecoregion. Elevations range from 600 to 1,300 feet AMSL. Vegetation types consist of oak savanna, oak-hickory woodlands, and eastern red cedar interspersed with openings of tall grass prairie in upland areas. Scattered riparian areas consist of cottonwood, willow, walnut, ash, elm, and sycamore. Cultural features in this ecoregion consist primarily of rangeland and pastureland with some croplands. Where cropland occurs, it consists largely of corn, soybeans, hay, and grain sorghum. Other cultural modifications include natural gas and oil fields with associated facilities, distribution and high-voltage transmission lines, paved and unpaved roadways, scattered rural residences, and farms and associated appurtenances.

The ROI in Region 3 crosses the Cross Timbers ecoregion (Figure 3.17-1 in Appendix A).

3.18.4.6 High Plains

The High Plains ecoregion is characterized by nearly level gently rolling terrain, with some sand plains and hills and scattered playa depressions. Playas are flat-bottom depressions typically found in arid and semiarid regions that are seasonally covered by water. In addition to playas, other water sources that occur within this ecoregion primarily include intermittent and ephemeral streams. Elevations range from 2,400 to 4,800 feet AMSL. Vegetation types are mostly short and midgrass prairie, with other types of vegetation including Harvard shin oak, fourwing saltbush, sand sagebush, and yucca. Riparian vegetation such as cottonwood and willow can be found scattered along riparian areas. Cultural features in this ecoregion include cropland and grazing land. Croplands largely consist of winter wheat and grain sorghum. Center-pivot irrigation is widely used. Concentrated hog feeding operations and natural gas and oil development facilities are common within this ecoregion. Other cultural modifications include distribution and high-voltage transmission lines, wind farms, paved and unpaved roadways, scattered rural residences, and farms and associated appurtenances.

The ROI in Region 1 crosses the High Plains ecoregion (Figure 3.17-1 in Appendix A).

3.18.4.7 Mississippi Alluvial Plain

The Mississippi Alluvial Plain ecoregion is characterized primarily by broad, flat to nearly flat floodplains and river terraces threaded with numerous drainages. Several large streams and rivers flow and wind generally south, including the White, Cache, and Mississippi rivers. Many of the waterways have been channelized and several flood-control levees installed. Elevations range from 100 to 275 feet AMSL. Vegetation consist primarily deciduous hardwood forest, forested wetlands, and wetlands. Forests are comprised of hickory, maple, oak, ash and bald cypress, tupelo, sweetgum, sycamore in wetter areas. Cropland occurs extensively in floodplain areas and consists largely of soybeans, rice, grain sorghum, corn, cotton, and wheat. Other cultural modifications include distribution and high-voltage transmission lines, paved and unpaved roads, scattered rural residences, and farms and associated appurtenances, and commercial catfish and crawfish farms.

The ROI in Regions 5, 6, and 7 crosses the Mississippi Alluvial Plain ecoregion (Figure 3.17-1 in Appendix A).

3.18.4.8 Mississippi Valley Loess Plains

The Mississippi Valley Loess Plains ecoregion is characterized primarily by low, steeply to gently sloping ridges and low terraces dissected by numerous small ravines and intermittent streams. Few lakes occur within this ecoregion. Elevations range from 200 to 500 feet AMSL. Vegetation types consist of mixed deciduous forests consisting of oaks, hickories and loblolly and shortleaf pines. Crops include soybeans, cotton, corn, and wheat. Other cultural modifications that occur within this ecoregion include distribution and high-voltage transmission lines, paved and unpaved roads, rural residences, and farms and associated appurtenances.

The ROI in Regions 6 and 7 crosses the Mississippi Valley Loess Plains ecoregion (Figure 3.17-1 in Appendix A).

3.18.4.9 Ozark Highlands

The Ozark Highlands ecoregion is characterized by gently rolling plains to moderate and highly dissected hilly plateaus, small steep valley, and sharp narrow ridges. Perennial and intermittent streams are common in this ecoregion as are ponds, lakes, and reservoirs. Elevations range from 300 to 1,850 feet AMSL. Vegetation types consist of upland forest dominated by oak, hickory, and pine. Forests are most common and dense on north-facing slopes and ravines. Cultural modifications in this ecoregion include pasturelands, typically found in flatter areas at the periphery of the ecoregion. Grazing, logging and recreation are common activities in this ecoregion. Croplands are not prevalent in this ecoregion. Other cultural modifications include mining facilities, distribution and high-voltage transmission lines, paved and unpaved roads, and scattered rural residences.

The ROI in Region 4 crosses the Ozark Highlands ecoregion (Figure 3.17-1 in Appendix A).

3.18.4.10 Southwestern Tablelands

The Southwestern Tablelands ecoregion is characterized by broad, flat elevated tablelands with red-hued shallow canyons, mesas, badlands, gorges, and dissected river breaks. Water is generally scarce, limited mostly to ephemeral and intermittent streams. Elevations range from 1,900 to 3,450 feet AMSL. Vegetation types consist mostly of shortgrass prairie, wheat grass, western wheatgrass, bluestem, and dropseed, with some occurrences of sagebrush, yucca, and cholla. Juniper-pinyon woodlands occur in some areas. Scattered riparian areas consist of cottonwoods, willow, elm, and hackberry. Cultural features in this ecoregion consists mostly of semiarid range land with some cropland areas. Croplands largely consist of winter wheat, grain sorghum, corn, and alfalfa. Other cultural modifications include natural gas and oil fields with associated facilities such as pump jacks, storage tanks, and piping, wind farms, distribution and high-voltage transmission lines, paved and unpaved roadways, scattered rural residences, and farms and associated appurtenances.

The ROI in Region 1 crosses the Southwestern Tablelands ecoregion (Figure 3.17-1 in Appendix A).

3.18.5 Regional Description

Several route variations to the Applicant Proposed Route in Regions 2–7 were developed in response to public comments on the Draft EIS, which are described in Appendix M and summarized in Sections 2.4.2.1–2.4.2.7. Assessments of the impacts related to the route variations by Project region, including accompanying HVDC alternative route adjustments, are provided below. The variations are presented graphically in Exhibit 1 of Appendix M. No route variations were proposed in Region 1.

3.18.5.1 Region 1

Region 1 is referred to as the Oklahoma Panhandle Region and includes the Applicant Proposed Route Links 1 through 5, HVDC Alternative Routes I-A through I-D, Oklahoma converter station siting area and associated AC interconnection siting area, and AC collection system. The ROI in Region 1 crosses the following Level III ecoregions: High Plains, found within the western portion of the region; Southwestern Tablelands, found in the central and eastern portion; and Central Great Plains, found in the far eastern portion of the region. The landscape character within the ROI is predominantly agricultural and rural with open rangeland, grassland, and some cropland. The flat, open terrain allows for expansive views across the landscape (GIS Data Sources: Clean Line 2013a, 2013b; Tetra Tech 2014a). Other topographic features found within the ROI include small canyons, ravines, low escarpments, bluffs and rocky outcrops; however these features are scarce. The ROI traverses the Beaver River/North Canadian River and several intermittent streams, creeks, and dry washes. Vegetation consists primarily of grasses with riparian species found along rivers and other drainageways and in wetland areas. In addition, trees associated with residential development are common within the landscape and can be seen clustered around rural residential homes and along fields and roads. Cultural modifications include agriculture and croplands, farms and associated appurtenances, local roads and highways, wind farms, and high-voltage transmission lines. Several small communities are located within and/or adjacent to the ROI including the towns of Hardesty, Laverne, May, and Fort Supply, and the communities of Balko, Bryans Corner, and Elmwood.

Visual resources identified in the ROI include rural residences and residential areas associated with the towns and other small communities, Lake Schultz State Park, Beaver Dune State Park, several NWRs, Palo Duro and Kiowa creeks and Beaver River/North Canadian River, and historic landmarks.

3.18.5.1.1 Landscape Character Description by KOP

Fort Supply WMA Recreation Area Applicant Proposed Route (identified as Proposed Route [PR] in Appendix K). This KOP represents views from recreational users near the northern edge of the Fort Supply Reservoir. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from a community recreation area. The strong concern refers to the public concern for the state of the environment as defined in environmental aesthetic philosophy. The landscape viewed from this KOP is characterized by gently rolling terrain and dense deciduous and evergreen forest. In addition, a large reservoir dominates many views from within the recreation area. Given the variation in vegetation and the dominant water feature, this landscape is categorized as Distinct. Cultural modifications include recreational facilities associated with the Fort Supply WMA Recreation Area, including playground equipment and picnic shelters.

Hardesty Alternative Route (AR). This KOP represents views from residential areas along the southern boundary of Hardesty, Oklahoma. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residential areas. The landscape viewed from this KOP consists primarily of grasslands and cultivated croplands with scattered rural residences; and was therefore categorized as Common. Cultural modifications include chain-link fences and electric distribution lines associated with scattered rural residences.

Lake Schultz State Park AR. This KOP represents views to the north from recreational users near the west entrance to the Lake Schultz State Park and WMA. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from a public park and WMA. The landscape viewed from this KOP consists of level to gently rolling terrain, sloping down towards Shultz Lake, a shallow depression in the landscape. Vegetation includes low grasses and shrubs, including Yucca, with dense stands of trees concentrated in the bottom of the depression. Water is not present year round within the lake. Given the variation in vegetation, presence of water and the State Park designation, this landscape is categorized as Distinct. Cultural modifications that are visible to the north include scattered rural residential structures in the BG.

Lake Schultz State Park PR. This KOP represents views to the south from recreational users near the west entrance to the Lake Schultz State Park and WMA. Similar to the Lake Schultz State Park AR KOP, visual sensitivity at this KOP is also high and was categorized as Distinct given the variation in vegetation, presence of water, and the State Park designation. Cultural modifications that are visible from this KOP include fences and a high-voltage transmission line in the FG/MG.

Laverne AR. This KOP represents views from a residential neighborhood in Laverne, Oklahoma. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residential areas. The landscape viewed from this KOP is characterized by flat terrain with vegetation consisting primarily of low grasses. Vegetation includes trees planted along roadways and around rural residential structures. Croplands and grasslands are typical within the region; therefore, this landscape is categorized as Common. Cultural modifications include light poles, electric distribution lines, and residential structures.

Local Historical Marker AR/PR. This KOP represents views to the south from a local historical marker located on the northern side of Route 3/270. Visual sensitivity at this KOP is moderate because of the low level of use and short viewing durations and the fact that, besides the historical markers, there are no other facilities. The landscape viewed from this KOP is characterized by relatively level to gently rolling terrain covered primarily with grasses and scattered trees; therefore, this landscape is categorized as Common. Cultural modifications visible from this KOP include low wire fences, unpaved roads, and distribution and high voltage transmission lines. The lack of variation in terrain allows panoramic views of the surrounding landscape to the south Cultural modifications visible from this KOP include electric distribution lines.

May PR. This KOP represents residential views to the south from the community of May, Oklahoma. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residential areas. The landscape viewed from this KOP is characterized by relatively level to gently rolling terrain with stands of deciduous trees clustered around rural residential structures or dense stands within open fields. Grasslands and scattered rural residential developments are typical within the region; therefore, this landscape is categorized as Common. Cultural modifications include scattered residential structures, sheds and storage buildings, low fences, and electric distribution lines.

Optima NWR AR. This KOP represents views from the southern edge of the Optima NWR, which primarily serves as an access point for hunters. Visual sensitivity at this KOP is high because of the long viewing durations from a National Wildlife Refuge. The landscape viewed from this KOP is characterized as gently rolling to low hills with vegetation consisting primarily of grasses. Although there is some variation in the terrain, there is very little variation in vegetation and the area is primarily grasslands that are typical within the region; therefore, this landscape is categorized as Common. Cultural modifications include multiple electric distribution lines in the FG/MG.

3.18.5.2 Region 2

Region 2 is referred to as the Oklahoma Central Great Plains Region and includes the Applicant Proposed Route Links 1 through 3 and HVDC Alternative Routes 2-A and 2-B. The ROI in Region 2 traverses Woodward, Major, and Garfield counties in Oklahoma. The ROI crosses only one Level III ecoregion, Central Great Plains. The landscape character within the ROI in Region 2 is predominantly rangeland and cropland. The relatively flat to gently rolling terrain allows for expansive views across much of the landscape (GIS Data Sources: Clean Line 2013a, 2013b; Tetra Tech 2014a). Other topographic features found within the ROI include low escarpments, terraced buttes, ravines, sand dunes, and rocky outcrops, although these features are scarce. The Cimarron River and Turkey Creek traverse the ROI along with several smaller creeks, drainages, and washes. Several man-made impoundment ponds occur along drainages in the ROI. Vegetation consists primarily of grasses, low shrubs, oak savanna, and riparian species scattered along streams, washes, and other drainageways and wetlands. In addition, trees associated with residential development are common within the landscape and can be seen clustered around rural residential homes and along fields and roads. Cultural modifications include agriculture, croplands, farms and associated appurtenances, wind farms, natural gas and oil facilities, hog and poultry operations, feed lots, roads, highways, high-voltage transmission lines, and rural residences. Several communities are located within and/or adjacent to the ROI including the cities of Fairview and Woodward; the towns of Ames, Cleo Springs, and Mooreland; and the communities of Bison and Waukomis.

Visual resources identified in the ROI include rural residences and residences associated with cities, towns, and other small communities; Gloss Mountain State Park; Boiling Springs State Park; several State Conservation Areas; and Cimarron River and Turkey Creek.

Two route variations to the Applicant Proposed Route were developed in Region 2 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.2. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant

Proposed Route and the landscape setting and visual resources would remain consistent within the ROI. Applicant Proposed Route Link 1, Variation 1, would avoid crossing a wooded area crossed by the original Applicant Proposed Route and would be located farther from Boiling Springs State Park. However, this variation would be closer to more residences and structures. Applicant Proposed Route Link 2, Variation 2, crosses a similar landscape setting as the original Applicant Proposed Route including grasslands and cultivated crops. Although this variation would be located further from some residences, it would be located closer to others.

3.18.5.2.1 Landscape Character Description by KOP

Ames PR/AR. The Ames KOP represents residential views in Ames, Oklahoma, as well as representative views from the historic Cimarron River Branch Cattle Trail. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residential areas and the historical designation and long viewing duration of visitors and tourists engaged in leisure activities of the trail. The landscape viewed from this KOP is characterized by nearly level to low rolling hills covered with grasses and with scattered trees and grasses in the FG/MG and denser stands of trees in the BG. Grasslands are typical within the region; therefore, this landscape is categorized as Common. Cultural modifications include electric distribution lines.

Bison AR. This Bison AR KOP is located on the northern side of Bison, Oklahoma and represents typical residential views. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residential areas. The landscape viewed from this KOP is categorized as Developed in the FG because of cultural modifications associated with Bison and the landscape in the MG is characterized as Common because of the level terrain and lack of vegetation. Cultural modifications include fences, residential structures, storage sheds, silos, street lights and electric distribution lines.

Bison PR. This Bison AR KOP is located on the southern side of Bison, Oklahoma and represents typical residential views. The landscape viewed from this KOP is categorized as Developed in the FG because of cultural modifications associated with Bison and the landscape in the MG is categorized as Common because it consists of grasslands and croplands with scattered rural residences typical within the region. Cultural modifications include fences and residential structures, storage structures, and electric distribution lines.

Boiling Springs State Park PR. This KOP represents views from the Boiling Springs State Park recreation area. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from a state park recreation area. The landscape viewed from this KOP consists of level to gently rolling terrain with grasses and scattered areas of dense trees and shrubs. Small lakes occur within the park but are not dominant features. Given the variation in vegetation, presence of water and the State Park designation, this landscape is categorized as Unique.

Canton WMA and Lake Recreation Area PR. This KOP represents views from a Canton Lake. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from a community recreation area. The landscape viewed from this KOP is characterized by level terrain in the immediate FG, a large expansive lake in the FG/MG, and dense vegetation along the northern edge of the lake in the BG. Given the dominance of the water feature and variation in vegetation around the lake, this landscape is categorized as Distinct. Cultural modifications include recreational elements associated with Canton Lake Recreation Area.

Cimarron River Crossing AR. This KOP represents the crossing of a major river. Visual sensitivity at this KOP is moderate because a concern for aesthetics is generally secondary to commuting from this location, even though it represents a major water body. The landscape viewed from this KOP consists of level terrain sloping down to a wide, flat sandy river bottom. Water meanders along the sandy bottom creating a braided pattern. Dense stands of riparian species occur along the banks of the river. Due to the dense stands and variety of vegetation and presence of water, this landscape is categorized as Distinct. Cultural modifications include a bridge and guard rails, fences and a distribution line in the FG and a transmission line in the MG.

Cimarron River Crossing PR. This KOP represents views of the Cimarron River crossing from a local road. Visual sensitivity at this KOP is moderate because a concern for aesthetics is generally secondary to commuting from this location, even though it represents a major water body. The landscape viewed from this KOP consists of a wide, flat sandy river bottom. When the river is not flowing full, water meanders along the sandy bottom creating a braided pattern. Dense stands of riparian vegetation occur along the banks of the river. Cultural modifications are limited to the road and bridge crossing the river, guardrails and road signs. Due to the presence of water, the variety of vegetation and lack of cultural modifications, this landscape is categorized as Distinct.

Cleo Springs AR. This KOP represents views to the south from residential areas along the southern boundary of Cleo Springs, Oklahoma. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residential areas. From this KOP the landscape in the FG is categorized as Developed because of cultural modifications associated with Cleo Springs, and the landscape in the MG is categorized as Common because it consists primarily of grasslands, rural residences, and scattered stands of trees. Cultural modifications include residential structures, outbuildings (e.g., sheds, barns) associated with farms, communications structures, and transmission lines.

Fairview PR. This KOP represents a view looking south from along the southern boundary of Fairview, Oklahoma. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residential areas and a public park. From this KOP, the landscape in the FG is categorized as Developed because of cultural modifications associated with Fairview, and the landscape in the MG is categorized as Common because it consists primarily of croplands, rural residences, and scattered stands of trees. Cultural modifications include ball fields, fences, light poles, and electric distribution lines in the FG and residential structures, electric distribution lines, and a communication tower in the MG.

Gloss Mountain State Park AR. This KOP is representative of the view looking northeast from the north overlook at Gloss Mountain State Park. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from a state park. The landscape viewed from this KOP consists of mesas, with steep slopes and flat tops surrounded by level to gently rolling terrain. Erosion over time has caused the sides of the mesas to erode, leaving v-shaped slopes that are deep red/rust in color. Vegetation is limited to grasses and shrubs on the mesas and the adjacent area. Dense stands of trees are visible in the MG/BG and are associated with the Cimarron River to the north. This landscape is categorized as Distinct due to the tall, steep rugged landforms and color, which are not typical features in the region. Cultural modifications include scattered oil and gas facilities and transmission structures.

Gloss Mountain State Park APR. This KOP is representative of the view looking southwest from an overlook in Gloss Mountain State Park. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from a state park. The landscape viewed from this KOP consists of mesas, with steep slopes and flat tops surrounded by level to gently rolling terrain. Erosion over time has caused the sides of the mesas to erode, leaving v-shaped slopes that are deep red/rust in color. Vegetation is limited to grasses on the mesas; the surrounding plains are covered with grasses and scattered shrubs and trees. This landscape is categorized as Distinct. Cultural modifications are limited to primarily roads within the FG/MG.

Mooreland PR. This KOP is representative of the view from a ball field on the southern edge of the community of Mooreland, Oklahoma. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from a community park and residential areas. The landscape viewed from this KOP is characterized by gently rolling terrain with grasses and scattered evergreen and deciduous trees. This landscape is categorized as Developed because of cultural modifications associated with Mooreland including fences, light poles, structures associated with the ball field, and residential structures. The rolling terrain and vegetation surrounding the ball field obstructs views beyond the MG.

State Road (SR) 60 West of Fairview PR. This KOP represents views from along eastbound SR 60 west of Fairview, Oklahoma. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residential areas along the roadway and because it was identified as an important resource during public scoping (Clean Line 2014). This landscape is characterized by gently rolling terrain, grasslands, and large fields cleared for agricultural activities, with evergreen and deciduous trees clustered around rural residences. This type of landscape is typical within the region and was therefore categorized as Common. Cultural modifications visible from this KOP include residential structures and outbuildings associated with an adjacent farm, wood H-frame transmission structures, a distribution line that parallels the southern side of SR 60, and a communication tower in the BG. Views of the surrounding landscape are open due to the lack of variation in terrain and vegetation.

Waukomis AR. This KOP represents typical views from a residential area along the southern edge of Waukomis, Oklahoma. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residential areas. The landscape viewed from this KOP consists primarily of cultivated croplands with evergreen and deciduous trees clustered around rural residences; therefore this landscape was categorized as Common. Cultural modifications include short wire fences around fields, a distribution line and residential structure in the FG and a communication tower and transmission lines in the MG.

3.18.5.3 Region 3

Region 3 is referred to as the Oklahoma Cross Timbers Region and includes the Applicant Proposed Route Links 1 through 6 and HVDC Alternative Routes 3-A through 3-E. The ROI in Region 3 traverses Garfield, Kingfisher, Logan, Payne, Lincoln, Creek, Okmulgee, and Muskogee counties in Oklahoma. The ROI crosses three Level III ecoregions: Central Irregular Plains, found within the western portion of the region; Cross Timbers, found in the central portion; and Central Great Plains, found within the eastern portion of the region. The landscape character within the ROI is predominantly rangeland, cropland, and pastureland with some woodland and grassland areas. The relatively flat to gently rolling terrain found primarily in the western portion of the region allows for expansive views across much of the landscape (GIS Data Sources: Clean Line 2013a, 2013b; Tetra Tech 2014a). The terrain transitions to more steeply rolling hills interspersed with ravines, low escarpments, sand dunes, and cuestas in the central and eastern portion of the ROI. In these areas, the varied terrain and forested areas limit distant views. The ROI traverses the Cimarron and Arkansas rivers and several small ephemeral streams. Other surface waters in the region include wetlands, impoundment ponds, reservoirs, and lakes (i.e., Lake Carl Blackwell, Lake McMurtry, Lake Perry, Okmulgee Lake, and Lake Cushing). Vegetation consists primarily of grasses and shrubs, oak savanna, oak-hickory woodland, eastern red cedar, and riparian species along streams, at the edges of lakes and reservoirs and in wetland areas. In addition, rows of trees along fields and roadways are common within this region. Cultural modifications include agriculture, croplands, farms and associated appurtenances, wind farms, natural gas and oil facilities, hog and poultry operations, feed lots, roads, highways, high-voltage transmission lines, and rural residences. Several large and small communities occur within and/or adjacent to the ROI including the cities of Crescent, Stillwater, Perkins, Cushing, Drumright, Bristow, Stroud, Beggs, Okmulgee, and Muskogee and the towns of Marshall, Ripley, Shamrock, Winchester, Haskell, Wainwright, Oktaha, Summit, Rentiesville, and Webbers Fall.

Visual resources identified in the ROI include rural residences and residences associated with towns and cities, several state and National Wildlife Conservation areas, Robert S. Kerr Reservoir, Cimarron and Arkansas rivers, and several historic landmarks, such as Tank Farm Loop Route 66 Roadbed, Irvings Castle, and Little Deep Fork Creek Bridge.

Five route variations to the Applicant Proposed Route were developed in Region 3 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.3. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route and the landscape setting and visual resources would remain consistent within the ROI. Applicant Proposed Route Link 1, Variation 2, crosses a landscape setting that is similar to the Applicant Proposed Route, including grasslands and wooded areas; however, this variation would avoid crossing an agricultural field crossed by the original Applicant Proposed Route. Although this variation would be located further from some residences, it would be located closer to others. Applicant Proposed Route Links 1 and 2, Variation 1, crosses a similar landscape setting as the original Applicant Proposed Route and would be located farther from some residences and closer to others. It should be noted that a route adjustment was made for HVDC Alternative Route 3-A to maintain an end-to-end route with the Links 1 and 2 variations. Applicant Proposed Link 4, Variation 1, would avoid crossing a quarry operation crossed by the Applicant Proposed Route; however, this variation would be closer to more residences and structures. Applicant Proposed Route Link 4, Variation 2, crosses a landscape setting that is similar to the original Applicant Proposed Route, including woodlands and grasslands, and would be located further from residences. Applicant Proposed Route Link 5, Variation 2, would cross more wooded areas than the Applicant Proposed Route, and the eastern portion of Variation 2 would parallel an existing 500kV transmission line for approximately 0.6 mile. However, this variation would be located closer to more residences and structures.

3.18.5.3.1 Landscape Character Description by KOP

Agra AR. This KOP represents views from a residential area near the southern boundary of Agro, Oklahoma. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residential areas. The landscape viewed from this KOP is characterized by gently rolling terrain with grasses and dense stands of evergreen and deciduous trees. This landscape is categorized as Developed because of cultural modifications associated with Agra including wood and chain-link fences, light poles, electric distribution lines and commercial structures.

Beggs AR. This KOP represents residential views from the southern edge of the Beggs, Oklahoma. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residential areas. The landscape viewed from this KOP is characterized by gently to moderately rolling terrain in the FG with larger, steeper hills in the MG. Large dense stands of evergreen and deciduous trees cover the landscape in the FG and

MG. Given the variation in terrain and vegetation, this KOP is categorized as Distinct. Cultural modifications include residential structures, low wire fences and a distribution line. Views from this KOP are limited by the rolling terrain and dense stands of trees.

Beggs PR. This KOP represents views from a school and an environmental education facility located near the northern boundary of Beggs, Oklahoma. Visual sensitivity at this KOP is moderate because of the low level of use and activities are directed inward to the wetlands features within the environmental education facility. The view from this KOP consists of grasslands with dense stands of evergreen and deciduous trees clustered around rural residences and man-made retention ponds. Grasslands are typical within the region, so this landscape was categorized as Common. Cultural modifications include a boardwalk and picnic pavilion associated with the environmental interpretive center and a chain-link fence around the facility in the FG and residential structures in the MG.

Boynton AR. Views from this KOP represent residential views from the western edge of Boynton, Oklahoma. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residential areas. The landscape viewed from this KOP is categorized as Common because it consists of grasslands and croplands with scattered rural residences with deciduous and evergreen trees clustered around residences and along roadways. Cultural modifications include residential structures, low wire fences, and a distribution line. The level terrain allows for open views of the MG/BG; however, views may be limited by dense stands of trees.

Bristow and Route 66 AR. This KOP represents views from residences located along the southern edge of the town of Bristow, Oklahoma. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residential areas. The view from this KOP is categorized as Common within the FG because it consists of grasslands with pockets of wooded areas interspersed around cleared fields typical within the region. Cultural modifications include electric distribution lines and existing wood H-frame transmission line structures. Views from this KOP are limited by a dense wooded area within the FG.

Cimarron River Crossing PR. This KOP represents the crossing of a major river from a local roadway. Visual sensitivity at this KOP is moderate because from this route, concern for aesthetics is generally secondary to commuting. The landscape viewed from this KOP consists of a wide flat sandy river bottom with riparian vegetation along the banks of the river in the FG and grasslands with scattered trees and small pockets of wooded areas in the MG. Due to the presence of water and variety of vegetation, this landscape is categorized as Distinct. Cultural modifications include a transmission line in the FG (crossing the river) and the MG, and structures associated with agricultural activities. Views from along this roadway are partially limited by the dense riparian vegetation along the banks of the river.

Council Hill AR. This KOP represents views to the north from a residential area along the northern boundary of Council Hill, Oklahoma. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residential areas. From this KOP, the landscape in the immediate FG is categorized as Developed because of cultural modifications associated with Council Hill, and the landscape in the MG is categorized as Common because it consists primarily of grasslands with small pockets of wooded areas. Cultural modifications include fences, barn structures and a distribution line. Views are limited due to the small wooded areas and vegetation along roadways.

Cushing PR. This KOP represents views from a rural residential area northwest of Cushing, Oklahoma. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residential areas. The view from this KOP is characterized as gently to moderately rolling grasslands and croplands with pockets of wooded areas and small man-made retention areas typical within this region, so this landscape is categorized as Common. Cultural modifications include fences, residential structures, out structures associated with farms (e.g., barns, sheds, corrals), in the FG and a communication tower and transmission line in the MG.

Depew and Route 66 AR. This KOP represents views to the northeast from a rural residential area near the northern boundary of Depew, Oklahoma. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residential areas. From this KOP the landscape in the immediate FG is categorized as Developed because of cultural modifications associated with Depew, and the landscape in the MG is categorized as Common because it consists of grasslands/agricultural fields, rolling hills, and pockets of wooded areas. Cultural modifications include residential and commercial buildings. Vegetation screens much of the view past the immediate FG from this KOP, with intermittent views of the MG.

Heyburn Lake PR. This KOP represents views to the southwest from recreational users on the northern side of Heyburn Lake. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from a public park and recreational area. The landscape viewed from this KOP is characterized by a large lake surrounded by riparian vegetation along the edge of the lake. Given the variation in vegetation and the dominant water feature, this landscape is categorized as Distinct. Cultural modifications include recreational facilities associated with the recreation area, including playground equipment and picnic and camping areas. Views from this KOP are limited by the dense vegetation along the southern side of the lake.

Honey Springs Battlefield Historic Site and Rentiesville AR South. This KOP represents views north from the southern boundary of the historic Honey Springs Battlefield site. Visual sensitivity at this KOP is high due to the historic designation of the site. The landscape viewed from this KOP is characterized by level terrain—open fields with pockets of wooded areas. There is a small, narrow stream that meanders through the landscape; however, this water feature does not dominate the landscape. This type of landscape is typical within this region, so this landscape is categorized as Common. Cultural modifications include structures associated with the interpretive facilities including a small bridge, rock interpretive shelter and several stone monuments, and a distribution line.

Honey Springs Battlefield Historic Site AR North. This KOP represents views north from the northern boundary of the historic Honey Springs Battlefield site. Visual sensitivity at this KOP is high due to the historic designation of the site. The landscape viewed from this KOP is characterized by level open fields with pockets of wooded areas around the fields typical within this region, so this landscape is categorized as Common. Cultural modifications include small interpretive signs and a transmission line.

Lake Carl Blackwell AR. This KOP represents views south from the southern side of Lake Carl Blackwell. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from a recreational area. The landscape viewed from this KOP is characterized by level to gently rolling terrain and a large lake with dense stands of riparian vegetation along the banks. Given the variation in vegetation and the dominant water feature, this landscape is categorized as Distinct. Cultural modifications include recreational facilities associated with the recreation area, including picnic shelters, campers, and docks; and a communication tower, cell phone tower and transmission line in the MG.

Marshall AR. This KOP represents a view looking north from a residential area near the northern edge of Marshall, Oklahoma. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residential areas. The view from this KOP is characterized as flat croplands with vegetation along the edge of fields and clustered around residential development typical within this region, so this landscape is categorized as Common. Cultural modifications include small wire fences, residential structures, and a distribution line.

Marshall PR. This KOP represents a view southwest from the southern edge of Marshall, Oklahoma. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residential areas. The view from this KOP is characterized as level to gently rolling terrain and croplands with vegetation along the edge of fields and clustered around residential structures and along small streams that traverse the landscape. Croplands and rural residences are typical within this region, so this landscape is categorized as Common. Cultural modifications consist of residential structures, electric distribution lines, and oil and gas features (i.e., tanks and pump jacks) in the MG and a communication tower in the BG.

McLain AR. This KOP represents the view south from a rural country road near the community of McLain, Oklahoma. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residential areas. The view from this KOP is characterized as level to gently rolling terrain in the FG transitioning to larger hills in the MG. Vegetation includes evergreen and deciduous trees along the edge of fields and clustered around residential structures. The landscape is categorized as Common because it consists primarily of grasslands with small pockets of wooded areas, typical within the region. Cultural modifications include wire fences, residential structures and storage sheds, and a wood H-frame transmission line.

McLain PR. This KOP represents a view east from a rural country road near the community of McLain, Oklahoma. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from a residential area. The view from this KOP is characterized as moderately rolling terrain with open fields and patches of wooded areas typical in the region, so this landscape is categorized as Common. Cultural modifications include wire fences, residential structures, a distribution line paralleling the road and a high-voltage transmission line.

Mehan AR. This KOP represents views north from the eastern edge of Mehan, Oklahoma. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residential areas. The landscape viewed from this KOP is categorized as Common as it consists of open and agricultural fields with pockets of wooded areas and vegetation clustered around rural residences. Cultural modifications include rural residential structures, oil rigs, and transmission lines in the MG.

Mehan PR. This KOP represents views south from the eastern edge of Mehan, Oklahoma. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residential areas. The landscape viewed from this KOP is categorized as Common, because it consists of open and agricultural fields with pockets of wooded areas and vegetation clustered around rural residences. In addition there is a small man-made retention pond. Cultural modifications include rural residential structures, oil rigs and tanks, and a distribution line.

Mulhall AR. This KOP represents views north from the center of Mulhall on the main road through town (Highway 77). Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residences in and near the town center. The landscape viewed from this KOP is categorized as Developed because of the cultural modifications associated with Mulhall, including commercial and residential structures, light poles, a railroad, and distribution line. Views are limited to the FG by the existing buildings and vegetation in and around the town center.

Mulhall PR. This KOP represents views south-southwest from the southern edge of Mulhall, Oklahoma. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from a residential area. The landscape viewed from this KOP is categorized as Common because it consists of gently to moderately rolling grasslands/croplands with pockets of wooded areas, typical within the region. Cultural modifications include short wire fences, residential structures, and structures associated with farming (e.g., barns, storage sheds), and a distribution line.

Okmulgee AR. This KOP represents views to the north from the northern edge of Okmulgee, Oklahoma. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residential areas. The landscape viewed from this KOP is characterized by level terrain in the immediate FG transitioning to moderately rolling in the MG. Agricultural fields with trees lined around the perimeter are visible in the FG and forested hills are visible in the MG. This landscape is typical within the region, so it is categorized as Common. Cultural modifications include low wire fences, gas and oil facilities (pumps and tanks), and a distribution line.

Oktaha School AR. This KOP represents views southeast from a school and baseball field located on the eastern edge of Oktaha, Oklahoma. Visual sensitivity at this KOP is moderate because concern for aesthetics is not the primary focus of viewers associated with the school or ball field, where activities are focused more internally in the park. The landscape viewed from this KOP is categorized as Common because it consists of open grassy fields with small pockets of wooded area and vegetation along drainageways. Cultural modifications include a low wire fence, light poles, gravel parking area, and a transmission line.

Orlando AR. This KOP represents views looking south from the southern edge of Orlando, Oklahoma. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residential areas. Views from this KOP are open due to the level terrain and lack of vegetation. The landscape is categorized as Common because it consists of open fields and croplands with vegetation occurring along roadways and clustered along drainageways; which is typical within the region. Cultural modifications include low wire fences around fields, residential structures, and electric distribution lines in the FG and a transmission line in the MG.

Perkins AR. This KOP represents views looking east from the southeastern edge of Perkins, Oklahoma. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residential areas. The landscape viewed from this KOP is characterized by level open fields in the FG transitioning to moderately rolling wooded hills in the MG. This landscape is typical within the region, so it is categorized as Common. Cultural modifications include low wire fences around fields, residential structures, and electric distribution lines.

Preston AR. This KOP represents views south from the Jim Waller Sports Complex in Preston, Oklahoma. Visual sensitivity at this KOP is moderate because concern for aesthetics is not the primary focus of viewers associated with the sports complex, where activities are focused internally within the complex. The landscape viewed from this KOP is characterized by open fields and small pockets of wooded areas, typical within the region, so this landscape is categorized as Common. Cultural modifications include low fences, residential structures, sheds, and electric distribution lines.

Ripley PR. This KOP represents a view looking northeast from the eastern edge of Ripley, Oklahoma. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residential areas. The landscape viewed from this KOP is characterized by level rangelands and scattered trees in the FG and rolling forested hills in the MG, typical within the region, so this landscape is categorized as Common. Cultural modifications include low fences around rangelands and a distribution line. Views from this KOP are open due to the level terrain and lack of vegetation in the FG.

Shamrock AR. This KOP represents views to the southwest from the western edge of Shamrock, Oklahoma. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residential areas. The landscape from this view is characterized by open fields and scattered trees in the FG and dense wooded areas in the MG. Typical of the region, this landscape setting is categorized as Common. Cultural modifications include low wire fences, residential structures, and electric distribution lines. Views from this KOP are open due to the level terrain and lack of vegetation in the FG.

Shamrock PR. This KOP represents views to the northwest from the western edge of Shamrock, Oklahoma. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residential areas. The landscape from this view is characterized by open fields and scattered trees in the FG and dense wooded areas in the MG. Typical to the region, this landscape setting is categorized as Common. Cultural modifications include low fences. Views from this KOP are open due to the level terrain and lack of vegetation in the FG.

Stillwater PR/AR. This KOP represents views looking south from a residential subdivision in the southern portion of Stillwater, Oklahoma. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from a residential area. From this KOP the landscape is categorized as Developed because of cultural modifications associated with Stillwater. Cultural modifications include residential structures and a communication tower. Views from this KOP are limited because of the dense vegetation surrounding the residential development in the FG.

Summit PR. This KOP represents views southwest from the southern edge of Summit, Oklahoma. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from a residential area. The landscape viewed from this KOP is characterized by open fields and scattered trees, which are typical in this region, so this landscape setting is categorized as Common. Cultural modifications include low wire fences around fields, residential structures, storage buildings, and a transmission line that is a dominant feature in the immediate FG. Views from this KOP are open due to the level terrain and lack of vegetation in the FG.

Taft PR. This KOP represents views south from the southern edge of Taft, Oklahoma. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from a residential area. From this KOP, the landscape is categorized as Developed because of cultural modifications associated with Taft, including a church, commercial and residential structures, light poles, and electric distribution lines. Views from this KOP are limited to the immediate FG by dense wooded areas along the southern edge of the community.

Webbers Falls Reservoir PR/AR. This KOP represents views looking south from the southern side of the Webbers Falls Reservoir. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from a recreation area. The landscape viewed from this KOP is characterized by level terrain and a portion of the reservoir and is surrounded by dense vegetation. Because of variation in vegetation and the presence of the reservoir, this landscape is categorized as Distinct. Cultural modifications are limited to features associated with the recreation area including a playground, road and shelters. Views from this KOP are limited by the dense vegetation in the immediate FG.

3.18.5.4 Region 4

Region 4 is referred to as the Arkansas River Valley Region and includes the Applicant Proposed Route Links 1 through 9 and HVDC Alternative Routes 4-A through 4-E as well as the Lee Creek Variation. The ROI in Region 4 traverses Muskogee and Sequoyah counties in Oklahoma and Crawford, Franklin, Johnson, and Pope counties in Arkansas. The ROI crosses three Level III ecoregions: Arkansas Valley, found primarily along the southern portion of the region; Boston Mountains, found primarily along the northern portion; and a small portion of the Ozark Highlands, located within the northwestern portion of the region. The landscape character within the ROI is predominantly rugged natural areas, mountains, and forested land in the northern portion, which transitions to undulating plains, terraces, cuestas and floodplains associated with the Arkansas River in the southern portion. The rugged hills, mountains, rolling hills, and forested landscapes in the northern portion of the ROI limit distant views, whereas in the southern portion of the ROI the less varied terrain and lack of vegetation allow for expansive view across the landscape (GIS Data Sources: Clean Line 2013a, 2013b; Tetra Tech 2014a). The ROI traverses the Arkansas and Illinois rivers and intermittent and perennial streams such as Little Lee Creek, Lee Creek, Frog Bayou, Illinois Bayou, Mulberry River and Big Penny Creek. Other surface waters in the region include wetlands, impoundment ponds, reservoirs, and several lakes (i.e., Tenkiller Lake, Marble City Lake, Brushy Lake, Reagan Lake, and Ozark Lake). Vegetation consists primarily of oak-hickory forests in the hills to the north and oak-hickory forest, dense deciduous hardwood riparian forest, and scattered prairies in the bottomlands to the south. Cultural modifications include agriculture, croplands, farms and associated appurtenances, natural gas and oil facilities, mining operations, poultry and livestock operations, recreation development, roads, highways, high-voltage transmission lines, and rural residences. Several communities occur within and/or adjacent to the ROI including the towns of Gore and Vain and cities of Marble City and Sallisaw in Oklahoma, the town of Dyer, and the cities of Cedarville, Van Buren, Alma, Kibler, Mulberry, Ozark, Wiederkehr Village, Clarksville, and Lamar in Arkansas.

Visual resources identified in the ROI include rural residences and residences associated with towns and cities, Tenkiller Ferry and Pine Creek Cove State Parks, Sallisaw State Park, Ozark National Forest, Trail of Tears, Arkansas River, Mulberry and Big Piney Creek (both designated as an Arkansas Wild and Scenic River), Little Lee Creek and Lee Creek (both designated as an Oklahoma Scenic River), scenic byways (i.e., Route 21, 23, 71, and 220, State Routes 59 and 282, and Interstates 40 and 540), and several state and national wildlife conservation areas, local and municipal parks, and historic landmarks. Other recreation areas identified within this region include Frog Bayou, Illinois Bayou, Robert S. Kerr, Webbers Fall and Brushy Creek reservoirs, and Marble, Brushy, and Tenkiller lakes.

Seven route variations to the Applicant Proposed Route were developed in Region 4 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.4. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant

Proposed Route and the land setting and visual resources would remain consistent within the ROI. Applicant Proposed Route Link 3, Variations 1, 2, and 3, would all cross a similar landscape setting as the Applicant Proposed Route, including grasslands, wooded areas, and croplands. Link 3, Variation 1, would be located approximately 0.1 mile north of the original Applicant Proposed Route, and although this variation would be located further from some residences and a cemetery, it would be located closer to other residences. Link 3, Variation 2, would be located approximately 0.8 to 1.4 miles north of the original Applicant Proposed Route and would be located farther away from a greater number of residences than it would be moved closer to. Link 3, Variation 3, would be located 0.75 mile north of the original Applicant Proposed Route and would be located farther from the Lee Creek (Scenic River) KOP.

Applicant Proposed Route Link 6, Variations 1, 2, and 3, would all cross a landscape setting similar to the original Applicant Proposed Route, including grasslands, wooded areas, and croplands. Each of these variations would only shift the original Applicant Proposed Route approximately 500 feet. Applicant Proposed Route Link 9, Variation 1, would cross a landscape setting similar to the original Applicant Proposed Route, including Big Piney Creek, wooded areas, grasslands and cultivated croplands. This variation would be located approximately 300 feet from the original Applicant Proposed Route.

3.18.5.4.1 Landscape Character Description by KOP

Alma AR. This KOP represents views to the southwest from residences in Alma, Arkansas. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residential areas. The landscape viewed from this location includes wood power poles, wetlands, scattered trees, and a low ridge with dense forest in the distance. Because of the vegetation and terrain visible from this location, this landscape is categorized as Common.

Arkansas River at Gore PR/AR. This KOP is the view northwest from a historic ferry crossing and boat launch ramp at Summers Ferry Park Historical Site on the eastern side of the Arkansas River. Visual sensitivity at this KOP is high due to the extended viewing times associated with the historic site and recreational use of the river. Nearby cultural modifications include a picnic and recreation area, parking lot, and boat launch. Looking across the river the dense vegetation along the river banks can be seen as well as a low ridge in the distance. Because the landscape presents unobstructed views of open water, and because of the historic designation and recreational use of the area, this landscape is categorized as Distinct.

Arkansas River PR/AR. This KOP represents the view from the east bank for the Arkansas River west of Gore. The visual sensitivity at this KOP is moderate because, while it represents a major water body, the landscape has already been heavily impacted by cultural modifications. Looking across the river, dense vegetation is visible on the other side with a low bluff in the BG. Cultural modifications in this view include several large existing transmission structures in view. While the river itself has high scenic integrity, due to the proximity to cultural modifications such as nearby dam and existing transmission structures in view, this area is categorized as Common.

Aux Arc Park PR. This KOP represents the view from Aux Arc Park and campground along the southwestern edge of the Arkansas River. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from a public park. The landscape viewed from this location includes open water with low hills and ridges and dense tree growth along the river bank. Cultural modifications include numerous buildings and other structures are visible on the far shore. Open water is dominant from this view and since this represents a scarce resource in the area this landscape is categorized as Distinct.

Big Piney Creek PR. This KOP represents the view looking northeast from a recreation and access point at Big Piney Creek just downstream from the Highway 164 crossing. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from a public recreation area. The landscape viewed from this KOP consists of open water and dense vegetation on either side of the river with a low ridgeline in the distance. From this view, the bridge where Highway 164 crosses Big Piney Creek is also visible, but the landscape is generally free of cultural modifications. Because this area has been primarily left in its natural form and water is a dominant element in view, this landscape is categorized as Distinct.

Bluff Hole Park PR/AR. This KOP represents views looking north from the entrance to Bluff Hole park and picnic area. The visual sensitivity at this KOP is considered high because of the concern for aesthetics and generally long viewing durations associated with a public park and recreation area. While the surrounding park is relatively natural, the landscape being viewed at this KOP contains cultural modifications including various signs and fences as well as both wood and metal power poles with an elevated roadway in the MG. Although this is a recreation area, this particular view contains several cultural modifications and is categorized as Common.

Boys and Girls Camp AR. This KOP represents the view looking north from a youth camp. Since this is a recreation area, the visual sensitivity is high because of the concern for aesthetics and long viewing durations associated with this type of use. The landscape viewed from this location consists of an open field with tall grasses bordered by dense forest. Cultural modifications in view include an existing transmission line and low barbed-wire fence. Because of the vegetation in the area and existing cultural modifications, this landscape is categorized as Common.

Brushy Creek Reservoir and Sallisaw State Park PR/AR. This KOP represents the view from the recreational area at Brushy Creek Reservoir. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from a recreation area. The FG view contains picnic benches and grills along the shore of the reservoir. The MG consists of open water bordered by a low ridge with dense trees in the BG. This area has a relatively low amount of cultural modifications, and because water is present and the area is used recreationally, it is categorized as a Distinct landscape.

Cedarville AR. This KOP represents views looking southeast from a partially developed subdivision in Cedarville, Arkansas. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations associated with residences. The view from this KOP is of a small open field in the FG enclosed by rolling hills with dense vegetation in the MG and BG. This KOP is located near developed land, but looks out to a more typical landscape for the region, so the landscape at this KOP is classified as Common.

City Park/Ball Fields and Rudy PR/AR. This KOP is representative of views from a community ball field in Rudy, Arkansas. Visual sensitivity is high from this KOP because of the long viewing durations associated with a public park and recreation area. Looking north, the FG landscape consists of a small open field with several residential structures, garages and utility poles. Large trees are mixed in with the residential area in the MG. Looking southwest from this KOP, the FG views are dominated by various structures and cultural modifications associated with the park. Because this area contains numerous cultural modifications and residential structures, the landscape is classified as Developed.

Clarksville PR/AR. This KOP represents the view looking southeast from the northern edge of the community of Clarksville, Arkansas. Visual sensitivity is high from this KOP because of the long viewing durations associated with residential areas. The landscape viewed from this KOP includes open grassy fields and barbed wire fences in the FG. The MG and BG consist primarily of low, rolling hills with scattered residences. Additional cultural modifications visible on the landscape include several existing transmission structures. Because of vegetation and the agricultural nature of the landscape at this KOP, it is categorized as Common.

Clear Creek Park PR. This KOP represents views from the Clear Creek Park and boat launch area. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from a recreation area. The view looking to the north and northeast looks out across a parking lot in the FG with open water, scattered trees and shrubs in the MG. Beyond that, a dense line of trees can be seen on the far side of the stream bank. Although there are cultural modifications such as picnic areas, signs, and light poles, the surrounding area is in its natural state. These modifications, combined with the presence of a large body of water, resulted in a classification of Distinct.

Coal Hill AR. The KOP at Coal Hill represents views from the northern edge of the community. Visual sensitivity is high from this KOP because of the long viewing durations associated with residential areas to the north. The FG views contain cultural modifications including wood power poles, several residences and outbuildings, and a school bus parking area. In the MG and BG, the landscape consists of rolling hills with scattered trees and residences. The landscape in this area contains some cultural modifications in the FG, but the MG and BG landscape is typical of the area, so it is categorized as Common.

Dyer PR. This KOP represents views from the southeastern edge of the town of Dyer, Arkansas. Visual sensitivity is high from this KOP because of the concern for aesthetics and typically long viewing durations associated with residential areas. This view is looking out over a large, open agricultural field with a dense line of trees and forested ridge in the distance. Also in the vicinity of the KOP are single–family residences. The rural landscape free of heavy cultural modification visible from this KOP is typical of the area and categorized as Common.

East Side City Park PR. This KOP represents views from a community park on the bank of a small body of water. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a community park. Standing on the bank, the view of the landscape consists of open water in the FG and residences and densely forested banks in the MG. Cultural modifications in view include metal power poles and residential structures. There are cultural modifications in view, but because of the presence of water and natural surroundings of the area, the landscape is classified as Distinct.

Field of Dreams PR/AR. This KOP represents views from the Field of Dreams ball field. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a recreation area. In the FG view, the landscape contains multiple fences and tall metal light poles are visible along with wood H-frame transmission structures. Also present are wood shelters and structures associated with the baseball fields. This is a heavily modified area and is categorized as Developed.

Fire Tower Lookout AR. This KOP is representative of views from a recreational area in a National Forest. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a National Forest and recreation area. Looking out from here the landscape consists of a small field surrounded by dense vegetation and varied terrain creating very enclosed views. Because this area is free of cultural modifications and in an area designated as National Forest, it is categorized as Distinct.

Frog Bayou Creek AR. This KOP represents the view looking west from Highway 282, overlooking Frog Bayou Creek. Visual sensitivity is high at this location because it represents a major water body being viewed from a scenic byway. Looking out from an elevated viewing location, the landscape is primarily rolling hills covered in dense trees in the BG, and dense riparian vegetation in the FG/MG. In the MG is a creek that winds through open fields with very few cultural modifications. Because of the elevated viewing location, views are nearly panoramic and bordered by rolling hills covered in dense trees. Immediately behind this viewpoint is Interstate 540, a designated scenic byway. The landscape in this area has been left mostly natural; combined with the presence of a major water body, it is categorized as Distinct.

Hagarville PR/AR. This KOP represents views from the southern edge of Hagarville, Arkansas. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a residential area. The landscape viewed from this location consists of an open field in the FG with multiple large metal buildings and scattered residences. In the MG and BG the landscape turns to high, rolling hills covered in dense vegetation. Because the landscape in this area is not highly developed and contains vegetation and terrain typical for the region, it is categorized as Common.

Highway 10 PR. This KOP is representative of views from a well-traveled highway used by recreationists travelling to and from recreation areas along the Arkansas River. Visual sensitivity is moderate from this location because of the relatively short viewing durations associated with traveling along a highway. Looking to the northwest, the landscape consists of open fields with rolling hills covered in dense trees. The landscape being viewed from this location contains vegetation and landform typical to the area and is categorized as Common. Visible cultural modifications are limited to wood transmission poles and the paved road.

Highway 21 Scenic Byway AR. This KOP represents views from Highway 21. Visual sensitivity at this KOP is moderate because from this route, concern for aesthetics is generally secondary to commuting. The landscape viewed to the south/southwest consists of a tall chain-link fence, wood power poles lining the road, and nearby residences in the FG. The MG contains large stands of trees transitioning to rolling hills covered in dense vegetation. The landscape viewed from this location contains typical terrain and vegetation for the area and few cultural modifications and is categorized as Common. It should be noted that this particular section of Highway 21 is not designated as a Scenic Byway.

Highway 82 PR/AR. This KOP represents the views from a highway that is well travelled by recreationist traveling to and from Tenkiller Reservoir and nearby parks. Visual sensitivity at this KOP is moderate because from this route, concern for aesthetics is generally secondary to travelling to a destination. The landscape viewed from this KOP consists of dense vegetation on either side of the highway that traverses the rolling hills. Vegetation and terrain is consistent with the region and this landscape is categorized as Common.

Highway 82 AR 4-B. This KOP represents the views from a highway that is well travelled by recreationalists traveling to and from Tenkiller Reservoir and nearby parks. Visual sensitivity at this KOP is moderate because from this route, concern for aesthetics is generally secondary to travelling to a destination. The landscape viewed from this KOP consists of dense vegetation on either side of the highway that traverses the rolling hills. The landscape viewed in the BG consists of low rolling hills covered in dense tree growth. Vegetation and terrain is consistent with the region and this landscape is categorized as Common. Cultural modifications consist of rural residences and wood power poles.

Horsehead Lake Recreation Area PR. This KOP is representative of the view looking south near the boundary of the Ozark National Forest. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a recreational area in a national forest. The landscape viewed from this location is rolling hills in the MG and a meandering stream surrounded by riparian vegetation in the FG. Because this is national forest land and has been left in its natural state is categorized as Distinct.

Hunt PR. This KOP represents the view looking southeast from the town of Hunt, Arkansas. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a residential area. The landscape being viewed from this location consists of single family residences in the FG and rolling hills with tall stands of trees in the MG and BG. The only cultural modifications in view are the residential structures and the terrain and vegetation is consistent with the region, so the landscape at this KOP is categorized as Common.

Interstate 40 (Scenic Highway) Rest Stop PR. This KOP represents the view looking north from a developed rest stop on westbound Interstate 40, which is a state-designated scenic highway. The visual sensitivity at this KOP is moderate due to the relatively short viewing duration associated with a highway rest area and associated travel. In the FG, the landscape being viewed is a large, open grassy field enclosed in the MG by tall trees. Because the vegetation and landform at this KOP is typical for the region, the landscape is categorized as Common.

Lake Ludwig PR. This KOP represents the view looking south from a recreation area at Lake Ludwig. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a recreation area. The immediate FG includes open water surrounded by dense tree growth that rises to low densely vegetated trees in the MG. Because the view from this KOP is free from any cultural modifications combined with the presence of a large body of water, the landscape is categorized as Distinct.

Lamar AR. This KOP represents a view near the southern edge of the community of Lamar, Arkansas. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a residential area. The landscape in the FG of this view is of agricultural fields with scattered trees and residential structures and barns. Other cultural modifications in the FG are a small church and metal sheds. The BG of this view is rolling hills with dense trees. Although there are some cultural modifications present in view, the landscape is primarily agricultural fields with grasses and pockets of wooded areas and is therefore categorized as Common.

Lee Creek PR. This KOP represents the view from a boat launch and fishing pier at a lake on Lee Creek. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a recreation area. Looking to the north, the landscape consists of open water with a dock leading to a parking lot in the FG surrounded by dense forest creating enclosed views in the MG. Several cultural modifications are present including a dock, light poles and a restroom facility, but because this area is adjacent to open water, which is a unique landscape feature in the area, the landscape is categorized as Distinct.

Little Lee Creek (Scenic River) AR. This KOP represents a view looking northeast from a bridge crossing Little Lee Creek, a designated scenic river. Visual sensitivity from this KOP is high because of long viewing durations associated with the viewing of a scenic river. The landscape viewed from here consists of the river and riparian vegetation covering the banks on either side. In the BG, a ridgeline covered in dense trees is visible. The landscape in this area is in its natural state and the presence of water represents a scarce resource; therefore, the landscape is categorized as Distinct.

Marble City AR. This KOP represents a view from the edge of Marble City, Oklahoma. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a residential area. Looking to the southeast, the FG view consists of single family residences surrounded by open fields with scattered trees in the FG. The MG and BG views consist of rolling hills covered in dense vegetation. Because the landscape being viewed from this KOP consists of vegetation and terrain typical for the region and does not contain cultural modifications other than a few residential structures, the landscape is categorized as Common.

Mulberry. This KOP represents views looking west from a park in Mulberry, Arkansas. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a public park and recreation area. The immediate FG contains playground equipment and an open field bordered by a line of scattered trees. Beyond the trees is an open agricultural field with a line of dense tree growth in the distance. This landscape is categorized as Common because it consists of vegetation and terrain consistent with the region and is free of cultural modifications other than park equipment.

Mulberry River and Trail of Tears PR/AR. This KOP represents views of the Mulberry River from the Trail of Tears. Visual sensitivity at this KOP is high because of the strong concern for aesthetics due to the historical designation. The landscape in the FG view consists of a rocky bank sloping down into open water bordered by riparian vegetation on either side. Looking out to the MG is an open field bordered by a dense line of trees with low rolling hills covered in dense trees. Cultural modifications are limited to a transmission line that crosses the river in the MG. Because the water that is dominant in view represents a scarce resource combined with the lack of cultural modification, the landscape in this area is categorized as Distinct.

Mulberry River AR. This KOP represents a view from the east bank of the Mulberry River. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a public recreation area. The view is dominated by open water in the FG with banks covered in dense trees on either side. A low ridge covered in dense trees is visible in the MG/BG. This is an area free of cultural modification with views of open water and interesting terrain and is therefore categorized as Distinct.

Ozark City Boat Launch PR. This KOP represents the view from the boat launch ramp at the northwestern corner of Ozark City Lake. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a public recreation area. The FG of the landscape being viewed is dominated by open water with the vegetated berm of the dam clearly visible. Across the lake the terrain rises into a low ridge covered in dense trees. This landscape is categorized as Distinct because of the presence of open water and varied vegetation.

Ozark AR. This KOP represents views from the northern edge of the community of Ozark, Arkansas. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a residential area. The landscape being viewed consists of agricultural land in the FG with low forested hills in the MG and BG. Cultural modifications in view are a rural dirt road bordered by wood power poles and scattered rural residences. This landscape consists of agricultural land and vegetation consistent with the region, so it is categorized as Common.

Robert S. Kerr Reservoir PR. This KOP represents views from the Sallisaw Creek Public Use Area at the Robert S. Kerr Reservoir. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a public recreation area. The landscape viewed from the KOP includes picnic structures and scattered trees in the FG. Beyond that, the terrain slopes down slightly to the edge of the water, providing views across open water to forested hills in the MG. Because this landscape is in an area free of major cultural modification and adjacent to a major water body, it is classified as Distinct.

Route 21 (Scenic Byway). This KOP represents views along the scenic byway of Route 21. Visual sensitivity is high from this KOP because of the concern for aesthetics associated with a scenic byway. Looking north, the landscape being viewed from this point consists of a rural road with a few single family residences and small power poles paralleling the road. Dense trees line the road as it transitions to densely vegetated rolling hills in the MG and BG. This landscape is classified as Distinct because it consists of varied terrain and vegetation and has a low number of cultural modifications. Route 21 is also a scenic byway that is used to access a National Forest.

Route 71 (Scenic Byway) AR. This KOP represents views along the scenic byway of Route 71. Visual sensitivity is high from this KOP because of the concern for aesthetics associated with a scenic byway. The landscape being viewed looking south is an agricultural landscape with groupings of trees and slightly rolling terrain. Cultural modifications in the area include wood power poles and scattered residences with surrounding agricultural use buildings. Because this landscape contains vegetation, terrain, and cultural modifications consistent with the region, it is categorized as Common.

Route 220 (Scenic Byway) AR. This KOP represents views looking north along the Route 220 scenic byway. Visual sensitivity is high from this KOP because of the concern for aesthetics associated with a scenic byway. In the FG, a rural road winds through a dense forest with views of rolling hills in the BG. The dense vegetation and rolling terrain create enclosed views of the landscape. Because this landscape consists of a variety of vegetation and interesting terrain with few cultural modifications, it is categorized as Distinct.

Sallisaw PR. This KOP represents the view looking north-northeast along Highway 59 in the community of Sallisaw. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a residential area. The landscape being viewed from here consists of gently rolling terrain with open fields and agricultural lands scattered with groupings of large trees in the FG and MG. In the BG, the landscape consists of rolling hills covered in dense vegetation. Cultural modifications in view include wood power poles, small fences and scattered residences. Because the landscape and vegetation features at this KOP are consistent with the region, it is categorized as Common.

Scott Farm AR. This KOP represents a view from the Scott Farm subdivision near Highway 59. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a residential area. The landscape being viewed to the south consists of gently rolling grassy terrain with cultural modifications including a large wrought iron fence and several residences in the FG and MG. In the BG, a high bluff covered in dense vegetation is visible. Although there are several cultural modifications in view from this KOP, the terrain is somewhat unique to the region, so the landscape is categorized as Common.

Scott Farm PR. This KOP represents a view from the Scott Farm subdivision near Highway 59. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a residential area. The landscape being viewed to the north consists of gently rolling grassy terrain with cultural modifications including a large wrought iron fence and several residences in the FG and MG. In the BG, the landscape consists of rolling hills covered in tall trees. Cultural modifications including communications towers and residences are also visible. Although there are several cultural modifications in view from this KOP, the terrain is somewhat unique to the region, so the landscape is categorized as Common.

Sequoyah NWR Boat Launch PR. This KOP represents views from the boat launch area at the Sequoyah National Wildlife Refuge. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a wildlife refuge. Looking to the north, the landscape being viewed includes open grasslands, wetlands and agricultural fields bordered by dense trees in the BG. This area contains few cultural modifications and the vegetation and terrain are consistent with the region, so the landscape is categorized as Common.

Sequoyah's Cabin. This KOP represents the view looking to the south from Sequoyah's Cabin historic site. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a historic site. The grounds contain interpretive exhibits and historic features including a historic cabin, offices, classrooms, information and gift center and picnic facilities. The view beyond the FG is mostly screened by large trees. Because of the sensitive nature of a historic site, this landscape is categorized as Distinct.

Tenkiller State Park PR/AR. This KOP is located in the southern end of Tenkiller State Park near the water's edge. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a state park and recreation area. Looking out over the open water in the FG, low ridges with dense vegetation are visible in the distance. There are no noticeable cultural modifications in view. Because of the lack of cultural modifications to the landscape, the unique presence of water in the region, and the state park designation, this landscape is categorized as Distinct.

Trail of Tears (Highway 352) PR/AR. This KOP represents views from Highway 352 and the Trail of Tears. Visual sensitivity is high from this KOP because of the sensitive nature of the Trail of Tears. The landscape being viewed includes open agricultural fields and scattered groupings of trees. The landscape in the BG consists of rolling hills covered in dense vegetation. Crossing the road in the FG is an existing wood H-frame transmission line. The rural agricultural nature of this landscape combined with few cultural modifications categorizes this landscape as Common.

Trail of Tears (Route 59) AR. This KOP is representative of the Trail of Tears along Route 59. Visual sensitivity is high from this KOP because of the sensitive nature of the Trail of Tears. Looking north, the landscape consists of open fields with groupings of dense trees in the FG. Densely forested hills rise up in the BG. Cultural modifications present are limited to wood power poles and the highway. The landscape here contains few modifications and has a variety of vegetation and interesting terrain features and is therefore categorized as Distinct.

Trail of Tears and Scenic Highway 220 AR. This KOP represents views from Scenic Highway 220. Visual sensitivity is high from this KOP because of the concern for aesthetics associated with a scenic highway. The landscape being viewed consists of agricultural fields in the FG bordered by a line of dense trees. Cultural modifications include a low fence and wood power poles. In the MG and BG, the landscape consists of rolling hills covered in tall dense trees. Because the terrain and vegetation in view are consistent with the region, the landscape is categorized as Common.

Trail of Tears Route 100 PR. This KOP represents views from the Trail of Tears along SR 100. Visual sensitivity is high from this KOP because of the concern for aesthetics associated with a scenic highway and historic trail. The view from here is dominated by a road lined with dense trees and wood power poles. There are limited cultural modifications to the landscape and the terrain and vegetation are consistent with the region, so the landscape is categorized as Common.

Trail of Tears Wire Road PR. This KOP represents views from the Trail of Tears along Wire Road. Visual sensitivity is high from this KOP because of the concern for aesthetics associated with an historic trail. The landscape being viewed from this KOP consists of open agricultural fields bordered by scattered trees. Cultural modifications present are limited to wood power poles and rural residences and associated agricultural buildings. Because the landscape is made up of elements typical of the region, it is categorized as Common.

Uniontown Highway (Scenic Highway) AR. This KOP is representative of views looking south from Uniontown Highway. Visual sensitivity is high from this KOP because of the concern for aesthetics associated with a scenic highway. The landscape being viewed in this area is of open agricultural fields with scattered trees in the FG transitioning into rolling hills covered in dense vegetation in the MG. The vegetation and terrain at this KOP is typical to the region and cultural modifications visible are limited to a low fence, so the landscape is categorized as Common.

Van Buren PR/AR. This KOP represents views looking northwest from nearby residences in the community of Van Buren, Arkansas. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a residential area. The landscape viewed from this location consists of grassy fields bordered by stands of tall deciduous trees. Cultural modifications include wood power poles and scattered residences and associated outbuildings. Because the landscape elements in this area are typical to the region, the landscape is categorized as Common.

Vian AR. This KOP represents views looking north and northeast from the edge to the community of Vian, Oklahoma. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a residential area. The landscape being viewed in the FG consists of open agricultural fields with scattered trees and low shrubs. In the BG, the landscape consists of low rolling hills covered in dense vegetation. Cultural modifications present include low, barbed wire fences and wood H-frame transmission structures. Because the agricultural landscape in this area is typical of the region, it is categorized as Common.

Vian Lake PR. This KOP represents views from the western edge of Vian Lake. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a recreation area. Looking to the northeast, views are of open water with densely vegetated rolling hills on the opposite side. Cultural modifications present on the landscape include a lattice structure transmission line. The presence of water in this region represents a scarce resource, so this landscape is categorized as Distinct.

Vine Prairie Park PR. This KOP represents views from a park and boat launch area. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a recreation area. The FG view includes a parking area and open water with tall trees and riparian vegetation bordering the banks. In the MG and BG are low, rolling hills covered in dense tree growth. This area is free from cultural modifications other than those associated with the park and the presence of water is a scarce resource, so the landscape is categorized as Distinct.

West Side City Park APR. This KOP represents the view from West Side City Park in Ozark. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a public park and recreation area. Looking north, the FG landscape consists of an open, grassy field bordered by tall coniferous and deciduous trees. Cultural modifications in view include a small shed, metal bleachers and a wood H-frame transmission line. The landscape at this KOP is typical for the region and is therefore categorized as Common.

White Oak AR. This KOP represents views from a small rural road running between the communities of Cravens and White Oak, Arkansas. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a residential area. Looking north, the landscape consists of an open field in the FG bordered by tall trees in the MG and BG. Cultural modifications present consist of a few small structures and a low barbed-wire fence. Because the vegetation, landform, and cultural modifications are typical of the region, this landscape is categorized as Common.

White Oak PR. This KOP represents views from a small rural road running between the communities of Cravens and White Oak, Arkansas. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a residential area. Looking south, views are enclosed by large trees in the FG. Cultural modifications present consist of a few small structures visible through the trees. Because the vegetation, landform, and cultural modifications are typical of the region, this landscape is categorized as Common.

White Oak Park PR. This KOP represents views from the edge of a lake. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a public park and recreation area. The landscape being viewed in the FG consists of a small dock leading out into a large, open water body. In the MG, the lake is bordered by dense tree growth. The BG landscape consists of low, rolling hills with dense vegetation. Because this area represents a recreation area and water body and is free of heavy cultural modification, it is categorized as Distinct.

Wiederkehr Village and Highway 186 PR/AR. This KOP represents the view along Highway 186 looking northwest. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a residential area. The landscape viewed consists of an open, agricultural field in the FG. In the MG, there are residential and agricultural structures with scattered trees. The BG landscape consists of rolling hills with dense vegetation. The landscape and vegetation features at this KOP are typical for the region, so the landscape is categorized as Common.

3.18.5.5 Region 5

Region 5 is referred to as the Central Arkansas Region and includes the Applicant Proposed Route Links 1 through 9, HVDC Alternative Routes 5-A through 5-F, and the Arkansas Converter Station Alternative Siting Area and AC interconnection and substation siting area. The ROI in Region 5 traverses Pope, Conway, Van Buren, Faulkner, Cleburne, White, and Jackson counties in Arkansas. The ROI crosses three Level III ecoregions: Arkansas Valley, which covers the majority of the region; Boston Mountains, which covers a small portion of the region in the north; and a small portion of the Mississippi Alluvial Plain, which covers the southeastern portion of the region. The landscape character within the ROI consists of varied terrain with low rugged hills, mountains, and benches in the northern portion transitioning to undulating plains, terraces, cuestas, and floodplains associated with the Arkansas River in the south. Generally, views are restricted in the northern portion of the ROI because of the rugged terrain and forested landscapes. In the southern portion of the ROI, the level to nearly level floodplains and pastureland and agricultural fields allow more expansive views in some areas. Views are limited primarily by rows of trees planted along fields and roads and riparian vegetation along waterways and drainages (GIS Data Sources: Clean Line 2013a, 2013b; Tetra Tech 2014a). The southwestern portion of the ROI crosses the Arkansas River, and the eastern portion of the ROI crosses the Little Red River and White River along with several smaller rivers and creeks such as Illinois Bayou and Cadron Creek. Other surface waters in the region include wetlands, impoundment ponds, and some small lakes and reservoirs, and the larger Greers Ferry Lake to the north. Vegetation consists primarily of oak-hickory forests, dense deciduous hardwood riparian forest, and scattered prairies and oaks in the south. Cultural modifications include croplands, poultry and livestock operations, farms and associated appurtenances, recreation development, natural gas facilities, logging and mining operations, roads and highways, electric distribution lines and several high-voltage transmission lines, and rural residences and suburban residential developments. Several communities occur within and/or adjacent to the ROI including the towns of Dover, Hector, Damascus, Guy, Twin Groves, Rose Bud, and Letona and the cities of Quitman and Bradford.

Visual resources identified in the ROI include rural residences and residences associated with towns and cities, Ozark National Forest, Woody Hollow State Park, Bald Knob NWR, Greers Ferry Lake, scenic byways (i.e., Applicant Proposed Route Links 5, 7, 9, 16, 25, 27, and 65), several state wildlife conservation areas, local and municipal parks, and historic landmarks.

Five route variations to the Applicant Proposed Route were developed in Region 5 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.5. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route and the landscape setting and visual resources would remain consistent within the ROI. Applicant Proposed Route Link 1, Variation 2, crosses a landscape setting similar to the original Applicant Proposed Route, which is primarily wooded. Although the variation would shift the Applicant Proposed Route to the south by approximately 1,800 feet to avoid residences, the variation would be closer to other residences in the area. Applicant Proposed Route Link 2, Variation 2, crosses a landscape setting similar to the original Applicant Proposed Route, which is primarily wooded. The variation would shift the Applicant Proposed Route to the west by between 0.7 mile and 1 mile and would be located farther from residences and structures. Applicant Proposed Route Links 2 and 3, Variation 1, crosses a landscape setting similar to the original Applicant Proposed Route, which is primarily wooded. The variation would shift the Applicant Proposed Route to the west and south by less than 1,000 feet and would be located farther from residences. It should be noted that a route adjustment was made for HVDC Alternative Route 5-B to maintain an end-to-end route with the Links 2 and 3, Variation 1. Applicant Proposed Route Links 3 and 4, Variation 2, would cross a similar landscape setting and would be located approximately 0.25 mile from the original Applicant Proposed Route. Although the variation would be located farther from an existing homestead, it would be located closer to other residences. A route adjustment was made for HVDC Alternative Route 5-E to maintain an end-to-end route with the Links 3 and 4, Variation 2. Applicant Proposed Route Link 7, Variation 1, crosses a landscape setting similar to the original Applicant Proposed Route. The variation would no longer parallel an existing high-voltage transmission line, and although it would be located farther from two residences, it would be located closer to several others.

3.18.5.5.1 Landscape Character Description by KOP

Boy Scout Campground PR/AR. This KOP represents the view from the eastern side of a Boy Scout campground. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a public park and recreation area. The landscape in this area is a mostly natural area with rolling terrain and dense trees. Views are enclosed due to the dense vegetation in the FG. Nearby cultural modifications include a campground and recreational facilities associated with the Boy Scout camp. This landscape consists of vegetation and terrain features typical to the region and is categorized as Common.

Bradford. This KOP represents views looking northwest from a residential area north of the community of Bradford, Arkansas. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a residential area. The landscape being viewed from this KOP consists of grassy open areas with scattered trees and residential structures in the FG and groupings of dense trees in the MG and BG. Because the vegetation and cultural modifications at this KOP consist of vegetation and terrain typical for the region, it is categorized as Common.

Damascus AR. This KOP is representative of views from a residential area near the southern edge of the community of Damascus, Arkansas. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a residential area. Looking to the southwest, views of the landscape consist of open fields with groupings of dense tree growth and scattered rural, single family homes. The terrain and vegetation is consistent with the region, so the landscape is categorized as Common.

Damascus PR. This KOP is representative of views from a residential area near southern edge of the community of Damascus, Arkansas. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a residential area. Looking to the north/northwest, views of the landscape consist of open agricultural fields in the FG with scattered trees and rural, single family homes. The BG landscape consists of rolling hills covered in dense vegetation. The terrain and vegetation is consistent with the region, so the landscape is categorized as Common.

Dover and J.P. Lovelady Ball Park PR/AR. This KOP represents views from a park on the northern side of the rural community of Dover. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a public park and recreation area. The landscape viewed in the FG includes agricultural fields with groupings of trees. Cultural modifications to the landscape include residences, wood power poles, fences, and a roadway. In the BG are low, forested ridges. Since the vegetation, landform and cultural modifications in view from this KOP are typical to the region, the landscape is categorized as Common.

Guy PR/AR. This KOP represents typical views from the north central part of the community of Guy, Arkansas. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a residential area. The landscape viewed consists of rolling hills with dense trees and multiple residences. Cultural modifications include wood power poles and residential structures. The vegetation and landform in this area is consistent with the region, so the landscape is categorized as Common.

Hector PR/AR. This KOP represents views from a residential area on the southern edge of Hector, Arkansas. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a residential area. The landscape viewed from this KOP consists of a road lined with tall, densely growing trees.

Cultural modifications in view include wood power poles and scattered residential and commercial structures. The landscape in this area contains landform and vegetation typical of the region and so is categorized as Common.

Highway 7 (Scenic Byway) AR. This KOP represents the view looking north from the Highway 7 Scenic Byway. Visual sensitivity is high from this KOP because of the high level of concern for aesthetics associated with a Scenic Byway. Views are of scattered rural residences surrounded by small agricultural fields and rolling hills with dense trees. Cultural modifications to the landscape include small power poles, barbed-wire fences, and scattered residential homes. The landscape at this KOP consists of vegetation and landform consistent with the region and is categorized as Common.

Highway 7 (Scenic Byway) PR. This KOP represents the view looking north from the Highway 7 Scenic Byway. Visual sensitivity is high from this KOP because of the high level of concern for aesthetics associated with a Scenic Byway. The landscape being viewed consists of a rural highway lined with tall trees and dense vegetation. The views are mostly enclosed, but a low ridgeline can be seen in the distance through breaks in the trees. Because the vegetation, landform and cultural modifications are consistent with the region, this landscape is categorized as Common.

Highway 9 (Scenic Highway) AR. This KOP represents the view looking south from the Highway 9 Scenic Highway. Visual sensitivity is high from this KOP because of the high level of concern for aesthetics associated with a scenic highway. Views are of low rolling terrain consisting of open agricultural fields and scattered groupings of trees with a forested ridge in the BG. Cultural modifications visible include scattered residences, barns, sheds and commercial business structures. The landscape viewed from this KOP consists of vegetation and terrain typical to the region and without extensive cultural modification, and is therefore categorized as Common.

Highway 9 (Scenic Highway) PR. This KOP represents the view looking south from the Highway 9 Scenic Highway. Visual sensitivity is high from this KOP because of the high level of concern for aesthetics associated with a scenic highway. Views are of low rolling terrain consisting of open agricultural fields with groupings of dense trees. Cultural modifications are limited to a low fence and wood power poles. The landscape viewed from this KOP consists of vegetation and terrain typical to the region without extensive cultural modification, and is therefore categorized as Common.

Highway 16 (Scenic Highway) AR. This KOP represents a view looking south from the Highway 16 Scenic Highway. Visual sensitivity is high from this KOP because of the high level of concern for aesthetics associated with a scenic highway. Views are of flat, open agricultural fields with dense patches of trees. This landscape has vegetation and terrain typical to the region and so is categorized as Common.

Highway 16 (Scenic Highway) AR/PR. This KOP represents views looking south from the Highway 16 scenic highway. Visual sensitivity is high from this KOP because of the high level of concern for aesthetics associated with a scenic highway. Views include a rural landscape with rolling hills, low ridges, open fields, and dense trees. Cultural modifications include residential structures and metal barns visible in the FG. The landscape viewed from this KOP consists of vegetation and terrain typical of the region without extensive cultural modification, and is therefore categorized as Common.

Highway 25 Scenic Highway. This KOP represents views looking south from Highway 25. Visual sensitivity is high from this KOP because of the high level of concern for aesthetics associated with a scenic highway. The landscape viewed from this KOP contains cultural modifications including scattered residences and commercial buildings in the FG. Vegetation in the FG consists of scattered trees and a low ridgeline with dense trees is visible in the BG. Because the landscape elements are typical for the region, this landscape is categorized as Common.

Letona PR. This KOP represents views looking from the community of Letona, Arkansas. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a residential area. In the FG view are numerous cultural modifications including scattered residences, roads, and wood power poles. Vegetation in the FG consists primarily of scattered trees. In the MG/BG, dense trees and ridgelines are visible. The landscape in this area has considerable cultural modifications when compared to the rest of the region and so is categorized as Developed.

Pope County Residential Cluster PR/AR. This KOP represents views looking north/northwest from a cluster of residences in Pope County, Arkansas. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a residential area. Views are of a small open field with groupings of trees in the FG bordered by residences and a small church. In the MG, there is a high ridge covered in dense trees. Because the landscape being viewed from this KOP contains interesting terrain features and a low number of cultural modifications, it is categorized as Distinct.

Quitman PR/AR. This KOP is the view looking south from the southern edge of the community of Quitman, Arkansas. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a residential area. The landscape being viewed in the FG consists of an open agricultural field and a road lined with wood power poles. In the MG, several residences and scattered trees are visible. The landscape in the BG is low hills covered in dense vegetation. Because the landform and vegetation are typical for this region, the landscape is categorized as Common.

Rose Bud City Park PR/AR. This KOP represents the view looking north from a city park near the southern edge of the community of Rose Bud, Arkansas. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a public park and recreation area. The landscape in view consists of an open field with scattered trees and contains cultural modifications including a small picnic pavilion and a chain-link fence. Beyond the park in the MG, residential and commercial structures with scattered trees and shrubs are visible. The views are enclosed in the BG by a line of dense trees. The landscape at this KOP contains a high number of cultural modifications not typical in this region and is categorized as Developed.

Steprock PR/AR. This KOP represents views looking south-southeast from the community of Steprock, Arkansas. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a residential area. The FG views consist of gently rolling terrain with scattered groupings of trees. Cultural modifications in view include several residences, sheds, and an existing high-voltage 500kV lattice structure transmission line. Because of the existing cultural modifications, this landscape is characterized as Developed.

Twin Groves PR/AR. This KOP represents views from rural residences near the edge of the community of Twin Groves, Arkansas. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a residential area. The views from this location are enclosed by dense trees that line a small road. Cultural modifications are limited to street signage and wood power poles. This type of terrain and vegetation is typical of the region and so is characterized as Common.

White River AR. This KOP represents views looking northeast from the south bank of the White River, near Jackson Road 177. Visual sensitivity is high from this KOP because of the concern for aesthetics associated with a scarce resource such as a major water body. The FG view is dominated by open water with dense riparian vegetation lining each bank. This is a major water body and is not typical for this region. Because of the uniqueness of the vegetation and the presence of water, combined with no cultural modifications in view, this landscape is categorized as Distinct.

White River PR. This KOP is representative of views looking southeast from the Highway 67 bridge crossing the White River. Visual sensitivity is high from this KOP because of the concern for aesthetics associated with a scarce resource such as a major water body. Views are of a flat landscape with open water bordered by a mix of low vegetation and trees. In the MG, an open field is visible with a row of dense trees in the BG. Because water represents a unique landscape in this region, and the area is free of cultural modifications, this landscape is categorized as Distinct.

Wonderview School AR. This KOP represents the view looking south-southwest from the school and nearby residences. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a residential area. Views of the BG include dense trees and gently rolling hills with scattered residences. The view includes open agricultural fields in the FG with scattered groupings of trees. Cultural modifications in view include wood power poles, street signs, and structures associated with rural residences. The terrain and vegetation viewed from this KOP are typical of the region and it is categorized as Common.

Wonderview School PR. This KOP represents views looking north from the school and nearby residences. Visual sensitivity is high from this KOP because of the concern for aesthetics and long viewing durations associated with a residential area. The view from this KOP consists of a row of tall trees in the FG that provide some screening, but looking through the trees gives views of a broad valley in the MG with rolling hills and dense trees. In the BG, the landscape consists of rolling hills covered in dense vegetation. The variety of vegetation and somewhat unique terrain for the region, combined with the low number of cultural modifications, gives this landscape the categorization of Distinct.

3.18.5.6 Region 6

Region 6 is referred to as the Cache River and Crowley's Ridge Region and includes the Applicant Proposed Route Links 1 through 8 and HVDC Alternative Routes 6-A through 6-D. The ROI in Region 6 traverses Jackson, Cross, and Poinsett counties in Arkansas. The ROI crosses two Level III ecoregions: Mississippi Alluvial Plain, which covers the majority of the region, and Mississippi Valley Loess Plains, which run north and south through the central portion of the ROI and are associated with the South Francis River. The landscape character within the ROI is predominately agricultural, croplands, and natural areas including riparian woodlands and wetlands. The terrain is relatively flat to gently undulating with several meandering streams, branching channels, and other drainages. Views are generally open given the level terrain, although wooded areas and trees planted along the edges of field and roadways can limit expansive views in some areas (GIS Data Sources: Clean Line 2013a, 2013b; Tetra Tech 2014a). In the western portion of the region, the ROI crosses the White and Cache rivers, and in the east, the ROI crosses the Little River. The ROI crosses other surface waters including oxbow lakes, wetlands, impoundment ponds, lakes, reservoirs, and several small intermittent and perennial streams. Many of the streams are channelized and flood-control structures are common in this region. Vegetation consists of oak-hickory forests in the northern portion of the ROI and deciduous hardwood riparian forest and tall grass prairies and oaks to the south. Cultural modifications include croplands, poultry and livestock operations, farms and associated appurtenances, residential and commercial development, natural gas facilities, logging and mining operations, roads and highways, electric distribution lines and several high-voltage transmission lines, and rural residences and suburban residential developments. Several communities occur within and/or adjacent to the ROI including the towns of Fisher, Weldon, and Amagon and the cities of Cherry Valley and Marked Tree.

Visual resources identified in the ROI include rural residences and residences associated with towns and cities, Lake Poinsett State Park, Cache River NWR, Crowley's Ridge Parkway National Scenic Byway (State Route 163), and several state conservation areas and historic landmarks.

One route variation to the Applicant Proposed Route was developed in Region 5 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.5. This route variation would parallel more parcel boundaries to minimize impacts to agricultural operations and is shown in Exhibit 1 of Appendix M. The variation represents a minor adjustment to the Applicant Proposed Route and the landscape setting and visual resources would remain consistent with those described for the original Applicant Proposed Route. Applicant Proposed Route Link 2, Variation 1, crosses a landscape setting similar to the original Applicant Proposed Route, including primarily croplands. The variation would be approximately the same distance to residences as the original Applicant Proposed Route. It should be noted that a route adjustment was made for HVDC Alternative Route 6-A to maintain an end-to-end route with Link 2, Variation 1.

3.18.5.6.1 Landscape Character Description by KOP

Amagon AR. This KOP represents views west and southwest from the center of Amagon, Arkansas. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from commercial and residences in and near the town center. The landscape viewed from this KOP is categorized as Developed because of cultural modifications associated with Amagon, including commercial buildings and residential structures, light poles, and electric distribution lines. Views are limited to the FG by the existing buildings and vegetation in and around the town center.

Cherry Valley PR. This KOP represents views north from the northern edge of Cherry Valley, Arkansas. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from a residential area. From this KOP, the landscape is categorized as Common because it consists of agricultural fields lined with deciduous trees, typical within the region. Cultural modifications include storage buildings associated with agricultural lands and electric distribution lines.

Crowley's Ridge Scenic Byway AR. This KOP represents views southeast from Crowley's Ridge Scenic Byway (southbound). Visual sensitivity at this KOP is high due to the road's scenic designation. The landscape viewed from this KOP is categorized as Common because it consists of open fields lined with vegetation and pockets of wooded areas (such as the one that borders the roadway to the west), typical within the region. Cultural modifications include electric distribution lines. Views to the east and southeast from this KOP are open in the FG/MG due to the level terrain and lack of vegetation; views are limited to the west due to the dense wooded area in the immediate FG.

Crowley's Ridge Scenic Byway PR. This KOP represents the view looking north from the Crowley's Ridge Scenic Byway. Visual sensitivity at this KOP is high due to the road's scenic designation. The roadway is adjacent to a ridge and winds through dense forests on both sides. The landscape viewed from this KOP is not typical within the area; therefore it is categorized as Distinct. Cultural modifications include a distribution line. Views in this area are enclosed and limited to the immediate FG due to the terrain and dense vegetation.

Fisher and Park AR. This KOP represents views looking south from the entrance of a community park near the southern edge of Fisher, Arkansas. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residences. The landscape viewed in the immediate FG from this KOP is categorized as Developed because of cultural modifications associated with Fisher; views in the MG are categorized as Common because they consist of open fields and pockets of wooded areas. Cultural modifications include residential structures, light poles, and electric distribution lines.

Fisher and Park PR. This KOP represents views looking east from the entrance of a community park near the southern edge of Fisher, Arkansas. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residences. The landscape viewed from this KOP is categorized as Developed because of cultural modifications associated with Fisher. Cultural modifications include residential and commercial structures, storage structures, chain-link fences, a playground, and electric distribution lines.

Highway 14 Scenic Highway AR. This KOP represents the view looking east along Highway 14 west of Amagon, Arkansas. Visual sensitivity at this KOP is high due to the roads scenic designation. The landscape viewed from this KOP is categorized as Common because it consists of open fields and scattered rural residences and wooded areas typical within the region. Cultural modifications include residential structures and electric distribution lines in the FG/MG, and a communication tower in the BG. Views are open due to the level terrain and lack of vegetation in the FG.

Weldon PR/AR. The Weldon KOP represents views looking north from Highway 17 near the northern edge of Weldon, Arkansas. The view consists primarily of flat agricultural land with few cultural modifications such as wood power poles and an existing steel monopole transmission line. Scattered trees dot the landscape with a row of dense trees in the distance. This landscape has some modification and is categorized as Developed.

3.18.5.7 Region 7

Region 7 is referred to as the Arkansas Mississippi River Delta and Tennessee Region and includes the Applicant Proposed Route Links 1 through 5, HVDC Alternative Routes 7-A through 7-D, and the Tennessee converter station siting area. The ROI in Region 7 traverses Poinsett and Mississippi counties in Arkansas and Tipton and Shelby counties in Tennessee. The ROI crosses two Level III ecoregions: Mississippi Alluvial Plain, which covers the eastern portion of the region, and Mississippi Valley Loess Plains, which cover the western portion of the region. The landscape character within the ROI is predominantly agricultural and natural with some developed areas in Tennessee. The terrain primarily consists of flat, level floodplains associated with the Mississippi River in the western and central portion of the ROI that transition to gently undulating plains and low hills in the eastern portion of the ROI. Although the terrain is primarily flat within this region, views are typically limited given the numerous forested areas, vegetation associated with surface waters, waterways, drainages, wetlands, and trees planted along agricultural fields and along roadways (GIS Data Sources: Clean Line 2013a, 2013b; Tetra Tech 2014a). The ROI traverses the Mississippi River and its tributaries from north to south. The ROI crosses other surface waters including wetlands, several small streams, levees, drainage channels, and impoundment ponds. Vegetation consists primarily of riparian woodland and wetland species with smaller patches of hardwood forests dispersed throughout the region. Cultural modifications include croplands, pastures, agricultural operations, roads and highways, electric distribution lines and several high-voltage transmission lines, and rural residences and suburban residential developments. Dispersed rural residence and several small communities in Arkansas occur within and adjacent to the ROI in the western and eastern portion of Region 7 including towns of Tyronza, Dyess, Bassett, Birdsong, Marie, and Wilson and the cities of Joiner and Marked Tree. In the eastern portion of the ROI in Tennessee, larger communities are concentrated closer to one another and there is more dense mixed development including the town of Atoka and Tipton and cities of Millington and Munford. In addition, large private estates are common in the eastern portion of the ROI. The Naval Air Station Memphis at Millington is also located within the eastern portion of the ROI.

Visual resources identified in the ROI include rural residences and residences associated with towns and cities, Hampson-Archeological Museum State Park, Meeman-Shelby Forest State Park, Mississippi River (including a scenic trail), St. Francis River, Lower Hatchie NWR, Trail of Tears, Scenic Route 61, Scenic Byway 63, and several state wildlife conservation areas and municipal parks.

Three route variations to the Applicant Proposed Route were developed in Region 7 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.7. The variations are illustrated in Exhibit 1 of Appendix M. Applicant Proposed Route Link 1, Variation 1; Link 1, Variation 2; and Link 5, Variation 1, all cross landscape settings similar to the original Applicant Proposed Route. Applicant Proposed Route Link 1, Variation 1, would be located closer to a residence and Applicant Proposed Route Link 1, Variation 2, and Applicant Proposed Route Link 5, Variation 1, would be located approximately the same distances to residences as the original links of the Applicant Proposed Route.

3.18.5.7.1 Landscape Character Description by KOP

Atoka PR/AR. This KOP represents views from the edge of a residential neighborhood in Atoka, Tennessee. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residences. The landscape viewed from this KOP is categorized as Common because it consists of agricultural fields surrounded by wooded areas, typical within the region. Cultural modifications include a lattice communication tower in the MG.

Atoka Community Park PR/AR. This KOP represents views from a community park and recreation area in Atoka, Tennessee. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from a community recreation area and nearby residences. From this KOP, the landscape in the FG is categorized as Developed because of cultural modifications associated with the recreation facility. Cultural modifications include ball fields, light poles, fences, and covered picnic areas, and a playground. Views from this KOP are limited to the immediate FG due to the dense wooded area surrounding the park.

Aycock Park and Millington AR. This KOP represents views from a community park and recreation area in Millington, Tennessee. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from a community recreation area and nearby residences. The landscape viewed from this KOP is categorized as Developed because of the cultural modifications associated with Millington. Cultural modifications include ball fields and backstops, playground fences, electric distribution lines, light poles, a church, and a highway. Views from this KOP are limited to the immediate FG because a dense wooded area surrounds the park.

Birdsong PR. This KOP represents views from the northern edge of the small rural community of Birdsong, Arkansas. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from a residential area. The landscape viewed from this KOP is characterized by agricultural fields lined with trees and pockets of wooded areas. This type of landscape is typical within the region and was therefore categorized as Common. Cultural modifications are limited to residential structures and electric distribution lines.

Dyess AR. This KOP represents views looking south from the southern edge Dyess, Arkansas. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from a residential area. The landscape viewed from this KOP is characterized by agricultural fields lined with trees and scattered residences. This type of landscape is typical within the region and was therefore categorized as Common. Cultural modifications include residential structures and electric distribution lines. Views from this KOP are open due to lack of vegetation in the FG/MG.

Edmund Orgill Park PR/AR. This KOP represents views from the southern edge of a lake in Edmund Orgill Park. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from a community park and recreation area. The landscape viewed from this KOP is characterized by level terrain in the immediate FG and a large expansive lake in the FG/MG and dense vegetation along the northern edge of the lake. Given the dominance of the water feature and the variation in vegetation around the lake, this landscape is categorized as Distinct. Cultural modifications include recreational elements associated with the park, including a boat launch, a small picnic shelter and low wood fences.

Harold Park and Millington AR. This KOP represents views west from a park in the town of Millington, Tennessee. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from a community park and residential area. The landscape viewed from this KOP is categorized as Developed because of cultural modifications associated with Millington. Cultural modifications include residential structures and electric distribution lines. Views from this KOP are limited to the FG by the vegetation that surrounds residences and wooded areas in the MG.

Harold Park and Millington PR/AR. This KOP represents views north from a park in the town of Millington, Tennessee. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from a community park and residential area. The landscape viewed from this KOP is categorized as Developed because of cultural modifications associated with Millington. Views are similar to those described from the Harold Park and Millington AR KOP above.

Highway 61 (Scenic Byway) PR. This KOP represents views looking northeast from Highway 61 Scenic Byway near the northern edge of Frenchmans Bayou, Arkansas. Visual sensitivity at this KOP is high due to the scenic designation of the roadway. The landscape viewed from this KOP is categorized as Common, as the area consists of agricultural fields surrounded by trees, rural residents, and small pockets of wooded areas. Cultural modifications include residential structures and electric distribution lines.

Johnny Cash Home AR. This KOP represents the view looking south from Johnny Cash's childhood home near Dyess, Arkansas. The house is an Arkansas State University Heritage site. Visual sensitivity at this KOP is high due to the historic designation. The landscape viewed from this KOP is categorized as Common, as the area consists of agricultural fields surrounded by trees and small pockets of wooded areas. Cultural modifications include the historic home and electric distribution lines. Views from this KOP are open due to the lack of vegetation in the FG/MG.

Joiner PR. This KOP represents views looking south from the southern edge of Joiner, Arkansas. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from a residential area. The landscape viewed from this KOP is categorized as Common, as the area consists of agricultural fields surrounded by trees and small pockets of wooded areas. Cultural modifications include residential structures and electric distribution lines. Views from this KOP are open due to the lack of vegetation in the FG/MG.

Lower Hatchie NWR AR. This KOP represents views to the southeast from the Lower Hatchie NWR just east of the Mississippi River in Tennessee. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from national wildlife refuge. The landscape viewed from this KOP is characterized by gently to moderately rolling terrain and small ponds in the FG, wooded areas in the MG, and low forested hills in the BG. Given the variation in vegetation, landform, and the presence of water; this landscape is categorized as Distinct. Views are open due to limited vegetation in the FG/MG.

Marked Tree PR/AR. This KOP represents views from a municipal park in the community of Marked Tree, Arkansas. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from a community park and nearby residential area. The landscape viewed from this KOP is categorized as Developed because of cultural modifications associated with Marked Tree. Cultural modifications include residential and commercial structures, ball fields, chain-link fences, light poles, and electric distribution lines. Views from this KOP are limited by development and vegetation in the immediate FG.

McGavock-Grider Park AR. This KOP represents the view from a small memorial park on State Route 61 south of Osceola, Arkansas. Visual sensitivity at this KOP is moderate because this is a small park with no recreational facilities; viewing durations are not anticipated to be very long. The landscape viewed from this KOP is categorized as Common, because the area consists of agricultural fields surrounded by trees and wooded areas. Cultural modifications include electric distribution lines and transmission lines in the MG. Views are generally open due to the lack of vegetation in the FG/MG.

Millington East AR. This KOP represents views looking southeast from the edge of a residential neighborhood in Millington, Tennessee. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residential areas. The landscape viewed from this KOP is categorized as Common because it consists of agricultural fields surrounded by trees and small pockets of wooded areas. Cultural modifications include a transmission line in the MG. Views are typically limited to the FG due to the dense vegetation around agricultural fields.

Millington USA Baseball Stadium AR. This KOP represents views south and west from a large baseball park complex in Millington, Tennessee. Visual sensitivity at this KOP is moderate because concern for aesthetics is not the primary focus of viewers associated with the ball field, where activities are focused inside the park. The landscape viewed from this KOP is categorized as Developed because of cultural modifications associated with Millington. Cultural modifications include ball fields, dugouts, restroom facilities, light poles, chain-link fences, commercial and residential structures, and electric distribution lines; a communication tower is visible in the MG.

Views from this KOP are limited to the FG due to development, dense wooded areas to the south and vegetation surrounding residential homes to the west.

Mississippi River and Trail of Tears AR. This KOP represents views from the southern bank of the Mississippi River looking northeast. Visual sensitivity at this KOP is high as it represents a view from a scenic recreation area and national historic trail. The landscape viewed from this KOP consists of the Mississippi River, a dominant water feature in the landscape, bordered by dense vegetation along the northern bank. Due to the presence of water, the variety of vegetation this landscape is categorized as Distinct. Cultural modifications include a transmission line that crosses the river.

Mississippi River and Trail of Tears PR. This KOP represents views looking northwest from a local road near the Mississippi River and Trail of Tears. Visual sensitivity at this KOP is high as it represents a view from a scenic recreation area and historic trail. The view is dominated by open agricultural fields bordered by wooded areas, typical within the region, so this landscape is categorized as Common. The Mississippi River is visible in the distance but is not a dominant feature in the landscape. Cultural modifications include irrigation equipment silos and storage garage for farming equipment. Views from this KOP are open due to the lack of vegetation in the FG/MG.

Munford PR/AR. This KOP represents views southwest from a mixed residential and commercial area in southern Munford, Tennessee. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residents in the area. The landscape viewed from this KOP is categorized as Developed because of cultural modifications associated with Munford including residential and commercial structures, chain-link fences, electric distribution lines and a transmission line. Views from this KOP are limited to the FG due to dense wooded areas surrounding the community.

Rhodes Estates AR. This KOP represents views northeast from a residential area near Tipton, Tennessee. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residents in the area. The landscape viewed from this KOP is categorized as Developed because of cultural modifications associated with Rhodes Estates including residential structures, wooden fences, electric distribution lines and a transmission line. Views from this KOP are limited due to trees clustered around residences and wooded areas in the MG.

Rhodes Estates PR. This KOP represents views southeast from a residential area near Tipton, Tennessee. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residents in the area. The landscape viewed from this KOP is similar to the landscape viewed for the Rhodes Estates AR KOP in that it is categorized as Developed because of cultural modifications associated with Rhodes Estates including residential structures, wooden fences, and electric distribution lines. Views from this KOP are also limited due to trees clustered around residences and wooded areas in the MG.

Rockyford Park AR. This KOP represents views from a neighborhood park in a residential area in northern Bartlett, Arkansas. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residents and park users. The landscape viewed from this KOP is categorized as Developed because of cultural modifications associated with the Rockyford subdivision including a man-made pond, residential structures, benches, signs, a trail, light poles, and electric distribution lines. Views from this KOP are limited to the FG due to residential structures, scattered trees and wooded areas surrounding the subdivision.

Tyronza AR. This KOP represents views looking northwest from the western edge of Tyronza, Arkansas. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from a residential area. The view from this KOP consists of croplands with vegetation along the edge of fields and wooded areas. Croplands are typical within this region, so this landscape is categorized as Common. Cultural modifications include electric distribution lines. Views from this KOP are open due to the level terrain and lack of vegetation in the FG/MG.

Tyronza PR. This KOP represents views looking northwest from the western edge of Tyronza, Arkansas. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from a residential area. The landscape viewed from this KOP is categorized as Developed because of cultural modifications associated Tyronza, including residential and commercial structures, fence posts, chain-link fences, and electric distribution lines. Views are open due to open fields and the lack of vegetation in the immediate FG.

Wilkinsville AR. This KOP represents views south-southeast from the southern edge of Wilkinsville, Tennessee. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residential areas. The landscape viewed from this KOP is categorized as Common, because the area consists of agricultural fields with pockets of wooded areas in the MG. Cultural modifications include irrigation equipment. Views from this KOP are open due to lack of vegetation in the immediate FG.

Wilkinsville AR. This KOP represents views southeast from the eastern edge of Wilkinsville, Tennessee. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from residential areas. The landscape viewed from this KOP is categorized as Common, because the area consists of agricultural fields with small clumps of vegetation in the FG and pockets of wooded areas in the MG. Cultural modifications include residential structures, irrigation equipment, electric distribution lines and communication towers. Views are partially obstructed due to scattered vegetation in the immediate FG.

Wilson Park AR. This KOP represents views from Hudson Wren Memorial Park near the northwestern edge of Wilson, Arkansas. Visual sensitivity at this KOP is high because of the strong concern for aesthetics and long viewing durations from nearby residential areas and this public park. The landscape viewed from this KOP is categorized as Common, as the area consists of agricultural fields with pockets of wooded areas in the MG/BG and vegetation concentrated around scattered rural residences. Cultural modifications include electric distribution lines and residential structures in the MG. Views from this KOP are open due to the lack of vegetation in the FG.

3.18.5.8 Connected Actions

3.18.5.8.1 Wind Energy Generation

Wind energy development is a connected action to the Project. To assist in evaluating the potential environmental impacts of that wind energy development, the Applicant attempted to identify the likely locations of the wind energy development that would utilize the capacity on the HVDC transmission line. The Applicant identified thirteen WDZs, each within a 40-mile-radius of the Oklahoma County Converter Station Siting Area with adequate wind resource and within which future development of wind energy facilities could occur (see Figure 3.17-1 in Appendix A). The WDZs include approximately 1,700 square miles, or 1,082,000 acres in Oklahoma (Beaver, Cimarron, and Texas counties) and Texas (Hansford, Ochiltree, and Sherman counties). According to the BLM sponsored study “Wind Turbine Visibility and Visual Impact Threshold Distances in Western Landscapes” (Sullivan et al. 2011), given the right conditions, wind turbines can be visible at more than 36 miles and may be noticeable to the casual observer at distances up to 20 miles. Because of these findings, the ROI for the wind energy generation has been set at 30 miles from the boundary of each WDZ. Consistent with the Project, EPA Level III ecoregions were used to develop a description of the existing landscape character.

3.18.5.8.1.1 WDZ-A

WDZ-A falls primarily within the High Plains ecoregion. This ecoregion is characterized by gently rolling terrain with occasional sand plains and hills along with scattered playa depressions. Vegetation is primarily short and midgrass prairie scattered with other types of vegetation including Harvard shin oak, fourwing saltbush, sand sagebrush, and yucca. The generally flat, open landscape provides largely unobstructed panoramic views and the horizontal lines of the landform are occasionally interrupted with vertical elements such as grain silos, transmission structures, and scattered rural residences and farms, which can be visible from long distances.

The far western portion of WDZ-A transitions in the Southwestern Tablelands ecoregion and is characterized by broad, elevated tablelands with shallow canyons, mesas, badlands, gorges, and dissected river breaks. Vegetation in the region consists primarily of shortgrass prairie with some scattered riparian areas. The open landscape of this ecoregion offers broad panoramic views with strong horizontal lines and provides typical views similar to the High Plains ecoregion.

Cultural modifications within the ROI are primarily cropland and grazing land with associated buildings and that is occasionally interrupted with paved and unpaved roads. In addition, livestock feeding operations and oil and natural gas facilities are common.

Sensitive visual resources in the ROI include Perryton, Texas; Spearman, Texas; Hardesty Oklahoma and other small communities, Optima NWR, Schultz WMA, Lake Schultz State Park, as well as various local parks and recreation areas.

3.18.5.8.1.2 WDZ-B

WDZ-B is characterized primarily by the High Plains ecoregion transitioning into the Southwestern Tablelands ecoregion on the eastern edge and has similar landscape and vegetation characteristics as WDZ-A. The open landscape of both ecoregions offers largely unobstructed panoramic views and the horizontal lines of the landform are occasionally interrupted with vertical elements such as grain silos, transmission structures, and scattered rural residences and farms, which can be visible from long distances.

Cultural modifications within the ROI are primarily cropland and grazing land with associated buildings and large areas utilizing center pivot irrigation and scattered paved and unpaved roads. In addition, livestock feeding operations and oil and natural gas facilities are common.

Sensitive visual resources in the ROI include Gruver Texas; Perryton, Texas; Spearman, Texas; Hardesty, Oklahoma and other small communities, Optima NWR, Schultz WMA as well as various local parks and recreation areas.

3.18.5.8.1.3 WDZ-C

WDZ-C is characterized primarily by the High Plains ecoregion transitioning into the Southwestern Tablelands ecoregion and has similar landscape and vegetation characteristics as the previous WDZs. As described previously, the open landscape of both of these ecoregions offers largely unobstructed panoramic views and the horizontal lines of the landform are occasionally interrupted with vertical elements such as grain silos, center pivots, transmission structures, and scattered rural residences and farms, which can be visible from long distances.

Cultural modifications within the ROI are primarily cropland and grazing land with associated buildings and large areas utilizing center pivot irrigation. Scattered paved and unpaved roads, concentrated livestock feeding operations, and oil and natural gas facilities are common.

Sensitive visual resources in the ROI include Rita Blanca National Grassland (administered by Cibola National Forest), Lake Schultz State Park, Shultz Wildlife Management area, Optima NWR, local parks and recreation areas, and the towns of Cactus, Texas; Goodwell, Oklahoma; Guymon, Oklahoma; Hardesty, Oklahoma; Sunray, Texas and Texahoma, Oklahoma.

3.18.5.8.1.4 WDZ-D

WDZ-D falls within the Southwestern Tablelands ecoregion and is characterized by broad, elevated tablelands with shallow canyons, mesas, badlands, gorges, and dissected river breaks. Vegetation in the region consists primarily of shortgrass prairie with some scattered riparian areas. The open landscape offers largely unobstructed panoramic views and the horizontal lines of the landform are occasionally interrupted with vertical elements such as wind turbines, steel and wood transmission and distribution structures, center pivots, and scattered rural residences and farms, which can be visible from long distances.

Cultural modifications within the ROI are primarily cropland and grazing land with associated buildings, scattered paved and unpaved roads, livestock feeding operations, and oil and natural gas facilities are common and groupings of wind turbines can be found the southwestern area of the ROI.

Sensitive visual resources in the ROI include Hardesty, Texas; Goodwell, Oklahoma; Guymon, Oklahoma; Optima, Oklahoma; Lake Schultz State Park, Optima NWR, Optima WMA, Schultz WMA and local parks and recreation areas.

3.18.5.8.1.5 WDZ-E

WDZ-E is primarily within the High Plains ecoregion transitioning to Southwestern Tablelands along the southern and northeastern edges. Vegetation and landscape characteristics are as described in WDZ-A, and similar to the previously described WDZs the open landscape offers largely unobstructed panoramic views and the horizontal lines of the landform are occasionally interrupted with vertical elements such as center pivots, transmission structures, scattered rural residences and farms, as well as wind turbines, which can be visible from long distances.

Cultural modifications within the ROI are primarily grazing land and cropland with center pivot irrigation and associated buildings, scattered paved and unpaved roads, livestock feeding operations, oil and natural gas facilities are common and groupings of wind turbines can be found the southern portion of the WDZ.

Sensitive visual resources in the ROI include Guymon, Texas; Hardesty, Texas; Optima, Oklahoma; Goodwell Oklahoma, Hooker, Oklahoma; Optima NWR, Optima WMA, Lake Schultz State Park, Schultz WMA, Rita Blanca National Grassland (administered by Cibola National Forest), Cimarron National Grassland, local parks and recreation areas.

3.18.5.8.1.6 WDZ-F

WDZ-F is primarily within the High Plains ecoregion transitioning to Southwestern Tablelands along the boundary of the WDZ. Vegetation and landscape characteristics are as described in WDZ-A, and similar to the previously described WDZs the gently rolling terrain and open landscape offers largely unobstructed panoramic views and the horizontal lines of the landform are occasionally interrupted with vertical elements such as center pivots, transmission structures, and scattered rural residences and farms, which can be visible from long distances.

Cultural modifications within the ROI are primarily grazing land and cropland with center pivot irrigation and associated buildings, scattered paved and unpaved roads, transmission structures, livestock feeding operations, and oil and natural gas facilities are common.

Sensitive visual resources in the ROI include Goodwell, Oklahoma; Guymon Texas; Texhoma, Oklahoma; Optima, Oklahoma, Optima NWR, Rita Blanca National Grassland (administered by Cibola National Forest), and Cimarron National Grassland and local parks and recreation areas.

3.18.5.8.1.7 WDZ-G

WDZ-G is characterized primarily by the High Plains ecoregion which is characterized by gently rolling terrain with occasional sand plains and hills along with scattered playa depressions. Vegetation is primarily short and midgrass prairie scattered with other types of vegetation including Harvard shin oak, fourwing saltbush, sand sagebrush, and yucca. The generally flat, open landscape provides largely unobstructed panoramic views and the horizontal lines of the landform is intermixed with occasional vertical elements such as transmission structures, grain silos, and scattered rural residences and farms, which can be visible from long distances.

Cultural modifications within the ROI are primarily grazing land and cropland with associated buildings, scattered paved and unpaved roads, transmission structures, livestock feeding operations, and oil and natural gas facilities are common.

Sensitive visual resources in the ROI include Cimarron National Grassland, Comanche National Grassland, Rita Blanca National Grassland (administered by Cibola National Forest), and the communities of Elkhart, Kansas; Keyes, Oklahoma; Boise City, Oklahoma; and local parks and recreation areas.

3.18.5.8.1.8 WDZ-H

WDZ-H consists of the High Plains ecoregion transitioning into the Southwestern Tablelands ecoregion near the southeastern and northern borders and has similar landscape and vegetation characteristics as previously described WDZs. The open landscape of both of these ecoregions offers largely unobstructed panoramic views and the horizontal lines of the landform are mixed with vertical elements such as grain silos, transmission structures, and scattered rural residences and farms, which can be visible from long distances.

Cultural modifications within the ROI are primarily cropland and grazing land with associated buildings and large areas utilizing center pivot irrigation and scattered paved and unpaved roads. In addition, livestock feeding operations and oil and natural gas facilities are common.

Sensitive visual resources in the ROI include Rita Blanca National Grassland (administered by Cibola National Forest), Cimarron National Grassland, Comanche National Grassland, local parks and recreation areas, and the communities of Elkhart, Kansas; Goodwell, Oklahoma; Guymon, Oklahoma; and Texhoma, Oklahoma.

3.18.5.8.1.9 WDZ-I

WDZ-I is characterized primarily by the High Plains ecoregion which is characterized by gently rolling terrain with occasional sand plains and hills along with scattered playa depressions. Vegetation is primarily short and midgrass prairie scattered with other types of vegetation including Harvard shin oak, fourwing saltbush, sand sagebrush, and yucca. The generally level, open landscape provides unobstructed panoramic views and the horizontal lines of the landform is intermixed with occasional vertical elements such as transmission structures, grain silos, and scattered rural residences and farms, which can be visible from long distances.

Cultural modifications within the ROI are primarily grazing land and cropland with associated buildings, scattered paved and unpaved roads, transmission structures, livestock feeding operations, and oil and natural gas facilities are common.

Sensitive visual resources in the ROI include with the communities of Hooker, Texas; Optima, Oklahoma; Hardesty, Oklahoma; Liberal, Kansas; Tyrone, Oklahoma; Optima NWR, Optima WMA, Beaver River WMA, Lake Schultz State Park, Schultz WMA, and Rita Blanca National Grassland (administered by Cibola National Forest), and local parks and recreation areas.

3.18.5.8.1.10 WDZ-J

WDZ-J is characterized by the Southwestern Tablelands ecoregion in the west and the High Plains ecoregion to the east. The landscape and vegetation in these regions is similar to that described in previous WDZs. The open landscape of both of these ecoregions offers unobstructed panoramic views and the horizontal lines of the landform are occasionally interrupted with vertical elements such as grain silos, transmission structures, and scattered rural residences and farms, which are visible from long distances.

Cultural modifications within the ROI are primarily grazing land and cropland with associated buildings, scattered paved and unpaved roads, transmission structures, livestock feeding operations, and oil and natural gas facilities are common.

Sensitive visual resources in the ROI include the Beaver River WMA, Lake Schultz State Park, Schultz WMA, Beaver Dunes State Park, Optima WMA, Optima NWR, local parks and recreation areas, and the communities of Beaver, Oklahoma; Forgan, Oklahoma; and Perryton, Texas.

3.18.5.8.1.11 WDZ-K

WDZ-K is characterized by the Southwestern Tablelands ecoregion in the southern portion and transitioning to the High Plains ecoregion in the north. The landscape and vegetation in these regions is similar to that described in previous WDZs. The open landscape of both of these ecoregions offers unobstructed panoramic views and the horizontal lines of the landform are occasionally interrupted with vertical elements such as grain silos, transmission structures, and scattered rural residences and farms, which are visible from long distances.

Cultural modifications within the ROI are primarily grazing land and cropland with associated buildings, scattered paved and unpaved roads, transmission structures, livestock feeding operations, and oil and natural gas facilities are common.

Sensitive visual resources in the ROI include the communities of Booker, Texas; Beaver, Oklahoma; Darrouzett, Texas; Perryton, Texas; Beaver Dunes State Park, Beaver River WMA, and local parks and recreation areas.

3.18.5.8.1.12 WDZ-L

WDZ-L falls within the High Plains ecoregion to the west, transitioning into the Southwestern Tablelands ecoregion on towards the eastern border of the WDZ, and has similar landscape and vegetation characteristics as WDZ-A. The open landscape of both of these ecoregions offers largely unobstructed panoramic views and the horizontal lines of the landform are occasionally interrupted with vertical elements such as grain silos, transmission structures, and scattered rural residences and farms, which can be visible from long distances.

Cultural modifications within the ROI are primarily cropland and grazing land with associated buildings and large areas utilizing center pivot irrigation and scattered paved and unpaved roads. In addition, livestock feeding operations and oil and natural gas facilities are common.

Sensitive visual resources in the ROI include with the communities of Spearman, Texas; Gruver, Texas; Perryton, Texas; Booker, Texas; Borger, Texas; Canadian, Texas; Darrouzett, Texas; Stinnet, Texas, Gene Howe WMA. Pat Murphy Unit, Lake Meredith National Recreation Area, Lake Schultz State Park, Optima NWR, Optima WMA, Schultz WMA, Lake Fryer/Wolf Creek Park and various local parks and recreation areas.

3.18.5.8.2 Optima Substation

The ROI for the future Optima Substation is located entirely within the Southwestern Tablelands ecoregion and is characterized by relatively flat terrain that is bisected by drainages in the northern portion of the ROI, causing the landscape to appear gently rolling. Vegetation consists primarily of grasses and low shrubs with some scattered riparian vegetation occurring along drainages in the northern portion of the ROI and croplands in the southern portion. The level terrain and low vegetation allows for unobstructed panoramic views across the landscape.

Cultural modifications within the ROI for the future Optima Substation are primarily cropland and grazing land with associated buildings, paved and unpaved roads, oil and natural gas facilities, transmission lines, electric distribution lines, and several turbines located in the southwestern portion of the ROI.

Sensitive visual resources within the ROI include travelers along Highway 207 and local roads; however, visual sensitivity is low because concern for aesthetics is generally secondary to commuting to and from work or work activities. No other sensitive visual resources are identified with the ROI. The closest sensitive visual resource with moderate or high sensitivity includes recreational users associated with the Optima National Wildlife Refuge, located approximately 2.5 miles northeast of the substation ROI.

3.18.5.8.3 TVA Upgrades

The ROI for the direct assignment facilities (which are included in the Applicant Proposed Project) would occur within the Tennessee Converter Station Siting Area and more specifically within the Shelby Substation. The ROI for the network upgrades, and in particular TVA's future 500kV transmission line, cannot be fully determined at this time.

The new 500kV line would be constructed in western Tennessee. Upgrades to existing infrastructure would include upgrading terminal equipment at three existing 500kV substations and six existing 161kV substations, making appropriate upgrades to increase heights on 16 existing 161kV transmission lines to increase line ratings, and replacing the conductors on eight existing 161kV transmission lines.

3.18.6 Impacts to Visual Resources

3.18.6.1 Methodology

This section describes the methods used to assess impacts to visual resources as a result of the construction and operations and maintenance of the Project. The methodology for assessing impacts is graphically shown in a flowchart in Figure 3.18-4 in Appendix A.

Regulations or guidance for managing visual resources that is applicable to all lands (federal, state, and municipal) within the ROI were not found during initial research efforts. Therefore, the visual impact assessment methodology was developed using concepts from the BLM VRM system. The BLM VRM system outlines a systematic process for analyzing potential visual impacts of proposed projects and activities by analyzing the visual contrast created between the existing landscape without the Project, and the same landscape after a proposed project has been implemented (BLM 1986). The concept of contrast, the process for analyzing contrast, and the methodology employed to identify impacts to visual resources are described in the subsequent section.

To conduct the impact assessment for visual resources, information collected in the inventory process (see Section 3.18.4 and Figure 3.18.1 in Appendix A) was used to perform a contrast analysis for the Project and identify initial impacts to scenery and viewers from KOPs.

3.18.6.1.1 Assessing Contrast

Contrast is the degree of visual change that occurs in the landscape due to the construction and operations and maintenance of a project (BLM 1986). Visual contrast introduced by the Project would result from (1) landform modifications that are necessary to prepare ROWs for construction, (2) removal of vegetation to construct and maintain transmission lines, roads, and converter stations, (3) construction of temporary and permanent access roads required to erect and maintain transmission lines and converter stations, and (4) introduction of transmission lines and converter station facilities into the landscape setting. Contrast in the landscape is determined by comparing visual elements (form, line, color, and texture) of the existing landscape with the visual elements of the Project (i.e., transmission structures, converter stations, access road, etc.). The following are descriptions of each of the visual elements:

- Form—the shape and mass of landforms or structures which appear unified
- Line—the edge of shapes or masses in the landscape (edges, bands, silhouettes)
- Color—the property of reflecting light of a particular intensity and wavelength that the eye can see
- Texture—the aggregation of small forms or color mixture into a continuous surface pattern

Using this method for each KOP, Project components (transmission line alternatives and converter station siting areas) were assigned one of the following five contrast levels:

- Strong—contrast demands attention and is dominant in the landscape

- Moderate-Strong—contrast begins to demand attention and is still moderately dominant in the landscape
- Moderate—contrast attracts attention but is co-dominant in the landscape
- Moderate-Weak—contrast begins to attract attention and is moderately subordinate in the landscape
- Weak—contrast can be seen but does not attract attention

Modified BLM Contrast Rating Worksheets (Form 8400-4) were used to document and assess the existing conditions, the proposed changes, and potential impacts for each KOP (Appendix K). The contrast level was then used when considering impacts to scenery and viewers depending on the distance of the viewer from the Project (FG, MG, or BG distance zones).

Impacts were identified based on the Project description and the associated EPMs (Appendix F). The primary effects to visual resources that are described throughout this section are assessed and disclosed based on the assumption that the EPMs would be implemented and over time they would reduce impacts to scenery and viewers.

Environmental Protection Measures applicable to minimizing impacts on visual resources were identified in the Visual Resource Technical Report (Clean Line 2014) and include the following:

- GE-3: Clean Line will minimize clearing vegetation within the ROW, consistent with a Transmission Vegetation Management Plan (TVMP) filed with the NERC and applicable federal, state, and local regulations. The TVMP may require additional analysis under NEPA depending on whether and under what conditions DOE decides to participate in the Project.
- GE-6: Clean Line will restrict vehicular travel to the ROW and other established areas within the construction, access, or maintenance easement(s).
- GE-7: Roads not otherwise needed for maintenance and operations will be restored to preconstruction conditions. Restoration practices may include decompacting, recontouring, and re-seeding. Roads needed for maintenance and operations will be retained.
- GE-10: Clean Line will work with landowners to repair damage caused by construction, operation, or maintenance activities of the Project. Repairs will take place in a timely manner, weather and landowner permitting.
- GE-11: Clean Line will conduct construction, operation, and maintenance activities to minimize the creation of dust. This may include measures such as limitations on equipment, speed, and/or travel routes utilized. Water, dust palliative, gravel, combinations of these, or similar control measures may be used. Clean Line will implement measures to minimize the transfer of mud onto public roads.
- LU-3: Clean Line will work with landowners to avoid and minimize impacts to residential landscaping.
- LU-4: Clean Line will coordinate with landowners to site access roads and temporary work areas to avoid and/or minimize impacts to existing operations and structures.
- LU-5: Clean Line will make reasonable efforts, consistent with design criteria, to accommodate requests from individual landowners to adjust the siting of the ROW on their properties. These adjustments may include consideration of routes along or parallel to existing divisions of land (e.g., agricultural fields and parcel boundaries) and existing compatible linear infrastructure (e.g., roads, transmission lines, and pipelines), with the intent of reducing the impact of the ROW on private properties.

The anticipated visual impacts that would result from construction and operation of the Project are described as follows:

- High Impacts—Where Project components are dominant or readily apparent from KOPs. Project components would introduce form, line, color, and texture changes that are inconsistent with the existing landscape.
- Moderate Impacts—Where Project components are co-dominant with existing landscape features, and moderately apparent from viewing KOPs. Project components would mimic form, line, color, and texture of similar features within the existing landscape.
- Low Impacts—Project components are subordinate in the landscape and not readily apparent from KOPs. Project components would parallel existing high-voltage transmission lines or features with similar form, line, color, and texture.

3.18.6.1.2 Impacts to Scenery

Impacts to scenery were determined based on the comparison of the contrast associated with the Project (e.g., transmission lines, converter stations, access roads, etc.) and the factors that compose the existing landscape (e.g., vegetation, landform, water, and cultural modifications) as described in section 3.18.4. Impacts to the existing landscape were assessed by reviewing the landscape category (Distinct, Common, Developed) combined with the anticipated Project contrast. It is anticipated that Distinct or Common landscapes that would be substantially altered by the Project (i.e., where similar facilities do not exist in the landscape) would result in high impacts. Moderate–low impacts are anticipated in Common or Developed landscapes where similar features may be present and the introduction of Project features would result in low levels of modification to the existing landscape. Landscape Scenery Impact ratings are shown in Table 3.18-4.

Table 3.18-4:
Landscape Scenery Impacts Matrix

Landscape Category	Project Contrast				
	Strong	Moderate–Strong	Moderate	Moderate–Weak	Weak
Distinct	High	High	Moderate–High	Moderate	Moderate
Common	High	Moderate–High	Moderate	Moderate	Moderate–Low
Developed	Moderate	Moderate	Moderate–Low	Low	Low

3.18.6.1.3 Impacts to Sensitive Viewers

Impacts to sensitive viewers were determined based on an assessment of contrast, user concern level (moderate or high), distance from the Project (0 to 0.5 mile, 0.5 to 3 miles, greater than 3 miles), and visibility of the Project. Table 3.18-5 summarizes how user concern impacts were assessed and demonstrates how concern levels vary depending on how close the viewer is to the Project. High impacts are anticipated to occur where the Project is dominant within a view and highly noticeable by the casual observer, or where the Project introduces a high level of contrast to the existing landscape. Low impacts are anticipated to occur in the BG distance zone where, because of the distance of the viewer from the Project, Project components would be subordinate in the landscape and not readily apparent to the casual observer.

Table 3.18-5:
Viewer Concern Impacts Matrix

Viewer Concern Level	Distance Zones: Foreground (FG) (0–0.5 mile) Contrast Level			Middleground (MG) (0.5–3 miles) Contrast Level			Background(BG) (3–15 miles) Contrast Level		
	Strong	Moderate	Weak	Strong	Moderate	Weak	Strong	Moderate	Weak
High	High	Moderate–High	Moderate	Moderate–High	Moderate	Low	Moderate–High	Moderate	Low
Moderate	Moderate–High	Moderate	Moderate–Low	Moderate	Moderate–Low	Low	Moderate	Moderate–Low	Low
Low	Moderate	Moderate–Low	Low	Low	Low	Low	Low	Low	Low

3.18.6.1.4 Overall Project Impacts

The landscape scenery impacts were combined with the viewer concern impacts, resulting in overall Project impact. Table 3.18-6 summarizes how the overall impacts from the Project were assessed. Overall Project impacts are described for each KOP in Sections 3.18.6.2 and 3.18.6.3.

Table 3.18-6:
Overall Project Impacts Matrix

Landscape Scenery Impacts	Viewer Concern Impacts: High	Moderate–High	Moderate	Moderate–Low	Low
High	High	High	Moderate–High	Moderate	Moderate
Moderate–High	High	Moderate–High	Moderate–High	Moderate	Moderate
Moderate	Moderate–High	Moderate–High	Moderate	Moderate–Low	Moderate–Low
Moderate-Low	Moderate	Moderate	Moderate–Low	Moderate–Low	Low
Low	Moderate	Moderate	Moderate–Low	Low	Low

It should be noted that in some instances, the overall impacts described for each KOP in Sections 3.18.6.2 and 3.18.6.3 differ from the impacts included in the corresponding Contrast Rating Worksheets in Appendix K. These differences are a result of different visual methodologies used by the DOE in preparing this EIS and by Clean Line in preparing the Contrast Rating Worksheets. Overall, impacts described in the KOPs are similar to those noted on the Contrast Rating Worksheets. In instances where there are differences, the impact ratings are close (i.e., low vs. moderate–low or moderate vs. moderate-high).When visual assessment was conducted, structures were conservatively assumed to be a typical 200-foot-tall lattice structure, which would be the tallest typical structure used. The impacts described for each KOP in subsequent sections and the Contrast Rating Worksheets in Appendix K, were based upon this assumption. However, preliminary engineering indicates that when using a lattice structure, most structures would be less than 160 feet tall, and less than 140 feet tall when using monopole structures. For KOPs representing unobstructed views across open landscapes towards the Project, the 40-foot change in tower height (from 200 feet to 160 feet for lattice structures) would most likely not be discernible to the casual observer and the overall impacts would not change from the impacts disclosed in this assessment. However, impacts may be affected for KOPs that represent views where only the top portions of the transmission structures are visible—for example, when they extend above tree line—where a lower structure height would reduce the amount of the structures visible. In these instances, it is anticipated that a lower structure height would result in lower overall visual impacts. In these site-specific incidences, the KOP analysis and corresponding Contrast Rating Worksheet (Appendix K) were not updated to reflect this change.

3.18.6.1.5 Photographic Simulations

Photographic simulations were created to depict impacts resulting from the Project at specific viewing locations. DOE and Clean Line selected 56 KOPs to represent each viewing location type (residences, recreation areas, and travel routes), associated concern level, and distance from the Project. Photographic simulations were developed to support the contrast rating and impact analysis by simulating changes associated with the Project and to disclose anticipated representative effects of the Project. Photographic simulations are included in Appendix K.

The photographic simulations that are included in Appendix K demonstrate the views of lattice and monopole structures (that range between 120 and 200 feet in height) for each selected KOP. The photographic simulations were not updated to reflect the changes in structure height based on preliminary engineering as discussed in 3.18.6.1.4.

3.18.6.2 Impacts Associated with the Applicant Proposed Project

3.18.6.2.1 Converter Stations and AC Interconnection Siting Areas

3.18.6.2.1.1 Construction Impacts

Construction would result in the short-term visual intrusion of construction vehicles, equipment, materials, and a work force in staging areas, and final converter station location. Vehicles, heavy equipment, structure components, ancillary facility components and materials, and workers would be visible during converter station construction and modification, clearing and grading, structure erection, and cleanup and restoration would create short-term and local contrast within the areas of the ROW for the AC interconnection where construction is taking place. It should also be noted that lighting of construction yards and work areas would create temporary visual impacts to night skies where construction is taking place. Affected viewers would be aware of the temporary nature of the Project construction impacts, which should decrease their concern about the impact.

3.18.6.2.1.2 Operations and Maintenance Impacts

3.18.6.2.1.2.1 Oklahoma Converter Station Siting Area and AC Interconnection Siting Area

The Oklahoma Converter Station Siting Area would be located southwest of Hardesty. The surrounding area is primarily flat, open agricultural lands that offer panoramic views. The converter station and associated structures would contrast the rural landscape and be visible on the horizon from large distances. This area is already impacted by numerous vertical structures such as wind turbines and existing transmission lines, and there are no notable visual resources, so visual concern is low. The converter station and associated structures would add additional contrast to the landscape, but in this area overall visual impacts would be low due to existing modification to the landscape and low number of sensitive viewers.

3.18.6.2.1.2.2 Tennessee Converter Station Siting Area and AC Interconnection Tie

The Tennessee Converter Station Siting Area would be located adjacent to the existing Shelby substation. The area is primarily rural and undeveloped in nature with flat to rolling terrain and areas of dense vegetation. Most of the existing development is residential, and the residents in the developments would represent most of the sensitive viewers. While the region is largely undeveloped, there is an existing substation in close proximity that would reduce the overall visual contrast and impacts of the Project. Two KOPs were identified for this converter station, Shelby 1 and Shelby 2, as described below and detailed in Table 3.18-7.

Table 3.18-7:
Visual Impact Summary of KOPS—Tennessee Converter Station Siting Area

KOP	Converter Station	Distance (Miles)	Viewer Sensitivity	Landscape Category	Visibility	Viewer Concern Impact	Contrast	Overall Impact
Shelby 1	TN	0.2	High	Developed	Yes	High	Strong	Moderate–High
Shelby 2	TN	0.5	High	Common	Yes	High	Moderate	Moderate – High

Shelby 1. Looking southwest from this KOP, the Tennessee converter station would be located 0.2 mile away in the FG. Strong contrast would be created by Project components in the FG distance zone for high sensitive residential viewers represented by this KOP; therefore, viewer concern impacts would be high. Vegetation may screen portions of the converter station, but at this distance it would become a dominant feature on the landscape. The form and line of the converter station would be similar to the existing substation, but appearing at a larger scale because it is closer to the viewer. The Project would result in strong contrast at this location; however, due to the existing substation, which has introduced similar modifications to the landscape setting, the overall visual impact would be moderate-high.

Shelby 2. The Tennessee converter station would be located adjacent to the existing Shelby substation and would therefore be located approximately 0.3 to 0.4 mile to the north of this location. Moderate contrast would be created by Project components in the FG distance zone for high sensitive residential viewers represented by this KOP; therefore, viewer concern impacts would be moderate–high. The broad profile of the substation would be visible in the FG and contrast with the existing environment. Views of the substation from some residences may be unobstructed and for some residences, some elements of the substation may be visible above the tree line and silhouetted against the sky. In either case, the substation would appear similar to the Shelby Substation in form. The Project would result in moderate contrast and moderate–high overall visual impacts at this location.

3.18.6.2.1.3 Decommissioning Impacts

Project facilities would be removed at the end of the operational life of the converter station. Structures and related facilities would be removed and foundations removed to below the ground surface level. There would be residual visual impacts for many years after the Project has been decommissioned and structures removed such as vegetative cutbacks, cut-and-fill scars from construction activities, and access roads, all of which would have added to the visual impact, though these impacts would be at ground level. There would also be temporary visual impacts during decommissioning. These impacts would diminish over time as vegetation returned to the ROW or as redevelopment occurred.

3.18.6.2.2 AC Collection System

3.18.6.2.2.1 Construction Impacts

Construction would result in the short-term visual intrusion of construction vehicles, equipment, materials, and a work force in staging areas, along access roads, and along the new transmission line ROW. Vehicles, heavy equipment, structure components, and workers would be visible during transmission line construction and modification, access and spur road clearing and grading, structure erection, conductor stringing, and cleanup and restoration. However, disturbance from construction activities would be transient and of short duration as activities progress along the transmission line route. Affected viewers would be aware of the temporary nature of Project construction impacts, which may decrease their concern to the impact. The structures and cables (transmission lines) would cause the major long-term change in scenery.

3.18.6.2.2.2 Operations and Maintenance Impacts

The AC collection system routes are located in a sparsely populated area in a landscape that is primarily flat agricultural lands offering open panoramic views. The region does not contain a high number of sensitive viewers or sensitive resources, so impacts would be expected to be low-moderate. The AC collection system routes are located in a largely open and undeveloped landscape, and the introduction of large vertical elements such as a transmission line, would have the potential to affect viewers over a large viewing area. Thirteen viewing locations/KOPs were identified for the AC collection system routes as summarized in Table 3.18-8.

Table 3.18-8:
Visual Impact Summary of KOPS—AC Collection System Routes

KOP	Route	Distance (Miles)	Viewer Concern	Landscape Category	Visibility	Viewer Concern Impact	Contrast	Overall Impact
Farnsworth	SE-3	4	High	Common	Yes	Low	Weak	Low
Goodwell	W-1	1.3	High	Common	Yes	Moderate	Moderate	Moderate
Guymon East	NE-1, NW-2	3.7	High	Developed	Yes	Low	Weak	Low
Guymon West	NW-1	3.2	High	Common	Yes	Low	Weak	Low
Hardesty	E-1	0.5	High	Common	Yes	Moderate –High	Moderate	Moderate–High
Hooker	NE-1, NE-2	2.5	High	Developed	Yes	Low	Weak	Low
Lake Schultz State Park	E-3	1.2	High	Distinct	Yes	Moderate –High	Strong	High
Lake Schultz State Park South	E-2, SE-1, SE-3	1	High	Distinct	Yes	Moderate	Moderate	Moderate–High
Optima	NE-1, NW-2	2.4	High	Developed	Yes	Low	Weak	Low
Optima NWR	E-1	1.3	High	Common	Yes	Moderate	Moderate	Moderate
Perryton-Leatherman Park	SE-3	5	High	Common	Yes	Low	Weak	Low
Spearman	SE-1	5.6	High	Developed	Yes	Low	Weak	Low
Waka	SE-1	2	High	Common	Yes	Low	Weak	Low

Farnsworth. This KOP is located on the southeastern edge of the community of Farnsworth, Texas. Looking east, AC Collection System Route SE-3 would be located 4 miles away in the BG distance zone. Because weak contrast would be introduced by the Project in the BG distance zone for high sensitive residential viewers represented by this KOP, viewer concern impacts would be low. The transmission line would be faintly visible and would appear as a pattern of vertical elements spaced across the horizon. The transmission line structures would result in weak contrast at this location and the overall visual impact would be low.

Goodwell. AC Collection System Route W-1 would be located 1.3 miles south of this KOP. Moderate contrast would be created by the introduction of Project components in the MG distance zone for high sensitive residential viewers represented by this KOP; therefore, viewer concern impacts would be moderate. The landscape in this area is open, providing panoramic views and the transmission line structures would appear as vertical objects on the horizon, when not screened by FG trees and elements. At this distance, the structures would appear small, but there is not a lot of development in this area, so the introduction of additional vertical elements on the landscape would result in moderate visual contrast and Moderate overall visual impact.

Guymon East. AC Collection System Routes NE-1 and NW-2 would be located 3.7 miles to the east of this KOP. Weak contrast would be created by Project components in the BG distance zone for high sensitive residential and recreational viewers represented by this KOP; therefore, viewer concern impacts would be low. Transmission line Structures may be visible on the horizon, but at this distance they would appear as small objects on the horizon and would add to the irregular line of the horizon, resulting in weak contrast and low overall visual impacts.

Guymon West. AC Collection System Route NW-1 would be located 3.2 miles to the southwest of this KOP. Weak contrast would be created by Project components in the BG distance zone for high sensitive residential viewers represented by this KOP; therefore, viewer concern would be low. At this distance, the structures would appear as small vertical objects on the horizon and would have a similar impact as the existing structures in view, resulting in weak visual contrast and low overall visual impacts.

Hardesty. AC Collection System Route E-1 would be located 0.5 mile to the northwest of this KOP. Moderate contrast would be created by Project components in the FG distance zone for high sensitive residential viewers represented by this KOP; therefore, viewer concern impacts would be moderate–high. The structures in the open field would be visible and introduce a repeating pattern of tall vertical elements on the landscape. The structures would be a dominant feature on the open landscape and visual contrast would be moderate. The overall visual impact would be moderate–high.

Hooker. AC Collection System Route NE-1 and NE-2 would be located 2.5 miles south of the town of Hooker. Weak contrast would be created by Project components in the MG distance zone for high sensitive residential viewers represented by this KOP; therefore, viewer concern impacts would be low. Transmission line structures would be visible on the horizon and appear as vertical elements similar to existing structures in view. The overall visual contrast would be weak and overall visual impact low.

Lake Schultz State Park. AC Collection System Route E-3 would be located 1.2 miles to the northwest of Lake Schultz State Park. Strong contrast would be created by Project components in the MG distance zone for high sensitive recreational viewers represented by this KOP; therefore, viewer concern impacts would be moderate–high. The transmission line structures would introduce vertical elements to the landscape that is currently very natural and intact. At this distance, they would not be a dominate feature, but they would result in strong contrast and high overall visual impact because of the existing scenic integrity of the area.

Lake Schultz State Park South. AC Collection System Routes E-2, SE-1, and SE-3 would be located 1 mile to the south of this KOP. Moderate contrast would be created by Project components in the MG distance zone for high sensitive recreational viewers represented by this KOP; therefore, viewer concern impacts would be moderate. The transmission line structure would be parallel to the existing 345kV line and would introduce additional vertical structures to the environment. The proposed structures would be slightly larger in scale than the existing and would result in moderate visual contrast and moderate-high overall visual impact.

Optima. From the Optima KOP, AC Collection System Routes NE-1 and NW-2 would be located 2.4 miles to the west. The transmission line structures would appear on the horizon as a row of vertical objects, but would not attract attention at this distance, resulting in weak contrast. Weak contrast would be created by Project components in the MG distance zone for high sensitive residential viewers represented by this KOP; therefore, viewer concern impacts would be low. AC Collection System Route NE-2 would be located 3.5 miles to the east and have similar visual impacts.

Optima NWR. AC Collection System Route E-1 would be located 1.3 miles southwest of the Optima NWR. Moderate contrast would be created by Project components in the MG distance zone for high sensitive recreational viewers represented by this KOP; therefore, viewer concern impacts would be moderate. The transmission line structures would be visible on the open landscape and add additional vertical structures to the existing transmission line in view. The addition of these structures would add moderate visual contrast and result in moderate overall visual impact.

Perryton-Leatherman Park. AC Collection System Route SE-3 would be 5 miles to the west of this KOP. Weak contrast would be created by Project components in the BG distance zone for high sensitive recreational and residential viewers represented by this KOP; therefore, viewer concern impacts would be low. At this distance, the transmission line structures would be barely visible and would not be distinguishable as structures, but they would add to the irregular line of the horizon and existing vertical elements and resulting in weak contrast and low visual impact.

Spearman. AC Collection System Route SE-1 would be located 5.6 miles to the east. Weak contrast would be created by Project components in the BG distance zone for high sensitive residential viewers represented by this KOP; therefore, viewer concern impacts would be low. The transmission line structures would add small vertical elements to the horizon line similar to existing structures resulting in weak contrast and low visual impact.

Waka. AC Collection System Route SE-1 would be located 2 miles to the west of this KOP. Weak contrast would be created by Project components in the MG distance zone for high sensitive residential viewers represented by this KOP; therefore, viewer concern impacts would be low. The transmission line structures would appear as vertical objects on the horizon that add to the existing elements in view and resulting in weak contrast. The overall visual impact at this location would be low.

3.18.6.2.2.3 Decommissioning Impacts

Project facilities would be removed at the end of the operational life of the transmission line. Conductors, structures, and related facilities would be removed. Foundations would be removed to below the ground surface level. There would be residual visual impacts for many years after the Project has been decommissioned and structures removed such as vegetative cutbacks, cut and fill scars from construction activities, and access roads, which all add to the visual impact, though these impacts would be at ground level. These areas would be apparent after the removal of structures but are expected to diminish over time as vegetation returns to the ROW.

3.18.6.2.3 HVDC Applicant Proposed Route

3.18.6.2.3.1 Construction Impacts

Construction would result in the short-term visual intrusion of construction vehicles, equipment, materials, and a work force in staging areas, along access roads, and along the new transmission line ROW. Vehicles, heavy equipment, structure components, and workers would be visible during transmission line construction and modification, access and spur road clearing and grading, structure erection, conductor stringing, and cleanup and restoration. However, disturbance from construction activities would be transient and of short duration as activities progress along the transmission line route. Affected viewers would be aware of the temporary nature of Project construction impacts as well as existing structures in the area adjacent to the Project, which may decrease their concern to the impact. It should be noted that there would be short term impacts during the decommissioning of the Project which are similar in nature to the construction impacts described above.

3.18.6.2.3.2 Operations and Maintenance Impacts

3.18.6.2.3.2.1 Region 1

The landscape category in Region 1 is primarily Common, categorized by agricultural and grasslands and broad panoramic views. A portion of the Applicant Proposed Route in this region would parallel an existing 345kV transmission line, a 138kV transmission line, and several small electric distribution lines in other areas. The tall vertical geometric form of the proposed structures would result in strong contrast with the horizontal lines of the relatively flat landscape. Contrast would be reduced in areas where the Applicant Proposed Route would parallel or be seen in context with existing transmission and electric distribution lines; the level of contrast would depend on the form, line, color and texture of the existing structures and the distance the existing structures are from the Applicant Proposed Route. In addition, transmission lines in this landscape category are typically visible for long distances because the terrain lacks variation and dense stands of trees and the structures are silhouetted against the sky. Changes to the landscape and vegetation due to construction of access roads and ROW clearing may be visible, but changes would generally not be noticeable in the MG and BG; changes may, however, be noticeable to viewers where the Applicant Proposed Route is located in the FG and where the line crosses areas of varied terrain or dense vegetation. Contrast could be reduced in areas where existing access roads would be used and where the Applicant Proposed Route would parallel an existing transmission line corridor where vegetation clearing has previously occurred.

The visual impacts for the Region 1 KOPs are listed in Table 3.18-9 described below.

Table 3.18-9:
Visual Impact Summary of KOPs—Applicant Proposed Route—Region 1

KOP	APR Link	Distance (Miles)	Viewer Concern	Landscape Category	Visibility	Viewer Concern Impact	Contrast	Overall Impact
Lake Schultz State Park PR	2	1	High	Distinct	Yes	Moderate	Moderate	Moderate–High
Local Historical Marker PR	4	0.6	Moderate	Common	Yes	Low	Moderate	Moderate–Low
Fort Supply WMA Recreation Area	5	6.4	High	Distinct	No	Low	No Contrast/ Not Visible	No Impact
May	5	0.6	High	Common	Yes	Moderate	Moderate	Moderate

3.18.6.2.3.2.1.1 Applicant Proposed Route Link 2

Lake Schultz State Park. Applicant Proposed Route Link 2 would be located 1 mile to the south and would appear in the MG just beyond the nearest tree line. Moderate contrast would be created by Project components in the MG distance zone for high sensitive recreational viewers represented by this KOP; therefore, viewer concern impacts would be moderate. Applicant Proposed Route Link 2 would be seen in the context of the existing Hitchland to Woodward 345kV transmission line, which would parallel the Applicant Proposed Route Link 2. Proposed structures would appear wider and taller than existing structures; however, since the existing transmission line has already introduced vertical elements similar in form, line, color, and texture into the landscape setting contrast would be moderate. Overall visual impacts to high sensitivity viewers associated with this KOP would be moderate-high.

3.18.6.2.3.2.1.2 Applicant Proposed Route Link 4

Local Historical Marker. Applicant Proposed Route Link 4 would be located 0.6 mile to the south. Moderate contrast would be created by Project components in the MG distance zone for moderate sensitive recreational viewers represented by this KOP; therefore, viewer concern impacts would be low. The transmission structures would parallel an existing 345kV transmission line. Although the existing transmission line has introduced vertical elements into the landscape setting, the taller, wider lattice structures of the Applicant Proposed Route Link 4 would result in moderate contrast in form, line, and texture to the existing structures. Overall impacts to moderate sensitive viewers associated with this KOP would be moderate–low.

3.18.6.2.3.2.1.3 Applicant Proposed Route Link 5

Fort Supply WMA Recreation Area. Applicant Proposed Route Link 5 would be located 6.4 miles north of this KOP. Overall visual impacts are not anticipated at this location because the Project would be completely screened by terrain and vegetation.

May. The Applicant Proposed Route Link 5 would be located 0.6 mile to the south. Moderate contrast would be created by Project components in the MG distance zone for high sensitive residential viewers represented by this KOP; therefore, viewer concern impacts would be moderate. The transmission structures would appear on the horizon as a row of vertical elements. Applicant Proposed Route Link 5 would be seen in the context of existing electric distribution lines in the FG and transmission lines in the BG, which have already introduced vertical elements into the landscape setting. However, the taller, wider lattice structures of the Applicant Proposed Route Link 5 would result in moderate contrast in form, line, and texture to the existing structures, creating moderate contrast. Moderate contrast to high sensitivity viewers associated with this KOP would result in moderate impacts.

3.18.6.2.3.2.2 Region 1 Conclusion

Region 1 contains a low density of sensitive viewers and is primarily associated with small rural communities and scattered rural residences. Visual impacts are anticipated to be mostly moderate to moderate-low for high sensitivity viewers where the Project is visible in the MG or BG and would be seen in the context of existing vertical structures. Moderate–high impacts are anticipated for high sensitivity viewers associated with Lake Schultz State Park where the Applicant Proposed Route would cross a landscape categorized as Distinct in the MG.

3.18.6.2.3.2.3 Region 2

The landscape category in Region 2 is primarily Common, and similar to Region 1, is characterized by agricultural and grasslands and broad panoramic views. In Region 2, the Applicant Proposed Route is located near several existing transmission lines near Mooreland and Boiling Springs State Park. In addition, the Applicant Proposed Route would parallel 30 miles of the existing Okeene to Mooreland 115kV transmission line. The contrast introduced by the Applicant Proposed Route and visibility are similar to those described in Region 1 (see Section 3.18.6.2.3.2). The visual impacts for the Region 2 KOPs are listed in Table 3.18-10 and described below.

Table 3.18-10:
Visual Impact Summary of KOPs—Applicant Proposed Route—Region 2

KOP	Link	Distance (Miles)	Viewer Concern	Landscape Category	Visibility	Viewer Concern Impact	Contrast	Overall Impact
Boiling Springs State Park	1	0.9	High	Distinct	Yes	Moderate	Moderate	Moderate–High
Mooreland	1	1.8	High	Developed	No	Moderate	No Contrast/ Not Visible	No Impact
Canton WMA and Lake Recreation Area	2	6.5	High	Distinct	No	Low	No Contrast/ Not Visible	No Impact
Cimarron River Crossing	2	0	Moderate	Distinct	Yes	Moderate–High	Strong	High
Fairview	2	3.3	High	Common	Yes	Low	Weak	Low
Gloss Mountain State Park	2	11	High	Distinct	No	Low	No Contrast/ Not Visible	No Impact
SR 60 West of Fairview	2	1	High	Common	Yes	Moderate–High	Strong	High
Ames	3	2.5	High	Common	Yes	Low	Weak	Moderate–Low
Bison	3	1.4	High	Common	Yes	Low	Weak	Low

3.18.6.2.3.2.3.1 Applicant Proposed Route Link 1

Boiling Springs State Park. Applicant Proposed Route Link 1 would be located 0.9 mile to the northeast. Moderate contrast would be created by Project components in the MG distance zone for high sensitive recreational viewers represented by this KOP; therefore, viewer concern impacts would be moderate. The rolling terrain and vegetation in the area would only offer visitors to the park sporadic views of the transmission line structures through breaks in the vegetation. There are existing vertical elements in the landscape, and the additional transmission line structures would result in moderate contrast. Because Boiling Springs is a state park, it is considered a sensitive area, so the overall visual impact would be moderate-high.

Mooreland. Applicant Proposed Route Link 1 would be located 1.8 miles to the north, but terrain would block potential views from this location, so there would be no contrast and no overall visual impact would occur at this location.

3.18.6.2.3.2.3.2 Applicant Proposed Route Link 2

Canton WMA and Lake Recreation Area. Applicant Proposed Route Link 2 would be located 6.5 miles to the north of this KOP. Looking across the lake, the Project would most likely not be visible because of the large distance and dense vegetation on the other side of the lake. With no visibility, there would be no contrast and no overall visual impacts would occur at this location.

Cimarron River Crossing. Applicant Proposed Route Link 2 would cross the Cimarron River in the immediate FG. Strong contrast would be created by Project components where it crosses the road for moderate sensitive viewers represented by this KOP; therefore, viewer concern impacts would be moderate–high. Viewers at this location would see the transmission line running parallel to the road, crossing the river in a very rural area with little development and has moderate visual concern due to low numbers of viewers. The transmission line would be highly visible and dominant in view at this location. The large metal structures would be the only vertical elements on the landscape, resulting in strong contrast. The overall visual impact would be high. A visual simulation for this KOP is provided in Appendix K.

Fairview. Applicant Proposed Route Link 2 would be located 3.3 miles to the south. Weak contrast would be created by Project components in the BG distance zone for recreational and residential viewers represented by this KOP; therefore, viewer concern impacts would be low. Visitors to the park and fairgrounds may be able to see the transmission line structures appearing as a row of vertical objects on the distant horizon, where it is not blocked by vegetation. Because of the large distance, these proposed structures would appear smaller than the existing structures in view and there would be no change to landform or vegetation, resulting in weak visual contrast. The overall visual impact at this location would be low.

Gloss Mountain State Park. The HVDC Applicant Proposed Route Link 2 would be located 11 miles to the south and would not be visible to park visitors without the use of binoculars or other magnification resulting in no contrast. For this reason, there would be no overall visual impact. A visual simulation for this KOP is provided in Appendix K.

SR 60 West of Fairview. Applicant Proposed Route Link 2 would run parallel to the existing 115kV line as it crosses the landscape at a distance of 1 mile. The proposed transmission line structures would be larger in scale and differ in form, color, and texture than the existing wood structures of the 115kV line, and be dominant in MG views becoming less visible as it recedes in into the BG zone. Modifications to vegetation would also be visible as the line crosses the highway and would result in strong visual contrast. Because strong contrast would be created by the Project in the MG distance zone for high sensitive residential viewers represented by this KOP, viewer concern impacts would be moderate–high. The overall visual impacts at this location would be high.

3.18.6.2.3.2.3.3 Applicant Proposed Route Link 3

Ames. Applicant Proposed Route Link 3 would be visible and appear as small objects 2.5 miles to the southwest where it is not blocked by vegetation or terrain. The tall structures would introduce a new vertical element to the landscape, but at this distance, the transmission line would only introduce a weak level of contrast. Weak contrast created by the Project in the BG distance zone for high sensitive residential and recreational viewers associated with this KOP would result in low viewer concern impacts. Overall visual impact is low.

Bison. Applicant Proposed Route Link 3 would appear as small vertical elements on the horizon 1.4 miles to the south. The added structures would be taller and larger in form than the existing structures (as described in Section 3.18.5.2.1) in view, but would result in weak visual contrast due to existing cultural modifications to the landscape. Because the Project would appear subordinate in the landscape, landscape scenery impacts to this Common landscape would be moderate–low. Weak contrast created by Project components in the MG distance zone for high sensitive residential viewers represented by this KOP would result in low viewer concern impacts. The overall visual impact would be low.

3.18.6.2.3.2.3.4 Route Variations

Applicant Proposed Route Link 1, Variation 1, would cross a similar landscape setting as the original Applicant Proposed Route. Visual resources would also remain the same and include residences and Boiling Springs State Park.

Visual impacts are anticipated to be higher for high sensitive residential viewers because the Applicant Proposed Route Link 1, Variation 1, would be located approximately 650 feet closer (within 350 of residential structures), and while the original Applicant Proposed Route would be partially screened by vegetation, views of the Applicant Proposed Route Link 1, Variation 1 would be unobstructed. Impacts to high sensitive recreational viewers associated with the Boiling Springs Park KOP would be reduced because Variation 1 would be located farther from viewers in the park and because less of the structure would be visible given the rolling terrain and vegetation in the surrounding landscape. The Contrast Rating Worksheet for the Boiling Springs Park KOP is included in Appendix K.

Applicant Proposed Route Link 2, Variation 2, would cross a landscape setting similar to the original Applicant Proposed Route. Visual resources would also remain the same and include residences. Visual impacts would not change for high sensitive residential viewers as a result of this variation because they would still have unobstructed views of the Project crossing an open landscape in the FG distance zone.

3.18.6.2.3.2.4 Region 2 Conclusion

Region 2 contains a low density of sensitive viewers primarily associated with small rural communities and scattered rural residences. Visual impacts are anticipated to be mostly moderate–low to low for high sensitivity viewers where the Project is visible in the MG or BG distance zone. Higher impacts could occur for high sensitivity viewers associated with the community of Fairview where the Applicant Proposed Route would be located in the FG. Higher impacts could also occur for high sensitivity viewers associated with State Parks and other recreation areas (such as Boiling Springs State Park and the Cimarron River) within the region; however, views from some recreation areas, like Gloss Mountain State Park, would be obstructed due to variation in terrain and/or existing vegetation associated with these facilities.

3.18.6.2.3.2.5 Region 3

The landscape category in Region 3 is primarily Common, and is characterized by relatively level terrain in the western portion of the region transitioning to gently and moderately rolling hills in the western portion of the region. Vegetation also becomes varied transitioning from primarily grasses with low shrubs and scattered trees to wooded areas in the eastern portion of the region. Views are generally open within the western portion of the region where there is little variation in terrain and vegetation; and become more limited when hilly terrain and wooded areas become more prevalent in the eastern portion. In Region 3, the Applicant Proposed Route would parallel several medium and large transmission lines including a 69kV line (approximately 7 miles); 115kV line (approximately 4.5 miles); three 138kV lines (approximately 11 miles, 4 miles, and 30 miles); and a 345kV line (approximately 10 miles). The Applicant Proposed Route would also cross several transmission lines (138kV and 345kV) located throughout the region. The contrast introduced by the Applicant Proposed Route and visibility are similar to those described in Region 1 for the western portion of Region 3 (see Region 1 Conclusions Section 3.18.6.2.3.2). As noted above, visibility within the eastern portion of Region 3 becomes more limited with the increasing variation in terrain and wooded areas which can screen (partially or completely) transmission structures from viewers. The visual impacts for the Region 3 KOPs are listed in Table 3.18-11 and described below.

Table 3.18-11:
Visual Impact Summary of KOPs—Applicant Proposed Route—Region 3

KOP	Link	Distance (Miles)	Viewer Concern	Landscape Category	Visibility	Viewer Concern Impact	Contrast	Overall Impact
Marshall	1	3.1	High	Common	Yes	Low	Weak	Low
Mulhall	1	1	High	Common	Yes	Moderate	Moderate	Moderate
Stillwater	1	2.9	High	Developed	No	Low	No Contrast/ Not Visible	No Impact
Meehan	3	0.4	High	Common	Yes	High	Strong	High
Beggs	4	1.6	High	Common	Yes	Moderate	Moderate	Moderate
Cimarron River Crossing	4	0	Moderate	Distinct	Yes	Moderate–High	Strong	High
Cushing	4	1.4	High	Common	Yes	Moderate	Moderate	Moderate
Heyburn Lake	4	4.3	High	Distinct	No	Low	No Contrast/ Not Visible	No Impact
Ripley	4	0.7	High	Common	Yes	Moderate	Moderate	Moderate
Shamrock	4	1.2	High	Common	Yes	Moderate	Moderate	Moderate
Summit	5	0.15	High	Common	Yes	Moderate–High	Moderate	Moderate–High
Taft	5	3.5	High	Common	No	Low	No Contrast/ Not Visible	No Impact
McLain	6	0.7	High	Common	Yes	Low	Weak	Low
Webbers Falls	6	1.5	High	Distinct	No	Low	No Contrast/ Not Visible	No Impact

3.18.6.2.3.2.5.1 Applicant Proposed Route Link 1

Marshall. Applicant Proposed Route Link 1 would be faintly visible on the horizon 3.1 miles to the south and would appear smaller in scale than existing vertical elements. Weak contrast created by the Project in the BG distance zone for high sensitive residential viewers associated with this KOP would result in low viewer concern impacts. Because of the distance, the proposed structures would be highly noticeable resulting in weak contrast and low overall visual impact.

Mulhall. Applicant Proposed Route Link 1 would be located 1 mile to the south-southwest and would be visible as the transmission structures extend above the horizon line, resulting in a moderate increase in contrast. Moderate contrast created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP would result in moderate viewer concern impacts. Portions of the transmission line structures not screened by vegetation would appear as vertical elements spaced across the distant horizon above the vegetation, resulting in a moderate increase in contrast. This KOP represents a residential area with high visual concern and the overall visual impacts for this landscape would be moderate.

Stillwater. Applicant Proposed Route Link 1 would be located 2.9 miles to the south, but views would be screened by vegetation and houses in the FG, resulting in no visual impact. A visual simulation for this KOP is provided in Appendix K.

3.18.6.2.3.2.5.2 Applicant Proposed Route Link 3

Meehan. Applicant Proposed Route Link 3 would be located 0.4 mile to the south, just on the other side of the transmission line of trees in the FG. The height of the proposed structures would cause the upper portion to be clearly visible above the horizon line and larger in scale than the existing vertical elements, creating strong contrast. Strong contrast created by the Project in the FG distance zone for high sensitive residential viewers associated with this KOP would result in high viewer concern impacts. Overall visual impacts would be high.

3.18.6.2.3.2.5.3 Applicant Proposed Route Link 4

Beggs. The transmission line would be located 1.6 miles north of this KOP in the MG distance zone. Visitors to this site would have views of Applicant Proposed Route Link 4. Where the transmission line structures are not screened by FG vegetation, they would be visible on the horizon and would add moderate contrast to the landscape. Moderate contrast created by the Project in the MG distance zone for high sensitive recreational viewers associated with this KOP would result in moderate viewer concern impacts. The overall visual impacts would be moderate.

Cimarron River Crossing. Applicant Proposed Route Link 4 would cross the river at this point, running parallel to the existing line in view, but would be much larger in scale and highly visible in the FG distance zone. Strong contrast would be created by Project components where it crosses the road for moderate sensitive viewers represented by this KOP; therefore, viewer concern impacts would be moderate-high. In addition, vegetation would need to be cleared for the ROW, which would add to the strong visual contrast on the landscape. The overall visual impact at this location would be high.

Cushing. Applicant Proposed Route Link 4 would be located 1.4 miles to the southwest. Moderate contrast created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP would result in moderate viewer concern impacts. Portions of the transmission line structures would be visible on the horizon and would appear as dark vertical elements, resulting in moderate contrast. The visual impacts at this location would be moderate.

Heyburn Lake. Applicant Proposed Route Link 4 would be located 4.3 miles from this KOP. Because of distance and existing vegetation and terrain, structures would not be visible. There would be no visual impact at this location.

Ripley. Applicant Proposed Route Link 4 would be visible 0.7 mile to the northeast in the MG and appear as a row of objects on the horizon. Portions of the transmission line would be screened by vegetation and existing structures. Transmission line structures that are visible would be noticeably different from the existing landscape and result in moderate contrast. Moderate contrast created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP would result in moderate viewer concern impacts. Overall visual impact on the landscape would be moderate.

Shamrock. Applicant Proposed Route Link 4 would be located 1.2 miles to the northwest of this KOP. The visible transmission line structures would appear as dark objects, creating a repeating pattern across the forested ridgeline on the horizon. Moderate contrast created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP would result in moderate viewer concern impacts. This is a residential area and visual concern is high and the vertical elements of the transmission line would be noticeable with no other existing vertical features, resulting in moderate contrast. Overall visual impacts would also be moderate.

3.18.6.2.3.2.5.4 Applicant Proposed Route Link 5

Summit. Applicant Proposed Route Link 5 would be 0.15 mile to the south and would run parallel to the existing lattice transmission structure. From this view, the transmission line structures would be located and the near side of the existing line, so it would appear larger in scale and be more prominent in view, but with similar form. When added to the landscape, the additional structures would result in moderate contrast due to existing structures in view. Moderate contrast created by the Project in the FG distance zone for high sensitive residential viewers associated with this KOP would result in moderate–high viewer concern impacts. Overall visual impact would be moderate–high.

Taft. Applicant Proposed Route Link 5 is located 3.5 miles to the south and would be screened by vegetation and terrain resulting in no visual impact at this location.

3.18.6.2.3.2.5.5 Applicant Proposed Route Link 6

McLain. Applicant Proposed Route Link 6 is located 0.2 mile north and 0.7 mile east of this KOP in the FG and MG distance zones, respectively. The existing rolling terrain and dense vegetation would completely screen the transmission line to the north (located 0.2 mile from the KOP). The transmission line would be visible to the east (at 0.7 mile from the KOP); however, the lower portion of the transmission structures would be screened by vegetation. The upper portion of the transmission structures would be seen in the context of an existing 345kV transmission line that would parallel the Project and would be similar in form, line, and color. Because only a portion of the structures would be visible and seen in the context of existing similar structures, contrast introduced by the Project would be weak. Weak contrast created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP would result in low viewer concern impacts. Because the Applicant Proposed Route would be co-dominant in a Common landscape, landscape scenery impacts would be moderate–low. Because the Project would introduce a weak contrast in the MG distance zone to a Common landscape and from a KOP representing high sensitive viewers, the overall visual impact would be low.

Webbers Falls. The Applicant Proposed Route Link 6 would be located 1.5 miles to the southwest. Given the distance and existing vegetation, the transmission line structures would not be visible from this location and there would be no visual impact.

3.18.6.2.3.2.5.6 Route Variations

Applicant Proposed Route Link 1, Variation 2, and Applicant Proposed Route Links 1 and 2, Variation 1, would both cross a landscape setting similar to the original links of the Applicant Proposed Route, which includes croplands and scattered wooded areas. Visual resources would also remain the same and include a few residences in the FG/MG distance zone. Visual impacts are anticipated to be similar to those of the original Applicant Proposed Route Links 1 and 2 because the variations would be located farther from some high sensitive residential viewers but would be closer to others. These viewers would still have partially screened to unobstructed views of the variations crossing the landscape in the FG/MG distance zone. It should be noted that a route adjustment was made for HVDC Alternative Route 3-A to maintain an end-to-end route with this variation. Impacts to the HVDC Alternative Route 3-A are discussed in Section 3.18.6.3.2.2.3.1.

Applicant Proposed Route Link 4, Variation 1, and Applicant Proposed Route Link 4, Variation 2, would both cross a similar landscape setting as the original Applicant Proposed Route. Visual resources would also remain the same and include a few rural residences in the FG distance zone. Visual impacts are anticipated to be similar to those of Applicant Proposed Route Link 4 because the variations would be located in close proximity to the Link 4 alignment (approximately 0.2 mile or less) and would be farther from some high sensitive residential viewers but would be closer to others. These viewers would still have partially screened to unobstructed views of the variations crossing the landscape in the FG distance zone. Applicant Proposed Route Link 5, Variation 2, would cross a landscape setting similar to the original Applicant Proposed Route. Visual resources would also remain the same and include a few rural residences in the FG/MG distance zone. Visual impacts for some high sensitive residential viewers would be reduced because the variation would be located farther from the viewer and would be partially to completely screened by vegetation. However, other residences would have increased visual impacts because the variation would be located closer, and while vegetation in the immediate FG would screen the lower portions of the structures, more of the structures would be visible extending above the tree line.

3.18.6.2.3.2.6 Region 3 Conclusion

Region 3 contains a moderate density of sensitive viewers primarily associated with rural communities, scattered rural residences, and recreation areas. Visual impacts are anticipated to be mostly moderate for high sensitivity viewers where the Project is visible in the MG distance zone. The Applicant Proposed Route may be partially screened by vegetation and/or seen within the context of existing transmission lines. Low or no impacts are anticipated for high sensitivity viewers where the Project is located in the BG distance zone, where contrast would be weak due to viewing distance or the Project would be completely screened by existing terrain and/or vegetation. Higher impacts are anticipated for high sensitivity viewers associated with communities or recreation areas where the Project is located within the FG and is not seen in the context of other transmission lines.

3.18.6.2.3.2.7 Region 4

The landscape category in Region 4 is primarily Common and is characterized by varied terrain including undulating plains, rolling hills and terraces in the southern portion of the region. Landscapes categorized as Distinct occur throughout the region and are associated with more natural rugged terrain in the northern portion of the region and near water features (such as the Arkansas River, lakes and reservoirs). The rugged hills, mountains, rolling hills, and forested landscapes in the northern portion of the region limits distant views, whereas in the southern portion of the region the less varied terrain and lack of vegetation allows for expansive view across the landscape. In Region 4, the Applicant Proposed Route would parallel several medium and large existing transmission lines, including a 345kV line for approximately 5.5 miles north of Vian; a 138kV line for approximately 5 miles near the Oklahoma-Arkansas border; a 138kV line for approximately 5 miles northeast of Wiederkehr Village; a 138kV line for approximately 25 miles between Hunt and Big Piney Creek (this line would be between 0.25 and 0.5 miles away from the Applicant Proposed Route); and a 138kV line for approximately 3 miles north of Big Piney Creek. The Applicant Proposed Route would also cross or be located near several medium and large existing transmission lines that vary in size between 115kV and 345kV transmission lines.

The tall vertical geometric forms of the proposed structures would result in strong contrast with the horizontal lines of the relatively flat landscape found within the southern portion of the region. Contrast would be reduced in areas where the Applicant Proposed Route would parallel or be seen in context with existing transmission and electric distribution lines; the level of contrast would depend on the form, line, color and texture of the existing structures and the distance the existing structures are from the Applicant Proposed Route. In the northern region, transmission structures are often only visible in the FG/MG and tend to be partially obstructed by terrain and vegetation; however, structures often protrude above the terrain and trees and are silhouetted against the sky drawing viewer’s attention. The presence of other similar structures would reduce the contrast. Changes to the landscape and vegetation due to construction of access roads and ROW clearing may be visible but changes would generally not be noticeable in the MG and BG where terrain and vegetation may obscure these changes. In some instances, however, the Project may become visible as the viewer is elevated or as the transmission line traverses hilly terrain, ridges, or open spaces. Changes may also be noticeable to viewers where the Applicant Proposed Route is located in the FG in relatively flat terrain with minimal vegetation to obscure views. Contrast could be reduced in areas where existing access roads would be used and where the Applicant Proposed Route would parallel an existing transmission line corridor where vegetation clearing has previously occurred and additional clearing for the Project would make an existing corridor look wider. The visual impacts for the Region 4 KOPs are listed in Table 3.18-12 and described below.

Table 3.18-12:
Visual Impact Summary of KOPs—Applicant Proposed Route—Region 4

KOP	Link	Distance (Miles)	Viewer Concern	Landscape Category	Visibility	Viewer Concern Impacts	Contrast	Overall Impact
Arkansas River	1	0.2	Moderate	Common	Yes	Moderate	Moderate	Moderate
Arkansas River and Gore	1	3	High	Distinct	Yes	Low	Weak	Moderate–Low
Highway 10	1	0.2	Moderate	Common	Yes	Moderate–High	Strong	High
Tenkiller State Park	1	4	High	Distinct	No	Low	No Contrast/Not visible	No Impact
Trail of Tears State Route 100	1	0.2	High	Common	Yes	High	Strong	High
Brushy Creek Reservoir and Sallisaw State Park	3	2.8	High	Distinct	No	Low	No Contrast/ Not Visible	No Impact
Field of Dreams	3	2.6	High	Developed	No	Low	No Contrast/ Not Visible	No Impact
Highway 82	3	0.3	Moderate	Common	Yes	Moderate–Low	Weak	Moderate–Low
Lee Creek	3	0.5	High	Common	Yes	Moderate–High	Strong	High
Robert S Kerr Reservoir	3	7	High	Distinct	No	Low	No Contrast/ Not Visible	No Impact
Sallisaw	3	0.5	High	Common	Yes	Moderate	Moderate	Moderate
Sequoyah NWR Boat Launch	3	5	High	Common	No	Low	No Contrast/ Not Visible	No Impact
Sequoyah's Cabin	3	1.2	High	Distinct	Yes	Low	Weak	Moderate–Low
Van Buren PR	3	1.8	High	Common	Yes	Low	Weak	Low
Vian	3	0.7	High	Common	Yes	Moderate	Moderate	Moderate
Vian Lake	3	0.2	High	Distinct	Yes	High	Strong	High
Van Buren AR/PR	4, 5	2	High	Common	No	Low	No Contrast/ Not Visible	No Impact
Scott Farm	5	0.3	High	Common	Yes	Moderate–High	Moderate–High	Moderate–High
Alma	6	0.5	High	Common	Yes	Moderate	Moderate	Moderate
Bluff Hole Park	6	1.7	High	Common	Yes	Low	Weak	Low
City Park/Ball Fields and Rudy	6	2	High	Developed	No	Low	No Contrast/ Not Visible	No Impact

Table 3.18-12:
Visual Impact Summary of KOPs—Applicant Proposed Route—Region 4

KOP	Link	Distance (Miles)	Viewer Concern	Landscape Category	Visibility	Viewer Concern Impacts	Contrast	Overall Impact
Clear Creek Park	6	1.4	High	Distinct	No	Low	No Contrast/ Not Visible	No Impact
Dyer	6	0.3	High	Common	Yes	High	Strong	High
Mulberry Park	6	0.3	High	Common	Yes	High	Strong	High
Mulberry River and Trail of Tears	6	0.4	High	Distinct	Yes	High	Strong	High
Trail of Tears Wire Road	6	0.2	High	Common	Yes	High	Strong	High
Vine Prairie Park	6	1.5	High	Distinct	Yes	Low	Weak	Moderate–Low
Aux Arc Park	7	2.8	High	Distinct	Yes	Low	Weak	Moderate–Low
East Side City Park	7	2.1	High	Distinct	No	Low	No Contrast/ Not Visible	No Impact
Interstate 40 Rest Stop	7	0.04	Moderate	Common	Yes	Moderate–High	Strong	High
Ozark	7	0.8	High	Common	Yes	Low	Weak	Low
Ozark City Boat Launch	7	0.6	High	Distinct	No	Low	No Contrast/ Not Visible	No Impact
West Side City Park	7	2	High	Common	No	Low	No Contrast/ Not Visible	No Impact
White Oak	7	1.5	High	Common	No	Low	No Contrast/ Not Visible	No Impact
White Oak Park	7	3	High	Distinct	No	Low	No Contrast/ Not Visible	No Impact
Trail of Tears (Highway 352)	8	0.028	High	Common	Yes	High	Strong	High
Wiederkehr Village and Highway 186	8	0.7	High	Common	Yes	Low	Weak	Low
Big Piney Creek	9	0.2	High	Distinct	Yes	Moderate–High	Moderate	Moderate–High
Clarksville	9	2.5	High	Common	No	Low	No Contrast/ Not Visible	No Impact
Hagarville	9	1	High	Common	Yes	Moderate	Moderate	Moderate
Horsehead Lake Recreation Area	9	2.1	High	Distinct	No	Low	No Contrast/ Not Visible	No Impact
Hunt	9	0.2	High	Common	Yes	Moderate–High	Strong	High
Lake Ludwig	9	0.9	High	Distinct	Yes	Low	Weak	Moderate–Low
Route 21 (Scenic Byway)	9	0.1	High	Distinct	Yes	High	Strong	High

3.18.6.2.3.2.7.1 Applicant Proposed Route Link 1

Arkansas River. Applicant Proposed Route Link 1 would be located 0.2 mile away, running parallel to the existing transmission. Viewers at this location would be able to clearly see the lattice structures as well as a ROW cleared of vegetation on the river banks. The proposed transmission line structures would be located on the near side of the existing structures, and would appear more dominant in view. Since this is already a heavily impacted site, the proposed structures would be repeating form, line, color and texture and result in moderate contrast. Moderate contrast would be created by the Project in the FG distance zone for moderate sensitive viewers represented by this KOP; therefore, viewer concern impacts would be moderate. The overall visual impacts at this location would be moderate.

Arkansas River and Gore. Applicant Proposed Route Link 1 would be located 3 miles to the northwest. Portions of the structures may appear above the tree line in the distant BG, but would only be faintly noticeable, producing weak contrast. Because weak contrast would be created by the Project in the BG distance zone for high sensitive recreational viewers associated with this KOP, viewer concern impacts would be low. Overall visual impacts at this location would be moderate–low. A visual simulation for this KOP is provided in Appendix K.

Highway 10. Applicant Proposed Route Link 1 would be clearly visible as the line crosses the open field to the northwest and spans the highway. The structures would be a dominant element on the landscape and introduce new line, form, color, and texture. In addition, the clearing of vegetation near the sides of the highway would be clearly visible to motorists, introducing additional contrast. Strong contrast would be created by the Project in the FG distance zone for moderate sensitive viewers associated with this travel route; therefore, viewer concern impacts would be moderate–high. Overall visual impact at this location would be high. A visual simulation for this KOP is provided in Appendix K.

Tenkiller State Park. Applicant Proposed Route Link 1 would be located about 4 miles to the south of this KOP. From this vantage point, terrain and vegetation would screen all views of the transmission line and would result in no visual impact.

Trail of Tears State Route 100. Applicant Proposed Route Link 1 would be located 0.2 mile from this KOP. Transmission line structures would be clearly visible above tree line as the route crosses the highway and Trail of Tears. The Trail of Tears locations mapped by the NPS are representative of the historic location of the trail and the extent of the trail at each crossing location is not known. Transmission line structures would introduce new vertical elements into the landscape, becoming dominant as motorists approach, and the transmission line conductors would be visible crossing over the highway, resulting in strong contrast. In addition, ROW clearing would be visible to motorists as they approach the crossing, resulting in additional contrast. Because strong contrast would be created by the Project in the FG distance zone for high sensitive viewers associated with this travel route, viewer concern impacts would be high. The overall visual impact at this location would be high.

3.18.6.2.3.2.7.2 Applicant Proposed Route Link 3

Brushy Creek Reservoir and Sallisaw State Park. Applicant Proposed Route Link 3 would be located 2.8 miles to the south, but would not be visible due to distance, terrain, and vegetation. There would be no visual impact.

Field of Dreams. Proposed Route Link 3 would be located 2.6 miles to the north of the Field of Dreams ball field. Dense trees in the FG would obscure views of the Project from this location, resulting in no visual impact.

Highway 82. Applicant Proposed Route Link 3 would cross the highway 0.3 mile to the southwest. The Project would run parallel to an existing transmission line and the proposed transmission line would repeat the line, form, scale, and color. The proposed structures would be noticeable to viewers at this location, but since they would be additions to the existing structures, the contrast would be weak. Because weak contrast would be created by the Project in the

FG distance zone for moderate sensitive viewers associated with this travel route, viewer concern impacts would be moderate–low. The overall visual impact would be moderate–low.

Lee Creek. Applicant Proposed Route Link 3 would be located 0.5 mile to the north of this location. Recreationists standing at the boat launch or on the docks would most likely not see any of the structures due to vegetation and terrain. Once visitors were out on the lake, however, both the structures and vegetation clearing for the ROW would be clearly visible. The transmission line structures would introduce new vertical elements that would be visible above tree line and a cleared ROW would introduce lines in the vegetation inconsistent with the current natural landscape. Strong contrast would be created by the Project in the MG distance zone for moderate sensitive recreational viewers associated with this KOP; therefore, viewer concern impacts would be moderate–high. The visual contrast from many areas on or around the lake would be strong and the overall visual impact would be high.

Robert S. Kerr Reservoir. Applicant Proposed Route Link 3 would be located 7 miles to the north. From this location, the line would not be visible due to distance and FG terrain and vegetation. There would be no visual impact from this location.

Sallisaw. Applicant Proposed Route Link 3 would be located 0.5 mile to the north-northeast and be visible crossing the open field in the MG. Some of the structures would extend above tree line and be prominent in view. There are existing vertical elements, so the additional structures would result in moderate contrast. Because moderate contrast would be created by the Project in the MG distance zone for high sensitive recreational viewers associated with this KOP, viewer concern impacts would be moderate. Overall visual impact would be moderate.

Sequoyah NWR Boat Launch. Applicant Proposed Route Link 3 would be located 5 miles to the north, but would not be visible given the dense vegetation. There would be no overall visual impact at this location.

Sequoyah's Cabin. Applicant Proposed Route Link 3 would be located 1.2 miles to the south. The majority of the views from the historic site grounds would be screened by FG vegetation, but some transmission line structures would be visible on the horizon, extending above the trees. The transmission line structures would introduce some vertical elements to the landscape, but they would not be dominant elements. The visual contrast would be weak. Because weak contrast would be created by the Project in the MG distance zone for high sensitive viewers associated with this historic site, viewer concern impacts would be low. Overall visual impact would be moderate–low, since it is a sensitive historic site. A visual simulation for this KOP is provided in Appendix K.

Van Buren. Applicant Proposed Route Link 3 would be located about 1.8 miles to the northwest from this residential area with high visual concern. The rolling terrain and dense vegetation would screen views of the transmission line structures. If visible through breaks in the FG vegetation, the structures would appear as small dark objects extending above the trees on the horizon and would result in weak contrast. Because weak contrast would be created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP, viewer concern impacts would be low. The overall visual impact would be low.

Vian. Applicant Proposed Route Link 3 would be located about 0.7 mile to the north-northeast. There are several transmission line structures visible from this location, and the Project would be located parallel to the existing lattice structures that are just barely visible in the MG. The proposed structures would be similar in form to the existing lattice structures, but larger in scale introducing moderate contrast to the landscape. Because moderate contrast would be created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP, viewer concern impacts would be moderate. Overall visual impact would be moderate.

Vian Lake. Applicant Proposed Route Link 3 would be visible running parallel to the existing transmission line on the far side of the lake, 0.2 mile away. Because of the dense vegetation in the area, large amounts of trees would be cleared for the ROW, leaving open views of the existing structures as well as the proposed structures. The combination of vegetation clearing and introduction of vertical elements in the landscape would result in strong contrast. Because strong contrast would be created by the Project in the FG distance zone for high sensitive recreational viewers associated with this KOP, viewer concern impacts would be high. Overall visual impacts would be high. A visual simulation for this KOP is provided in Appendix K.

3.18.6.2.3.2.7.3 Applicant Proposed Route Link 4

Van Buren. Applicant Proposed Route Link 4 would be located 2 miles to the north of this KOP. Large trees and rolling terrain would obscure views of the transmission line structures from this location, resulting in no visual impact.

3.18.6.2.3.2.7.4 Applicant Proposed Route Link 5

Scott Farm. Applicant Proposed Route Link 5 would be located 0.3 mile to the north. Residents of the subdivision would be able to see the transmission line structures clearly from both the entrance and several of the residences. The subdivision is on high ground, so residents looking down towards the transmission line structures would see the structures at a reduced contract because of the backdrop of existing vegetation. Several other vertical structures such as communication structures and antennas occur within the existing landscape setting. Because of existing vertical elements in the landscape, the Project would introduce moderate contrast. Because moderate contrast would be created by the Project in the FG distance zone for high sensitive residential viewers associated with this KOP, viewer concern impacts would be moderate–high. Overall visual impacts would also be moderate–high. A visual simulation for this KOP is provided in Appendix K.

Van Buren. See description for Applicant Proposed Route Link 4.

3.18.6.2.3.2.7.5 Applicant Proposed Route Link 6

Alma. Applicant Proposed Route Link 6 would be visible crossing the open field 0.5 mile to the north. The transmission line structures would be visible just in front of the dense line of trees in the MG and would extend above tree line, adding vertical elements to the irregular line of the horizon. The transmission line structures would be visible to motorists and residents of Alma and would result in moderate contrast. Because moderate contrast would be created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP, viewer concern impacts would be moderate. Overall visual impact would be moderate.

Bluff Hole Park. Applicant Proposed Route Link 6 would be located about 1.7 miles to the north. Most views of the transmission line structures would be screened by FG vegetation, but if they were visible, they would appear as small dark objects and likely would not attract the attention of visitors at the park; therefore, resulting in weak contrast. Because weak contrast would be created by the Project in the MG distance zone for high sensitive recreational viewers associated with this KOP, viewer concern impacts would be low. Because the Project would not be readily noticeable to recreational viewers from this location, the overall visual impacts would be low.

City Park Ball Fields and Rudy. Applicant Proposed Route Link 6 would be located 2 miles to the southwest of the City Park Ball Fields in Rudy. People at the park would not be able to see any of the structures due to vegetation and terrain in the FG. There would be no visual impact at this location.

Clear Creek Park. Dense trees in the FG view from Clear Creek Park would screen all views of the Applicant Proposed Route 1.4 miles to the north. There would be no visual impact at this location.

Dyer. Applicant Proposed Route Link 6 would be clearly visible in the FG as it crosses the open field 0.3 mile to the southeast. The transmission line structures would introduce large vertical elements to an open landscape free of heavy modification, creating a dominant feature and resulting in strong visual contrast. Because strong contrast would be created by the Project in the FG distance zone for high sensitive residential viewers associated with this KOP, viewer concern impacts would be high. Overall visual impacts would be high.

Mulberry Park. Applicant Proposed Route Link 6 would be located 0.3 mile from this KOP in the FG distance zone. The proposed transmission line would be visible through scattered trees along the parks boarder as it crosses the open field. The transmission line structures would introduce new vertical forms into the landscape that would differ in size, line, color, and texture than existing structural features and would therefore appear as a dominant feature resulting in strong contrast. Because strong contrast would be created by the Project in the FG distance zone for high sensitive recreational and residential viewers associated with this KOP, viewer concern impacts would be high. Overall visual impacts would be high at this location.

Mulberry River and Trail of Tears. Applicant Proposed Route Link 6 would cross the river 0.4 mile from this KOP in the FG distance zone. Transmission line structures would primarily be screened by dense vegetation adjacent to the river; however, portions of the transmission line would be visible through breaks in vegetation. In addition, transmission structures would be clearly visible across the open field to the east. The proposed transmission line structures would be noticeably different than existing structures in view, introducing new form and line to the landscape resulting in strong contrast. Because strong contrast would be created by the Project in the FG distance zone for high sensitive viewers associated with this river and historic trail, viewer concern impacts would be high. Overall visual impact would be high.

Trail of Tears Wire Road. Applicant Proposed Route Link 6 would be located 0.2 mile to the southwest. The proposed transmission line structures would be visible across the open field and highway from this location and would introduce large vertical elements to an open landscape that differ in size, form, line, color, and texture of other existing vertical elements. The proposed transmission line would be a dominant feature in the landscape, resulting in strong visual contrast. Because strong contrast would be created by the Project in the FG distance zone for high sensitive viewers associated with this historic trail, viewer concern impacts would be high. Overall visual impact would be high.

Vine Prairie Park. Applicant Proposed Route Link 6 would be located 1.5 miles to the northwest of this park and boat launch area. Visitors using these facilities may be able to see the tops of the transmission line structures extending above the tree line, but they would appear as small dark objects, adding to the already irregular line of the horizon, therefore the Project would introduce weak contrast. Because weak contrast would be created by the Project in the MG distance zone for high sensitive recreational viewers associated with this KOP, viewer concern impacts would be low. Overall visual impacts would be moderate–low.

3.18.6.2.3.2.7.6 Applicant Proposed Route Link 7

Aux Arc Park. Applicant Proposed Route Link 7 would be across the river, 2.8 miles to the north of Aux Arc Park. The proposed transmission line would be visible on the far side of the Arkansas River; however, the transmission line would be seen in the context of existing urban development and would appear subordinate, resulting in weak contrast. Because weak contrast would be created by the Project in the MG distance zone for high sensitive recreational viewers associated with this KOP, viewer concern impacts would be low. Because of distance and weak level of contrast added, overall visual impacts would be moderate–low.

East Side City Park. Applicant Proposed Route Link 7 would be located 2.1 miles from East Side City Park, but would not be visible due to dense vegetation in the FG. There would be no visual impact at this location.

Interstate 40 (Scenic Highway) Rest Stop. Applicant Proposed Route Link 7 would be located 200 feet to the north of this location as it crosses the field in the immediate FG distance zone. The transmission line would dominate the view of anyone stopping at this rest stop and the clearing of the ROW would be clearly visible, resulting in strong contrast. Because strong contrast would be created by the Project in the immediate FG distance zone for moderate sensitive viewers associated with a rest area along a scenic highway, viewer concern impacts would be moderate–high. Overall visual impact would be high. A visual simulation for this KOP is provided in Appendix K.

Ozark. Applicant Proposed Route Link 7 would be located 0.8 mile to the north. The tops of the structures may be visible extending above the tree line, however, the majority of the transmission line structures would be screened by dense vegetation and the low ridgeline in the MG. Any structures extending above the tree line would be visible as small dark objects adding weak contrast to the irregular line and form of the existing tree line. Because weak contrast would be created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP, viewer concern impacts would be low. The overall visual impact would be low.

Ozark City Lake Boat Launch. Applicant Proposed Route Link 7 would be located 0.6 mile from the boat launch at Ozark City Lake. The dense trees and ridgeline on the far side of the lake would likely block all views of the transmission line structures from recreationists on the lake. Because there is no visibility, there would be no visual impacts at this location.

West Side City Park. Applicant Proposed Route Link 7 would be located 2 miles from this KOP. Tall trees and terrain in the FG/MG would obscure views of the transmission line structures from this park, resulting in no visual impact.

White Oak. Applicant Proposed Route Link 7 would be located 1.5 miles to the south. Dense trees line the road in this area and would screen all potential views of the transmission line structures, resulting in no visual impact.

White Oak Park. Applicant Proposed Route Link 7 would be located 3 miles to the north of White Oak Park. The dense vegetation on the banks surrounding the lake would obscure all views of the HVDC Applicant Proposed Route, resulting in no visual impact.

3.18.6.2.3.2.7.7 Applicant Proposed Route Link 8

Trail of Tears (Highway 352). Applicant Proposed Route Link 8, would cross Highway 352 and the Trail of Tears 150 feet to the northwest. The Trail of Tears locations mapped by the NPS are representative of the historic location of the trail and the extent of the trail at each crossing location is not known. The transmission line would run parallel to the existing H-frame structures and be highly visible to people in this area. The proposed structures would be much larger in scale and introduce a new dominant form to the landscape that would result in strong contrast. Because strong contrast would be created by the Project in the immediate FG distance zone for high sensitive viewers associated with this travel route, viewer concern impacts would be high. Overall visual impacts would be high.

Wiederkehr Village and Highway 186. Applicant Proposed Route Link 8 would be located 0.7 mile to the northwest of Wiederkehr Village. Viewers in this location may be able to see the transmission line structures extending above the tree line, appearing as small dark objects. The structures would not be very noticeable because of terrain and vegetation, however, and would result in weak contrast. Because weak contrast would be created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP, viewer concern impacts would be low. Overall visual impacts would be low.

3.18.6.2.3.2.7.8 Applicant Proposed Route Link 9

Big Piney Creek. Applicant Proposed Route Link 9 would cross Big Piney Creek 0.2 mile to the northeast. Recreationists on the creek may see the tops of the structures extending above the tree line. Portions of the proposed transmission structures would be visible, but these structures would be co-dominant with the existing line that crosses in the same place. In addition to the structures, vegetation would be cleared along the banks of the river, resulting in additional contrast as well as exposure to the proposed and current transmission lines. This KOP represents a sensitive area in a primarily natural landscape. Because the proposed transmission line structures would be adding contrast to existing, similar structures in view, the overall visual contrast would be moderate. Because moderate contrast would be created by the Project in the FG distance zone for high sensitive recreational viewers associated with this KOP, viewer concern impacts would be moderate–high. The overall visual impact would be moderate-high. A visual simulation for this KOP is provided in Appendix K.

Clarksville. Applicant Proposed Route Link 9 would be located 2.5 miles to the north of the Clarksville KOP. Due to the large amount of dense vegetation and rolling hills between the viewer and Project, there would be no visibility from this location and, therefore, no visual impact.

Hagarville. Applicant Proposed Route Link 9 would be 1 mile to the northeast, and much of the transmission line would be screened by terrain and vegetation. As the transmission line crossed the open fields, the structures would be highly visible and have different form than other structures in the area, resulting in moderate contrast. Because moderate contrast would be created by the Project in the MG distance zone for high sensitive recreational viewers associated with this KOP, viewer concern impacts would be moderate. The overall visual impact would be moderate.

Horsehead Lake Recreation Area. Applicant Proposed Route Link 9 would be 2.1 miles to the south. High ridges and dense vegetation border this dry lake bed and would screen views of the transmission line structures. There would be no visual impact at this location.

Hunt. Applicant Proposed Route Link 9 would be located 0.2 mile to the southeast. The tops of the transmission line structures would be visible above the tree line in the MG and different in form and scale than the existing H-frames which are barely visible through the trees. Because the proposed transmission line structures are taller than and differ in form, line, color and texture from other existing structures, the proposed structures would result in strong contrast. Because strong contrast would be created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP, viewer concern impacts would be moderate–high. Overall visual impacts would be high.

Lake Ludwig. Applicant Proposed Route Link 9 would be located 0.9 mile to the north. Looking out over the lake from the northern side, the transmission line structures would be visible extending above the tree line, appearing as dark vertical elements on the horizon. Many of the structures would be screened by dense vegetation, and the portion extending about the trees would result in weak visual contrast. Because weak contrast would be created by the Project in the MG distance zone for high sensitive recreational viewers associated with this KOP, viewer concern impacts would be moderate–high. Overall visual impacts would be moderate–low.

Route 21 (Scenic Byway). Applicant Proposed Route Link 9 would cross this scenic byway 0.1 mile to the north. The transmission line structures would be clearly visible to motorists traveling on the scenic byway. The tall structures would introduce a new element to the rural landscape and dominate the view where the line crosses the highway. In addition, the ROW clearing would be visible on the sides of the highway and the Project would result in strong visual contrast at this location. Because strong contrast would be created by the Project in the FG distance zone for high sensitive viewers associated with this travel route, viewer concern impacts would be high. Contrast would be reduced the farther away viewers are from the transmission line crossing because the bottom portion of the structures would be screened by vegetation and the ROW clearing would not be as apparent. Overall visual impact would be high.

3.18.6.2.3.2.7.9 Route Variations

Applicant Proposed Route Link 3, Variation 1, would be shifted approximately 0.1 mile north, and although the variation would be located farther from some residences, it would be closer to others. Given the minimal shift in location, overall visual impacts are not anticipated to change for high sensitive residential viewers as a result of this variation. Viewers would still have intermittent and partially screened views of the transmission lines across the landscape in the FG and MG distance zone in approximately the same location.

Applicant Proposed Route Link 3, Variation 2, crosses more wooded area than the original Applicant Proposed Route Link 3, and parallels an existing transmission line for the majority of its length, and although the variation crosses more wooded area, overall visual impacts are not anticipated to change for high sensitive residential viewers. Viewers would still have unobstructed or partially screened views of the Project crossing and croplands in the FG distance zone. Residences located greater than 0.5 mile (MG and BG distance zones) from the Applicant Proposed Route Link 3, Variation 2 would most likely have views that would be completely screened by heavily wooded areas in the landscape setting. For example, impacts to high sensitive residential viewers associated with the Sequoyah County KOP (included in Appendix K) are not anticipated because the variation would be located approximately 0.6 mile from the viewers and would be completely screened by vegetation in the FG distance zone.

Applicant Proposed Route Link 3, Variation 3, crosses less wooded area than the original Applicant Proposed Route Link 3 and would not parallel an existing transmission line. Impacts to high sensitive recreational viewers associated with the Lee Creek (Scenic River) KOP (included in Appendix K) would be reduced because the variation would be located approximately 0.7 mile farther from the viewer and would be screened by vegetation in the FG. However, the variation would be located closer to residences. Visual impacts to high sensitive residential viewers would increase because they would have unobstructed to partially screened views of the transmission line across an open field in the FG distance zone.

Applicant Proposed Route Link 6, Variations 1, 2, and 3, would be shifted approximately 500 feet from the original Applicant Proposed Route. Visual resources would remain the same and include rural residences within the FG and MG distance zones. Although the variations would be located farther from some residences, it would be closer to others. Given the minimal shift in location, overall visual impacts are not anticipated to change for high sensitive residential viewers as a result of these variations. Viewers would still have unobstructed or intermittent views of the Project crossing croplands in the FG and MG distance zone.

Applicant Proposed Route Link 9, Variation 1, would be shifted approximately 350 feet to the east and would cross a landscape setting similar to the original Applicant Proposed Route. Visual resources would remain the same and include rural residences and Big Piney Creek. Given the minimal shift in location, overall visual impacts are not anticipated to change for high sensitive residential viewers. Impacts to high sensitive recreational viewers associated with Big Piney Creek are also not anticipated to change. The Big Piney Creek KOP and the Big Piney Creek KOP (Route Variation) are included in Appendix K. Both KOPs are in the same location adjacent to the Big Piney Creek looking towards the Project.

3.18.6.2.3.2.8 Region 4 Conclusion

Region 4 contains a high density of visual resources primarily associated with rural and suburban communities, scattered rural residences, creeks, bayous, lakes, and reservoirs associated with recreation areas, wild and scenic rivers, scenic byways, NWR, national forests, state and local parks and historic landmarks. Visual impacts are anticipated to be mostly moderate–low for high and moderate sensitive viewers where the Project is located in the MG/BG distance zone. Typically, the Applicant Proposed Route is either seen in the context of other existing transmission lines or viewers are partially to completely obstructed by terrain and/or vegetation. Higher impacts are anticipated for high sensitivity viewers associated with communities or recreation areas where the Applicant Proposed Route is located within the FG and is not seen in the context of other transmission lines.

3.18.6.2.3.2.9 Region 5

The landscape category in Region 5 is primarily Common and is characterized by varied terrain with low rugged hills, mountains, and benches in the northern portion transitioning to undulating plains, terraces, cuestas, and floodplains associated with the Arkansas River in the south. Landscapes categorized as Distinct occur throughout the region and are associated with more natural rugged terrain in the northern portion of the region and the Arkansas River. In Region 5, existing transmission lines are not common within the landscape setting; therefore, the Applicant Proposed Route would cross and/or parallel fewer transmission lines than in Regions 1 through 4. The Applicant Proposed Route would parallel a 138kV line for approximately 1 mile and a 500kV line for approximately 4 miles and would cross two 161kV transmission lines. The contrast introduced by the Applicant Proposed Route and the visibility are similar to the conditions described for Region 4 in Section 3.18.6.2.3.2.

The visual impacts for the Region 5 KOPs are listed in Table 3.18-13 and described below.

Table 3.18-13:
Visual Impact Summary of KOPs—Applicant Proposed Route—Region 5

KOP	Link	Distance (Miles)	Viewer Concern	Landscape Category	Visibility	Viewer Concern Impact	Contrast	Overall Impact
Dover and JP Lovelady	1	2.8	High	Common	No	Low	No Contrast/ Not Visible	No Impact
Hector	1	2.5	High	Common	No	Low	No Contrast/ Not Visible	No Impact
Highway 7 (Scenic Byway)	1	0.1	High	Common	Yes	High	Strong	High
Pope Co. Residential Cluster	1, 2	0.8	High	Distinct	Yes	Low	Weak	Moderate–Low
Boy Scout Campground	3	0.5	High	Common	No	Low	No Contrast/ Not Visible	No Impact
Damascus	3	0.7	High	Common	Yes	Moderate	Moderate	Moderate
Guy	3	2.8	High	Common	No	Low	No Contrast/ Not Visible	No Impact
Highway 9 Scenic Highway	3	0.2	High	Common	Yes	High	Strong	High
Twin Groves	3	3	High	Common	No	Low	No Contrast/ Not Visible	No Impact
Wonderview School	3	1.8	High	Distinct	Yes	Low	Weak	Moderate–Low
Quitman	4	0.2	High	Common	Yes	High	Strong	High
Rose Bud City Park	4	3.4	High	Developed	No	Low	No Contrast/ Not Visible	No Impact
Letona	5	0.6	High	Developed	Yes	Moderate–High	Strong	Moderate–High
Highway 16 (Scenic Highway)	6	0.3	High	Common	Yes	High	Strong	High
Steprock	7, 8	0.6	High	Developed	Yes	Low	Weak	Low
Bradford	9	0.9	High	Common	No	Low	No Contrast/ Not Visible	No Impact
White River	9	0.06	High	Distinct	Yes	High	Strong	High

3.18.6.2.3.2.9.1 Applicant Proposed Route Link 1

Dover and JP Lovelady Ball Park. Applicant Proposed Route Link 1 would be located 2.8 miles to the north-northwest. Looking out from the ballpark in Dover, the transmission line structures would be screened from view given the low forested ridges in the distance and the dense vegetation in the FG. There would be no visual impact at this location.

Hector. Looking south from Hector, Applicant Proposed Route Link 1 would be located 2.5 miles away at its closest point. Dense vegetation in the FG/MG would screen all views of the HVDC Applicant Proposed Route at this location, resulting in no visual impact.

Highway 7 (Scenic Byway). Applicant Proposed Route Link 1 would cross the highway 0.1 mile to the north. Motorists traveling on the Highway 7 would have clear views of the transmission line structures as the line crossed the highway. The structures would extend above tree line and introduce large vertical elements that would differ greatly from anything within the current landscape setting. When approaching the line, motorists would have clear views of the vegetation clearing for the ROW, resulting in strong contrast. Because strong contrast would be created by the Project in the FG distance zone for high sensitive viewers associated with this travel route, viewer concern impacts would be high. Contrast would be reduced the farther away viewers are from the transmission line crossing because the bottom portion of the structures would be screened by vegetation and the ROW clearing would not be as apparent. The overall visual contrast would be strong and overall visual impacts high at this location.

Pope County Residential Cluster. Applicant Proposed Route Link 1 would be located 0.8 mile to the north of this KOP. Views would likely be screened by terrain and vegetation, but if visible, the transmission line structures would appear as dark vertical elements extending above the trees in the distance as the line goes down the ridge and into the valley. At this distance and because most of the transmission line would be screened, contrast introduced would be weak. Because weak contrast would be created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP, viewer concern impacts would be low. Overall visual impacts would be moderate–low because it is considered a Distinct landscape with high visual sensitivity.

3.18.6.2.3.2.9.2 Applicant Proposed Route Link 2

Pope County Residential Cluster. Views looking north-northwest from this location towards Applicant Proposed Route Link 2 would be screened by FG vegetation, resulting in no visual contrast.

3.18.6.2.3.2.9.3 Applicant Proposed Route Link 3

Boy Scout Campground. Applicant Proposed Route Link 3 would be located 0.5 mile to the north of the Boy Scout Campground. Dense vegetation in the FG and MG would screen all potential views of the Project, resulting in no visual impact at this location.

Damascus. This KOP represents views looking north-northwest from the community of Damascus and represents residential views, so visual concern is high. Applicant Proposed Route Link 3 would be located in the MG 0.7 mile to the north. The transmission line structures would be visible crossing open fields and extending above existing structures and appear as a repeating vertical element on the rural landscape. The structures would introduce a new form to the existing elements of the landscape (as described in Section 3.18.5.5). The area does have some existing transmission line structures and other cultural modifications, so the proposed transmission line structures would result in moderate contrast. Because moderate contrast would be created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP, viewer concern impacts would be moderate. Overall visual impact at this location would be moderate.

Guy. Applicant Proposed Route Link 3 would be located 2.8 miles to the north. A low ridge line covered in dense vegetation would screen all views of the transmission line structures from this location resulting in no visual impact. A visual simulation for this KOP is provided in Appendix L.

Highway 9 Scenic Highway. Applicant Proposed Route Link 3 would be located 0.2 mile to the south, where it crosses over Highway 9. The transmission line structures would be highly visible above trees and where the lines cross the highway. The structures would be dominant in the FG view and would introduce new form and line to the landscape at a much larger scale than existing features (as described in Section 3.18.5.5.1); therefore, contrast is strong. Strong contrast created by the Project in the FG distance zone for high sensitive viewers associated with this scenic travel route would result in high viewer concern impacts. Overall visual impact would be high.

Twin Groves. Applicant Proposed Route Link 3 would be located 3 miles north of the Twin Groves KOP. Dense vegetation and terrain features in the FG/MG would screen all views of the Project, resulting in no visual impact.

Wonderview School. Applicant Proposed Route Link 3 would be located 1.8 miles to the north. Viewers in this location may be able to see the transmission line structures in the valley through breaks in the trees. The structures would be mostly screened by vegetation and terrain, with the possibility of some structures extending above trees. The structures would not be highly noticeable and weak contrast would be created for portions that are visible. Weak contrast created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP would result in low viewer concern impacts. Overall visual impacts would be moderate–low.

3.18.6.2.3.2.9.4 Applicant Proposed Route Link 4

Quitman. Applicant Proposed Route Link 4 would be visible crossing the open field 0.2 mile to the south. Due to scale and form, the transmission line structures would be a dominant feature in the FG. The structures would be different in line and form than existing elements on the landscape (as described in Section 3.18.5.5.1 and would result in strong visual contrast. Strong contrast created by the Project in the FG distance zone for high sensitive residential viewers associated with this KOP would result in high viewer concern impacts. Overall visual impacts would be high. A visual simulation for this KOP is provided in Appendix K.

Rose Bud City Park. Applicant Proposed Route Link 4 would be located 3.4 miles north of the Rose Bud City Park KOP. Views of the transmission line structures from this location would be screened by tall trees and rolling terrain, resulting in no visual impact.

3.18.6.2.3.2.9.5 Applicant Proposed Route Link 5

Letona. Applicant Proposed Route Link 5 would be located 0.6 mile to the north and would be partially visible through breaks in trees and extending above tree line in places. The structures would introduce a new form to the landscape that is noticeably different than existing forms on the landscape (as described in Section 3.18.5.5.1), resulting in strong contrast. Strong contrast created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP would result in moderate–high viewer concern impacts. Overall visual impacts would be moderate-high from this KOP.

3.18.6.2.3.2.9.6 Applicant Proposed Route Link 6

Highway 16 (Scenic Highway). The Applicant Proposed Route Link 6 would cross Scenic Highway 16 0.3 mile from this KOP. Transmission line structures would be clearly visible and noticeable across the open field in the FG and extended above tree line introducing new, vertical elements to the landscape. This KOP represents views from a scenic highway, so visual concern is high and because of the scale of the structures, at this distance they would be a dominant form on the landscape and result in strong contrast. Strong contrast created by the Project in the FG distance zone for high sensitive viewers associated with this travel route would result in high viewer concern impacts. Overall visual impacts would be high.

3.18.6.2.3.2.9.7 Applicant Proposed Route Link 7

Steprock. Applicant Proposed Route Link 7 would be located 0.6 mile to the south. Dominant in the view at this location is an existing 500kV transmission line. The proposed transmission line structures would be similar in form and scale, but farther away and partially screened by FG trees causing them to appear subordinate on the landscape, resulting in weak contrast. Weak contrast created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP would result in low viewer concern impacts. Overall visual impacts would be low.

3.18.6.2.3.2.9.8 Applicant Proposed Route Link 8

Steprock. See description of Steprock KOP for Applicant Proposed Route Link 7. Distance and visibility are the same.

3.18.6.2.3.2.9.9 Applicant Proposed Route Link 9

Bradford. Applicant Proposed Route Link 9 would be located 0.9 mile to the north. Tall trees, dense vegetation, and rolling terrain in the FG would block all potential views of the transmission line structures from this location, resulting in no visual impact.

White River. Applicant Proposed Route Link 9 would be located 300 feet to the southeast and would run parallel to the highway. The transmission line would be highly visible above existing FG vegetation as it crosses the river and open fields. Because the transmission line would introduce new elements into a natural landscape, the large metal structures would become a dominant feature; therefore, contrast is strong. Strong contrast created by the Project in the immediate FG distance zone for high sensitive viewers, concerned with a scarce natural resource, would result in high viewer concern impacts. The Project would result in strong visual contrast and high overall visual impact.

3.18.6.2.3.2.9.10 Route Variations

Applicant Proposed Route Link 1, Variation 2, would be shifted approximately 0.4 mile to the south and would cross a heavily wooded area, similar to the original Applicant Proposed Route. Overall visual impacts are not anticipated to change for high sensitive residential viewers as a result of this variation. Although the variation would be located farther from some residences, it would be closer to others and viewers would still have partially screened views of the Project extending above the tree line in the FG distance zone.

Applicant Proposed Route Link 2, Variation 2, would cross a heavily wooded area, similar to the original Applicant Proposed Route. This variation would be located farther from high sensitive residential viewers, and although the tops of the structures would still be visible above the tree line, less of the structure would be visible because of the distance. Therefore, overall visual impacts to high sensitive viewers are anticipated to be reduced.

Applicant Proposed Route Links 2 and 3, Variation 1, would be shifted approximately 150 feet from the original Applicant Proposed Route where it crosses near residences. Given the minimal shift in location, overall visual impacts are not anticipated to change for high sensitive residential viewers as a result of this variation. It should be noted that a route adjustment was made for HVDC Alternative Route 5-B to maintain an end-to-end route with this variation. Impacts to the HVDC Alternative Route 5-B are discussed in Section 3.18.6.3.2.2.5.2.

Applicant Proposed Route Links 3 and 4, Variation 2, would be shifted approximately 400 feet from the original Applicant Proposed Route. Although the variation would be shifted away from some residences, it would be located even closer to others. Overall visual impacts are anticipated to be higher for high sensitive residential viewers where a greater portion of the structures would be visible extending above the tree line given the closer proximity of the line to the viewer. It should be noted that a route adjustment was made for HVDC Alternative Route 5-E to maintain an end-to-end route with this variation. Impacts to the HVDC Alternative Route 5-E are discussed in Section 3.18.6.3.2.2.5.5.

Applicant Proposed Route Link 7, Variation 1, would be shifted approximately 500 feet or less and would cross a landscape setting similar to the original Applicant Proposed Route. Visual resources would remain the same and include rural residences. Given the minimal shift in location, overall visual impacts are not anticipated to change for high sensitive residential viewers.

3.18.6.2.3.2.10 Region 5 Conclusion

Region 5 contains a moderate density of sensitive viewers primarily associated with rural communities, scattered rural residences, the Ozark National Forest, recreation areas (state and local parks), scenic byways, and conservation and wildlife management areas. Visual impacts are anticipated to be mostly moderate–low for high sensitivity viewers where the Applicant Proposed Route is located in the MG distance zone. No visual impacts are anticipated for many sensitive viewers where the Project is located in the edge of the MG and BG and views would be completely obstructed given the variation in terrain and heavily wooded areas. Higher visual impacts are anticipated to occur within this region though they would typically occur where the Project crosses scenic byways or is located in the FG distance zone.

3.18.6.2.3.2.11 Region 6

The landscape category in Region 6 is primarily Common and is characterized by predominately agricultural, croplands, and natural areas including riparian woodlands and wetlands. The terrain is relatively flat to gently undulating with several meandering streams, branching channels, and other drainages. Views are generally open given the level terrain, although wooded areas and trees planted along the edges of field, roadways, and drainages and channels can limit expansive views in some areas. In Region 6, existing transmission lines are not common within the landscape setting; however, the Applicant Proposed Route crosses two 161kV transmission lines and parallels another 161kV transmission line for approximately 2 miles.

The tall vertical geometric forms of the proposed structures would result in strong contrast with the horizontal lines of the relatively flat landscape found throughout most of the region. Contrast would be reduced in areas where the Applicant Proposed Route would parallel or be seen in context with existing transmission and electric distribution lines; the level of contrast would depend on the form, line, color and texture of the existing structures and the distance the existing structures are from the Applicant Proposed Route. Views of structures in some areas are limited to the upper portions that extend above tree lines and other vegetation. Changes to the landscape and vegetation due to construction of access roads and ROW clearing may be visible but changes would generally not be noticeable in the MG and BG where terrain and vegetation may obscure these changes. Changes may be noticeable to viewers where the Applicant Proposed Route is located in the FG in relatively flat terrain with minimal vegetation to obscure views. Contrast could be reduced in areas where existing access roads would be used and where the Applicant Proposed Route would parallel an existing transmission line corridor where vegetation clearing has previously occurred. The visual impacts for the Region 6 KOPs are listed in Table 3.18-14 and described below.

Table 3.18-14:
Visual Impact Summary of KOPs—Applicant Proposed Route—Region 6

KOP	Link	Distance (Miles)	Viewer Concern	Scenic Quality	Visibility	Viewer Concern Impact	Contrast	Overall Impact
Weldon	1	2.6	High	Common	Yes	Low	Weak	Low
Fisher and Park	4	1	High	Developed	Yes	Moderate	Moderate	Moderate–Low
Cherry Valley	6	0.9	High	Common	Yes	Moderate	Moderate	Moderate
Crowley's Ridge Byway	6	0.1	High	Distinct	Yes	High	Strong	High

3.18.6.2.3.2.11.1 Applicant Proposed Route Link 1

Weldon. Applicant Proposed Route Link 1 would be located 2.6 miles to the north. The flat open landscape would allow for multiple visible transmission-line structures, but at a distance of 2.6 miles, they would appear as a row of dark vertical elements and would be co-dominant with the existing structures on the landscape. Given the distance of 2.6 miles and the co-dominance with the existing transmission line, contrast introduced by the Project would be weak. Weak contrast created by the Project in the MG distance zone for high sensitive residential viewers represented by this KOP would result in low viewer concern impacts. Overall visual impacts would be low. Applicant Proposed Route Link 4

Fisher and Park. Applicant Proposed Route Link 4 would be located 1 mile to the east. Vegetation in the FG distance zone would screen some of the transmission line structures, but the structures would be visible across the open land just on the other side of the trees. There are existing vertical elements on the landscape, so combined with the partial screening, the contrast would be moderate. Because moderate contrast would be created by the Project in the MG distance zone for high sensitive recreational and residential viewers associated with this KOP viewer concern impacts, would be moderate. The overall visual impact would be moderate–low. The impact may be higher, however, in other locations in town where there is no screening.

3.18.6.2.3.2.11.2 Applicant Proposed Route Link 6

Cherry Valley. Applicant Proposed Route Link 6 would be located 0.9 mile to the north of town. A line of dense vegetation would partially screen the transmission line structures, but due to the large scale of the structures they would be clearly visible above tree line, creating a pattern of vertical elements on the irregular line of the horizon and resulting in moderate contrast at this location. Moderate contrast created by the Project in the MG distance zone for high sensitive residential viewers represented by this KOP would result in moderate viewer concern impacts. Overall visual impacts would be moderate.

Crowley's Ridge Scenic Byway. Applicant Proposed Route Link 3 would cross the byway 0.1 mile to the north of this KOP in the FG distance zone. Where viewers are in close proximity to the transmission line crossing, the transmission structures would be visible as would be the areas where vegetation has been cleared for the ROW, resulting in strong contrast. Contrast would be reduced the farther viewers are from the transmission line crossing because the transmission structures would be screened by vegetation and the ROW clearing would not be as apparent. Because strong contrast would be created by the Project in the FG distance zone for high sensitive viewers associated with this scenic travel route, viewer concern impacts would be high. Strong contrast and high impacts to sensitive viewers would result in high overall visual impacts.

3.18.6.2.3.2.11.3 Route Variations

Applicant Proposed Route Link 2, Variation 1 would cross a similar landscape setting as the original Applicant Proposed Route. Visual resources would also remain the same and include a few residences within the FG/MG distance zone. Visual impacts would not change for high sensitive residential viewers as a result of this variation because they would still have intermittent views of the Project crossing the FG/MG distance zone in approximately the same location. It should be noted that a route adjustment was made for HVDC Alternative Route 6-A to maintain an end-to-end route with this variation. Impacts to the HVDC Alternative Route 6-A are discussed in Section 3.18.6.3.2.2.6.1.

3.18.6.2.3.2.11.4 Region 6 Conclusion

Region 6 contains a low density of sensitive viewers primarily associated with rural communities and scattered rural residences, recreation areas and scenic byways. Visual impacts are anticipated to be mostly moderate–low for high sensitivity viewers where the Project is located in the MG distance zone and would either be seen in the context of existing transmission structure or would be partially screened by existing vegetation. Higher impacts are anticipated to occur for Distinct landscapes associated with Crowley's Ridge, where the Applicant Proposed Route would be located in the FG and would introduce vertical elements into the landscape setting creating strong contrast.

3.18.6.2.3.2.12 Region 7

The landscape category in Region 7 is primarily Common and is characterized by flat floodplains associated with the Mississippi River in the western and central portions and transitioning to gently undulating plains and low hills in the eastern portion. Although the terrain is primarily flat within this region, views are typically limited given the numerous forested areas, vegetation associated with surface waters, waterways, drainages, wetlands, and trees planted along agricultural fields and along roadways. In Region 7, the Applicant Proposed Route crosses two 161kV and one 500kV transmission lines and parallels a 161kV transmission line for approximately 2 miles.

The tall vertical geometric forms of the proposed structures would result in strong contrast with the horizontal lines of the relatively flat landscape found within the southern portion of the region. Contrast would be reduced in areas where the Applicant Proposed Route would parallel or be seen in context with existing transmission and electric distribution lines; the level of contrast would depend on the form, line, color and texture of the existing structures and the distance the existing structures are from the Applicant Proposed Route. Views of structures in some areas are limited to the upper portions that extend above tree lines and other vegetation. Changes to the landscape and vegetation due to construction of access roads and ROW clearing may be visible but changes would generally not be noticeable in the MG and BG where terrain and vegetation may obscure these changes. Changes may be noticeable to viewers where the Applicant Proposed Route is located in the FG in relatively flat terrain with minimal vegetation to obscure views. Contrast could be reduced in areas where existing access roads would be used and where the Applicant Proposed Route would parallel an existing transmission line corridor where vegetation clearing has previously occurred. The visual impacts for the Region 7 KOPs are listed in Table 3.18-15 and described below.

Table 3.18-15:
Visual Impact Summary of KOPs—Applicant Proposed Route—Region 7

KOP	Link	Distance (Miles)	Viewer Concern	Landscape Category	Visibility	Viewer Concern Impact	Contrast	Overall Impact
Birdsong	1	0.4	High	Common	Yes	High	Strong	High
Highway 61 (Scenic Byway)	1	0.4	High	Common	Yes	High	Strong	High
Joiner	1	1.7	High	Common	Yes	Low	Weak	Low
Marked Tree	1	2.2	High	Developed	No	Low	No Contrast/ Not Visible	No Impact
Mississippi River and Trail of Tears	1	0.7	High	Common	Yes	Moderate–High	Strong	High
Tyronza	1	2	High	Developed	Yes	Low	Weak	Low
Wilkinsville	4	0.1	High	Common	Yes	High	Strong	Moderate–High
Atoka	5	0.7	High	Common	No	Low	No Contrast/ Not Visible	No Impact
Atoka Community Park	5	4	High	Developed	No	Low	No Contrast/ Not Visible	No Impact
Edmund Orgill Park	5	1	High	Distinct	Yes	Low	Weak	Moderate–Low
Harold Park and Millington	5	2	High	Developed	No	Low	No Contrast/ Not Visible	No Impact
Munford	5	2	High	Developed	No	Low	No Contrast/ Not Visible	No Impact
Rhodes Estates	5	0.6	High	Developed	Yes	Moderate	Moderate	Moderate–Low

3.18.6.2.3.2.12.1 Applicant Proposed Route Link 1

Birdsong. Applicant Proposed Route Link 1 would be located 0.4 mile to the north. The transmission line structures would be highly noticeable crossing the open field. The tall vertical structures would create a pattern on the landscape different in form from existing structures (as described in Section 3.18.5.7.1) and much larger in scale, resulting in strong visual contrast. Because strong contrast would be created by the Project in the FG distance zone for high sensitive residential viewers associated with this KOP, viewer concern impacts would be strong. Overall visual impact would be high.

Highway 61 Scenic Byway. Applicant Proposed Route Link 1 would cross the Highway 61 Scenic Byway 0.4 mile to the northeast. The FG vegetation would partially screen the transmission line structures in this view, but due to their large scale, they would be visible extending above tree line. As motorists travelling the Scenic Byway approached the highway crossing, the structures would be a dominant feature on the landscape because of their scale and form, resulting in strong visual contrast and high overall visual impacts. Since most viewers in this location would be traveling on the highway, views would be primarily of short duration.

Joiner. Applicant Proposed Route Link 1 would be located 1.7 miles to the south and would appear as a pattern of vertical elements along the horizon, where not screened by FG vegetation. Visual contrast at this distance would be weak. Weak contrast created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP would result in low viewer concern impacts. Overall visual impact would be low.

Marked Tree. Applicant Proposed Route Link 1 would be located 2.2 miles to the south. Foreground vegetation and structures would screen all views of the transmission line structures, resulting in no visual impact.

Mississippi River and Trail of Tears. Applicant Proposed Route Link 1 would cross the open field 0.7 mile at the closest point. The transmission line structures would be highly visible and introduce a repeating geometric form to the landscape. Structures on either side of the river crossing would also be visible from this location and would be taller than the transmission structures leading up to the river crossing due to clearance requirements. In addition, markers (which may be orange, yellow, or white) on the transmission lines crossing the river would be added for safety reasons and would add additional contrast. The introduction of transmission structures and crossing markers in a relatively natural setting, would result in strong visual contrast. Because strong contrast would be created by the Project in the MG distance zone for high sensitive recreational viewers, viewer concern impacts would be moderate–high. The Trail of Tears locations mapped by the NPS are representative of the historic location of the trail and the extent of the trail at each crossing location is not known. At this location, overall visual impacts would be high. A visual simulation for this KOP is provided in Appendix K.

Tyronza. Applicant Proposed Route Link 1 would be located 2 miles southwest of the Tyronza KOP in the MG distance zone. The transmission line structures would be visible through openings in vegetation in the FG distance zone and would extend above the tree line. The structures would appear as dark vertical objects on the horizon at this distance and would result in weak visual contrast. Because weak contrast would be created by the Project in the MG distance zone for high sensitive residential viewers represented by this KOP, viewer concern impacts would be low. Overall visual impacts would be low.

3.18.6.2.3.2.12.2 Applicant Proposed Route Link 4

Wilkinsville. Applicant Proposed Route Link 4 would be visible as it traverses the open field 0.1 mile east of this KOP. The structures would be prominent features on the landscape as they cross the field. The proposed structures would be considerably larger than existing structures in view (as described in Section 3.18.5.7.1), and would result in strong visual contrast. Because strong contrast would be created by the Project in the FG distance zone for high sensitive residential viewers represented by this KOP, viewer concern impacts would be high. Overall visual impacts on the landscape would be high.

3.18.6.2.3.2.12.3 Applicant Proposed Route Link 5

Atoka. Applicant Proposed Route Link 5 would be located 0.7 mile to the south from this location, but views of the transmission line structures would be screened by FG vegetation and terrain, resulting in no visual impact.

Atoka Community Park. Applicant Proposed Route Link 5 would be located 4 miles to the southwest of the Atoka Community Park, but views of the transmission line structures would be screened by FG vegetation resulting in no visual impact.

Edmund Orgill Park. Applicant Proposed Route Link 5 would be located 1 mile to the south. From here, the transmission line structures would likely be screened. If visible, the view would be a small portion of the top of the structures extending above the tree line, resulting in weak contrast and moderate–low visual impact since this is a natural environment.

Harold Park and Millington. Applicant Proposed Route Link 5 would be located 2 miles to the north and would be screened by FG structures and trees, resulting in no visual impact.

Munford. Applicant Proposed Route Link 5 would be located 2 miles to the south. Due to existing structures and dense vegetation in the FG, the proposed transmission line structures would not be visible from this location and there would be no visual impact.

Rhodes Estates. Applicant Proposed Route link 5 would be located 0.6 mile to the southeast. Most of the transmission line structures would be partially screened by vegetation and terrain, leaving the tops visible extending above tree line. The portions of the transmission lines that would be visible would be seen in the context of other existing vertical structures; however, the transmission lines would be taller than and differ in form, line, and color from existing vertical features; therefore, contrast would be moderate. Because moderate contrast would be created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP, viewer concern impacts would be moderate. Overall visual impacts would be moderate–low.

3.18.6.2.3.2.12.4 Route Variations

Applicant Proposed Route Link 1, Variation 1, would cross a similar landscape setting as the original Applicant Proposed Route. Visual resources would also remain the same and include rural residences in the FG/MG distance zone. Visual impacts are anticipated to be higher for high sensitive residential viewers because the Applicant Proposed Route Link 1, Variation 1, would be located approximately 700 feet closer (within 300 feet of a residential structure). Although vegetation in the immediate FG would screen the lower portions of the structures because the variation is closer, more of the structures would be visible extending above the tree line, resulting in higher impacts.

Applicant Proposed Route Link 1, Variation 2, would cross a similar landscape setting as the original Applicant Proposed Route. Visual resources would also remain the same and include a few rural residences in the MG distance zone. Visual impacts are anticipated to be lower for high sensitive residential viewers because the Applicant Proposed Route Link 1, Variation 2, would be located farther away and would be partially to completely screened by vegetation.

Applicant Proposed Route Link 5, Variation 1, would cross a similar landscape setting as the original Applicant Proposed Route. Visual resources would also remain the same and include rural residences in the FG/MG distance zone. Visual impacts would not change for high sensitive residential viewers as a result of this variation because the variation would be located in close proximity (approximately 600 feet or less) to the original Applicant Proposed Route, and because of the rolling terrain and wooded areas, viewers would still have partially to completely screened views of the Project.

3.18.6.2.3.2.13 Region 7 Conclusion

Region 7 generally contains a low density of sensitive viewers in the western portion of the region (west of the Mississippi) and a higher density of sensitive viewers in the eastern portion (east of the Mississippi River) near Millington. Sensitive viewers are typically associated with rural and suburban communities and scattered residences and recreation areas associated with the communities and the Mississippi River. Visual impacts are anticipated to be mostly moderate–low to low for high sensitivity viewers where the Project is located in the MG distance zone and would either be seen in the context of existing transmission structure or would be partially screened by existing vegetation. Higher impacts are anticipated where the Applicant Proposed Project is located in the FG and would introduce vertical elements into the landscape setting creating strong contrast and where it crosses Distinct landscapes such as the Mississippi River.

3.18.6.2.3.3 Decommissioning Impacts

Project facilities would be removed at the end of the operational life of the transmission line. Conductors, structures, and related facilities would be removed. Foundations would be removed to below the ground surface level. There would be temporary visual impacts during decommissioning of the Project. There would be residual visual impacts for many years after the Project has been decommissioned and structures removed such as vegetative cutbacks, cut and fill scars from construction activities, and access roads, which all add to the visual impact, though these impacts would be at ground level. These areas would be apparent after the removal of structures but are expected to diminish over time as vegetation returns to the area.

3.18.6.3 Impacts Associated with the DOE Alternatives

3.18.6.3.1 Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area

3.18.6.3.1.1 Construction Impacts

Construction would result in the short-term visual intrusion of construction vehicles, equipment, materials, and a work force in staging areas, and final converter station and substation location. Vehicles, heavy equipment, structure components, and workers would be visible during converter station and substation construction and modification, access and spur road clearing and grading, structure erection, and cleanup and restoration. Affected viewers would be aware of the existing structures in the area adjacent to the Project and the temporary nature of Project construction impacts, which would decrease both scenic quality and viewer concern to the impact. It should be noted that the converter station would be similar to the proposed converter stations proposed in Oklahoma and Tennessee.

3.18.6.3.1.2 Operations and Maintenance Impacts

3.18.6.3.1.2.1 Arkansas Converter Station Siting Area and AC Interconnection Siting Area

The surrounding landscape is primarily rural and agricultural and other than rural residences, does not contain a high number of sensitive resources that would be impacted. When visible in the FG, the facilities associated with the converter station and the substation would result in high contrast on the rural landscape, but given low numbers of sensitive viewers in the area, it would have an overall low-moderate impact.

3.18.6.3.1.3 Decommissioning Impacts

Project facilities would be removed at the end of the operational life of the converter station. There would be temporary visual impacts during decommissioning of the Project. Structures, and related facilities would be removed and foundations removed to below the ground surface level. There would be residual visual impacts for many years after the Project has been decommissioned and structures removed such as vegetation removal and access roads, which all add to the visual impact, though these impacts would be at ground level. These areas would be apparent after the removal of structures but are expected to diminish over time as vegetation returns to the area.

3.18.6.3.2 HVDC Alternative Routes

3.18.6.3.2.1 Construction Impacts

Construction would result in the short-term visual intrusion of construction vehicles, equipment, materials, and a work force in staging areas, along access roads, and along the new transmission line ROW. Vehicles, heavy equipment, structure components, and workers would be visible during structure erection, conductor stringing, access and spur road clearing and grading, and cleanup and restoration. However, disturbance from construction activities would be transient and of short duration as activities progress along the transmission line route. Affected viewers would be aware of the temporary nature of Project construction impacts, which should decrease their concern to the impact.

3.18.6.3.2.2 Operations and Maintenance Impacts

3.18.6.3.2.2.1 Region 1

A description for Region 1 is provided in Section 3.18.6.2.3.2.1. Additional sensitive resources in proximity to HVDC Alternative Routes in region 1 include the Lake Schultz State Park and Optima NWR. The visual impacts for the Region 1 AR KOPs are listed in Table 3.18-16 and described below.

Table 3.18-16:
Visual Impact Summary of KOPs—HVDC Alternative Routes—Region 1

KOP	AR	Distance (Miles)	Viewer Concern	Landscape Category	Visibility	Viewer Concern Impact	Contrast	Overall Impact
Laverne	1-A	0.9	High	Developed	Yes	Moderate	Moderate	Moderate–Low
Hardesty	1-A, 1-C	0.8	High	Common	Yes	Moderate	Moderate	Moderate
Optima NWR	1-A, 1-C	2.5	High	Common	Yes	Low	Weak	Moderate–Low
Lake Schultz State Park	1-B	0.9	High	Distinct	Yes	Moderate	Strong	High
Local Historical Marker	1-D	0.8	Moderate	Common	Yes	Moderate–Low	Moderate	Moderate–Low

3.18.6.3.2.2.1.1 HVDC Alternative Route 1-A

HVDC Alternative Route 1-A corresponds to Applicant Proposed Route Links 2, 3, 4, and 5.

Laverne. DOE Alternative Route 1-A would be located 0.9 mile to the north. The transmission lines structures would be noticeable in open fields and extend above vegetation and low structures, but they would not dominate the view and there would be no change to landform or vegetation. The tall vertical structures would be larger in scale than surrounding structures, resulting in moderate visual contrast. Moderate contrast created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP would result in moderate viewer concern impact. The overall visual impact at this location would be moderate–low.

Hardesty. HVDC Alternative Route 1-A would be located 0.8 mile to the south. The transmission line structures would be a prominent feature on the flat landscape, but because of the distance, would appear at a similar scale to existing vertical elements and would be co-dominant in the view and there would be no change to landform or vegetation at this location; therefore, contrast would be moderate. Moderate contrast created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP would result in moderate viewer concern impacts. The overall visual impact at this location would be moderate. A visual simulation for this KOP is provided in Appendix K.

Optima NWR. HVDC Alternative Route 1-A would be visible about 2.5 miles to the southeast. Because of distance, transmission line structures would be faintly visible in the distance. Structures may be noticeable as they traverse open lands, but would only result in weak contrast. Weak contrast created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP would result in moderate viewer concern impacts. This KOP represents views from a wildlife refuge, so visual concern is high and the overall visual impact at this location would be moderate–low.

3.18.6.3.2.2.1.2 HVDC Alternative Route 1-B

HVDC Alternative Route 1-B corresponds to Applicant Proposed Route Links 2 and 3.

Lake Schultz State Park. HVDC Alternative Route 1-B would be located 0.9 mile to the north. The view from this KOP is panoramic and the transmission structures would extend above the horizon line, introducing new vertical elements into a very natural landscape free of cultural modifications, resulting in strong contrast. This KOP represents views from a public park, so visual concern is high. Strong contrast created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP would result in moderate–low viewer concern impacts, and the overall visual impact of HVDC Alternative Route 1-B would be high.

3.18.6.3.2.2.1.3 HVDC Alternative Route 1-C

HVDC Alternative Route 1-C corresponds to Applicant Proposed Route Links 2 and 3.

Hardesty. See description of Hardesty KOP for HVDC Alternative Route 1-A. Distance and visibility from HVDC Alternative Route 1-C are similar.

Optima NWR. See description of Optima NWR KOP for HVDC Alternative Route 1-A. Distance and visibility are the same.

3.18.6.3.2.2.1.4 HVDC Alternative Route 1-D

HVDC Alternative Route 1-D corresponds to Applicant Proposed Route Links 3 and 4.

Local Historical Marker. HVDC Alternative Route 1-D would be located 0.8 mile to the north. HVDC Alternative Route 1-D would run adjacent to the existing transmission line, which is located 0.6 mile from this location. The proposed transmission line structures would result in similar impacts as corresponding Applicant Proposed Route Link 4, but would have slightly less contrast due to distance. Moderate contrast created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP would result in moderate–high viewer concern impacts. The overall visual impact of HVDC Alternative Route 1-D would be moderate–low.

3.18.6.3.2.2.1.5 Region 1 Alternative Comparison

Table 3.18-17 provides a comparison of the visual impacts for Region 1.

Table 3.18-17:
Visual Impact Comparison Summary—Region 1

Proposed and Alternative Routes	Miles of Distinct Lands Crossed	Miles of Common Lands Crossed	Miles of Developed Lands Crossed	Residences within 0.5 mile
HVDC Alternative Route 1-A	10.5	105.6	7.1	89
APR Links Corresponding to 1-A	5.2	101.7	8.1	95
HVDC Alternative Route 1-B	2.7	44.1	5.4	37
APR Links Corresponding to 1-B	0.1	49.1	3.9	32
HVDC Alternative Route 1-C	1.9	45.1	5.4	63
APR Links Corresponding to 1-C	0.1	49.1	3.9	32
HVDC Alternative Route 1-D	1	30.3	2.3	45
APR Links Corresponding to 1-D	1.3	32.4	1	51

HVDC Alternative Route 1-A. Visual impact to public, private, and state lands resulting from the operations and maintenance of HVDC Alternative Route 1-A is anticipated to be mostly moderate–low with some high impacts at Lake Schultz State Park. The majority of the area that would be crossed by HVDC Alternative Route 1-A is flat to rolling terrain with dispersed residential areas. There are approximately 89 residences within 0.5 mile of the alignment of this alternative route. HVDC Alternative Route 1-A crosses more lands classified as Distinct (10.5 mile) than the corresponding links of the Applicant Proposed Route, although both cross a similar length of lands classified as Common.

HVDC Alternative Route 1-B. Visual impact to public, private, and state lands resulting from the operations and maintenance of HVDC Alternative 1-B is anticipated to be mostly high due to viewers at Lake Schultz State Park. The majority of the area that would be crossed by HVDC Alternative Route1-B is flat to rolling terrain with dispersed residential areas. There are approximately 37 residences within 0.5 mile of the alignment of this alternative route, which would be less than the corresponding links of the Applicant Proposed Route or HVDC Alternative Route 1-A. HVDC Alternative Route 1-B crosses more lands classified as Distinct (2.7 miles) than the corresponding links of the Applicant Proposed Route and crosses slightly fewer lands classified as Common (44.1 miles).

HVDC Alternative Route 1-C. Visual impact to public, private, and state lands resulting from the operations and maintenance of HVDC Alternative Route 1-C is anticipated to be mostly moderate with some moderate–low impacts at Optima NWR. The majority of the area that would be crossed by HVDC Alternative Route 1-C is flat to rolling terrain with dispersed residential areas. There are approximately 63 residences within 0.5 mile of the alignment of this alternative route. HVDC Alternative Route 1-C crosses more lands classified as Distinct (1.9 miles) than the corresponding links of the Applicant Proposed Route, and impacts approximately twice as many residences within 0.5 mile.

HVDC Alternative Route 1-D. Visual impact to public, private, and state lands resulting from the operations and maintenance of HVDC Alternative Route 1-D is anticipated to be mostly moderate–low because of a local historic marker identifying the 37th parallel and the 1854 boundary of the Territory of Kansas. The majority of the area that would be crossed by HVDC Alternative Route 1-D is flat to rolling terrain with dispersed residential areas. There are approximately 45 residences within 0.5 mile of the alignment of this alternative route, slightly less than the corresponding Applicant Proposed Route links. HVDC Alternative Route 1-D crosses fewer lands classified as Distinct (1.0 mile) and Common (30.3 miles) than the corresponding links of the Applicant Proposed Route.

3.18.6.3.2.2.2 Region 2

A description for Region 2 is provided in Section 3.18.6.2.3.2.2. Towns and residences would be the primary source of sensitive viewers in this region, although there are some additional sensitive resources such as state parks, the Cimarron River and Gloss Mountain State Park. The visual impacts for the Region 2 KOPs are listed in Table 3.18-18 and described below.

Table 3.18-18:
Visual Impact Summary of KOPs—HVDC Alternative Routes—Region 2

KOP	AR	Distance (Miles)	Viewer Concern	Landscape Category	Visibility	Viewer Concern Impacts	Contrast	Overall Impact
Cimarron River Crossing	2-A	0.7	Moderate	Common	Yes	Moderate–Low	Moderate	Moderate–Low
Cleo Springs	2-A	3	High	Common	Yes	Low	Weak	Low
Gloss Mountain State Park	2-A	0.8	High	Distinct	Yes	Moderate	Moderate	Moderate–High
Ames	2-A, 2-B	1.3, 2.6	High	Common	Yes	Low	Weak	Moderate–Low
Bison	2-B	1.8	High	Developed	Yes	Low	Weak	Low
Waukomis KOP	2-B	3.5	High	Common	Yes	Low	Weak	Low

3.18.6.3.2.2.2.1 HVDC Alternative Route 2-A

HVDC Alternative Route 2-A corresponds to Applicant Proposed Route Link 2.

Cimarron River Crossing. HVDC Alternative Route 2-A would cross the Cimarron River 0.7 mile to the south of this KOP in the MG distance zone. There are existing H-frame and T-frame structures prominent in FG in this view, and the proposed structures would appear as additional vertical elements on the horizon. The form of the proposed structures would be taller and wider than the existing monopole structures, resulting in moderate visual contrast. Because moderate contrast would be created by the Project in the MG distance zone for moderate sensitive viewers associated with this local roadway, viewer concern impacts would be moderate–low. Although this is a major river crossing, because visual concern is moderate and there are existing cultural modifications, overall visual impacts would be moderate–low.

Cleo Springs. HVDC Alternative Route 2-A would be located 3 miles to the south of this KOP. There are two existing wood H-frame 115kV lines visible from this location, and although the proposed transmission line would be larger in form, it would be located farther away from the viewer and would appear as small vertical elements on the horizon, similar to the existing transmission lines. Because these proposed structures would be adding to existing vertical elements and are not prominent in the view, they would result in weak visual contrast. Because weak contrast would be created by the Project in the BG distance zone for high sensitive residential viewers associated with this KOP, viewer concern impacts would be low. The overall visual impacts at this location would be low.

Gloss Mountain State Park. HVDC Alternative Route 2-A would be visible 0.8 mile to the northeast. Although the proposed transmission line would introduce new vertical elements to the open landscape, the Project would be seen in the context of existing transmission structures, so visual contrast would be moderate. Moderate contrast created by the Project in the MG distance zone for high sensitive recreational viewers associated with this KOP would result in moderate viewer concern impacts. Overall visual impacts for HVDC Alternative Route 2-A in this location would be moderate-high. A visual simulation for this KOP is provided in Appendix K.

Ames. HVDC Alternative Route 2-A would be located 1.3 miles to the south in the MG distance zone and would appear as small objects in the distance. Where the structures are not blocked by FG/MG trees and vegetation, they would appear similar in scale to existing structures and would introduce a weak level of contrast. Because weak contrast would be created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP, viewer concern impacts would be low. The overall visual impacts at this location would be low.

3.18.6.3.2.2.2.2 HVDC Alternative Route 2-B

HVDC Alternative Route 2-B corresponds to Applicant Proposed Route Link 3.

Ames. Views are similar to Ames KOP description for HVDC Alternative Route 2-A, but slightly less noticeable due to greater distance (2.6 miles).

Bison. Viewers looking to the north from this location would see the transmission line structures of HVDC Alternative Route 2-B appearing as small vertical objects on the horizon 1.8 miles away. Trees in the FG would obstruct the majority of the views and HVDC Alternative Route 2-B in this location, resulting in weak contrast. Weak contrast created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP would result in low viewer concern impacts. Overall visual impacts would be low.

Waukomis. HVDC Alternative Route 2-B would be located 3.5 miles to the south. From the Waukomis KOP, the line would be barely visible above the horizon, where it is not screened by FG trees, resulting in weak contrast. Weak contrast created by the Project in the BG distance zone for high sensitive residential viewers associated with this KOP would result in low viewer concern impacts. Overall visual impact at this location is low.

3.18.6.3.2.2.2.3 Region 2 Alternative Comparison

Table 3.18-19 provides a comparison of the visual impacts for Region 2.

Table 3.18-19:
Visual Impact Comparison Summary of KOPs—Region 2

Proposed and Alternative Routes	Miles of Distinct Lands Crossed	Miles of Common Lands Crossed	Miles of Developed Lands Crossed	Residences within 0.5 mile
HVDC Alternative Route 2-A	9	44.4	4	66
APR Links Corresponding to Alternative 2-A	8.5	43.9	2.2	155
HVDC Alternative Route 2-B	0.2	28.7	1	71
APR Links Corresponding to Alternative 2-B	1.2	26.1	4	29

HVDC Alternative Route 2-A. Visual impacts to public, private, and state lands resulting from the operations and maintenance of HVDC Alternative Route 2-A are anticipated to be mostly moderate–low and are associated with residences and towns and the Cimarron River. The majority of the area that would be crossed by HVDC Alternative Route 2-A is flat to rolling terrain with dispersed residential areas. There are approximately 66 residences within 0.5

mile of the alignment of this alternative route, less than the corresponding links of the Applicant Proposed Route, which have 155 residences within 0.5 mile. HVDC Alternative Route 2-A would cross approximately the same amount lands classified as Distinct and Common (9 miles and 44.4 miles, respectively) as the corresponding links of the Applicant Proposed Route, which cross 8.5 miles and 43.9 miles of lands classified as Distinct and Common, respectively.

HVDC Alternative Route 2-B. Visual impacts to public, private, and state lands resulting from the operations and maintenance of HVDC Alternative Route 2-B are anticipated to be mostly low to moderate–low and are associated primarily with residential viewers. The majority of the area that would be crossed by HVDC Alternative Route 2-B is flat to rolling terrain with dispersed residential areas. There are approximately 71 residences within 0.5 mile of HVDC Alternative Route 2-B, more than the corresponding links of the Applicant Proposed Route, which have 29 residences within 0.5 mile of the alignment. HVDC Alternative Route 2-B crosses fewer lands classified as Distinct (0.2 mile) but more lands classified as Common (28.7 miles) than the corresponding Applicant Proposed Route links which crosses 1.2 miles of lands classified as Distinct and 26.1 miles of lands classified as Common.

3.18.6.3.2.2.3 Region 3

A description for Region 3 is provided in Section 3.18.6.2.3.2.3. Towns and residences would continue to be the majority of the sensitive viewers, but there are additional resources in proximity to the HVDC Alternative Routes in this region including lakes and recreation areas that are considered sensitive resources. The visual impacts for the Region 3 KOPs are listed in Table 3.18-20 and described below.

Table 3.18-20:
Visual Impact Summary of KOPs—HVDC Alternative Routes—Region 3

KOP	AR	Distance (Miles)	Viewer Concern	Landscape Category	Visibility	Viewer Concern Impacts	Contrast	Overall Impact
Lake Carl Blackwell	3-A, 3-B	2.7	High	Distinct	No	None/ Not Visible	No Contrast/ Not Visible	No Impact
Marshall	3-A, 3-B	1	High	Common	Yes	Low	Weak	Low
Mulhall	3-A, 3-B	3	High	Developed	No	None/ Not Visible	No Contrast/ Not Visible	No Impact
Orlando	3-A, 3-B	2.7	High	Common	Yes	Low	Weak	Low
Stillwater	3-A, 3-B	2	High	Developed	No	None/ Not Visible	No Contrast/ Not Visible	No Impact
Mehan	3-B	0.7	High	Common	Yes	Moderate	Moderate	Moderate
Agra	3-C	1.5	High	Developed	Yes	Low	Weak	Low
Beggs	3-C	1.5	High	Distinct	Yes	Low	Weak	Moderate–Low
Bristow and Route 66	3-C	3.4	High	Common	No	None/Not Visible	No Contrast/ Not Visible	No Impact
Depew and Route 66	3-C	1.4	High	Common	Yes	Low	Weak	Low
Okmulgee	3-C	1.5	High	Common	Yes	Low	Weak	Low
Perkins	3-C	0.6	High	Common	Yes	Moderate	Moderate	Moderate
Preston	3-C	0.6	High	Common	Yes	Moderate–High	Strong	High

Table 3.18-20:
Visual Impact Summary of KOPs—HVDC Alternative Routes—Region 3

KOP	AR	Distance (Miles)	Viewer Concern	Landscape Category	Visibility	Viewer Concern Impacts	Contrast	Overall Impact
Shamrock	3-C	3	High	Common	No	None/ Not Visible	No Contrast/ Not Visible	No Impact
Boynton	3-C, 3-D	1.5	High	Common	Yes	Low	Weak	Low
Council Hill	3-C, 3-D	2.1	High	Common	Yes	Moderate	Moderate	Moderate
Honey Springs Battlefield Historic Site and Rentiesville South	3-C, 3-D	2.9	High	Common	Yes	Low	Weak	Low
Honey Springs Battlefield Historic Site North	3-C, 3-D	0.5	High	Common	Yes	Moderate–High	Moderate	Moderate–High
McLain	3-C, 3-D, 3-E	0.7	High	Common	Yes	Moderate	Moderate	Moderate
Oktaha School	3-C, 3-D	0.4	High	Common	Yes	Moderate	Weak	Moderate-Low
Webbers Falls	3-C, 3-D, 3-E	1.5 (APR), 2.5 (AR)	High	Distinct	No	None/ Not Visible	No Contrast/ Not Visible	No Impact

3.18.6.3.2.2.3.1 HVDC Alternative Route 3-A

HVDC Alternative Route 3-A corresponds to Applicant Proposed Route Link 1.

As described in Appendix M and summarized in Section 2.4.2.3, a route adjustment was developed for HVDC Alternative Route 3-A to maintain an end-to-end route with Applicant Proposed Route Links 1 and 2, Variation 1. The route adjustment would bring the route due south to connect with the modified Applicant Proposed Route. The route adjustment would be located within approximately 0.25 mile of the original Alternative Route 3-A alignment and would be located farther from some high sensitive residential viewers and located closer to others. Overall, viewers in the area would still have partially to unobstructed views of the line in the FG distance zone; therefore, no changes to visual impacts are anticipated as a result of the route adjustment.

Lake Carl Blackwell. HVDC Alternative Route 3-A would be located 2.7 miles to the south. Due to distance, terrain, and dense vegetation the transmission line structures are not likely to be visible from this location, resulting in no visual impact.

Marshall. HVDC Alternative Route 3-A would be located 1 mile to the north and would be visible above the FG trees and existing structures. The proposed structures would add to the existing vertical elements in the FG, resulting in weak contrast. Because weak contrast would be created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP, viewer concern impacts would be low. Overall visual impact would be low.

Mulhall. HVDC Alternative Route 3-A would be located 3 miles to the north, but would not be noticeable given the distance from the KOP and the surrounding dense vegetation. There would be no overall visual impact from this location.

Orlando. HVDC Alternative Route 3-A would be located 2.7 miles to the south. Views of the structures would be obscured by vegetation and terrain in many places, but where visible, the structures would be similar in form to the existing lattice structures in view and would therefore, introduce a weak level of contrast. Because weak contrast would be created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP, viewer concern impacts would be low. The overall visual impact would be low.

Stillwater. HVDC Alternative Route 3-A would be located 2 miles to the south, but views of the transmission line structures would be blocked by terrain and vegetation, resulting in no visual impact. A visual simulation for this KOP is provided in Appendix K.

3.18.6.3.2.2.3.2 HVDC Alternative Route 3-B

HVDC Alternative Route 3-B corresponds to Applicant Proposed Route Links 1, 2 and 3.

Lake Carl Blackwell. See description of Lake Carl Blackwell KOP for HVDC Alternative Route 3-A. Distance and visibility are the same.

Marshall. See description of Marshall KOP for HVDC Alternative Route3-A. Distance and visibility are the same.

Mullhall. See description of Mulhall KOP for HVDC Alternative Route 3-A. Distance and visibility are the same.

Orlando. See description of Orlando KOP for HVDC Alternative Route 3-A. Distance and visibility are the same.

Stillwater. See description of Stillwater KOP for HVDC Alternative Route 3-A. Distance and visibility are the same.

Mehan. HVDC Alternative Route 3-B would be located 0.7 mile to the northeast. Much of the transmission line would be obscured by FG vegetation, but portions would likely be visible extending above tree line and through clearings in vegetation. The form and line of the proposed lattice structures would differ from existing elements in the rural landscape and would therefore result in moderate contrast. Because moderate contrast would be created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP, viewer concern impacts would be moderate. Overall visual impacts at this KOP would be moderate.

3.18.6.3.2.2.3.3 HVDC Alternative Route 3-C

HVDC Alternative Route 3-C corresponds to Applicant Proposed Route Links 3, 4, 5 and 6.

Agra. HVDC Alternative Route 3-C would be located 1.5 miles to the north. The transmission line structures would be visible through openings in the vegetation and FG structures and would appear as dark vertical objects on the horizon. There are multiple existing vertical elements on the existing landscape, so these proposed structures would introduce only weak visual contrast. Because weak contrast would be created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP, viewer concern impacts would be low. Overall visual impacts at this KOP would be low.

Beggs. HVDC Alternative Route 3-C would be located 1.5 miles to the south of this KOP at the closest point. The transmission line may be visible in the distance, but would be mostly screened by FG vegetation and terrain, resulting in weak contrast levels. This KOP represents views from a residential area, so visual concern is high. Weak contrast created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP would result in low viewer concern impacts. Given the weak contrast introduced into the landscape for high sensitive residential viewers in the MG distance zone, overall visual impacts at this KOP would be moderate–low.

Boynton. HVDC Alternative Route 3-C would be located 1.5 miles to the west. Viewers at this location would be able to see the transmission line structures through breaks in the FG vegetation and they would appear as additional vertical elements. Much of HVDC Alternative Route 3-C in this location would be screened from this viewpoint, resulting in weak visual contrast. Weak contrast created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP would result in low viewer concern impacts. Given the weak contrast introduced into the landscape for high sensitive residential viewers in the MG distance zone, overall visual impacts at this KOP would be low.

Bristow and Route 66. HVDC Alternative Route 3-C would be located 3.4 miles to the south of this KOP. The terrain and dense vegetation would obscure views of the structures resulting in no visual impact.

Council Hill. HVDC Alternative Route 3-C would be located 2.1 miles to the north. An existing 345kV line is located 1 mile closer that is not visible from the KOP. The proposed transmission line structures would be considerably taller, and portions may be visible above tree line, but much of the structures would be screened by FG elements. Due to distance and screening, the visual contrast from this KOP would be moderate. Moderate contrast created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP would result in moderate viewer concern impacts. Given the moderate contrast introduced into the landscape for high sensitive residential viewers in the MG distance zone, overall visual impacts would be moderate.

Depew and Route 66. HVDC Alternative Route 3-C would be located 1.4 miles away and appear as vertical elements on the horizon. Views would be blocked by vegetation in many areas, but where visible the large scale of the structures would be noticeable. Due to distance and FG obstructions, HVDC Alternative Route 3-C in this location would result in weak contrast. Weak contrast created by the Project in the MG distance zone for high sensitive residential and recreational viewers associated with this KOP would result in low viewer concern impacts. Given the weak contrast introduced into the landscape for high sensitive residential/recreational viewers in the MG distance zone, overall visual impact at this location would be low.

Honey Springs Battlefield Historic Site and Rentiesville South. HVDC Alternative Route 3-C would be located 2.9 miles to the north. It is unlikely that the transmission line structures would be visible from this location because of terrain and vegetation screening. If visible, they would appear as small objects on the horizon and would introduce weak contrast. Weak contrast created by the Project in the MG distance zone for high sensitive recreational viewers associated with this KOP would result in low viewer concern impacts. Given the weak contrast introduced into the landscape for high sensitive recreational viewers in the MG distance zone, overall visual impact would be low.

Honey Springs Battlefield Historic Site North. HVDC Alternative Route 3-C would be located 0.5 mile to the north and would run parallel to an existing transmission line. HVDC Alternative Route 3-C in this location would be visible where not screened by FG vegetation and would repeat form similar to the existing structures. The proposed structures would be located on the near side of the existing line and introduce moderate contrast. Moderate contrast created by the Project in the MG distance zone for high sensitive recreational viewers associated with this KOP would result in moderate–high viewer concern impacts. This KOP represents a historic site, so visual concern is high. Given the moderate contrast introduced into the landscape for high sensitive (recreational) viewers in the MG distance zone, the overall visual impact is moderate–high.

McLain. HVDC Alternative Route 3-C would be visible, appearing as vertical objects above tree line where not screened by FG elements. The proposed structures would be parallel to an existing line and would be larger in form and scale, but be farther from the viewer resulting in co-dominance with existing structure in view. The proposed transmission line structures would be noticeable to viewers and result in moderate contrast. Moderate contrast created by the Project in the MG distance zone for high sensitive recreational viewers associated with this KOP would result in moderate viewer concern impacts. Given the moderate contrast introduced into the landscape for high sensitive recreational viewers in the MG distance zone, the overall visual impact would be moderate.

Okmulgee. HVDC Alternative Route 3-C would be located 1.5 miles to the north. At this distance, the transmission line would be partially visible on the horizon line and on top of the ridgeline and appear as dark vertical shapes silhouetted against the sky. The structures however, would not distract from the view and would result in weak contrast. Weak contrast created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP would result in low viewer concern impacts. Given the weak contrast introduced into the landscape for high sensitive (recreational) viewers in the MG distance zone, the overall visual impact on the landscape would be low.

Oktaha School. HVDC Alternative Route 3-C would be 0.4 mile to the southeast and would be visible above tree line. This is a recreational facility in a residential area, so visual concern is high. There are multiple vertical elements on the existing landscape including an existing transmission line, and these structures would introduce additional contrast. Since HVDC Alternative Route 3-C would be located behind an existing transmission line in this location, the contrast would be weak. Weak contrast created by the Project in the MG distance zone for high sensitive recreational and residential viewers associated with this KOP would result in moderate viewer concern impacts. Overall visual impacts would be moderate–low. A visual simulation for this KOP is provided in Appendix K.

Perkins. HVDC Alternative Route 3-C would be 0.6 mile to the east of this location. The transmission line structures would be visible above the trees in the MG and in the open fields to the southeast. The introduction of additional vertical elements and difference in form of the proposed structures would result in moderate contrast. Moderate contrast created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP would result in moderate viewer concern impacts. Given the moderate contrast introduced into the landscape for high sensitive residential viewers in the MG distance zone, overall visual impacts on this landscape would be moderate.

Preston. HVDC Alternative Route 3-C would be visible 0.6 mile to the south. The transmission line structures would be clearly visible on the horizon, above the tree line adding vertical elements to the landscape resulting in strong contrast. This KOP represents views from a park in a residential area, so visual concern is high. Strong contrast created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP would result in moderate–high viewer concern impacts. Given the strong contrast introduced into the landscape for high sensitive (residential) viewers in the MG distance zone, overall visual impacts would be high.

Shamrock. HVDC Alternative Route 3-C would be located 3 miles to the southwest of this location. Given the vegetation and terrain, the transmission line structures would not be visible from this location and there would be no visual impact.

Webbers Falls. See the Applicant Proposed Route Link 6 description.

3.18.6.3.2.2.3.4 HVDC Alternative Route 3-D

HVDC Alternative Route 3-D corresponds to Applicant Proposed Route Links 5 and 6.

Boynton. See description of Boynton KOP for HVDC Alternative Route 3-C. Distance and visibility are the same.

Council Hill. See description of Council Hill KOP for HVDC Alternative Route 3-C. Distance and visibility are the same.

Honey Springs Battlefield Historic Site and Rentiesville South. See description of Honey Springs Battlefield Historic Site and Rentiesville South KOP for HVDC Alternative Route 3-C. Distance and visibility are the same.

Honey Springs Battlefield Historic Site North. See description of Honey Springs Battlefield Historic Site North KOP for HVDC Alternative Route 3-C. Distance and visibility are the same.

McLain. See description of McLain KOP for HVDC Alternative Route 3-C. Distance and visibility are the same

Oktaha School. See description of Oktaha School KOP for HVDC Alternative Route 3-C. Distance and visibility are the same.

Webbers Falls. HVDC Alternative Route 3-D would be located 2.5 miles to the southwest. Given the distance and existing vegetation, the transmission line structures would not be visible from this location and there would be no visual impact.

3.18.6.3.2.2.3.5 HVDC Alternative Route 3-E

McLain. See description of McLain KOP for HVDC Alternative Route 3-C. Distance and visibility are the same.

Webbers Falls. See description of Webbers Falls KOP for HVDC Alternative Route 3-D. Distance and visibility are the same.

3.18.6.3.2.2.3.6 Region 3 Alternative Comparison

Table 3.18-21 provides a comparison of the visual impacts for Region 3.

Table 3.18-21:
Visual Impact Comparison Summary—Region 3

Proposed and Alternative Routes	Miles of Distinct Lands Crossed	Miles of Common Lands Crossed	Miles of Developed Lands Crossed	Residences within 0.5 Mile
HVDC Alternative Route 3-A	4.4	30.5	2.8	186
APR Links Corresponding to Alternative 3-A	5.5	32.5	2.1	168
HVDC Alternative Route 3-B	4.9	39.7	3.3	476

Table 3.18-21:
Visual Impact Comparison Summary—Region 3

Proposed and Alternative Routes	Miles of Distinct Lands Crossed	Miles of Common Lands Crossed	Miles of Developed Lands Crossed	Residences within 0.5 Mile
APR Links Corresponding to Alternative 3-B	18.9	41.2	2.5	520
HVDC Alternative Route 3-C	15.9	102.3	3.7	1,450
APR Links Corresponding to Alternative 3-C	28.4	98.2	4.9	1,545
HVDC Alternative Route 3-D	1.8	36.0	1.6	600
APR Links Corresponding to HVDC Alternative Route 3-D	1.5	32.2	1.5	552
HVDC Alternative Route 3-E	1.2	6.9	0.4	162
APR Links Corresponding to Alternative 3-E	1.2	6.1	0.5	137

HVDC Alternative Route 3-A. Visual impact to public, private, and state lands resulting from the operations and maintenance of HVDC Alternative Route 3-A is anticipated to be mostly low and associated with towns or scattered residences. The majority of the area that would be crossed by HVDC Alternative Route 3-A is flat to rolling terrain with dispersed residential areas. There are approximately 186 residences within 0.5 mile of the alignment of this alternative route. HVDC Alternative Route 3-A would cross less land classified as Distinct (4.4 miles) and Common (30.5 miles) than the corresponding links of the Applicant Proposed Route, which cross 5.5 miles of land classified as Distinct and 32.5 miles of land classified as Common.

HVDC Alternative Route 3-B. Visual impact to public, private, and state lands resulting from the operations and maintenance of HVDC Alternative Route 3-B is anticipated to be mostly low because of the distance of the Project to towns and scattered residences. The majority of the area that would be crossed by HVDC Alternative Route 3-B is flat to rolling terrain with dispersed residential areas. There are approximately 476 residences within 0.5 mile of the alignment of this alternative route, which would be less than the corresponding links of the Applicant Proposed Route links and more than twice as many as HVDC Alternative Route 3-A. HVDC Alternative Route 3-B crosses more lands classified as Distinct (4.9 miles) and lands classified as Common (39.7 miles) than HVDC Alternative Route 3-A.

HVDC Alternative Route 3-C. Visual impact to public, private, and state lands resulting from the operations and maintenance of HVDC Alternative Route 3-C is anticipated to be mostly moderate because of the towns and scattered residences; impacts would be moderate–high at the Honey Springs Battlefield site. The majority of the area that would be crossed by HVDC Alternative Route 3-C is flat to rolling terrain with dispersed residential areas. There are approximately 1,450 residences within 0.5 mile of the alignment of this alternative route, the most of any of the other HVDC route alternatives. HVDC Alternative Route 3-C crosses fewer lands classified as Distinct (15.9 miles) than the corresponding links of the Applicant Proposed Route (28.4 miles). HVDC Alternative Route 3-C would also cross more lands classified as Common (102.3 miles) than the corresponding Applicant Proposed Route links (98.2 miles) and any of the HVDC Route Alternatives

Alternative 3-D. Visual impact to public, private, and state lands resulting from the operations and maintenance of HVDC Alternative Route 3-D is anticipated to be mostly moderate because residential development and towns are dispersed, although there would be moderate–high impacts at the Honey Springs Battlefield Historic Site. The majority of the area that would be crossed by HVDC Alternative Route 3-D is flat to rolling terrain. There are approximately 600 residences within 0.5 mile of the alignment of this alternative route, more than the corresponding links of the Applicant Proposed Route (552 residences within 0.5 mile) and more than any HVDC alternative routes except HVDC Alternative Route 3-C. HVDC Alternative Route 3-D crosses more lands classified as Distinct (1.8 miles) and Common (36 miles) than the corresponding links of the Applicant Proposed Route.

Alternative 3-E. Visual impact to public, private, and state lands resulting from the operations and maintenance of HVDC Alternative Route 3-E is anticipated to be mostly low because residential development and towns are dispersed. The majority of the area that would be crossed by HVDC Alternative Route 3-E is flat to rolling terrain. There are approximately 162 residences within 0.5 mile of the alignment of this alternative route, the least of any HVDC Alternative Route. HVDC Alternative Route 3-E crosses an equal amount of lands classified as Distinct (1.2 miles) and slightly more lands classified as Common (6.9 miles) than the corresponding links of the Applicant Proposed Route.

3.18.6.3.2.2.4 Region 4

A description for Region 4 is provided in Section 3.18.6.2.3.5. Region 4 has multiple sensitive resources including the Arkansas River, lakes and reservoirs, state parks, and Ozark-St. Francis National Forest land that would have sensitive viewers using the resources for recreation. HVDC Alternative Route 4-B would cross the Ozark-St. Francis National Forest and visual analysis related to USFS lands would be discussed after the HVDC Alternative Route 4-B KOP analysis. The visual impacts for the Region 4 KOPs are listed in Table 3.18-22 and described below.

Table 3.18-22:
Visual Impact Summary of KOPs—HVDC Alternative Routes—Region 4

KOP[1]	AR	Distance (Miles)	Viewer Concern	Landscape Category	Visibility	Viewer Concern Impacts	Contrast	Overall Impact
Arkansas River	3-C, 3-D	0.5	Moderate	Common	Yes	Low	Weak	Moderate–Low
Arkansas River and Gore PR	3-D, 3-C, 3-E, 4-B	3	High	Distinct	Yes	Low	Weak	Moderate–Low
Brushy Creek Reservoir and Sallisaw State Park	4-A	2.2	High	Distinct	No	Low	No Contrast/ Not Visible	No Impact
Highway 82	4-A	0.1	Moderate	Common	Yes	Moderate–High	Strong	High
Little Lee Creek (Scenic River)	4-A, 4-B	0.4	High	Distinct	Yes	High	Strong	High
Route 71 (Scenic Byway)	4-A	0.1	High	Common	Yes	High	Strong	High
Uniontown Highway (Scenic Highway)	4-A	0.1	High	Common	Yes	High	Strong	High
Marble City	4-A, 4-B	0.3	High	Common	Yes	High	Strong	High
Tenkiller State Park PR and AR	4-A, 4-B	4	High	Distinct	No	Low	No Contrast/ Not Visible	No Impact
Vian	4-A, 4-B	1.8	High	Common	Yes	Low	Weak	Low
Bluff Hole Park	4-A, 4-D	2.7	High	Common	Yes	Low	Weak	Low
Boys and Girls Camp	4-A, 4-D	0.3	High	Common	Yes	High	Strong	High
City Park/Ball Fields and Rudy	4-A, 4-D	3.2	High	Developed	No	Low	No Contrast/ Not Visible	No Impact

Table 3.18-22:
Visual Impact Summary of KOPs—HVDC Alternative Routes—Region 4

KOP[1]	AR	Distance (Miles)	Viewer Concern	Landscape Category	Visibility	Viewer Concern Impacts	Contrast	Overall Impact
Frog Bayou Creek	4-A, 4-D	0.1	High	Distinct	Yes	High	Strong	High
Mulberry River and Trail of Tears	4-A, 4-D	0.7	High	Distinct	Yes	Moderate–High	Strong	High
Fire Tower Lookout	4-B	0.9	High	Distinct	No	Low	No Contrast/ Not Visible	No Impact
Highway 82	4-B	0.2	High	Common	Yes	High	Strong	High
Mulberry River	4-B	0.1	High	Distinct	Yes	High	Strong	High
Route 220 (Scenic Byway)	4-B	0.1	High	Distinct	Yes	High	Strong	High
Trail of Tears (Highway 352)	4-B	0.1	High	Common	Yes	Moderate–High	Moderate	Moderate–High
Trail of Tears (Route 59)	4-B	0.1	High	Distinct	Yes	High	Strong	High
White Oak	4-B	0.9	High	Common	No	Low	No Contrast/ Not Visible	No Impact
Wiederkehr Village and Highway 186	4-B	3.4	High	Common	Yes	Low	Weak	Low
Ozark	4-B, 4-E	3.7	High	Common	No	Low	No Contrast/ Not Visible	No Impact
Field of Dreams	4-C	2.3	High	Developed	No	Low	No Contrast/ Not Visible	No Impact
Scott Farm	4-C	0.7	High	Common	Yes	Moderate	Moderate	Moderate
Cedarville	4-A, 4-D	0.8	High	Common	Yes	Moderate–High	Strong	High
Trail of Tears and Scenic Highway 220	4-D	0.1	High	Common	Yes	High	Strong	High
Van Buren	4-D, 4-C	1.1	High	Common	No	Low	No Contrast/ Not Visible	No Impact
Clarksville	4-E	0.4	High	Common	Yes	High	Strong	High
Coal Hill	4-E	3.2	High	Common	No	Low	No Contrast/ Not Visible	No Impact
Hagarville	4-E	2.3	High	Common	No	Low	No Contrast/ Not Visible	No Impact
Highway 21 Scenic Byway	4-E	0.4	High	Common	Yes	High	Strong	High
Lamar	4-E	3.25	High	Common	No	Low	No Contrast/ Not Visible	No Impact
Wiederkehr Village and Highway 186	4-E	0.6	High	Common	Yes	Low	Weak	Low

1 The Arkansas River and Arkansas River and Gore KOPs are located in Region 4, but HVDC Alternative Routes in Region 3 will potentially be visible from these KOPs. As a result, these KOPs are discussed in the Region 4 section, and the Region 3 HVDC alternative routes potentially visible from these KOPs are included in the impact analysis for Region 4.

3.18.6.3.2.2.4.1 HVDC Alternative Route 3-C

HVDC Alternative Route 3-C corresponds to Applicant Proposed Route Links 3, 4, 5 and 6.

Arkansas River. From this KOP, HVDC Alternative Route 3-C would be visible extending above the tree line 0.5 mile away on the far side of the river. The transmission line structures would be similar in form to the existing structures and would appear co-dominant on the horizon. Views represented are only of the HVDC Alternative Route section not including the river crossing, and would result in weak contrast. Weak contrast created by the Project in the MG distance zone for moderate sensitive viewers associated with this KOP would result in low viewer concern impacts. Given the distance of the Project from the KOP and the presence of existing high-voltage transmission lines in close proximity to the Project, the overall impact would be moderate–low.

Arkansas River and Gore. See description of Arkansas River and Gore KOP for Applicant Proposed Route Link 1. Distance and visibility are the same. A visual simulation for this KOP is provided in Appendix K.

3.18.6.3.2.2.4.2 HVDC Alternative Route 3-D

HVDC Alternative Route 3-D corresponds to Applicant Proposed Route Links 5 and 6.

Arkansas River. See description of Arkansas River KOP for HVDC Alternative Route 3-C. Distance and visibility are the same.

Arkansas River and Gore. See description of Arkansas River and Gore KOP for Applicant Proposed Route Link 1. Distance and visibility are the same.

3.18.6.3.2.2.4.3 HVDC Alternative Route 3-E

HVDC Alternative Route 3-E corresponds to Applicant Proposed Route Link 6.

Arkansas River and Gore. See description of Arkansas River and Gore KOP for Applicant Proposed Route Link 1. Distance and visibility are the same.

3.18.6.3.2.2.4.4 HVDC Alternative Route 4-A

HVDC Alternative Route 4-A corresponds to Applicant Proposed Route Links 3, 4, 5, and 6.

Bluff Hole Park. Looking north from Bluff Hole Park, the HVDC Alternative Route 4-A would be located 2.7 miles away. At this distance, the transmission line structures would be mostly screened by vegetation and terrain. If any of the structures are visible, they would appear as small dark vertical elements on the irregular horizon line and result in weak contrast. Weak contrast created by the Project in the MG distance zone for high sensitive recreational viewers associated with this KOP would result in low viewer concern impacts. Because the Project would not be readily noticeable to recreational viewers from this location, the overall visual impact at this location would be low.

Boys and Girls Camp. This KOP represents views from a youth camp in a rural landscape. HVDC Alternative Route 4-A would be located 0.3 mile to the north, just beyond the line of trees in the FG. The transmission line structures would be clearly visible to anyone traveling to or from the camp, extending above tree line and creating a pattern of vertical elements different from the existing landscape. This KOP represents views from a recreation area, so visual concern is high. The resulting contrast would be strong. Strong contrast created by the Project in the FG distance zone for high sensitive recreational viewers associated with this KOP, would result in high viewer concern impacts and overall visual impacts would be high.

Brushy Creek Reservoir and Sallisaw State Park. HVDC Alternative Route 4-A would be located 2.2 miles north of this recreation area at Brushy Creek Reservoir. People visiting the park would not be able to see the transmission line structures in this location because hills and dense trees around the lake screening views. There would be no visual impact at this location.

City Park/Ball Fields and Rudy. Looking out from the community ball field in Rudy, views of HVDC Alternative Route 4-A, 3.2 miles away, would be blocked by FG structures and vegetation resulting in no visual impact.

Frog Bayou Creek. HVDC Alternative Route 4-A would be highly visible crossing the valley and continuing up over the ridge in the MG. Structures would appear as tall vertical elements breaking up an otherwise mostly natural environment creating strong contrast. Additional contrast would be added to the landscape with the ROW clearing going up the ridge creating straight lines on the rolling hills. This KOP represents the crossing of a waterbody being viewed from a scenic highway, so visual concern is high. Strong contrast created by the Project in the FG distance zone for high sensitive viewers associated with this scenic byway would result in high viewer concern impacts. The overall visual impact in this area would be high. A visual simulation for this KOP is provided in Appendix K.

Highway 82. HVDC Alternative Route 4-A would be located 0.1 mile to the southwest of this viewpoint along Highway 82. The structures would be highly visible, extending above tree line and dominating the view of motorists as it crosses the highway. ROW clearing would be visible as straight lines of cleared vegetation along the sides of the road, adding additional contrast to the landscape. This KOP represents views from a well-traveled highway with moderate visual concern and the transmission line would result in strong contrast and high overall visual impact at this location.

Little Lee Creek (Scenic River). HVDC Alternative Route 4-A would cross this scenic river 0.4 mile to the northeast. Where not screened by FG vegetation, transmission line structures in this location would introduce tall vertical structures, and color, line and texture different from what exists currently (as described in Section 3.18.5.4.1 in this primarily natural landscape; therefore, contrast would be strong. On the sides of the river, ROW clearing of dense vegetation would create additional horizontal lines in the landscape visible to people using this river for recreation. Strong contrast created by the Project in the FG distance zone for high sensitive recreational viewers associated with this KOP would result in high viewer concern impacts. These impacts to the landscape would result in high overall visual impact. A visual simulation for this KOP is provided in Appendix K.

Marble City. HVDC Alternative Route 4-A would be located 0.3 mile to the southeast. The structures would be screened by a ridge until crossing the open field in the MG. Through breaks in the FG vegetation and structures, the transmission line structures would be prominent in view and appear as tall vertical objects much larger in scale than the existing wood power poles in view. This KOP represents views from a residential area with high visual concern and the transmission line would result in strong visual contrast. Strong contrast created by the Project in the FG distance zone for high sensitive residential viewers associated with this KOP would result in high viewer concern impacts. Overall visual impacts are anticipated to be high.

Mulberry River and Trail of Tears. HVDC Alternative Route 4-A would cross the river 0.7 mile from this location. Most of the transmission line structures would be screened because of the dense vegetation in the area, but when they were visible through breaks in vegetation, they would be clearly visible across the open field to the east. The proposed transmission line structures would be noticeably different than existing structures in view, introducing new form and line to the landscape; therefore, contrast introduced by the Project would be strong. Strong contrast created by the Project in the MG distance zone for high sensitive recreation viewers associated with the river and historic trail would result in moderate–high viewer concern impacts. Because this is a sensitive viewpoint representing a historic trail, and because the proposed structures would result in strong contrast, high overall visual impacts are anticipated. A visual simulation for this KOP is provided in Appendix K.

Route 71 (Scenic Byway). HVDC Alternative Route4-A would cross the scenic byway 0.1 mile to the south. The scale of the transmission structures would be much larger than anything in the current landscape in this area and would dominate the views of motorists traveling down the scenic byway as the transmission line crosses the road and cut across the open fields in the FG. This KOP represents views from a Scenic Byway, and strong contrast created by the Project in the FG distance zone for high sensitive viewers associated with this scenic travel route would result in high viewer concern impacts. The overall contrast at this location would be strong and the overall visual impact high.

Tenkiller State Park. See the Applicant Proposed Route Link 1 description.

Uniontown Highway (Scenic Byway). HVDC Alternative Route 4-A would cross the highway 0.1 mile from this point. The tall transmission line structures would dominate views in the area as they contrast the rural landscape free of tall man-made vertical structures. Combined with the ROW clearing of vegetation along the highway, HVDC Alternative Route 4-A would create strong contrast. Strong contrast created by the Project in the FG distance zone for high sensitive viewers associated with this scenic travel route would result in high viewer concern impacts. Overall visual impacts would also be high. Because most viewers in this location would be traveling on the highway, views would be primarily of short duration.

Vian. HVDC Alternative Route 4-A would be located 1.8 miles to the north. From this location, the transmission line structures would appear behind the ridge in the BG and most likely not be visible. If any of the structures appeared above the tree line, they would appear as dark objects on the horizon and be difficult to notice, resulting in weak contrast and low overall visual impact.

3.18.6.3.2.2.4.5 HVDC Alternative Route 4-B

HVDC Alternative Route 4-B corresponds to Applicant Proposed Route Links 2, 3, 4, 5, 6, 7 and 8.

Arkansas River and Gore. See the Applicant Proposed Route Link 1 description.

Fire Tower Lookout. This KOP represents views from the Ozark-St. Francis National Forest and was chosen by USFS staff to represent forest views. Surrounding the open field are tall trees that would block all views to HVDC Alternative Route 4-B, 0.9 mile to the south. There would be no visual impact at this location.

Highway 82. HVDC Alternative Route4-B would be located 0.2 mile to the south. The transmission line structures would be highly visible in the FG and extend above tree line. The form and scale would be much different than the existing landscape and create strong contrast combined with additional contrast created by the clearing of vegetation in the ROW. Strong contrast created by the Project in the FG distance zone for high sensitive residential viewers associated with this KOP would result in high viewer concern impacts. Overall visual impacts would also be high. This KOP represents views from a residential area, so visual concern is high and the overall visual impact would be high.

Little Lee Creek (Scenic River). Impacts would be similar to HVDC Alternative Route 4-A. See HVDC Alternative Route 4-A description.

Marble City. See description of Marble City KOP for HVDC Alternative Route 4-A. Distance and visibility are the same.

Mulberry River. HVDC Alternative Route 4-B, would be located 0.1 mile to the north. The transmission line structures would be highly visible on the banks of the river and as they cross over to the other side. This KOP represents views from a recreation area along a river, and the Project would appear in the near FG. The large vertical structures would be dominant in view, and combined with the vegetation being cleared for the ROW, there would be strong contrast. Strong contrast created by the Project in the FG distance zone for high sensitive recreation viewers associated with the river would result in high viewer concern impacts. Overall visual impacts would also be high.

Ozark. HVDC Alternative Route 4-B would be located 3.7 miles to the north and be screened by MG trees and rolling hills resulting in no visual impact.

Route 220 (Scenic Byway). HVDC Alternative Route 4-B would cross the Route 220 scenic highway less than 0.1 mile to the north. Large amounts of vegetation would need to be cleared for the ROW, resulting in straight lines cutting through the curves of the rolling hills and trees in the otherwise natural landscape. The transmission line structures would be larger in scale and form than anything in the vicinity (as described in Section 3.18.5.4.1) and dominate the views of motorists traveling the highway in this area. This KOP represents views from a Scenic Byway, and the Project would have strong visual contrast. Strong contrast created by the Project in the FG distance zone for high sensitive viewers associated with this travel route would result in high viewer concern impacts. Overall visual impacts would also be high. Since most viewers in this location would be traveling on the byway, views would be primarily of short duration.

Tenkiller State Park. See description of Tenkiller State Park KOP for Applicant Proposed Route Link 1. Distance and visibility are the same.

Trail of Tears (Highway 352). HVDC Alternative Route 4-B would cross Highway 352 and the Trail of Tears 0.1 mile to the northwest of this KOP. HVDC Alternative Route 4-B would cross the open field on the other side of the existing H-frame structures. The proposed transmission line structures would be larger in scale and considerably different in form than the existing and result in moderate contrast. Moderate contrast created by the Project in the immediate FG distance zone for high sensitive viewers associated with this travel route, would result in moderate-high viewer concern impacts. The overall visual impacts would be moderate-high.

Trail of Tears (Route 59). HVDC Alternative Route 4-B would be located 0.1 mile to the north and be highly visible to motorists traveling the route. The transmission line structures would introduce a vertical element different in form and scale to the existing structures in the area, and the clearing for the ROW would create strong lines in the dense vegetation, resulting in strong overall contrast. Strong contrast created by the Project in the FG distance zone for high sensitive recreational viewers associated with this scenic trail would result in high viewer concern impacts. Overall visual impacts would be high.

Vian. See HVDC Alternative Route 4-A description. Views are similar, but with a slightly longer distance (2.8 miles) to the transmission line structures.

White Oak. HVDC Alternative Route 4-B would be located 0.9 mile to the north of this KOP. The FG vegetation and terrain would screen any views of HVDC Alternative Route 4-B from this location, resulting in no visual impacts.

Wiederkehr Village and Highway 186. HVDC Alternative Route 4-B would be located 3.4 miles to the northwest of Wiederkehr Village. The upper portions of the transmission structures may be visible extending above the tree line and in front of the distant ridge line; however, the structures would be back-dropped by vegetation, which would help blend the transmission structures into the surrounding landscape. The visible portions of the transmission structures would be subordinate in the landscape, resulting in weak contrast. Because weak contrast would be created by the Project in the BG distance zone for high sensitive residential viewers associated with this KOP, viewer concern impacts would be low. Overall visual impacts would be low.

3.18.6.3.2.2.4.6 HVDC Alternative Route 4-B USFS SMS Compliance

HVDC Alternative Route 4-B was developed in response to comments received during scoping for the EIS for the Project. HVDC Alternative Route 4-B is 78.89 miles in length and located in Sequoyah County, Oklahoma, and Crawford and Franklin counties, Arkansas. Of this, 10.51 miles is within the Forest Service Administrative Boundary of the Ozark-St. Francis National Forest, in Crawford County, Arkansas; however, less than one-half of this length (4.19 miles) is on Ozark-St. Francis National Forest land within the Boston Mountains Ranger District. The remaining 6.32 miles is on private land holdings.

The USFS provided DOE with SIOs and the land management plan for the Ozark-St. Francis National Forest. No KOPs were chosen on USFS lands because no viewpoints were identified through consultation with the USFS or identified during the data collection field effort. For USFS lands, consistency with SIOs involves the comparison of existing landscape integrity with integrity that would occur with implementation of HVDC Alternative Route 4-B. Impacts to landscape scenery were determined by measuring the extent of effects of HVDC Alternative Route 4-B on the scenic landscape through USFS scenic attractiveness ratings, and scenic quality on private, state, and other federal lands. Impacts to viewers were determined by measuring the extent of effects of HVDC Alternative Route 4-B through USFS viewer concern levels and distances and viewer sensitivity levels. The intent of a Land and Resource Management Plan (LRMP) is to provide a framework for integrated resource management and for guiding all project and activity decision making on USFS lands.

The Ozark-St. Francis National Forests' LRMP divides the Ozark-St. Francis National Forest into management areas (MAs) (USFS 2005a). The purpose of these MAs is to identify allowable uses and opportunities within certain areas on the Ozark-St. Francis National Forest. HVDC Alternative Route4-B would cross the Pine Woodland and Oak Woodland MAs (see Figure 2, "Ozark National Forest Management Areas," from the Visual Resources Technical Report (Clean Line 2014; Appendix F).

Lands within these two MAs are primarily managed for timber production. The primary emphasis for both of these MAs is to restore and maintain a landscape mosaic of open woodland that approximates historical conditions. The common purpose for each MA is to provide habitat for associated plants and animals, and to create a setting for recreation that is different, uncommon, visually appealing, and rich in wildlife.

MA Standards are mandatory requirements that apply to site-specific activities such as the Project. There are no MA Standards for the Pine Woodland or Oak Woodland MAs that are relevant to the Project or potential effects on scenery resources.

Scenic Class 1 (Extremely High) Areas. HVDC Alternative Route 4-B crosses a total of 0.24 miles consisting of two small areas the Ozark-St. Francis National Forest inventoried and classified as having Extremely High public value associated with them. The first area occurs along HVDC Alternative Route 4-B approximately 0.35 mile southeast of where it crosses Route 220 (scenic highway). This is an area of uninterrupted forest and rolling terrain located within the Oak Woodland MA. No roads, trails, water, rock outcrops, or other distinctive landscape features are evident. Their scenic attractiveness is typical. The area is classified as Scenic Class 1 because it is within the FG view of the scenic highway and, consequently, also a high public concern area.

The second area occurs along HVDC Alternative Route 4-B approximately 0.38 mile west of where HVDC Alternative Route 4-B crosses Route 59. This is a densely forested area located within the Pine Woodland MA. No distinctive landscape features are evident. The area is classified as Scenic Class 1 because it is within the FG view of Route 59 and an area of high public concern because of its proximity to potential viewers.

With the introduction of Project elements, the landform, vegetation patterns, and cultural features would still combine to provide ordinary or common scenic quality in these areas. Because of the landscape's ability to absorb visual change (i.e., topography, tall trees, constrained views), the overall scenic attractiveness class would not change, so the total acreage of land classified as Scenic Class 1 would not be affected.

Scenic Class 2 (Very High) Areas. HVDC Alternative Route 4-B crosses a total of 2.01 miles consisting of several areas the Ozark-St. Francis National Forest inventoried and classified as having Very High public value. These areas are characterized by rolling terrain and forested areas within both the Oak and Pine Woodland MAs. A few unimproved roads or trails are evident. There are no distinctive landscape features. These areas are fairly homogenous, and their scenic attractiveness would be considered typical of this part of the Ozark-St. Francis National Forest. These areas are all classified as scenic Class 2 because they are within the FG view of secondary roads or rural residences adjacent to the Ozark-St. Francis National Forest.

With the introduction of Project elements, the landform, vegetation patterns, and cultural features would still combine to provide ordinary or common scenic quality in these areas. Because of the landscape's ability to absorb visual change, the overall scenic attractiveness class would not change and, therefore, the total acreage of land classified as Scenic Class 2 would not be affected.

Scenic Class 3 (High) Areas. HVDC Alternative Route 4-B crosses a total of 0.28 mile consisting of two small areas the Ozark-St. Francis National Forest inventoried and classified as having High public value. The areas occur along HVDC Alternative Route 4-B approximately 0.6 mile and 1 mile southeast of where it crosses Route 220 (scenic highway). These are typical forested areas located within the Oak Woodland MA. No roads, trails, water, rock outcrops, or other distinctive landscape features are evident. Their scenic attractiveness is typical. These areas are classified as Scenic Class 3 because they are within the MG view of the scenic highway as well as other secondary roads and are also of moderate public concern.

With the introduction of Project elements, the landform, vegetation patterns, and cultural features would still combine to provide ordinary or common scenic quality in these areas. Because of the landscape's ability to absorb visual change, the overall scenic attractiveness class would not change and, therefore, the total acreage of land classified as Scenic Class 3 would not be affected.

SIO Compliance. Transmission line structures and cleared ROWs would contrast with the landscape character in High, Moderate, and Low SIO areas. Gray-colored structures would extend above the tree line, disrupting the line of the landscape and introducing angular and coarse cultural (human) elements into an otherwise intact and natural-appearing setting. Cleared ROWs would create additional lines on the landscape that vary in terms of line, color, and texture from the surrounding visual landscape. These visual deviations would be most evident to viewers from a superior vantage point or areas where no vegetation was in the immediate FG. Due to their height, transmission line structures may be visible in these areas from Route 220 (scenic highway). Forest projects and activities should contribute to the achievement or attainment of desired conditions. The USFS desires for a certain percentage of projects occurring on NFS lands to meet the intended SIO as identified in the LRMP over the long term. Transmission lines cause visible disruption to the surrounding landscape from two primary actions:

- ROW clearing (visually disruptive through the removal of trees, shrubs, and ground cover, creation of unnatural openings, and abnormal vegetative edges)
- Installation of structures (utility structures typically oppose landscape forms because they are geometric, forceful, and large)

The landscape character for High SIO areas should appear unaltered and intact, and any deviations must "repeat the form, line, color, texture, and pattern common to the landscape character so completely and at such a scale that they are not evident" (USFS 2005b). Even with avoidance and minimization measures, the implementation of HVDC Alternative Route 4-B would not meet this standard and would degrade the Desired Condition for scenic resources described in the LRMP. Due to DOE Action Alternative resulting in high visual impacts HVDC Alternative Route 4-B would not comply with High SIOs. The HVDC Alternative Route 4-B would not be allowed to cross lands managed with non-complying objectives without changing the LRMP.

The landscape character for Moderate SIO areas may appear slightly altered, and deviations "must remain visually subordinate to the landscape character being viewed" (USFS 2005b). It may be possible, but is not likely, for Project elements to meet this standard in 100 percent of locations depending on the avoidance and minimization measures employed and local landscape conditions. With these measures, the implementation of HVDC Alternative Route 4-B would neither enhance nor degrade the Desired Condition for scenic resources described in the LRMP. Due to the DOE Alternative resulting in moderate–high and high visual impacts HVDC Alternative Route 4-B would not comply with Moderate SIOs.

The landscape character for Low SIO areas may appear moderately altered, and deviations may "begin to dominate the valued landscape character being viewed" provided they "borrow valued attributes such as size, shape, edge effect and pattern of natural openings, vegetative type changes, or architectural styles outside the landscape being viewed" (USFS 2005b). Project elements would meet this standard in 100 percent of locations depending on avoidance and minimization measures and local landscape conditions. With these measures, the implementation of HVDC Alternative Route 4-B would enhance the Desired Condition for scenic resources described in the LRMP. Due to the DOE Action Alternative resulting in moderate–high and high visual impacts, HVDC Alternative Route 4-B would comply with Low SIOs.

3.18.6.3.2.2.4.7 HVDC Alternative Route 4-C

HVDC Alternative Route 4-C corresponds to Applicant Proposed Route Link 5.

Field of Dreams. HVDC Alternative Route 4-C would be located 2.3 miles to the north of the Field of Dreams ball field. Dense trees in the FG would obscure views of the Project from this location, resulting in no visual impact.

Scott Farm. HVDC Alternative Route 4-C would be located 0.7 mile away in the FG. The large transmission line structures would be noticeable in view of the residences nearby and introduce a strong vertical element not present in the existing landscape (as described in Section 3.18.4.1). Portions of the structures would be screened by the rolling hills and tall vegetation, resulting in moderate contrast. Because moderate contrast would be created by the Project in the FG distance zone for high sensitive residential viewers associated with this KOP, viewer concern impacts would be moderate. Overall visual impacts would also be moderate. A visual simulation for this KOP is provided in Appendix K.

Van Buren. HVDC Alternative Route 4-C would be located 1.1 miles to the northeast of this KOP. Large trees and rolling terrain would obscure views of the transmission line structures from this location, resulting in no visual impact.

3.18.6.3.2.2.4.8 HVDC Alternative Route 4-D

HVDC Alternative Route 4-D corresponds to Applicant Proposed Route Links 4, 5 and 6.

Bluff Hole Park. See description of Bluff Hole Park KOP for HVDC Alternative Route 4-A. Distance and visibility are the same.

Boys and Girls Camp. See description of Boys and Girls Camp KOP for HVDC Alternative Route 4-A. Distance and visibility are the same.

Cedarville. HVDC Alternative Route 4-D would be located 0.8 mile to the southeast. Structures would be partially screened by FG vegetation and terrain, but the top portion would be clearly visible, extending above tree line. The addition of the proposed transmission line structures would introduce new vertical elements to the landscape and result in strong contrast. Because strong contrast would be created by the Project in the MG distance zone for high sensitive residential viewers represented by this KOP, viewer concern impacts would be moderate–high. Overall visual impacts are anticipated to be high because of the strong contrast introduced in the MG distance zone.

City Park/Ball Fields and Rudy. See description of Bluff Hole Park KOP for HVDC Alternative Route 4-A. Distance and visibility are the same.

Frog Bayou Creek. See description of Frog Bayou Creek KOP for HVDC Alternative Route 4-A. Distance and visibility are the same.

Mulberry River and Trail of Tears. See description of Mulberry River and Trail of Tears KOP for HVDC Alternative Route 4-A. Distance and visibility are the same.

Trail of Tears and Scenic Highway 220. HVDC Alternative Route 4-D would cross the highway about 0.1 mile to the southeast. The proposed transmission line structures would be much larger and different in form than existing elements on the landscape and be dominant in the view of people traveling the scenic highway. In addition to the structures, the ROW clearing would create strong lines in the landscape that would be highly visible from the roadway. This KOP represents views from the Trail of Tears and scenic highway, so visual concern is high and would result in strong visual contrast. Because strong contrast would be created by the Project in the FG distance zone for high sensitive viewers associated with this scenic travel route, viewer concern impacts would be high. Overall visual impacts would also be high. Because most viewers in this location would be traveling on the highway, views would primarily be of short duration.

Van Buren. See description of Van Buren KOP for Applicant Proposed Route Link 4. Distance and visibility are the same.

3.18.6.3.2.2.4.9 HVDC Alternative Route 4-E

HVDC Alternative Route 4-E corresponds to Applicant Proposed Route Links 8 and 6.

Clarksville. HVDC Alternative Route 4-E would be located 0.4 mile to the southeast of the Clarksville KOP, representing views from a residential area. The transmission line structures would be highly noticeable and visible across the open agricultural fields. The Project would introduce tall, vertical, geometric structures into a relatively rural and natural landscape, creating strong contrast. Strong contrast created by the Project in the FG/MG distance zone for high sensitive viewers associated with this scenic travel route would result in high viewer concern impacts. Overall visual contrast would be strong and HVDC Alternative Route 4-E would result in high overall visual impacts in this location.

Coal Hill. HVDC Alternative Route 4-E would be located 3.2 miles to the north and would not be visible due to rolling hills and dense vegetation. There would be no overall visual impact.

Hagarville. HVDC Alternative Route 4-E would be located 2.3 miles south. The transmission line structures of HVDC Alternative Route 4-E would not be visible from this location due to FG vegetation and terrain screening, resulting in no visual impact in this location.

Highway 21 Scenic Byway. HVDC Alternative Route 4-E would cross the highway approximately 0.4 mile to the south-southeast in the FG distance zone. The transmission line structures would be much greater in scale than the existing wood structures in view and introduce additional vertical elements into the landscape. The structures would be clearly visible above tree line across the highway, resulting in strong visual contrast. Strong contrast created by the Project in the FG distance zone for high sensitive viewers associated with this scenic travel route would result in high viewer concern impacts. Overall visual impacts would also be high. Because most viewers in this location would be traveling on the highway, views would be primarily of short duration.

Lamar. HVDC Alternative Route 4-E would be located 3.25 miles to the north of this KOP, but would not be visible due to FG vegetation and terrain, resulting in no visual impact.

Ozark. See description of Ozark KOP for HVDC Alternative Route 4-B. Distance and visibility are the same.

Wiederkehr Village and Highway 186. HVDC Alternative Route 4-E would be located 0.6 mile to the northwest. The transmission line structures may be partially visible from this location and, if so, would appear as small dark vertical elements appearing above tree line on the horizon, resulting in weak visual contrast. At this distance, weak contrast created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP would result in low viewer concern impacts. Overall visual impacts would be low.

3.18.6.3.2.2.4.10 Region 4 Alternative Comparison

Table 3.18-23 provides a comparison of the visual impacts for Region 4.

Table 3.18-23:
Visual Impact Comparison Summary—Region 4

Proposed and Alternative Routes	Miles of Distinct Lands Crossed	Miles of Common Lands Crossed	Miles of Developed Lands Crossed	Residences within 0.5 mile
HVDC Alternative Route 4-A	10.2	17.7	30.6	1,030
APR Links Corresponding to Alternative 4-A	11.6	47.3	1.7	1,039
HVDC Alternative Route4-B	19.6	15.1	44.2	1,094
APR Links Corresponding to Alternative 4-B	15.8	58.3	7.4	1,735
HVDC Alternative Route4-C	1.4	1.9	0.1	278
APR Links Corresponding to Alternative 4-C	0.9	1.2	0.1	123
HVDC Alternative Route 4-D	4.9	10.6	9.9	882
APR Links Corresponding to Alternative 4-D	3.8	20.4	1.2	719
HVDC Alternative Route 4-E	11.0	24.6	1.2	901
APR Links Corresponding to Alternative 4-E	7.6	11.0	20.3	527

HVDC Alternative Route 4-A. Visual impact to public, private, and state lands resulting from the operations and maintenance of HVDC Alternative Route 4-A is anticipated to be mostly moderate–high; higher impacts would be associated with Little Lee Creek, Mulberry River, and Frog Bayou Creek. The majority of the area that would be crossed by HVDC Alternative 4-A is flat to rolling terrain with dispersed residential areas. There are approximately 1,030 residences within 0.5 mile of the alignment of this alternative route. HVDC Alternative Route 4-A would cross fewer lands classified as Distinct (10.2 miles) and Common (17.7 miles) than the corresponding links of the Applicant Proposed Route, which cross 11.6 miles of lands classified as Distinct 47.3 miles of lands classified as Common.

HVDC Alternative Route 4-B. Visual impact to public, private, and state lands resulting from the operations and maintenance of HVDC Alternative Route 4-B is anticipated to be mostly high and are associated with Little Lee Creek and Mulberry River. The majority of the area that would be crossed by HVDC Alternative Route 4-B is flat to rolling terrain with dispersed residential areas. There are approximately 1,094 residences within 0.5 mile of the alignment of this alternative route, which would be less than the corresponding links of the Applicant Proposed Route (1,735 residences within 0.5 mile of the alignment).

HVDC Alternative Route 4-C. Visual impact to public, private, and state lands resulting from the operations and maintenance of HVDC Alternative Route 4-C is anticipated to be mostly moderate–low because towns and scattered residences are present. The majority of the area that would be crossed by HVDC Alternative Route 4-C is flat to rolling terrain with dispersed residential areas. There are approximately 278 residences within 0.5 mile of the alignment of this alternative route, the least of any of the other HVDC alternative routes. HVDC Alternative Route 4-C crosses more lands classified as Distinct (1.4 miles) and Common (1.9 miles) than the corresponding links of the Applicant Proposed Route, which cross 0.9 mile of lands classified as Distinct and 1.2 miles classified as Common.

HVDC Alternative Route 4-D. Visual impact to public, private, and state lands resulting from the operations and maintenance of HVDC Alternative Route 4-D is anticipated to be mostly high because of the abundance of sensitive sites such as Mulberry River, Frog Bayou Creek, and the Trail of Tears. The majority of the area that would be crossed by HVDC Alternative 4-D is flat to rolling terrain with dispersed residential areas. There are approximately 882 residences within 0.5 mile of the alignment of this alternative route, more than the corresponding links of the Applicant Proposed Route, in which there are 719 residences within 0.5 of the alignment. HVDC Alternative Route 4-D crosses more lands classified as Distinct (4.9 miles), but fewer land classified as Common (10.6 miles) than the corresponding links of the Applicant Proposed Route, which cross 3.8 miles of lands classified as Distinct and 20.4 miles of lands classified as Common.

HVDC Alternative Route 4-E. Visual impact to public, private, and state lands resulting from the operations and maintenance of HVDC Alternative Route 4-E is anticipated to be mostly moderate due to scattered residences and towns as well as Highway 21, a scenic byway. The majority of the area that would be crossed by HVDC Alternative 4-E is flat to rolling terrain with dispersed residential areas. There are approximately 901 residences within 0.5 mile of the alignment of this alternative route, more than the corresponding links of the Applicant Proposed Route, in which there are 527 residences within 0.5 mile of the alignment. HVDC Alternative Route 4-E crosses 11.0 miles of lands classified as Distinct and 24.6 miles of lands classified as Common, which is more than the corresponding Applicant Proposed Route links which crosses 7.6 miles of lands classified as Distinct and 11.0 miles classified as Common.

3.18.6.3.2.2.5 Region 5

A description for Region 5 is provided in Section 3.18.6.2.3.2.7. This region would have residential viewers as well as several parks and recreational areas where viewers would be more sensitive due to extended viewing periods at these resources. The visual impacts for the Region 5 KOPs are listed in Table 3.18-24 and described below.

Table 3.18-24:
Visual Impact Summary of KOPs—HVDC Alternative Routes—Region 5

KOP	AR	Distance (Miles)	Viewer Concern	Landscape Category	Visibility	Viewer Concern Impact	Contrast	Overall Impact
Dover and JP Lovelady Ball Park	5-A	3.2	High	Common	No	None	No Contrast/ Not Visible	No Impact
Hector	5-A	3	High	Common	No	None	No Contrast/ Not Visible	No Impact
Highway 7 (Scenic Byway)	5-A	0.1	High	Common	Yes	High	Strong	High
Pope Co. Residential Cluster	5-A	0.8	High	Distinct	Yes	Low	Weak	Moderate–Low
Boy Scout Campground	5-B	2.1	High	Common	No	None	No Contrast/ Not Visible	No Impact
Damascus	5-B	1.5	High	Common	No	None	No Contrast/ Not Visible	No Impact

Table 3.18-24:
Visual Impact Summary of KOPs—HVDC Alternative Routes—Region 5

KOP	AR	Distance (Miles)	Viewer Concern	Landscape Category	Visibility	Viewer Concern Impact	Contrast	Overall Impact
Highway 9 Scenic Highway	5-B	0.5	High	Common	Yes	Moderate–High	Strong	High
Twin Groves	5-B	0.1	High	Common	Yes	High	Strong	High
Wonderview School	5-B	0.7	High	Common	Yes	Moderate	Moderate	Moderate
Guy	5-B, 5-E	3	High	Common	No	None	No Contrast/ Not Visible	No Impact
Highway 25 Scenic Highway	5-B, 5-E	0.1	High	Common	Yes	High	Strong	High
Quitman	5-B, 5-E	1.4	High	Common	Yes	Low	Weak	Low
Highway 16 (Scenic Highway)	5-B, 5-E, 5-F	0.2	High	Common	Yes	High	Strong	High
Rose Bud City Park	5-B, 5-E, 5-F	2.1	High	Developed	No	None	No Contrast/ Not Visible	No Impact
Highway 16 (Scenic Highway)	5-C	0.3	High	Common	Yes	High	Strong	High
Steprock	5-C	0.4	High	Developed	Yes	Moderate	Weak	Moderate–Low
White River	5-D	1	Moderate	Distinct	Yes	Moderate–High	Strong	High

3.18.6.3.2.2.5.1 HVDC Alternative Route 5-A

HVDC Alternative Route 5-A corresponds to Applicant Proposed Route Link 1.

Dover and JP Lovelady Ball Park. See the Applicant Proposed Route Link 1 description. HVDC Alternative Route 5-A would be located 3.2 miles to the north-northwest.

Hector. HVDC Alternative Route 5-A would be located 3 miles to the south. Dense vegetation in the FG/MG would screen all views of the alternative route at this location, resulting in no visual impact.

Highway 7 (Scenic Byway). HVDC Alternative Route 5-A would be located 0.1 mile north in the FG of this view. Motorists would clearly see the structures as they travel the Scenic Byway, and at this distance, the structures would be a dominant element on the landscape. HVDC Alternative Route 5-A would also require vegetation clearing for the ROW in this area and would be visible from the Scenic Byway, appearing as strong lines in the vegetation. The visual concern is high because it represents views from a Scenic Byway and the overall visual contrast at this location would be strong. Strong contrast created by the Project in the FG distance zone for high sensitive residential viewers associated with this KOP would result in high viewer concern impacts. Given strong contrast introduced into the landscape for high sensitive residential viewers in the FG distance zone, overall visual impacts at this KOP would be high.

Pope County Residential Cluster. See description of Pope County Residential Cluster for Applicant Proposed Route Link 1. Distance and visibility are the same.

3.18.6.3.2.2.5.2 HVDC Alternative Route 5-B

HVDC Alternative Route 5-B corresponds to Applicant Proposed Route Links 3, 4, 5 and 6.

As described in Appendix M and summarized in Section 2.4.2.5, a route adjustment was developed for HVDC Alternative Route 5-B to maintain an end-to-end route with Applicant Proposed Route Links 2 and 3, Variation 1. Alternative Route 5-B route adjustment would shift the route west to connect with the modified Applicant Proposed Route. The route adjustment would be located within approximately 400 feet of the original HVDC Alternative Route 5-B alignment and would be located farther from some high sensitive residential viewers. Overall, visual impacts would be reduced for residential viewers because less of the structures would be visible extending above the tree line because of the increased distance.

Boy Scout Campground. HVDC Alternative Route 5-B would be located 2.1 miles to the south of the Boy Scout Campground. Dense vegetation in the FG would screen all views of HVDC Alternative Route 5-B in this location, resulting in no visual impact.

Damascus. HVDC Alternative Route 5-B would be located 1.5 miles to the south, but views would be screened by FG vegetation and terrain, resulting in no visual impact.

Guy. HVDC Alternative Route 5-B would be located 3.0 miles to the north. The rising terrain and dense vegetation in the FG would screen all views of HVDC Alternative Route 5-B in this location, resulting in no visual impact. A visual simulation for this KOP is provided in Appendix K.

Highway 9 Scenic Highway. HVDC Alternative Route 5-B would cross Highway 9, 0.5 mile to the south The structures would be highly visible as motorists approach the highway crossing and they would differ noticeably in scale, form, and line, than existing elements on the landscape (as described in Section 3.18.5.4.1). ROW vegetation would be noticeable along the sides of the highway, creating additional contrast. Strong contrast created by the Project in the MG distance zone for high sensitive recreational viewers associated with this KOP would result in moderate–high viewer concern impacts. Given the strong contrast introduced into the landscape for high sensitive recreational viewers in the MG distance zone, overall visual impacts at this KOP would be high.

Highway 16 Scenic Highway. HVDC Alternative Route 5-B would be located 0.2 mile away and be highly visible on the landscape. Transmission line structures would be seen crossing the open field in front of a line of trees in the FG. Because of their scale, the structures would be highly visible to motorists, extending above the trees and creating a dominant feature on the landscape. HVDC Alternative Route 5-B would introduce form and line to the landscape that is not currently present at this location, resulting in strong contrast. Strong contrast created by the Project in the FG distance zone for high sensitive viewers associated with this scenic highway would result in high viewer concern impacts. Overall impacts would be high.

Highway 25 Scenic Highway. HVDC Alternative Route 5-B would be visible on the landscape 0.1 mile to the south of this KOP. The tall vertical structures would create a repeating pattern different in form and scale than existing elements on the landscape. HVDC Alternative Route 5-B would be dominant in view when motorists traveled along Highway 25 in this location, and ROW clearing would become evident as motorists approached the highway crossing. The visual concern is high because it represents views from a scenic highway and the resulting contrast would be strong. Strong contrast created by the Project in the FG distance zone for high sensitive recreational viewers associated with this KOP would result in high viewer concern impacts. Given the strong contrast introduced into the landscape for high sensitive recreational viewers in the FG distance zone, overall visual impacts at this KOP would be high.

Quitman. HVDC Alternative Route 5-B would be located 1.4 miles to the south. Dense vegetation in the FG would screen much of transmission line structures from view, but some structures may be visible extending above the tree line. The visible structures would appear as small dark objects that would add to the already irregular line of trees on the horizon, resulting in weak contrast. Weak contrast created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP would result in low viewer concern impacts. Given the weak contrast introduced into the landscape for high sensitive residential viewers in the MG distance zone, overall visual impacts at this KOP would be low. A visual simulation for this KOP is provided in Appendix K.

Rose Bud City Park. HVDC Alternative Route 5-B would be located 2.1 miles to the north of Rose Bud City Park, but any potential views of the transmission line structures in this location would be screened by FG terrain and vegetation, resulting in no visual impact.

Twin Groves. HVDC Alternative Route 5-B would be located 0.1 mile to the northwest. Dense trees line the road in this area, but the transmission line structures would be visible through the trees and extend above the trees. The form and line of HVDC Alternative Route 5-B would be noticeably different than anything in the area and would result in strong contrast. Strong contrast created by the Project in the FG distance zone for high sensitive residential viewers associated with this KOP would result in high viewer concern impacts. Overall visual impacts at this KOP would be high.

Wonderview School. HVDC Alternative Route 5-B would be visible as it crosses the highway 0.7 mile to the south and the structures would be visible extending about trees. The vegetation in the FG and MG would absorb some of the impact and the overall contrast would be moderate. Moderate contrast created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP would result in moderate viewer concern impacts. Overall visual impacts at this KOP would be moderate.

3.18.6.3.2.2.5.3 HVDC Alternative Route 5-C

HVDC Alternative Route 5-C corresponds to Applicant Proposed Route Links 6 and 7.

Highway 16 Scenic Highway. HVDC Alternative Route 5-C would cross Scenic Highway 16, 0.3 mile to the southeast. Transmission line structures would be clearly visible and noticeable across the open field in the FG and extended above tree line introducing new, vertical elements to the landscape. Because of the scale of the structures, at this distance they would be a dominant form on the landscape and result in strong contrast. Strong contrast created by the Project in the FG distance zone for high sensitive viewers associated with this scenic highway would result in high viewer concern impacts. Given the strong contrast introduced into the landscape for high sensitive viewers in the FG distance zone, overall visual impacts at this KOP would be high.

Steprock. See the Applicant Proposed Route Link 7 description.

3.18.6.3.2.2.5.4 HVDC Alternative Route 5-D

HVDC Alternative Route 5-D corresponds to Applicant Proposed Route Link 9.

White River. HVDC Alternative Route5-D transmission line would be located 1 mile to the northeast. The structures on either side of the river would be visible, extending above tree line, and the conductors would be seen stretching across the river. Some vegetation clearing for the ROW may also be visible on the banks. This KOP represents views from a major waterbody, but potential viewers are low, so visual concern is moderate. HVDC Alternative Route 5-D would introduce large vertical structures to a very natural landscape and result in strong contrast. Strong contrast created by the Project in the MG distance zone for high sensitive recreational viewers associated with this KOP would result in moderate–high viewer concern impacts. Given the strong contrast introduced into the landscape for high sensitive recreational viewers in the MG distance zone, overall visual impacts at this KOP would be high.

3.18.6.3.2.2.5.5 HVDC Alternative Route 5-E

HVDC Alternative Route 5-E corresponds to Applicant Proposed Route Links 4, 5 and 6.

As described in Appendix M and summarized in Section 2.4.2.5, a route adjustment was developed for HVDC Alternative Route 5-E to maintain an end-to-end route with Applicant Proposed Route Links 3 and 4, Variation 2. The route adjustment would shift the route west to connect with the variation of the Applicant Proposed Route. The route adjustment would be located within approximately 700 feet of the original HVDC Alternative Route 5-B alignment and would be located farther from some high sensitive residential viewers. Overall, visual impacts would be reduced for residential viewers because less of the structures would be visible extending above the tree line because of the increased distance.

Guy. See description of Guy KOP for Alternative Route 5-B. Distance and visibility are the same.

Highway 16 Scenic Highway. See description of Highway 16 Scenic Highway KOP for HVDC Alternative Route 5-B. Distance and visibility are the same.

Highway 25 Scenic Highway. See description of Highway 25 Scenic Highway KOP for HVDC Alternative Route 5-B. Distance and visibility are the same.

Quitman. See description of Quitman KOP for HVDC Alternative Route 5-B. Distance and visibility are the same.

Rose Bud City Park. See description of Rose Bud City Park KOP for HVDC Alternative Route 5-B. Distance and visibility are the same.

3.18.6.3.2.2.5.6 HVDC Alternative Route 5-F

HVDC Alternative Route 5-F corresponds to Applicant Proposed Route Links 5 and 6.

Highway 16 Scenic Highway. See description of Highway 16 Scenic Highway KOP for HVDC Alternative Route 5-B. Distance and visibility are the same.

Rose Bud City Park. See description of Rose Bud City Park KOP for HVDC Alternative Route 5-B. Distance and visibility are the same.

3.18.6.3.2.2.5.7 Region 5 Alternative Comparison

Table 3.18-25 provides a comparison of the visual impacts for Region 5.

Table 3.18-25:
Visual Impact Comparison Summary—Region 5

Proposed and Alternative Routes	Miles of Distinct Lands Crossed	Miles of Common Lands Crossed	Miles of Developed Lands Crossed	Residences within 0.5 mile
HVDC Alternative Route 5-A	7.6	4.9	0.2	165
APR Links Corresponding to Alternative 5-A	7.9	4.3	0.2	136
HVDC Alternative Route5-B	12.2	57.2	1.8	975
APR Links Corresponding to Alternative 5-B	16.7	48.5	2.3	868
HVDC Alternative Route5-C	1.1	7.8	0.3	221
APR Links Corresponding to Alternative 5-C	1.5	7.6	0.3	175
HVDC Alternative Route5-D	3.8	17	1	382
APR Links Corresponding to Alternative 5-D	1.5	17.4	1.7	305
HVDC Alternative Route5-E	4.9	30.6	0.9	421
APR Links Corresponding to Alternative 5-E	5.2	26.6	1.4	578
HVDC Alternative Route5-F	3.0	18.7	0.6	239
APR Links Corresponding to Alternative 5-F	4.1	13.9	0.9	328

HVDC Alternative Route 5-A. Visual impact to public, private, and state lands resulting from the operations and maintenance of HVDC Alternative Route 5-A is anticipated to be mostly moderate with higher impacts associated with Highway 7 Scenic Byway. The majority of the area that would be crossed by HVDC Alternative Route 5-A is flat to rolling terrain with dispersed residential areas. There are approximately 165 residences within 0.5 mile of the alignment of this alternative route. The transmission line structures would cross slightly fewer lands classified as Distinct (7.6 miles) but more lands classified as Common (4.9 miles) than the corresponding links of the Applicant Proposed Route, which would cross 7.9 miles of lands classified as Distinct and 4.3 miles of lands classified as Common.

HVDC Alternative Route 5-B. Visual impact to public, private, and state lands resulting from the operations and maintenance of HVDC Alternative Route 5-B is anticipated to be mostly moderate–high and are associated with scattered residences and scenic highways. The majority of the area that would be crossed by HVDC Alternative 5-B is flat to rolling terrain with dispersed residential areas. There are approximately 975 residences within 0.5 mile of the alignment of this alternative route, fewer than in the corresponding links of the Applicant Proposed Route (868 residences within 0.5 mile of the alignment), but more than any other HVDC alternative route. HVDC Alternative Route 5-B crosses fewer lands classified as Distinct (12.2 miles) and lands classified as Common (57.2) than the corresponding links of the Applicant Proposed Route, which cross 16.7 miles of lands classified as Distinct and 48.5 miles of lands classified as Common.

HVDC Alternative Route 5-C. Visual impact to public, private, and state lands resulting from the operations and maintenance of HVDC Alternative Route 5-C is anticipated to be mostly moderate with higher visual impacts associated with Scenic Highway 16. The majority of the area that would be crossed by HVDC Alternative Route 5-C is flat to rolling terrain with dispersed residential areas. There are approximately 221 residences within 0.5 mile of the alignment of this alternative route, the least of any of the other HVDC alternative routes with the exception of HVDC Alternative 5-A. HVDC Alternative 5-C crosses fewer lands classified as Distinct (1.1 miles) than the corresponding links of the Applicant Proposed Route, HVDC Alternative Route 5-A, or Alternative Route 5-B. HVDC Alternative 5-C would also cross slightly more lands classified as Common (7.8 miles) than the corresponding links of the Applicant Proposed Route, which cross 7.6 miles of lands classified as Common.

HVDC Alternative Route 5-D. Visual impact to public, private, and state lands resulting from the operations and maintenance of HVDC Alternative Route 5-D is anticipated to be mostly high because of the abundance of sensitive sites like the White River as well as scattered residences and towns. The majority of the area that would be crossed by HVDC Alternative Route 5-D is flat to rolling terrain with dispersed residential areas. There are approximately 382 residences within 0.5 mile of the alignment of this alternative route, which is more than the corresponding links of the Applicant Proposed Route, in which there are 305 residences within 0.5 mile of the alignment). HVDC Alternative Route 5-D crosses fewer lands classified as Distinct (3.8 miles) than HVDC Alternative Routes 5-A or 5-B (7.6 miles and 12.2 miles, respectively). HVDC Alternative 5-C would still cross the least amount of land classified as Distinct. HVDC Alternative 5-D would cross slightly fewer lands classified as Common (17.0 miles), compared with the corresponding links of the Applicant Proposed Route, which cross 17.4 miles of land classified as Common.

HVDC Alternative Route 5-E. Visual impact to public, private, and state lands resulting from the operations and maintenance of HVDC Alternative Route 5-E is anticipated to be mostly moderate because of scattered residences and towns as well as scenic highways. The majority of the area that would be crossed by HVDC Alternative Route 5-E is flat to rolling terrain with dispersed residential areas. There are approximately 421 residences within 0.5 mile of the alignment of this alternative route. HVDC Alternative Route 5-E crosses 4.9 miles of lands classified as Distinct and 30.6 miles of land classified as Common. HVDC Alternative Route 5-E would cross fewer lands classified as Distinct than the corresponding links of the Applicant Proposed Route (5.2 miles), but more lands classified as Common (26.6 miles).

HVDC Alternative Route 5-F. Visual impact to public, private, and state lands resulting from the operations and maintenance of HVDC Alternative Route 5-F is anticipated to be mostly moderate because of scattered residences and towns as well as scenic highways. The majority of the area that would be crossed by HVDC Alternative Route 5-F is flat to rolling terrain with dispersed residential areas. There are approximately 239 residences within 0.5 mile of the alignment of this alternative route. HVDC Alternative Route 5-F crosses 3.0 miles of lands classified as Distinct and 19.7 miles of lands classified as Common. HVDC Alternative Route 5-F would cross fewer lands classified as Distinct than the corresponding links of the Applicant Proposed Route, HVDC Alternative Route 5-A, HVDC Alternative Route 5-B, HVDC Alternative Route 5-D, or HVDC Alternative Route 5-E but more than HVDC Alternative Route 5-C.

3.18.6.3.2.2.6 Region 6

A description for Region 6 is provided in Section 3.18.6.2.3.2.11. Rural residences and small towns would make up majority of the sensitive viewers in this location and the areas of flat, agricultural lands would increase the viewing distance in many of these areas. The visual impacts for the Region 6 KOPs are listed in Table 3.18-26 and described below.

Table 3.18-26:
Visual Impact Summary of KOPs—HVDC Alternative Routes—Region 6

KOP	AR	Distance (Miles)	Viewer Concern	Landscape Category	Visibility	Viewer Concern Impact	Contrast	Overall Impact
Fisher and Park	6-A	0.5	High	Developed	Yes	High	Strong	Moderate–High
Weldon	6-A	2.8	High	Common	Yes	Low	Weak	Low
Amagon	6-B	0.2/0.4	High	Developed	Yes	Moderate–High	Moderate	Moderate
Highway 14 Scenic Highway	6-B	0.3	High	Common	Yes	High	Strong	High
Crowley's Ridge Byway	6-C	0.2	High	Common	Yes	High	Strong	High
Crowley's Ridge Byway	6-D	2.8	High	Common	Yes	Low	Low	Low

3.18.6.3.2.2.6.1 HVDC Alternative Route 6-A

HVDC Alternative Route 6-A corresponds to Applicant Proposed Route Links 2, 3, and 4.

As described in Appendix M and summarized in Section 2.4.2.6, a route adjustment was developed for HVDC Alternative Route 6-A to maintain an end-to-end route with Applicant Proposed Route Link 2, Variation 1. The Applicant Proposed Route Link 2, Variation 1, includes extending the route east by the same length that the route variation is reduced; therefore, no changes to visual impacts are anticipated as a result of the route adjustment.

Fisher and Park. HVDC Alternative Route 6-A would be visible in the open field 0.5 mile to the south. The structures would be a dominate feature on the landscape and would add a pattern of vertical structures with larger form than existing vertical elements. Although portions of the transmission line may be screened by development and vegetation in the FG distance zone, contrast would be strong because of the distance of the structures. Strong contrast created by the Project in the FG distance zone for high sensitive residential viewers associated with this KOP would result in high viewer concern impacts. Overall visual impacts would be moderate-high.

Weldon. HVDC Alternative Route 6-A would be located 2.8 miles to the northeast. The flat open landscape would allow for multiple visible transmission-line structures, but at a distance of 2.8 miles, they would appear as a row of dark vertical elements and would be co-dominant with the existing structures on the landscape; therefore, contrast is weak. Weak contrast created by the Project in the MG distance zone for high sensitive residential viewers associated with this KOP would result in low viewer concern impacts. At this distance, and given the presence of existing transmission line structures, the overall visual impacts would be low.

3.18.6.3.2.2.6.2 HVDC Alternative Route 6-B

HVDC Alternative Route 6-B corresponds to Applicant Proposed Route Link 3.

Amagon. HVDC Alternative Route 6-B would be located 0.2 mile to the south/southwest, running parallel to the existing H-frame structures and 161kV transmission line near the community represented by this KOP. This KOP represents views from a residential area and the visual concern is high. The proposed transmission line structures would be considerably larger and different in form than the existing structures, making them visible above tree line and resulting moderate contrast. Moderate contrast created by the Project in the FG distance zone for high sensitive residential viewers associated with this KOP would be moderate–high. Given the presence of existing transmission structures in the landscape and the screening provided by development and vegetation, overall impacts are anticipated to be moderate.

Highway 14 Scenic Highway. HVDC Alternative Route 6-B would cross Highway 14 0.3 mile from this location and then run parallel to the roadway. This is a flat and open landscape and the transmission line structures would be dominant features in the FG where they cross the highway and then continue as a dominant element as they follow the road into the distance. This KOP represents views from a scenic highway, so visual concern is high. Strong contrast created by the Project in the immediate FG for high sensitive viewers represented by this scenic travel route would result in high viewer concern impacts. HVDC Alternative Route 6-B would result in high overall visual impact in this location. A visual simulation for this KOP is provided in Appendix K.

3.18.6.3.2.2.6.3 HVDC Alternative Route 6-C

HVDC Alternative Route 6-C corresponds to Applicant Proposed Route Links 3, 4 and 5.

Crowley's Ridge Scenic Byway. HVDC Alternative Route 6-C would be located 0.2 mile to the southeast, crossing the open field and Scenic Byway. Structures would be dominant features on the landscape and motorists traveling the Scenic Byway would have unobstructed views. The transmission line structures would attract attention as large vertical elements on an open landscape and result in strong visual contrast. Strong contrast created by the Project in the immediate FG for high sensitive viewers represented by this scenic travel route would result in high viewer concern impacts. Since this KOP represents views from a Scenic Byway, visual concern is high and the overall visual impact would be high at this location.

3.18.6.3.2.2.6.4 HVDC Alternative Route 6-D

HVDC Alternative Route 6-D corresponds to Applicant Proposed Route Link 7.

Crowley's Ridge Scenic Byway. HVDC Alternative Route 6-D would be located 2.8 miles southwest of this KOP in the MG distance zone. The transmission structures would mostly be screened by vegetation along the highway or along agricultural fields in the FG and MG distance zones. Where the transmission line is visible from along the highway, it would be back-dropped by vegetation in the BG distance zone and the structures would blend into the surrounding landscape. Since the transmission line would either be screened or appear subordinate in the landscape, contrast would be weak. Weak contrast created by the Project in the MG distance zone for high sensitive viewers associated with this scenic travel route would result in low viewer concern impacts. In addition, since the Project would be a subordinate feature where visible in a Common landscape, impacts to landscape scenery would be moderate–low. Overall visual impacts are anticipated to be low.

3.18.6.3.2.2.6.5 Region 6 Alternative Comparison

Table 3.18-27 provides a comparison of the visual impacts for Region 6.

Table 3.18-27:
Visual Impact Comparison Summary—Region 6

Proposed and Alternative Routes	Miles of Distinct Lands Crossed	Miles of Common Lands Crossed	Miles of Developed Lands Crossed	Residences within 0.5 mile
HVDC Alternative Route 6-A	0.1	15.3	0.9	45
APR Links Corresponding to Alternative 6-A	0.1	16.9	0.8	64
HVDC Alternative Route 6-B	0	13.3	0.8	141

Table 3.18-27:
Visual Impact Comparison Summary—Region 6

Proposed and Alternative Routes	Miles of Distinct Lands Crossed	Miles of Common Lands Crossed	Miles of Developed Lands Crossed	Residences within 0.5 mile
APR Links Corresponding to Alternative 6-B	0.1	9.3	0.3	24
HVDC Alternative Route 6-C	2.7	19.9	0.6	66
APR Links Corresponding to Alternative 6-C	3.9	20.5	0.53	66
HVDC Alternative Route 6-D	0.3	8.8	0.1	5
APR Links Corresponding to Alternative 6-D	0.2	8.1	0.2	0

HVDC Alternative Route 6-A. Visual impact to public, private, and state lands resulting from the operations and maintenance of HVDC Alternative Route 6-A is anticipated to be mostly moderate with towns and residences being the primary sensitive viewers. HVDC Alternative Route 6-A crosses almost entirely rural agricultural land with the exception of the Cache River crossing, but the area crossed does not have sensitive viewers associated with it. Similar to the corresponding links of the Applicant Proposed Route, HVDC Alternative Route 6-A crosses almost entirely lands classified as Common (15.3 miles) with very small lengths of lands classified as Distinct and Developed. The total number of residences within 0.5 mile with potential visual impacts is 45, compared to 64 residences within 0.5 mile of the corresponding links of the Applicant Proposed Route.

HVDC Alternative Route 6-B. Visual impact to public, private, and state lands resulting from the operations and maintenance of HVDC Alternative Route 6-B is anticipated to be mostly moderate–high with the majority of sensitive viewers being residences. The HVDC Alternative Route 6-B crosses almost entirely rural agricultural land except at the Cache River crossing, but the area crossed does not have sensitive viewers associated with it. Throughout the length of the HVDC Alternative Route 6-B, 141 residences are within 0.5 mile of the route, compared to only 24 with the corresponding links of the Applicant Proposed Route.

HVDC Alternative Route 6-C. Visual impact to public, private, and state lands resulting from the operations and maintenance of HVDC Alternative Route 6-C is anticipated to be mostly low as it crosses through the rural agricultural lands, but it would have high impacts in the Crowley's Ridge region. HVDC Alternative Route 6-C would cross 2.7 miles of lands classified as Distinct compared to 3.9 miles with the corresponding links of the Applicant Proposed Route; both would be within 0.5 mile of 66 residences.

HVDC Alternative Route 6-D. Visual impact to public, private, and state lands resulting from the operations and maintenance of HVDC Alternative Route 6-C is anticipated to be mostly low. The alternative would cross a rural agricultural landscape, but it would cross 0.3 mile of lands classified as Distinct compared to the corresponding links of the Applicant Proposed Route that only cross lands classified as Common and Developed. The area has low numbers of sensitive resources and the majority of viewers would be residences. The total residences within 0.5 mile of HVDC Alternative Route 6-D would be 5 compared to 38 in the corresponding links of the Applicant Proposed Route.

3.18.6.3.2.2.7 Region 7

A description for Region 7 is provided in Section 3.18.6.2.3.2.11. As the Project moves east, there would be areas of higher population and correspondingly higher amounts of sensitive residential viewers, although the more developed areas have more structures and vertical elements that would offer a higher level of screening and reduce the viewing distance for many of the sensitive viewing areas. The visual impacts for the Region 7 KOPs are listed in Table 3.18-28 and described below.

Table 3.18-28:
Visual Impact Summary of KOPs—HVDC Alternative Routes—Region 7

KOP	AR	Distance (Miles)	Viewer Concern	Landscape Category	Visibility	Viewer Concern Impact	Contrast	Overall Impact
Dyess	7-A	2.6	High	Common	Yes	Low	Weak	Low
Johnny Cash Home	7-A	3.5	High	Common	Yes	Low	Weak	Low
Lower Hatchie NWR	7-A	4.7	High	Distinct	No	Low	No Contrast/ Not visible	No Impact
Marked Tree AR	7-A	1	High	Developed	Yes	Low	Weak	Low
McGavock-Grider Park	7-A	1.8	High	Common	Yes	Low	Weak	Low
Mississippi River and Trail of Tears	7-A	0.3	High	Distinct	Yes	High	Strong	High
Tyronza	7-A	2.4	High	Common	Yes	Low	Weak	Low
Wilson Park	7-A	1.8	High	Common	Yes	Low	Weak	Low
Harold Park and Millington	7-B	2	High	Developed	No	Low	No Contrast/ Not visible	No Impact
Wilkinsville	7-B	0.7	High	Common	Yes	Moderate–High	Strong	Moderate–High
Atoka	7-C	0.7	High	Common	No	Low	No Contrast/ Not visible	No Impact
Aycock Park and Millington	7-C	0.2	High	Developed	Yes	Moderate–High	Moderate	Moderate
Harold Park and Millington	7-C	0.6	High	Developed	Yes	Moderate	Moderate	Moderate–Low
Millington East	7-C	0.3	High	Common	Yes	Moderate–High	Moderate	Moderate–High
Millington USA Baseball Stadium	7-C	0.5	High	Developed	Yes	Low	Weak	Low
Rockyford Park	7-C	2.9	High	Developed	No	Low	No Contrast/ Not visible	No Impact
Edmund Orgill Park	7-C, 7-B, 7-D	1.7	High	Distinct	No	Low	No Contrast/ Not visible	No Impact
Atoka	7-D	0.2	High	Common	Yes	High	Strong	High
Atoka Community Park	7-D	3.2	High	Developed	No	Low	No Contrast/ Not visible	No Impact
Munford	7-D	0.4	High	Developed	Yes	Moderate	Weak	Moderate–Low
Rhodes Estates	7-D	0.6	High	Developed	Yes	Low	Weak	Low

3.18.6.3.2.2.7.1 HVDC Alternative Route 7-A

HVDC Alternative Route 7-A corresponds to Applicant Proposed Route Links 2, 3 and 4.

Dyess. HVDC Alternative Route 7-A would be located 2.6 miles to the south. Since this is a very flat landscape with panoramic views, the transmission line structures may be visible in the distance and appear as a series of dark vertical objects on the horizon and would result in weak contrast. Weak contrast created by the Project in the MG distance zone for high sensitive residential viewers would result in low viewer concern impacts. Given the distance and partial/intermittent screening of the Project, overall visual impacts would be low from this location.

Johnny Cash Home. HVDC Alternative Route 7-A would be located 3.5 miles south of the Johnny Cash Boyhood Home Historic site, so the visual concern is high. The flat landscape in this area provides panoramic views and the transmission line structures would be faintly visible on the horizon. At this distance, the structures would appear as dark vertical objects creating a pattern on the horizon, resulting in weak visual contrast. Weak contrast created by the Project in the BG distance zone for high sensitive viewers represented by this KOP would result in low viewer concern impacts. Overall visual impacts are anticipated to be low.

Lower Hatchie NWR. HVDC Alternative Route 7-A would be located 4.7 miles to the west. Terrain and dense vegetation would screen all potential views of the transmission line structures at this location, resulting in no visual impact.

Marked Tree. HVDC Alternative Route 7-A would be located 1 mile to the southeast of this location. Existing structures and vegetation in view would screen most of the structures, leaving just the top portion of the HVDC Alternative Route 7-A structures visible. This KOP represents views from a park and recreation area and visual concern is high. There are several existing structures in view, so the proposed structures would result in weak contrast. Weak contrast created by the Project in the MG distance zone for high sensitive residential and recreational viewers represented by this KOP would result in low viewer concern impacts. Overall visual impacts are anticipated to be low. A visual simulation for this KOP is provided in Appendix K.

McGavock-Girder Park. HVDC Alternative Route 7-A would be located 1.8 miles to the south-southwest. The open landscape would offer views of the transmission structures, appearing as a pattern of vertical structures in the distance. The transmission line structures would not be a dominant feature on the landscape and would result in weak visual contrast at this location. Weak contrast created by the Project in the MG distance zone for high sensitive recreational viewers represented by this KOP would result in low viewer concern impacts. Overall visual impacts are anticipated to be low.

Mississippi River and Trail of Tears. HVDC Alternative Route would cross the Mississippi River 0.3 mile from this location. The transmission line structures would be highly visible crossing the open landscape leading up to the river and would introduce tall, vertical, geometric structures, evenly spaced across the landscape, resulting in strong contrast. Transmission line structures on either side of the river crossing would also be visible from this location and would be taller than the transmission structures leading up to the river crossing because of clearance requirements. In addition, markers (which may be orange, yellow, or white) on the transmission lines crossing the river would be added for safety reasons and would add additional contrast. Although an existing 500kV transmission line would be visible in the MG distance zone from this viewpoint, the proposed transmission structures would be closer and much larger in scale. Strong contrast created by the Project in the immediate FG distance zone for high sensitive viewers, concerned with a scarce natural resource, would result in high viewer concern impacts. At this location, the visual contrast would be strong and overall visual impacts would be high. A visual simulation for this KOP is provided in Appendix K.

Tyronza. HVDC Alternative Route 7-A would be located 2.4 miles to the north. Because the landscape in this area is flat and offers panoramic views, the transmission line structures would be visible above the trees in the distance. At this distance, they would appear on the horizon as dark vertical elements and would not appear substantially different than the FG structures, resulting in weak contrast. Weak contrast created by the Project in the MG distance zone for high sensitive residential viewers represented by this KOP would result in low viewer concern impacts. Overall visual impacts are anticipated to be low.

Wilson Park. HVDC Alternative Route 7-A would be located 1.8 miles to the northwest. This KOP represents views from a public park, so visual concern is high. The transmission line structures would be visible as a pattern of vertical objects, evenly spaced along the horizon with different form and line than the existing vertical elements. The proposed structures would be larger in scale than the existing structures, but because of distance, they would not be a dominant element on the landscape. HVDC Alternative Route 7-A would result in weak visual contrast. Weak contrast created by the Project in the MG distance zone for high sensitive residential viewers represented by this KOP would result in low viewer concern impacts. Overall visual impacts are anticipated to be low at this location.

3.18.6.3.2.2.7.2 HVDC Alternative Route 7-B

HVDC Alternative Route 7-B corresponds to Applicant Proposed Route Links 3 and 4.

Edmund Orgill Park. HVDC Alternative Route 7-B would be located 1.7 miles from Edmund Orgill Park. The dense trees and rolling terrain in the FG would screen all views of the transmission line structures, resulting in no visual impact at this location.

Harold Park and Millington. See the Applicant Proposed Route Link 5 description.

Wilkinsville. HVDC Alternative Route 7-B would be located 0.7 mile to the south. The structures would appear as a row of objects extending above the trees in the MG adding a strong vertical element to a landscape. Strong contrast created by the Project in the MG distance zone for high sensitive residential viewers represented by this KOP would result in moderate–high viewer concern impacts. Overall visual impacts are anticipated to be moderate-high.

3.18.6.3.2.2.7.3 HVDC Alternative Route 7-C

HVDC Alternative Route 7-B corresponds to Applicant Proposed Route Links 3, 4, and 5.

Atoka. See description of Atoka KOP for Applicant Proposed Route Link 5. Distance and visibility are the same.

Aycock Park and Millington. HVDC Alternative Route 7-C would be located less than 0.2 mile north of this KOP in the FG distance zone and would parallel an existing 161kV transmission line. Both the proposed and existing transmission lines would be partially screened by vegetation; the tops of the structures would be visible above the tree line and existing structures. Since the proposed structure would be seen in the context of an existing transmission line, with similar form, line, color and texture, and it would be partially screened, the Project would result in moderate contrast. Moderate contrast created by the Project in the FG distance zone for high sensitive recreational viewers represented by this KOP would result in moderate–high viewer concern impacts. Because the Project would be co-dominant in a Developed landscape setting, landscape scenery impacts would be moderate. Overall impacts would be moderate.

Edmund Orgill Park. See description of Edmund Orgill Park KOP for HVDC Alternative Route 7-B. Distance and visibility are the same.

Harold Park and Millington. HVDC Alternative Route 7-C would be located 0.6 mile west. Looking west, the transmission line structures would be visible through breaks in the FG trees, extending above the trees in the distance. The structures would differ in form than the existing low, primarily horizontal houses in the area, resulting in moderate contrast. Moderate contrast created by the Project in the MG distance zone for high sensitive residential viewers represented by this KOP would result in moderate viewer concern impacts. Overall visual impacts would be moderate–low. A visual simulation for this KOP is provided in Appendix K.

Millington East. HVDC Alternative Route 7-C would be located 0.3 mile to the southeast, running parallel to an existing 161kV transmission line. The proposed transmission line structures would be larger in scale than the existing transmission line structures and extend above tree line, with the bottom portion screened by vegetation in the FG. This KOP represents views from a residential area and visual concern is high. The structures would be prominent on the landscape and result in moderate contrast. Moderate contrast created by the Project in the FG distance zone for high sensitive residential viewers represented by this KOP would result in moderate–high viewer concern impacts. Given the moderate contrast introduced into the landscape for high sensitive viewers in the FG distance zone, overall visual impacts would be moderate–high.

Millington USA Baseball Stadium. HVDC Alternative Route 7-C would be located 0.5 mile to the south of the KOP in the MG distance zone and would parallel an existing 161kV transmission line. Given the dense vegetation surrounding the park, and at this distance, it is not likely that the Project would be visible. Views of the Project may include the tops of the transmission line structures extending above the tree line. However, given the existing structures and other vertical elements in the landscape, the Project would be subordinate and would not attract attention; therefore, contrast would be weak. Weak contrast created by the Project in the MG distance zone for high sensitive recreational viewers represented by this KOP would result in low viewer concern impacts. Because the Project would appear subordinate in a Developed landscape, impacts to landscape scenery would also be low. Overall visual impacts from this KOP would be low.

Rockyford Park. HVDC Alternative Route 7-C would be located 2.9 miles to the northwest. The dense trees and terrain would block all views of HVDC Alternative Route 7-C, resulting in no overall visual contrast at this location.

3.18.6.3.2.2.7.4 HVDC Alternative Route 7-D

HVDC Alternative Route 7-D corresponds to Applicant Proposed Route Links 4 and 5.

Atoka. HVDC Alternative Route 7-D would be located less than 0.2 mile to the southwest in the FG. This KOP represents views from a residential area and visual concern is high. The transmission line structures would be a dominant feature crossing the open fields in front of the FG trees and vegetation clearing may be visible. Because HVDC Alternative Route 7-D would be introducing new dominant features into an undeveloped landscape, it would result in strong visual contrast. Strong contrast created by the Project in the MG distance zone for high sensitive residential viewers represented by this KOP would result in high viewer concern impacts. Overall visual impacts would be high.

Atoka Community Park. See description of Atoka Community Park KOP for Applicant Proposed Route Link 5. Distance and visibility are the same.

Edmund Orgill Park. See description of Edmund Orgill Park KOP for HVDC Alternative Route 7-C. Distance and visibility are the same.

Munford. HVDC Alternative Route 7-D would be located 0.4 mile to the southwest. This KOP represents views from a residential area and visual concern is high. HVDC Alternative Route 7-D would run parallel to an existing 500kV transmission line and would be visible extending above the FG trees. The proposed structures would not introduce any new form, line, color, or texture but would add to existing elements, resulting in weak visual contrast. Weak contrast created by the Project in the FG distance zone for high sensitive residential viewers represented by this KOP would result in moderate viewer concern impacts. Overall visual impacts would be moderate–low.

Rhodes Estates. HVDC Alternative Route 7-D would be located 0.6 mile to the northeast and would run parallel to an existing 500kV transmission line, but at a farther distance. Given the increased distance to the structures, the structures would appear smaller in size and less dominant, resulting in weak visual contrast. Weak contrast created by the Project in the MG distance zone for high sensitive residential viewers represented by this KOP would result in low viewer concern impacts. Overall visual impacts would be low.

3.18.6.3.2.2.7.5 Region 7 Alternative Comparison

Table 3.18-29 provides a comparison of the visual impacts for Region 7.

Table 3.18-29:
Visual Impact Comparison Summary—Region 7

Proposed and Alternative Routes	Miles of Distinct Lands Crossed	Miles of Common Lands Crossed	Miles of Developed Lands Crossed	Residences within 0.5 mile
HVDC Alternative Route 7-A	1.9	40.5	0.8	127
APR Links Corresponding to Alternative 7-A	1.5	25.5	1.6	61
HVDC Alternative Route 7-B	1.8	6.2	0.6	503
APR Links Corresponding to Alternative 7-B	3.0	5.2	0.2	537
HVDC Alternative Route 7-C	2.1	20.5	1.2	1,536
APR Links Corresponding to Alternative 7-C	3.7	9.0	0.5	717
HVDC Alternative Route 7-D	0.3	6.0	0.2	1,400
APR Links Corresponding to Alternative 7-D	0.8	5.3	0.3	334

HVDC Alternative Route 7-A. Visual impact to public, private, and state lands resulting from the operations and maintenance of HVDC Alternative Route 7-A is anticipated to be mostly moderate–low with high impacts related to the crossing of the Mississippi River. HVDC Alternative Route 7-A would cross mostly agricultural areas with the crossing of the Mississippi River as a major component of this alternative. The route would be located within 0.5 mile of 127 residences that would have potential views of the Project compared to 61 residences with the corresponding links of the Applicant Proposed Route. HVDC Alternative Route 7-A would cross almost entirely lands classified as Common, but would cross slightly more lands classified as Distinct than the corresponding links of the Applicant Proposed Route.

HVDC Alternative Route 7-B. Visual impact to public, private, and state lands resulting from the operations and maintenance of HVDC Alternative Route 7-B is anticipated to be mostly moderate–high and sensitive viewers would primarily be residences. The landscape crossed by HVDC Alternative Route 7-B is primarily low rolling vegetated hills; the majority of the route land classified as Common (6.2 miles) mixed in with 1.9 miles of lands classified as Distinct, primarily around the Mississippi River Area. This route would cross 1.1 miles fewer lands classified as Distinct and impact 34 fewer residences than the corresponding links of the Applicant Proposed Route.

HVDC Alternative Route 7-C. Visual impact to public, private, and state lands resulting from the operations and maintenance of HVDC Alternative Route 7-C is anticipated to be mostly moderate and the most sensitive viewers would be residences. The route crosses primarily rolling vegetated hills because it starts just east of the Mississippi River and moves into more densely populated areas to the east. HVDC Alternative Route 7-C would cross slightly fewer lands classified as Distinct than the corresponding links of the Applicant Proposed Route, but there would be 1,536 residences within 0.5 mile of the route that would potentially have views of the transmission line structures, compared to 717 with the corresponding links of the Applicant Proposed Route.

HVDC Alternative Route 7-D. Visual impact to public, private, and state lands resulting from the operations and maintenance of HVDC Alternative Route 7-D is anticipated to be mostly moderate–low and the most sensitive viewers would be residences. The route would cross open agricultural land and low rolling vegetated hills with nearby residential development. The route would cross primarily lands classified as Common, with 0.3 mile of lands classified as Distinct compared to the 0.8 mile lands classified as Distinct for the corresponding links of the Applicant Proposed Route. The route would be near several residential developments: 1,400 residences within 0.5 mile compared to 334 for the corresponding links of the Applicant Proposed Route.

3.18.6.3.2.3 Decommissioning Impacts

Project facilities would be removed at the end of the operational life of the transmission line. There would be temporary visual impacts during decommissioning activities. Conductors, structures, and related facilities would be removed. Foundations would be removed to below the ground surface level. There would be residual visual impacts for many years after the Project has been decommissioned and structures removed such as vegetative cutbacks, cut and fill scars from construction activities, and access roads, which all add to the visual impact, though these impacts would be at ground level. These areas would be apparent after the removal of structures but are expected to diminish over time as the removed vegetation grows back.

3.18.6.4 Best Management Practices

The Applicant has developed a comprehensive list of EPMs that would minimize or avoid potential adverse impacts to visual resources. A complete list of EPMs for the Project is provided in Appendix F.

3.18.6.5 Unavoidable Adverse Impacts

Unavoidable impacts include the potential loss or alteration of sensitive views from public or private lands that are located within or adjacent to (within the FG/MG) the transmission line ROW or adjacent to converter station siting areas.

3.18.6.6 Irreversible and Irretrievable Commitment of Resources

Irreversible and irretrievable commitment of visual resources are anticipated where large trees are removed in the ROW, since trees would not be replanted or would be replanted and would result in age disparities, the effects of which would be noticeable to the casual observer. Removed trees would not be available for use by future generations even if new trees are replanted.

Impacts to visual resources from the introduction of structures (e.g., transmission structures and converter stations) and vegetation clearing would be irretrievable during the life of the Project. Once the Project has been decommissioned, however, visual resources could be restored; therefore, the introduction of structures would be not result in any irreversible commitment of visual resources.

3.18.6.7 Relationship between Local Short-term Uses and Long-term Productivity

Short-term vegetation management may impair long-term visual resources where trees or areas of thick vegetation are removed and take years to grow back.

3.18.6.8 Impacts from Connected Actions

3.18.6.8.1 Wind Energy Generation

The WDZs fall within a 40-mile radius from the Oklahoma Converter Station in Region 1, as described in Section 3.18.5.8. The region is primarily flat agricultural lands with open and expansive views and the tall vertical wind turbines would be potentially visible from large distances. Sensitive viewers in this area would be primarily rural residences and small towns, but there are several local parks, state parks, wildlife areas and the Rita Blanca National Grassland that would have possible views because of the panoramic views in the region. This region is free of heavy development and for the most part, cultural modifications are limited to grain silos, center pivots, and scattered transmission structures. The primarily horizontal lines of the landscape would have strong contrast with the tall vertical wind turbines when in the FG and near MG. Additionally, required FAA lighting would be visible for long distances and would likely attract attention when it is flashing. Most of the high sensitive resources, such as the national grassland and recreation areas, however, would be located in the BG distance zone, so impacts would not be as strong as turbines would not be a dominant feature at that distance.

3.18.6.8.2 Optima Substation

Construction and operations and maintenance of the future Optima Substation would result in low visual impacts because of the low visual sensitivity of viewers associated with local roads and existing cultural modifications in the area that have already introduced vertical elements in the a relatively flat landscape setting. High sensitive resources, such as viewers associated with the Optima National Wildlife Refuge, would be located in the BG distance zone, and views of the substation would be obstructed by the rolling terrain; therefore no visual impacts are anticipated to high sensitivity viewers in the BG.

3.18.6.8.3 TVA Upgrades

Upgrades to existing facilities related to terminal modifications and conductor replacement are not expected to result in high visual impacts because contrast would be weak because the existing facilities have already introduced vertical elements into the landscape that are similar in form, line, color, and texture. Increasing the heights of existing towers and constructing the new 500kV transmission line could have higher contrast and higher overall impacts depending on the specific locations of the towers that would be increased in height and location of the new transmission line. The level of potential visual impacts would depend on whether these upgrades were constructed in visually important or unique landscapes or near high sensitive viewer locations such as community enhancement areas (e.g., roadside parks, viewpoints and historic markers) or locations with special scenic, historic, recreation, cultural, and/or natural qualities that have been recognized as such through legislation or some other official declaration.

3.18.6.9 Impacts Associated with the No Action Alternative

Under the No Action Alternative, DOE assumes for analytical purposes that the Project would not be constructed. Current management across the Regions 1 through 7 of the Project would be maintained under the No Action Alternative. Under this alternative, there would be no Project construction or operation to impact visual resources.

Contents

Tables

This page intentionally left blank.

3.19 Wetlands, Floodplains, and Riparian Areas

3.19.1 Regulatory Background

This section includes a summary of the federal and state surface water resource regulations and standards relevant to wetlands, floodplains, and riparian areas.

3.19.1.1 Federal

3.19.1.1.1 Clean Water Act

The EPA regulates discharges of pollutants into waters of the United States as well as quality standards for surface waters under the CWA (33 USC § 1251 *et seq*.).

A new Clean Water Act rule was published on June 29, 2015 in the *Federal Register* (80 FR 37054). The final rule becomes effective on August 28, 2015. The final rule expands and clarifies the definition of "waters of the United States." The final rule can be found at 33 CFR Part 328. The U.S. District Court for North Dakota imposed a preliminary injunction against EPA's implementation of its "Waters of the U.S. Rule" which defines the waterways and wetlands regulated under the Clean Water Act. Under the order issued by the District Court of North Dakota, the parties that obtained the preliminary injunction are not subject to the new rule, and instead continue to be subject to the prior regulation .The injunction was granted for 13 states including the state of Arkansas. The states of Texas, Oklahoma, and Tennessee were not included within this decision (USACE 2015).

Dredge and fill activities in waters of the United States, including wetlands, must be authorized through either a nationwide permit, a regional permit (covering various classes of routine activities), or through an individual permit. The Project's seven regions traverse the jurisdiction of the USACE Tulsa, Little Rock, and Memphis District offices. Impacts to wetlands and other waters of United States will be avoided, minimized, and mitigated for the Project through permit-based efforts in consultation with the aforementioned offices of the USACE. Additionally, EPMs (Section 3.19.6.1.1) and BMPs (Section 3.19.6.4) will be adhered to for construction, operations and maintenance, and decommissioning phases of the Project.

Under Section 401 of the CWA, a federal agency cannot issue a permit or license for an activity that may result in a discharge to waters of the United States until the state or tribe where the discharge would originate has granted or waived Section 401 water quality certification, indicating that the proposed discharge would comply with the state's water quality standards. Any USACE Section 404 Individual Permits applied for would require individual review and water quality certification by the appropriate state agency (i.e., the TCEQ, the ODEQ, the ADEQ, or the TDEC).

3.19.1.1.2 Rivers and Harbors Appropriation Act of 1899

Section 10 of the Rivers and Harbors Appropriation Act of 1899 (33 USC § 403) prohibits the unauthorized obstruction or alteration of any navigable water of the U.S. Pursuant to the implementing regulations, Section 10 permits must be obtained from the USACE for power transmission line crossings of navigable waters of the United States, with limited exceptions (33 CFR Part 322).

3.19.1.1.3 DOE Floodplain and Wetland Environmental Review Requirements

Executive Orders 11988 "Floodplain Management" (May 24, 1977) and 11990 "Protection of Wetlands" (May 24, 1977) direct federal agencies to undertake various actions to protect floodplains and wetlands, including preparing a floodplain or wetland assessment for any action proposed in a floodplain and new construction proposed in a wetland. DOE's regulations implementing these Executive Orders, Compliance with Floodplain and Wetland Environmental Review Requirements (10 CFR Part 1022) require that any floodplain or wetland assessment normally be included in an Environmental Assessment or EIS, if one is being prepared (10 CFR 1022.13(b)). A floodplain or wetland assessment includes a description of the proposed action, a discussion of its potential effects on the floodplain or wetland (including a discussion of floodplain or wetland values), and consideration of alternatives (10 CFR 1022.4). The outcome of a floodplain assessment is documented in a floodplain statement of findings, which may be incorporated into a final EIS or record of decision (10 CFR 1022.14(c)). A wetland statement of findings may be similarly prepared for a wetland assessment but is not required.

3.19.1.2 State of Oklahoma

Oklahoma protects wetlands through the efforts of four agencies: Oklahoma Conservation Commission ODEQ, ODWC, and Oklahoma Water Resources Board. The Oklahoma Conservation Commission is the lead agency for wetland planning and coordinates the Oklahoma Wetlands Working Group. The Oklahoma Wetlands Working Group is guided by the Oklahoma Comprehensive Wetlands Conservation Plan. The ODEQ regulates wetlands by providing CWA Section 401 water quality certification for federal permits or licenses that result in impacts to waters of the state, including CWA Section 404 dredge and fill permits. The ODWC reviews federal actions that may cause impacts to wetlands in the state, assists in coordinating wetlands mitigation, and acquires wetlands for protection through fee title acquisition. The Oklahoma Water Resources Board develops state water quality standards, which are applicable to jurisdictional wetlands and stream resources.

3.19.1.3 State of Arkansas

The state of Arkansas' wetland regulatory program efforts are tied to CWA Section 401 water quality certification. Arkansas has a Multi-Agency Wetland Planning Team that is a consortium of state agencies that work together on restoration and planning for wetlands conservation. The team is guided by the Arkansas Wetlands Strategy, which is a comprehensive planning document that outlines objectives and strategies for state wetland initiatives.

3.19.1.4 State of Tennessee

Wetlands in the state of Tennessee are regulated by the TDEC Division of Water Pollution Control. TDEC requires either a CWA Section 401 certification or a state permit for any impacts to wetlands within Tennessee. The Tennessee Wildlife Resources Agency collaborates with TDEC on mitigation banking for wetland impacts. Tennessee Wildlife Resources Agency also administers a program to acquire and restore wetland properties within the state. Various federal agencies, such as the USACE, EPA, USFWS, and the USDA/NRCS may take part on Mitigation Banking Interagency Teams (IRT) when impacts to wetlands or streams in Tennessee require mitigation.

The Tennessee Water Quality Control Act of 1977 and the Aquatic Resources Alteration Rule establish the state's Aquatic Resources Alteration Permit program. This program regulates wetlands and wetland activities apart from those covered by individual CWA Section 404 permits.

3.19.1.5 State of Texas

As with the other states discussed in Section 3.19.1, the primary form of wetland regulation at the state level in Texas is the CWA Section 401 water quality certification program. There are several state agencies involved in the regulation of wetland-related activities, including the TCEQ, which conducts CWA Section 401 water quality certification for most activities. The Texas General land Office manages coastal wetlands under the Coastal Zone Management Plan; however, no coastal wetlands are involved in the proposed Project.

3.19.2 Data Sources

The primary data sources for this section on wetlands, floodplains, and riparian areas include the national wetland inventory (NWI) (GIS Data Source: USFWS 2014g), the national hydrography dataset, the NLCD, the Farm Service Agency's National Agriculture Imagery Program, and the national flood hazard layer data (GIS Data Sources: USGS 2014a; Jin et al. 2013; NAIP 2013a, 2013b, 2012a, 2012b; FEMA 2014).

3.19.3 Region of Influence

The ROI for evaluation of impacts on wetlands, floodplains, and riparian areas from the Project and connected actions is the same as that identified in Section 3.1.1.

3.19.4 Affected Environment

This affected environment section details overall numbers and types of wetlands, the 100-year floodplains, and the associated riparian areas. Each of these three resource types is discussed within the context of the ROI. The ROI traverses four states: Texas, Oklahoma, Arkansas, and Tennessee.

Several route variations to the Applicant Proposed Route in Regions 2–7 were developed in response to public comments on the Draft EIS and are described in Appendix M and summarized in Sections 2.4.2.1–2.4.2.7. The variations are presented graphically in Exhibit 1 of Appendix M.

3.19.4.1 Wetlands

Wetlands within the ROI were identified utilizing USFWS NWI program data (GIS Data Source: USFWS 2014g). These data have provided the number of wetlands per region, as well as the Cowardin classification (Cowardin et al. 1979) for each of the identified wetlands. Deepwater habitats, defined as aquatic systems deeper than 2 meters (6.6 feet), are also included in the classification system, and several of these lake systems have been identified in the ROI. The Cowardin classification system is an alpha-numeric coding system that corresponds to the classification nomenclature that best describes various wetland habitats. Cowardin classes represented within the ROI are summarized in Table 3.19-1. This table represents a subset of the overall Cowardin classification system, limited here to the systems, subsystems, and classes applicable to NWI wetlands mapped in the ROI. NWI wetlands are depicted on Figures 3.15-2a through 3.15-2f in Appendix A.

Table 3.19-1:
Cowardin Classifications Identified for Wetlands and Deepwater Habitats in the ROI

System	Subsystem	Class	Code	Description
Palustrine		Emergent	PEM	Non-tidal wetlands less than 6.6 feet in depth dominated by erect, rooted, herbaceous vegetation.
		Scrub/Shrub	PSS	Non-tidal wetlands less than 6.6 feet in depth dominated by woody plants less than 20 feet in height.
		Forested	PFO	Non-tidal wetlands less than 6.6 feet in depth dominated by woody plants 20 feet in height or taller.
		Aquatic Bed	PAB	Non-tidal wetlands less than 6.6 feet in depth dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years.
		Unconsolidated Bottom	PUB	Non-tidal wetlands less than 6.6 feet in depth. The substrate has at least 25 percent cover of particles smaller than stones and a vegetative cover less than 30 percent.
		Unconsolidated Shore	PUS	Non-tidal wetlands less than 6.6 feet in depth with substrates lacking vegetation except for pioneering plants that become established during brief periods when growing conditions are favorable.
Riverine	Lower Perennial	Unconsolidated Bottom	R2UB	All wetlands and deepwater habitats contained in well-formed channels and not dominated by trees, shrubs, and persistent emergent, emergent mosses or lichens. Lower perennial channels (R2) have low gradient, slow flows, and well-developed floodplains. The substrate has at least 25 percent cover of particles smaller than stones and a vegetative cover less than 30 percent.
		Unconsolidated Shore	R2US	All wetlands and deepwater habitats contained in well-formed channels and not dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens.
	Intermittent	Streambed	R4SB	Intermittent stream wetlands where flow is restricted to limited portions of the year. All wetlands are contained in well-formed channels and not dominated by trees, shrubs, persistent emergents, emergent mosses or lichens.
	Unknown Perennial	Unconsolidated Bottom	R5UB	This Subsystem designation was created specifically for use when the distinction between lower perennial, upper perennial and tidal cannot be made from aerial photography and no data is available. The substrate has at least 25 percent cover of particles smaller than stones and a vegetative cover less than 30 percent.
Lacustrine	Limnetic	Unconsolidated Bottom	L1UB	Deepwater (>6.6 feet) lake habitats lacking trees, shrubs, and emergent vegetation and exceeding 20 acres in size. The substrate has at least 25 percent cover of particles smaller than stones and a vegetative cover less than 30 percent.
	Littoral	Unconsolidated Bottom	L2UB	Lake shoreline (<6.6 feet) wetlands lacking trees, shrubs, and emergent vegetation and exceeding 20 acres in size. The substrate has at least 25 percent cover of particles smaller than stones and a vegetative cover less than 30 percent.
		Unconsolidated Shore	L2US	Lake shoreline (<6.6 feet) wetlands characterized by substrates lacking vegetation except for pioneering plants that become established during brief periods when growing conditions are favorable.
		Emergent	L2EM	Lake shoreline (<6.6 feet) wetlands dominated by erect, rooted, herbaceous vegetation

3.19.4.2 Floodplains

Floodplain data for the ROI were collected from the National Flood Hazard Layer (GIS Data Source: FEMA 2014). This section describes the mapped base floodplains and critical action floodplains in the ROI. Under 44 CFR 9.4, base floodplains are defined as the 100-year floodplain (1-percent annual-chance floodplain), and critical action floodplains are defined as the 500-year floodplain (0.2-percent annual-chance floodplain). No 500-year floodplain data were available in this most recent FEMA national flood hazard layer for this Project's ROI. FEMA has not delineated 500-yeard floodplains in the most current data set and these areas are thus considered non-special flood hazard areas. Floodplains have been identified using FEMA's national flood hazard layer where available, and "Q3" data where there are gaps in national flood hazard layer coverage. "Q3" data are digital data that FEMA developed by scanning existing Flood Insurance Rate Map hardcopies and vectorizing select data features (including 100-year and 500-year flood zones) into a countywide format (FEMA 2013b). Q3 data were used where national flood hazard layer data were not available in Van Buren, Jackson, and Cross counties in Arkansas. FEMA floodplain mapping for Beaver, Harper, and Major counties in Oklahoma, and for Sherman, Hansford, and Ochiltree counties in Texas is not available (FEMA 2013a). Floodplains for these counties are not shown on mapping or in the floodplain tables. 100-year floodplains are depicted on Figure 3.15-2 in Appendix A and they are described for the ROI below.

3.19.4.3 Riparian Areas

This section describes the mapped streams that may have associated riparian areas located within the ROI. Section 3.15 also provides a listing of streams by watershed for each region of the Project. Riparian areas, which are those lands considered to be transitional between uplands and riverine ecosystems, were evaluated using information available from the National Hydrography Dataset (GIS Data Source: USGS 2014a). These areas are typically linear in shape and act as important buffer strips between flowing surface waters and the surrounding upland landscapes. Riparian areas may be dominated by a variety of vegetation types, from herbaceous plants to shrubs, and also by gallery or streamside forests. Riparian areas have several beneficial functions including the control of upland runoff, dissipation of flood flows, stabilization of streambanks, provision of valuable wildlife habitat and habitat connectivity corridors, and they can act as noise and visual buffering for streams. Some common riparian tree species to be found in the ROI may include bald cypress (*Taxodium distichum*), cottonwood (*Populus* spp.), willow (*Salix* spp.), box elder (*Acer negundo*), red maple (*Acer rubrum*), willow oak (*Quercus phellos*), sycamore (*Plantanus occidentalis*), American beech (*Fagus grandifolia*), sweetgum (*Liquidamber styraciflua*), green ash (*Fraxinus pennsylvanica*), and water oak (*Quercus nigra*) (USDA 2013; Williams 2005).

Table 3.19-2 provides the total number of streams (named and unnamed) that would be crossed by the Project within the ROI of the respective Applicant Proposed Route and the HVDC alternative routes.

Table 3.19-2:
Total Stream Crossings by Region

Project Region	Total Stream Crossings[1]
Region 1—APR (Links 1–5)	115
Region 1—Alternative Routes (1-A, 1-B, 1-C, and 1-D)	326
Region 2—APR (Links 1–3)	96
Region 2—Alternative Routes (2-A, and 2-B)	101
Region 3—APR (Links 1–6)	327
Region 3—Alternative Routes 3-A, 3-B, 3-C, 3-D and 3-E	578

Table 3.19-2:
Total Stream Crossings by Region

Project Region	Total Stream Crossings[1]
Region 4—APR (Links 1–9)	212
Region 4—Alternative Routes 4-A, 4-B, 4-C, 4-D, and 4-E	322
Region 5 —APR (Links 1–9)	205
Region 5—Alternative Routes 5A, 5-B, 5-C, 5-D, 5-E, and 5-F	353
Region 6—APR (Links 1–8)	87
Region 6—Alternative Routes 6-A, 6-B, 6-C, and 6-D	118
Region 7—APR (Links 1–5)	81
Region 7—Alternative Routes 7-A, 7-B, 7-C, and 7-D	135

1 The values in the table do not reflect the minor changes that would result from application of the minor route variations and adjustments.
GIS Data Source: USGS (2014a)

3.19.5 Regional Description

The following sections provide detailed descriptions of wetlands, floodplains, and riparian areas in the ROI for Regions 1 through 7. The regional descriptions in this section identify these resource types as they are found within the 1,000-foot-wide ROI of the HVDC transmission line routes. Information for the AC collection system (included in the Region 1 description) is similarly presented in terms of a 2-mile-wide ROI. This information is used in evaluating potential impacts of the Project in Section 3.19.6, which is based on a 200-foot-wide representative ROW within the ROI.

3.19.5.1 Region 1

Region 1 is referred to as the Oklahoma Panhandle Region and includes the proposed Oklahoma Converter Station Siting Area and AC Interconnection, Applicant Proposed Route, and the HVDC Alternative Routes 1-A through 1-D.

No route variations were proposed in Region 1.

3.19.5.1.1 Wetlands

Desktop analysis for NWI-mapped wetland resources determined no NWI wetland resources present in the ROI for either the Oklahoma Converter Station Siting Area or the AC interconnection.

Table 3.19-3 provides a summary of wetlands identified for the Applicant Proposed Route (Links 1–5 in Region 1). The definition of Cowardin classifications is provided in Table 3.19-1. All of the streams have the potential to have riparian areas associated with them. The stream crossing totals in Table 3.19-3 are derived from the National Hydrography Dataset data set.

Table 3.19-3:
Wetlands in the 1,000-Foot Corridor—Region 1, Applicant Proposed Route

Wetland Type	No. of Wetlands	Acreage of Wetlands
PEM	7	9
Palustrine - farmed	5	40
PFO/PSS	1	1
PFO	10	7

Table 3.19-3:
Wetlands in the 1,000-Foot Corridor—Region 1, Applicant Proposed Route

Wetland Type	No. of Wetlands	Acreage of Wetlands
PSS	9	38
PUB	1	1
PUS	27	13
R2UB	1	3
R2US	1	4
Total	62	116

GIS Data Source: USFWS (2014g)

Table 3.19-4 provides a summary of wetlands identified for HVDC Alternative Route 1-A (corresponding to Applicant Proposed Route Links 2, 3, 4, and 5 in Region 1) within the 1,000-foot-wide ROI.

Table 3.19-4:
Wetlands in the 1,000-Foot Corridor—Region 1, HVDC Alternative Route 1-A

Wetland Type	No. of Wetlands	Acreage of Wetlands
PEM	21	46
PFO	5	7
PSS	4	11
PUB	3	1
PUS	20	7
R2UB	2	2
R2US	1	1
Total	56	75

GIS Data Source: USFWS (2014g)

Table 3.19-5 provides a summary of wetlands identified for HVDC Alternative Route 1-B (corresponding to Applicant Proposed Route Links 2 and 3 in Region 1).

Table 3.19-5:
Wetlands in the 1,000-Foot Corridor—Region 1, HVDC Alternative Route 1-B

Wetland Type	No. of Wetlands	Acreage of Wetlands
PEM/PSS	1	1
PSS	2	5
PUB	3	2
PUS	1	<1
R2UB	1	2
R2US	1	6
Total	9	16

GIS Data Source: USFWS (2014g)

Table 3.19-6 provides a summary of wetlands identified for HVDC Alternative Route 1-C (corresponding to Applicant Proposed Route Links 2 and 3 in Region 1).

Table 3.19-6:
Wetlands in the 1,000-Foot Corridor—Region 1, HVDC Alternative Route 1-C

Wetland Type	No. of Wetlands	Acreage of Wetlands
PEM	8	6
PFO	1	3
PSS	6	11
PUS	1	<1
R2UB	2	2
Total	18	22

GIS Data Source: USFWS (2014g)

Table 3.19-7 provides a summary of wetlands identified for HVDC Alternative Route 1-D (corresponding to Applicant Proposed Route Links 3 and 4 in Region 1).

Table 3.19-7:
Wetlands in the 1,000-Foot Corridor—Region 1, HVDC Alternative Route 1-D

Wetland Type	No. of Wetlands	Acreage of Wetlands
PEM	4	2
PFO	1	<1
PSS	2	5
PUS	7	2
R4SB	1	2
Total	15	11

GIS Data Source: USFWS (2014g)

Table 3.19–8 lists wetlands within the thirteen 2-mile-wide AC collection system routes.

Table 3.19-8:
Wetlands in the AC Collection System—Region 1

Route	Wetland Type	No. of Wetlands	Acreage of Wetlands
E-1	PEM/PFO	1	2
E-1	PEM/PSS	1	4
E-1	PEM1	21	125
E-1	Palustrine—Farmed	4	18
E-1	PFO	3	18
E-1	PSS	19	260
E-1	PUB	5	4
E-1	PUS	2	1
E-1	R2UB	1	32
E-1	R2US	4	28
	Total	65	492
E-2	L2EM	3	100
E-2	PEM/PSS	40	107
E-2	Palustrine—Farmed	11	82

Table 3.19-8:
Wetlands in the AC Collection System—Region 1

Route	Wetland Type	No. of Wetlands	Acreage of Wetlands
E-2	PFO/PSS	6	42
E-2	PFO	2	4
E-2	PSS	8	73
E-2	PUB	6	10
E-2	PUS	4	3
E-2	R2UB	3	25
E-2	R2US	5	14
	Total	88	460
E-3	L2EM	2	56
E-3	PEM/PSS	3	6
E-3	PEM	10	11
E-3	PFO/PSS	1	9
E-3	PFO	2	6
E-3	PSS	12	138
E-3	PUB	17	35
E-3	PUS	8	8
E-3	R2UB	2	25
E-3	R2US	6	13
	Total	63	307
NE-1	L2EM	4	141
NE-1	PEM/PSS	2	8
NE-1	PEM	26	112
NE-1	Palustrine—Farmed	11	79
NE-1	PFO/PEM	1	20
NE-1	PFO	4	9
NE-1	PSS	1	<1
NE-1	PUB	27	82
NE-1	PUS	7	19
NE-1	R2UB	1	20
NE-1	R2US	2	15
NE-1	R4SB	4	30
	Total	90	535
NE-2	L2EM	1	53
NE-2	PEM/PSS	10	77
NE-2	PEM	41	265
NE-2	Palustrine—Farmed	2	6
NE-2	PFO/PSS	2	10
NE-2	PFO	2	1
NE-2	PSS	7	24
NE-2	PUB	12	39
NE-2	PUS	2	2

Table 3.19-8:
Wetlands in the AC Collection System—Region 1

Route	Wetland Type	No. of Wetlands	Acreage of Wetlands
NE-2	R2UB	1	19
NE-2	R2US	9	18
NE-2	R4SB	3	37
	Total	92	551
NW-1	L2EM	3	203
NW-1	PEM/PSS	3	6
NW-1	PEM	22	83
NW-1	Palustrine—Farmed	3	45
NW-1	PFO	1	2
NW-1	PSS	4	20
NW-1	PUB	2	16
NW-1	R4SB	7	49
	Total	45	424
NW-2	L2EM	2	94
NW-2	PEM/PSS	2	8
NW-2	PEM	27	121
NW-2	Palustrine—Farmed	9	108
NW-2	PFO/PEM	1	20
NW-2	PFO	4	9
NW-2	PSS	1	<1
NW-2	PUB	35	112
NW-2	PUSC	6	6
NW-2	R2UB	1	20
NW-2	R2US	2	15
NW-2	R4SB	15	288
	Total	105	801
SE-1	L2EM	6	550
SE-1	PEM/PSS	13	87
SE-1	PEM	44	186
SE-1	Palustrine—Farmed	13	130
SE-1	PFO/PSS	9	53
SE-1	PSS	35	218
SE-1	PUB	7	10
SE-1	PUS	3	2
SE-1	R2UB	4	29
SE-1	R2US	5	14
	Total	139	1,279
SE-2	L2EM	1	20
SE-2	L2UB	1	53
SE-2	PEM	8	37
SE-2	Palustrine—Farmed	3	12

Table 3.19-8:
Wetlands in the AC Collection System—Region 1

Route	Wetland Type	No. of Wetlands	Acreage of Wetlands
SE-2	PSS	2	6
SE-2	PUB	2	1
SE-2	PUS	1	1
	Total	18	130
SE-3	L2EM	6	409
SE-3	L2US	1	131
SE-3	PEM/PSS	2	12
SE-3	PEM	52	198
SE-3	Palustrine—Farmed	35	409
SE-3	PFO/PSS	6	42
SE-3	PFO	2	4
SE-3	PSS	8	73
SE-3	PUB	15	35
SE-3	PUS	8	58
SE-3	R2UB	3	25
SE-3	R2US	5	14
	Total	143	1.410
SW-1	PEM	5	14
SW-1	Palustrine—Farmed	1	3
SW-1	PUB	1	1
	Total	7	18
SW-2	L2EM	1	9
SW-2	PEM	8	69
SW-2	Palustrine—Farmed	1	3
SW-2	PFO	1	2
SW-2	PUB	12	40
SW-2	R4SB	3	17
	Total	26	140
W-1	PEM	3	6
W-1	Palustrine—Farmed	1	29
W-1	PFO	1	2
W-1	PUB	2	6
W-1	R4SB	3	17
	Total	10	60

GIS Data Source: USFWS (2014g)

3.19.5.1.2 Floodplains

Table 3.19-9 provides the number and acreage of 100-year floodplain crossings estimated for each of the HVDC alternative routes and for the Applicant Proposed Route within the ROI in Region 1. The Applicant Proposed Route is anticipated to cross two of these 100-year floodplains. No 100-year or 500-year floodplains are documented for the Oklahoma Converter Station Siting Area.

Table 3.19-9:
100-Year Floodplains in the 1,000-Foot Corridor for the HVDC Transmission Line—Region 1

Alternative Route	No. of Floodplain Crossings	Estimated Acreage of Crossings
APR	2	254
1-A	2	31
1-B	2	49
1-C	2	31
1-D	0	0

Note: No FEMA floodplain data were available for Beaver and Harper counties, Oklahoma.

The AC collection system routes are estimated to cross 113 floodplains as identified in Table 3.19-10. AC Collection System Routes NW-1, SW-2, and W-1 would cross the greatest number of floodplains (12 each).

Table 3.19-10:
100-Year Floodplains in the ROI for the AC Collection System Routes—Region 1

Route	No. of Floodplain Crossings	Estimated Acreage of Crossings
E-1	6	133
E-2	9	1025
E-3	9	604
NE-1	9	1199
NE-2	5	1172
NW-1	12	2083
NW-2	9	1199
SE-1	9	1025
SE-2	6	78
SE-3	9	1025
SW-1	6	78
SW-2	12	1934
W-1	12	1360

Note: No FEMA floodplain data were available for Beaver County, Oklahoma, or for Sherman, Hansford, and Ochiltree counties, Texas.

3.19.5.1.3 Riparian Areas

Table 3.19-2 includes a total number of potential stream crossings for Region 1. These streams may all have associated riparian area resources. The Oklahoma Converter Station and AC Interconnection Siting Areas include 1.6 miles of intermittent streams, no perennial streams, and no other major waterbodies. Table 3.19-11 provides information on surface water resources within the 2-mile-wide corridor of the AC collection system. Riparian areas may be associated with many of these surface water systems.

Table 3.19-11:
Potential Riparian Areas associated with Surface Water Features within the 2-Mile-Wide Corridors of the AC Collection System Routes

Route	Perennial Streams (miles)	Intermittent Streams (miles)	Major Waterbodies (miles)	Reservoirs, Lakes, and Ponds (acres)
E-1	9.2	100.2	0	33.8
E-2	13.5	100.1	0.1	149.0
E-3	10.1	137.6	0.0	36.7
NE-1	24.1	33.0	0.1	141.0
NE-2	7.8	78.3	0.1	70.8
NW-1	13.1	110.9	0.1	167.3
NW-2	31.1	77.7	0.2	119.2
SE-1	21.5	75.7	0.04	677.8
SE-2	0.8	26.7	0.0	98.0
SE-3	14.5	98.5	0.1	768.0
SW-1	1.0	58.1	0.0	14.2
SW-2	8.0	125.1	0.1	57.4
W-1	6.2	45.1	0.1	9.3

GIS Data Source: USGS (2014a)

3.19.5.2 Region 2

Region 2 is referred to as the Oklahoma Central Great Plains Region and includes the Applicant Proposed Route and HVDC Alternative Routes 2-A and 2-B.

Two route variations to the Applicant Proposed Route were developed in Region 2 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.2. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route and the number of, and acreages for, wetlands, floodplains, and riparian areas, would remain relatively consistent within the ROI. Link 1, Variation 1, and Link 2, Variation 2, would both have less than 1 acre of forested wetland within the ROI. Route Link 1, Variation 2, would also have less than 1 acre of non-forested wetland within the ROI. There would be no other change to the number of, nor the acreage for, wetlands, floodplains, and riparian areas.

3.19.5.2.1 Wetlands

Table 3.19-12 provides a summary of wetlands identified for the Applicant Proposed Route (Links 1-3 in Region 2).

Table 3.19-12:
Wetlands in the 1,000-Foot Corridor—Region 2, Applicant Proposed Route

Wetland Type	No. of Wetlands	Acreage of Wetlands
PEM1/PSS	1	3
PEM	21	12
PFO	5	8
PSS/PEM	2	1
PSS	2	1

Table 3.19-12:
Wetlands in the 1,000-Foot Corridor—Region 2, Applicant Proposed Route

Wetland Type	No. of Wetlands	Acreage of Wetlands
PUB	35	21
PUS	27	8
R2UB	1	3
R2US	2	17
Total	96	74

GIS Data Source: USFWS (2014g)

Table 3.19-13 provides a summary of wetlands identified for HVDC Alternative Route 2-A (corresponding to Applicant Proposed Route Link 2 in Region 2) within the 1,000-foot-wide ROI.

Table 3.19-13:
Wetlands in the 1,000-Foot Corridor—Region 2, HVDC Alternative Route 2-A

Wetland Type	No. of Wetlands	Acreage of Wetlands
PEM	13	6
PFO	5	8
PSS	1	11
PUB	17	13
PUS	31	9
R2UB	1	4
R2US	4	15
R4SB	1	<1
Total	73	66

GIS Data Source: USFWS (2014g)

Table 3.19-14 provides a summary of wetlands identified for HVDC Alternative Route 2-B (corresponding to Applicant Proposed Route Link 3 in Region 2) within the 1,000-foot-wide ROI.

Table 3.19-14:
Wetlands in the 1,000-Foot Corridor—Region 2, HVDC Alternative Route 2-B

Wetland Type	No. of Wetlands	Acreage of Wetlands
PEM/PSS	1	3
PEM	19	26
PFO	1	3
PUB	7	4
PUS	20	9
Total	48	45

GIS Data Source: USFWS (2014g)

3.19.5.2.2 Floodplains

Table 3.19-15 provides the number and acreage of 100-year floodplain crossings estimated for the Applicant Proposed Route and HVDC Alternative Routes 2-A and 2-B within the ROI in Region 2.

Table 3.19-15:
100-Year Floodplains in the 1,000-Foot Corridor for the HVDC Transmission Line—Region 2

Alternative Route	No. of Floodplain Crossings	Estimated Acreage of Crossings
APR	6	800
2-A	1	23
2-B	4	457

Note: No FEMA floodplain data were available for Major County, Oklahoma.

3.19.5.2.3 Riparian Areas

Table 3.19-2 includes a total number of potential stream crossings for Region 2. These streams may all have associated riparian area resources.

3.19.5.3 Region 3

Region 3 is referred to as the Oklahoma Cross Timbers Region and includes the Applicant Proposed Route and HVDC Alternative Routes 3-A through 3-E.

Five route variations to the Applicant Proposed Route were developed in Region 3 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.3. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route and the number of, and acreages for, wetlands, floodplains, and riparian areas, would remain consistent within the ROI. Link 1, Variation 2, would have less than 1 mile of streams within the ROI. Links 1 and 2, Variation 1, would have less than 1 mile of streams and less than 1 acre of floodplains within a ROI. It should be noted that a route adjustment was made for HVDC Alternative Route 3-A to maintain an end-to-end route with the Links 1 and 2 variations, but this route adjustment would not add any additional numbers of, or acreages for, wetlands, floodplains, or riparian areas within the ROI. Link 4, Variation 1, would have three additional surface waterbodies within the ROI. The National Hydrography Dataset defines a waterbody as a hydrographic feature delineated using areas (e.g., ponds, lakes, and reservoirs). Link 4, Variation 2, would also add one additional surface waterbody within the ROI. Link 5, Variation 2, would have one additional surface waterbody within the ROI.

3.19.5.3.1 Wetlands

Table 3.19-16 provides a summary of wetlands identified for the Applicant Proposed Route (Links 1–6 in Region 3).

Table 3.19-16:
Wetlands in the 1,000-Foot Corridor—Region 3, Applicant Proposed Route

Wetland Type	No. of Wetlands	Acreage of Wetlands
L1UB	3	8
PAB	2	1
PEM	20	8
PFO/PEM	1	5

Table 3.19-16:
Wetlands in the 1,000-Foot Corridor—Region 3, Applicant Proposed Route

Wetland Type	No. of Wetlands	Acreage of Wetlands
PFO	37	143
PFO/PUB	2	1
PSS/PEM	1	5
PSS	4	1
PUB	304	144
PUS	43	11
R2UB	2	20
R2US	1	<1
Total	420	347

GIS Data Source: USFWS (2014g)

Table 3.19-17 provides a summary of wetlands identified for HVDC Alternative Route 3-A (corresponding to Applicant Proposed Route Link 1 in Region 3) within the 1,000-foot-wide ROI.

Table 3.19-17:
Wetlands in the 1,000-Foot Corridor—Region 3, HVDC Alternative Route 3-A

Wetland Type	No. of Wetlands	Acreage of Wetlands
PAB	1	1
PEM	9	4
PFO	7	17
PUB	23	20
PUS	59	19
Total	99	61

GIS Data Source: USFWS (2014g)

Table 3.19-18 provides a summary of wetlands identified for HVDC Alternative Route 3-B (corresponding to Applicant Proposed Route Links 1, 2, and 3 within Region 3) within the 1,000-foot-wide ROI.

Table 3.19-18:
Wetlands in the 1,000-Foot Corridor—Region 3, HVDC Alternative Route 3-B

Wetland Type	No. of Wetlands	Acreage of Wetlands
PAB	1	1
PEM	10	4
PFO	12	25
PUB	46	38
PUS	65	21
R2UB	1	1
Total	135	90

GIS Data Source: USFWS (2014g)

Table 3.19-19 provides a summary of wetlands identified for HVDC Alternative Route 3-C (corresponding to Applicant Proposed Route Links 3, 4, 5 and 6 within Region 3) within the 1,000-foot-wide ROI.

Table 3.19-19:
Wetlands in the 1,000-Foot Corridor—Region 3, HVDC Alternative Route 3-C

Wetland Type	No. of Wetlands	Acreage of Wetlands
L1UB	1	11
PEM	22	38
PFO/PSS	3	32
PFO	42	302
PFO/PUB	1	20
PSS/PEM	2	8
PUB	269	117
PUS	5	1
R2UB	1	11
R2US	2	13
R4US	1	<1
Total	349	553

Table 3.19-20 provides a summary of wetlands identified for HVDC Alternative Route 3-D (corresponding to Applicant Proposed Route Links 5 and 6 in Region 3) within the 1,000-foot-wide ROI.

Table 3.19-20:
Wetlands in the 1,000-Foot Corridor—Region 3, HVDC Alternative Route 3-D

Wetland Type	No. of Wetlands	Acreage of Wetlands
PEM	16	29
PFO/PSS	3	32
PFO	22	111
PSS/PEM	2	8
PUB	114	48
Total	157	228

GIS Data Source: USFWS (2014g)

Table 3.19-21 provides a summary of wetlands identified for HVDC Alternative Route 3-E (corresponding to Applicant Proposed Route Link 6 in Region 3) within the 1,000-foot-wide ROI.

Table 3.19-21:
Wetlands in the 1,000-Foot Corridor—Region 3, HVDC Alternative Route 3-E

Wetland Type	No. of Wetlands	Acreage of Wetlands
PFO/SS	3	33
PFO	6	15
PUB	24	10
Total	33	58

GIS Data Source: USFWS (2014g)

3.19.5.3.2 Floodplains

Table 3.19-22 provides the number and acreage of 100-year floodplain crossings estimated for each of the HVDC alternative routes and for the Applicant Proposed Route within the ROI in Region 3. The Applicant Proposed Route is estimated to cross twenty-four 100-year floodplains totaling an estimated 1,587 acres within the ROI for Region 3.

Table 3.19-22:
100-Year Floodplains in the 1,000-Foot Corridor for the HVDC Transmission Line—Region 3

Alternative Route	No. of Floodplain Crossings	Estimated Acreage of Crossings
APR	24	1587
3-A	11	233
3-B	14	328
3-C	32	1591
3-D	13	466
3-E	6	111

3.19.5.3.3 Riparian Areas

Table 3.19-2 includes a total number of potential stream crossings in Region 3. These streams may all have associated riparian area resources.

3.19.5.4 Region 4

Region 4 is referred to as the Arkansas River Valley Region and includes the Applicant Proposed Route, including the Lee Creek Variation, and HVDC Alternative Routes 4-A through 4-E.

Seven route variations to the Applicant Proposed Route were developed in Region 4 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.4. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route and the number of, and acreages for, wetlands, floodplains, and riparian areas, would remain consistent within the ROI. Link 3, Variation 1, would have less than 1 mile of streams within the ROI, two forested wetlands of approximately 2 total acres, and 3 acres of floodplains with one crossing exceeding more than 1,000 feet in width. Link 3, Variation 2, would have less than 1 mile of streams and three floodplains totaling approximately 15 acres with two crossings exceeding more than 1,000 feet in in the ROI. Variation 2 would also result in decreases in stream mileage crossed, the number and acreage of floodplains crossed, and the number of designated waterbodies crossed. Link 3, Variation 3, would have less than 1 mile of streams within the ROI. Link 6, Variation 1, would have less than 1 mile of streams within the ROI. Link 6, Variation 2, would have less than 1 mile of streams and one floodplain totaling approximately 33 acres and having a width of more than 1,000 feet within the ROI. Link 6, Variation 3, would have no crossings of wetlands, floodplains, or riparian areas within the ROI. Link 9, Variation 1, would have less than 1 mile of streams, and one floodplain totaling approximately 43 acres and having a width of more than 1,000 feet within the ROI. This variation would also have two additional surface waterbodies within the ROI.

3.19.5.4.1 Wetlands

Table 3.19-23 provides a summary of wetlands identified for the Applicant Proposed Route (Links 1–9 in Region 4).

Table 3.19-23:
Wetlands in the 1,000-Foot Corridor—Region 4, Applicant Proposed Route

Wetland Type	No. of Wetlands	Acreage of Wetlands
L1UB	2	40
L2US	1	<1
PEM	5	15
PFO	22	39
PSS	1	3
PUB	66	21
R2UB	5	11
R2US	3	3
Total	105	132

GIS Data Source: USFWS (2014g)

Table 3.19-24 provides a summary of wetlands identified for HVDC Alternative Route 4-A (corresponding to Applicant Proposed Route Links 3, 4, 5, and 6 in Region 4) within the 1,000-foot-wide ROI.

Table 3.19-24:
Wetlands in the 1,000-Foot Corridor—Region 4, HVDC Alternative Route 4-A

Wetland Type	No. of Wetlands	Acreage of Wetlands
PEM/PSS	1	1
PFO	6	12
PSS/PEM	1	7
PSS	2	3
PUB	64	23
R2UB	3	4
R2US	4	3
Total	81	53

GIS Data Source: USFWS (2014g)

Table 3.19-25 provides a summary of wetlands identified for HVDC Alternative Route 4-B (corresponding to Applicant Proposed Route Links 2, 3, 4, 5, 6, 7, and 8 in Region 4) within the 1,000-foot-wide ROI.

Table 3.19-25:
Wetlands in the 1,000-Foot Corridor—Region 4, HVDC Alternative Route 4-B

Wetland Type	No. of Wetlands	Acreage of Wetlands
PFO/PSS	1	3
PFO	9	16
PSS/PEM	1	7
PSS	3	3
PUB	43	16

Table 3.19-25:
Wetlands in the 1,000-Foot Corridor—Region 4, HVDC Alternative Route 4-B

Wetland Type	No. of Wetlands	Acreage of Wetlands
R2UB	4	3
R2US	1	1
Total	62	49

GIS Data Source: USFWS (2014g)

No NWI-mapped wetlands were documented in the desktop analysis for HVDC Alternative Route 4-C. NLCD land cover data were also reviewed and were determined to show 0.03 acres of woody wetlands present within the ROI for this alternative.

Table 3.19-26 provides a summary of wetlands identified for HVDC Alternative Route 4-D (corresponding to Applicant Proposed Route Links 4, 5, and 6 in Region 4) within the 1,000-foot-wide ROI.

Table 3.19-26:
Wetlands in the 1,000-Foot Corridor—Region 4, HVDC Alternative Route 4-D

Wetland Type	No. of Wetlands	Acreage of Wetlands
PUB	5	2
Total	5	2

GIS Data Source: USFWS (2014g)

No NWI-mapped wetlands were documented in the desktop analysis for HVDC Alternative Route 4-E. NLCD land cover data were also reviewed and documented a combined 14.3 acres of woody wetlands and emergent herbaceous wetland land cover in the ROI.

3.19.5.4.2 Floodplains

Table 3.19-27 provides the number and acreage of 100-year floodplain crossings estimated for each of the HVDC alternative routes and for the Applicant Proposed Route within the ROI in Region 4. The Applicant Proposed Route is estimated to cross thirty-six 100-year floodplains totaling an estimated 2,690 acres within the ROI for Region 4.

Table 3.19-27:
100-Year Floodplains in the 1,000-Foot Corridor for the HVDC Transmission Line—Region 4

Alternative Route	No. of Floodplain Crossings	Estimated Acreage of Crossings
APR	36	2,690
4-A	18	677
4-B	17	513
4-D	9	251
4-E	12	350

3.19.5.4.3 Riparian Areas

Table 3.19-2 includes a total number of potential stream crossings in Region 4. These streams may all have associated riparian area resources.

3.19.5.5 Region 5

Region 5 is referred to as the Central Arkansas Region and includes the Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area, the Applicant Proposed Route, and the HVDC Alternative Routes 5-A through 5-F.

Five route variations to the Applicant Proposed Route were developed in Region 5 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.5. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route and the number of, and acreages, for wetlands, floodplains, and riparian areas would remain consistent within the ROI. Link 1, Variation 2, would have less than 1 mile of streams within the ROI, two forested wetlands of approximately 0.5 acre, and 6 acres of floodplains with one crossing exceeding more than 1,000 feet in width. There is also one surface waterbody within the ROI for this variation. Applicant Proposed Route Link 2, Variation 2, would have less than 1 mile of streams within the ROI. Applicant Proposed Route Links 2 and 3, Variation 1, would have less than 1 mile of streams within the ROI and approximately 10 acres of floodplains with one crossing exceeding more than 1,000 feet in width. It should be noted that a route adjustment was made for HVDC Alternative Route 5-B to maintain an end-to-end route with Links 2 and 3, Variation 1. HVDC Alternative Route 5-B would have approximately 5 acres of floodplain within the ROI. Links 3 and 4, Variation 2, would have less than 1 mile of streams within the ROI. A route adjustment was made for HVDC Alternative Route 5-E to maintain an end-to-end route with Links 3 and 4, Variation 2. This route adjustment would cross one floodplain of less than 1 acre within the ROI. Link 7, Variation 1, would have less than 1 mile of streams within the RO, and would cross one more feature categorized as a surface waterbody.

3.19.5.5.1 Wetlands

Table 3.19-28 provides a summary of wetlands identified for the Applicant Proposed Route (Links 1–9 in Region 5).

Table 3.19-28:
Wetlands in the 1,000-Foot Corridor—Region 5, Applicant Proposed Route

Wetland Type	No. of Wetlands	Acreage of Wetlands
L2UB	1	8
PAB	1	2
PEM	7	8
PFO	7	39
PSS	3	3
PUB	21	14
R2UB	2	19
Total	42	93

GIS Data Source: USFWS (2014g)

Table 3.19-29 provides the potential wetland resources within the ROI of the Arkansas Converter Station Alternative Siting Area and the AC Interconnection Siting Area.

Table 3.19-29:
Wetlands in the Siting Area for the Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area—Region 5

Wetland Type	No. of Wetlands	Acreage of Wetlands
L	2	76
PUB	170	96
R4SB	53	125
R5UB	8	66
Total	233	363

GIS Data Source: USFWS (2014g)

The Region 5 Applicant Proposed Route and HVDC Alternative Route 5-D have been evaluated using NWI wetland data. No NWI-mapped wetlands were documented in the desktop analysis for HVDC Alternative Routes 5-A, 5-B, 5-C, 5-E and 5-F, so NLCD land cover data were reviewed to estimate acreage within the respective ROIs to make an evaluation of wetland resources for the HVDC alternative routes.

Table 3.19-30 provides a summary of wetlands identified for HVDC Alternative Routes 5-A, 5-B, 5-C, 5-E, and 5-F within the 1,000-foot-wide ROI.

Table 3.19-30:
Wetland Land Cover in the 1,000-Foot Corridor—Region 5, HVDC Alternative Routes* 5-A, 5-B, 5-C, 5-E and 5-F

Alternative Route	Wetland Land Cover Type	Acreage of Wetlands
5-A	Woody wetlands	2.3
5-B	Woody wetlands	29.9
5-C	Woody wetlands	2.6
5-E	Woody wetlands	13.0
5-F	Woody wetlands	8.9

*NLCD data used due to lack of NWI data

Table 3.19-31 provides a summary of wetlands identified for HVDC Alternative Route 5-D (corresponding to Applicant Proposed Route Link 9 in Region 5) within the 1,000-foot-wide ROI.

Table 3.19-31:
NWI Wetlands in the 1,000-Foot Corridor—Region 5, HVDC Alternative Route 5-D

Wetland Type	No. of Wetlands	Acreage of Wetlands
PEM	3	6
PFO	3	20
PUB	26	18
R2UB	2	26
Total	34	70*

*Note: For comparative purposes, the NLCD land cover data records 72.4 acres of woody wetlands in Alt. Rt. 5-D.

3.19.5.5.2 Floodplains

Table 3.19-32 provides the number and acreage of 100-year floodplain crossings estimated for each of the HVDC alternative routes and for the Applicant Proposed Route within the ROI in Region 5. The Applicant Proposed Route is estimated to cross twenty-six 100-year floodplains totaling an estimated 1,564 acres.

Table 3.19-32:
100-Year Floodplains in the 1,000-Foot Corridor for the HVDC Transmission Line—Region 5

Alternative Route	No. of Floodplain Crossings	Estimated Acreage of Crossings
APR	26	1,564
5-A	3	81
5-B	10	793
5-C	2	109
5-D	14	677
5-E	6	486
5-F	3	378
Total	64	4,088

3.19.5.5.3 Riparian Areas

Table 3.19-2 includes a total number of potential stream crossings in Region 5. These streams may all have associated riparian area resources.

3.19.5.6 Region 6

Region 6 is referred to as the Cache River and Crowley's Ridge Region and includes the Applicant Proposed Route and HVDC Alternative Routes 6-A through 6-D. Straight Slough, a designated Ecologically Sensitive Waterbody (ESW), occurs at the lower limit of the St. Francis River in Region 6 in Arkansas. ESWs are designated based on their provision of habitat within the existing range of threatened, endangered, or endemic species of aquatic or semi-aquatic life forms. Straight Slough is discussed in more detail in Sections 3.14.2 and 3.20.2.5.6.

One route variation was developed in Region 6 in response to public comments on the Draft EIS to parallel more parcel boundaries to minimize impacts to agricultural operations and is shown in Exhibit 1 of Appendix M. This variation represents a minor adjustment to the Applicant Proposed Route and the number of, and acreages for, wetlands, floodplains, and riparian areas, would remain consistent within the ROI. Link 2, Variation 1, would have less than 1 mile of streams within the ROI, two forested wetlands of approximately 1 acre, one non-forested wetland of less than 0.5 acre, and approximately 1 acre and 6 acres of floodplains with one crossing exceeding more than 1,000 feet in width. The NLCD database reveals this variation would have four forested wetlands of approximately 2 total acres within the ROI. It should be noted that a route adjustment was made for HVDC Alternative Route 6-A to maintain an end-to-end route with Link 2, Variation 1. The route adjustment for HVDC Alternative Route 6-A would cross 12 forested wetlands totaling 21 acres and one non-forested wetland totaling less than 1 acre in the ROI. Finally, the route adjustment would have five surface waterbodies (ponds, lakes, etc.) within the ROI.

3.19.5.6.1 Wetlands

The Region 6 Applicant Proposed Route and HVDC Alternative Routes 6-A and 6-B have been evaluated using NWI wetland data. No NWI-mapped wetlands were documented in the desktop analysis for HVDC Alternative Routes 6-C and 6-D, so NLCD land cover data were reviewed to estimate acreage within the respective ROIs to make an evaluation of wetland resources for the HVDC alternative routes.

Table 3.19-33 provides a summary of wetlands identified for the Applicant Proposed Route (Links 1-7 in Region 6).

Table 3.19-33:
Wetlands in the 1,000-Foot Corridor—Region 6, Applicant Proposed Route

Wetland Type	No. of Wetlands	Acreage of Wetlands
PEM	4	11
PFO	7	17
PSS	2	1
PUB	5	19
R2UB	2	12
Total	20	60

GIS Data Source: USFWS (2014g)

Table 3.19-34 provides a summary of wetlands identified for HVDC Alternative Route 6-A (corresponding to Applicant Proposed Route Links 2, 3, and 4 in Region 6) within the 1,000-foot-wide ROI.

Table 3.19-34:
Wetlands in the 1,000-Foot Corridor—Region 6, HVDC Alternative Route 6-A

Wetland Type	No. of Wetlands	Acreage of Wetlands
PEM	2	9
PFO	19	130
PSS	2	5
PUB	2	8
R2U	2	5
Total	27	157

GIS Data Source: USFWS (2014g)

Table 3.19-35 provides a summary of wetlands identified for HVDC Alternative Route 6-B (corresponding to Applicant Proposed Route Link 3 in Region 6) within the 1,000-foot-wide ROI.

Table 3.19-35:
Wetlands in the 1,000-Foot Corridor—Region 6, HVDC Alternative Route 6-B

Wetland Type	No. of Wetlands	Acreage of Wetlands
L2US	1	1
PFO	7	91
PSS	4	6
PUB	6	12
Total	18	110

GIS Data Source: USFWS (2014g)

Table 3.19-36 provides a summary of wetlands identified for HVDC Alternative Route 6-C and 6-D (corresponding to Region 6 Applicant Proposed Route Links 6, and 6 and 7, respectively) within the 1,000-foot-wide ROI.

Table 3.19-36:
Wetland Land Cover in the 1,000-Foot Corridor—Region 6, HVDC Alternative Route 6-C* and 6-D*

Alternative Route	Wetland Land Cover Types	Acreage of Wetlands
6-C	Woody wetlands	114.9
6-D	Woody wetlands and Emergent herbaceous wetlands	87.1

*NLCD data used due to lack of NWI data

3.19.5.6.2 Floodplains

Table 3.19-37 provides the number and acreage of 100-year floodplain crossings estimated for each of the HVDC alternative routes and for the Applicant Proposed Route within the ROI in Region 6. The Applicant Proposed Route is anticipated to cross 24 of these 100-year floodplains. The route adjustment for HVDC Alternative Route 6-A also would have one floodplain of 129 acres with one crossing of more than 1,000 feet in width within the ROI.

Table 3.19-37:
100-Year Floodplains in the 1,000-Foot Corridor for the HVDC Transmission Line—Region 6

Alternative Route	No. of Floodplain Crossings	Estimated Acreage of Crossings
APR	24	3319
6-A	7	1132
6-B	4	762
6-C	7	507
6-D	6	560

3.19.5.6.3 Riparian Areas

Table 3.19-2 includes a total number of potential stream crossings for Region 6. These streams may all have associated riparian area resources.

3.19.5.7 Region 7

Region 7 is referred to as the Arkansas Mississippi River Delta and Tennessee Region and includes the Tennessee Converter Station Siting Area and AC Interconnection Tie, the Applicant Proposed Route, and the HVDC Alternative Routes 7-A through 7-D.

Three route variations to the Applicant Proposed Route were developed in Region 7 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.7. The variations are illustrated in Exhibit 1 of Appendix M. Link 1, Variation 1, would not cross any wetlands, floodplains, or riparian areas within the ROI. Link 1, Variation 2, would have approximately 2 miles of streams within the ROI. There would be a crossing of 18 forested wetlands of approximately 30 acres and six floodplains totaling approximately 167 acres; three of the floodplain crossings would exceed more than 1,000 feet in width each. Link 5, Variation 1, would have less than 1 mile of streams within the ROI.

3.19.5.7.1 Wetlands

Table 3.19-38 provides a summary of wetlands identified for the Applicant Proposed Route (Links 1–5 in Region 7).

Table 3.19-38:
Wetlands in the 1,000-Foot Corridor—Region 7, Applicant Proposed Route

Wetland Type	No. of Wetlands	Acreage of Wetlands
PEM	7	9
PFO	24	138
PSS	2	11
PUB	11	15
R2UB	2	87
R2US	2	<1
Total	48	260

GIS Data Source: USFWS (2014g)

Table 3.19-39 provides a summary of wetlands identified for HVDC Alternative Route 7-A (corresponding to Applicant Proposed Route Link 1 in Region 7) within the 1,000-foot-wide ROI.

Table 3.19-39:
Wetlands in the 1,000-Foot Corridor—Region 7, HVDC Alternative Route 7-A

Wetland Type	No. of Wetlands	Acreage of Wetlands
PEM	3	10
PFO	8	81
R2UB	2	74
Total	13	165

GIS Data Source: USFWS (2014g)

Table 3.19-40 provides a summary of wetlands identified for HVDC Alternative Route 7-B (corresponding to Applicant Proposed Route Links 3 and 4 in Region 7) within the 1,000-foot-wide ROI.

Table 3.19-40:
Wetlands in the 1,000-Foot Corridor—Region 7, HVDC Alternative Route 7-B

Wetland Type	No. of Wetlands	Acreage of Wetlands
PEM	1	1
PFO	5	23
PSS	1	3
PUB	4	2
Total	11	29

GIS Data Source: USFWS (2014g)

Table 3.19-41 provides a summary of wetlands identified for HVDC Alternative Route 7-C (corresponding to Applicant Proposed Route Links 3, 4 and 5 in Region 7) within the 1,000-foot-wide ROI.

Table 3.19-41:
Wetlands in the 1,000-Foot Corridor—Region 7, HVDC Alternative Route 7-C

Wetland Type	No. of Wetlands	Acreage of Wetlands
PEM	5	5
PFO	22	96
PSS	5	3
PUB	12	9
Total	44	113

GIS Data Source: USFWS (2014g)

Table 3.19-42 provides a summary of wetlands identified for HVDC Alternative Route 7-D (corresponding to Applicant Proposed Route Links 4 and 5 in Region 7) within the 1,000-foot-wide ROI.

Table 3.19-42:
Wetlands in the 1,000-Foot Corridor—Region 7, HVDC Alternative Route 7-D

Wetland Type	No. of Wetlands	Acreage of Wetlands
PFO	6	18
PSS	2	0
PUB	4	3
Total	12	21

GIS Data Source: USFWS (2014g)

Table 3.19-43 provides a list of NWI wetland resources identified in the ROI for the Tennessee Converter Station Siting Area and AC Interconnection Tie.

Table 3.19-43:
Wetlands in Region 7, Tennessee Converter Station Siting Area and AC Interconnection Tie

Wetland Type	No. of Wetlands	Acreage of Wetlands
PFO	2	2.7
Total	2	2.7

GIS Data Source: USFWS (2014g)

3.19.5.7.2 Floodplains

Table 3.19-44 provides the number and acreage of 100-year floodplain crossings estimated for each of the HVDC alternative routes and for the Applicant Proposed Route within the ROI in Region 7. The Applicant Proposed Route is estimated to cross forty-one 100-year floodplains totaling an estimated 1,712 acres. The ROI for the Tennessee Converter Station Siting Area and AC Interconnection Tie is estimated to cross 3 separate 100-year floodplains.

Table 3.19-44:
100-Year Floodplains in the 1,000-Foot Corridor for the HVDC Transmission Line—Region 7

Alternative Route	No. of Floodplain Crossings	Estimated Acreage of Crossings
APR	41	1,712
7-A	10	1382
7-B	8	286

Table 3.19-44:
100-Year Floodplains in the 1,000-Foot Corridor for the HVDC Transmission Line—Region 7

Alternative Route	No. of Floodplain Crossings	Estimated Acreage of Crossings
7-C	33	725
7-D	19	223
Tennessee Converter Station Siting Area	3	37

3.19.5.7.3 Riparian Areas

Table 3.19-2 includes a total number of potential stream crossings in Region 7. These streams may all have associated riparian area resources.

3.19.5.8 Connected Actions

3.19.5.8.1 Wind Energy Generation

The NWI database has provided data to document palustrine (depressional), lacustrine (lakes), and riverine wetlands within the various WDZs. These wetland types include emergent, scrub-shrub, forested, farmed, unconsolidated bottom, unconsolidated shore, intermittent stream, and lower perennial stream types. The overall wetland acreages within each zone are discussed in the following subsections.

FEMA's 100-year national flood hazard layer (GIS Data Source: FEMA 2014) was used to identify potential floodplain impact areas within each wind development zone.

Riparian areas may potentially occur in areas with perennial or intermittent streams, as well as ponds, lakes, or reservoirs.

3.19.5.8.1.1 WDZ-A

The NWI database documents approximately 2,896 acres of wetlands within this development zone. This total of 2,896 acres of wetlands includes about 1,119 acres of lake shoreline wetlands and another 1,298 acres of farmed wetlands. As shown in Table 3.15-32, WDZ-A encompasses approximately 4.9 miles of perennial streams, 103.4 miles of intermittent streams, and 1,368 acres of reservoirs, lakes, and ponds, of which 97 percent are identified as only intermittent waterbodies. The acreage of reservoirs, lakes, and ponds, although mostly intermittent, is the second highest of any of the WDZs. There are no 100-year or 500-year floodplains mapped in this WDZ.

3.19.5.8.1.2 WDZ-B

The NWI database documents approximately 1,520 acres of wetlands within this development zone. This total includes 770 acres of lake shoreline wetlands and 202 acres of farmed wetlands. WDZ-B is located in the Palo Duro watershed (Table 3.15-31), but Palo Duro Creek, the watershed's primary drainage feature, runs adjacent to the zone's southeast extent, not through it. As shown in Table 3.15-32, WDZ-B encompasses about 8.0 miles of perennial streams, 124.1 miles of intermittent streams, and 976 acres of reservoirs, lakes, and ponds, of which 83 percent are identified as only intermittent waterbodies. There are no 100-year or 500-year floodplains mapped in this WDZ.

3.19.5.8.1.3 WDZ-C

The NWI database documents approximately 812 acres of wetlands within this development zone. Farmed wetlands account for approximately 131 acres of the total 812 acres of wetlands. There are approximately 226 acres of palustrine emergent wetlands in this zone. WDZ-C is located in the Coldwater watershed (Table 3.15-31), and both Frisco Creek and Coldwater Creek, the watershed's primary drainage features, run through portions of the zone. The north-central portion of WDZ-C includes a small segment of Frisco Creek and Coldwater Creek extends the entire length of the zone, running just inside or outside the southern and southeastern periphery. As shown in Table 3.15-32, WDZ-C encompasses about 6.4 miles of perennial streams, 204.4 miles of intermittent streams, and 323 acres of reservoirs, lakes, and ponds, of which 61 percent are identified as only intermittent waterbodies. There are no 100-year or 500-year floodplains mapped in this WDZ.

3.19.5.8.1.4 WDZ-D

The NWI database documents approximately 382 acres of wetlands within this development zone. There are approximately 121 acres of lake shoreline wetlands within the total of 382 total wetland acres. FEMA has mapped two 100-year floodplains totaling approximately 1,991 acres within this development zone. WDZ-D straddles the Middle Beaver, Coldwater, and Palo Duro watersheds (Table 3.15-31), but the watersheds' primary drainage features (i.e., Beaver River and Coldwater, Frisco, and Palo Duro creeks) do not run through the zone. As shown in Table 3.15-32, WDZ-D encompasses about 12.7 miles of perennial streams, 134.9 miles of intermittent streams, and 166 acres of reservoirs, lakes, and ponds, of which 66 percent are identified as only intermittent waterbodies. There are an estimated 1,991 acres of 100-year floodplains and no acreage of 500-year floodplains mapped in WDZ-D.

3.19.5.8.1.5 WDZ-E

The NWI database documents approximately 430 acres of wetlands within this development zone. There are approximately 121 acres of farmed wetlands and 185 acres if palustrine unconsolidated bottom wetlands in the total of 430 acres. WDZ-E is located primarily within the Middle Beaver watershed (Table 3.15-31), but the Beaver River, the watershed's primary drainage feature, is north of the zone and does not run through it. WDZ-E also extends into the Coldwater watershed, but this watershed's primary drainage features also do not run through the zone. As shown in Table 3.15-32, WDZ-E encompasses about 2.6 miles of perennial streams, 43.6 miles of intermittent streams, and 33 acres of reservoirs, lakes, and ponds, of which 24 percent are identified as only intermittent waterbodies. The miles of perennial and intermittent streams are the second lowest of any of the WDZs and the total acreage of reservoirs, lakes, and ponds is the lowest. There are no 100-year or 500-year floodplains mapped in this WDZ.

3.19.5.8.1.6 WDZ-F

The NWI database documents approximately 507 acres of wetlands within this development zone. These resources are somewhat evenly spread between lake shoreline, palustrine emergent, palustrine forested, and palustrine scrub-shrub wetland types. FEMA has mapped three 100-year floodplains totaling approximately 2,800 acres within this development zone. WDZ-F straddles the Middle Beaver and Coldwater watersheds (Table 3.15-31). The northern and western peripheries of WDZ-F extend over short segments of the Beaver River, a primary drainage feature, but the zone does not extend over either of the Coldwater watershed's primary drainage features. As shown in Table 3.15-32, WDZ-F encompasses about 13.0 miles of perennial streams, 207.1 miles of intermittent streams, and 52 acres of reservoirs, lakes, and ponds, of which 54 percent are identified as only intermittent waterbodies. The total acreage of reservoirs, lakes, and ponds is the second lowest of any of the WDZs. There are an estimated 2,800 acres of 100-year floodplains and no acreage of 500-year floodplains in WDZ-F.

3.19.5.8.1.7 WDZ-G

The NWI database documents approximately 776 acres of wetlands within this development zone. There are approximately 287 acres of farmed wetlands and 261 acres of palustrine emergent wetlands in the total of 776 total acres. WDZ-G is located primarily within the Upper Beaver watershed (Table 3.15-31), but the Beaver River, the watershed's primary drainage feature, does not run through the zone. As shown in Table 3.15-32, WDZ-G encompasses about 6.8 miles of perennial streams, 191.7 miles of intermittent streams, and 281 acres of reservoirs, lakes, and ponds, of which 96 percent are identified as only intermittent waterbodies. The 12 acres of perennial reservoirs, lakes, and ponds is the second lowest of any of the WDZs. There are no 100-year or 500-year floodplains mapped in this WDZ.

3.19.5.8.1.8 WDZ-H

The NWI database documents approximately 819 acres of wetlands within this development zone. This total primarily consists of intermittent riverine wetlands (416 acres), palustrine emergent wetlands (121 acres), and lakeshore emergent wetlands (224 acres). WDZ-H is located within the Upper Beaver watershed (Table 3.15-31) and the Beaver River, the watershed's primary drainage feature, runs adjacent to the zone's southeastern periphery, but does not run through it. As shown in Table 3.15-32, WDZ-H encompasses about 19.9 miles of perennial streams, 205.4 miles of intermittent streams, and 211 acres of reservoirs, lakes, and ponds, of which 96 percent are identified as only intermittent waterbodies. The 8 acres of perennial reservoirs, lakes, and ponds is the lowest acreage of this type of perennial waters from any of the WDZs. There are no 100-year or 500-year floodplains mapped in this WDZ.

3.19.5.8.1.9 WDZ-I

The NWI database documents approximately 1,620 acres of wetlands within this development zone. This total is composed primarily of farmed wetlands (318 acres), palustrine emergent wetlands (688 acres), and lakeshore emergent wetlands (400 acres). WDZ-I is located within the Middle Beaver watershed (Table 3.15-31), but the Beaver River, the watershed's primary drainage feature, does not run through the zone. As shown in Table 3.15-32, WDZ-I encompasses about 1.7 miles of perennial streams, 17.5 miles of intermittent streams, and 705 acres of reservoirs, lakes, and ponds, of which 98 percent are identified as only intermittent waterbodies. The miles of perennial and intermittent streams are the lowest of any of the WDZs. There are no 100-year or 500-year floodplains mapped in this WDZ.

3.19.5.8.1.10 WDZ-J

The NWI database documents approximately 759 acres of wetlands within this development zone. There are approximately 454 acres of palustrine emergent wetlands and 169 acres of palustrine scrub-shrub wetlands within the total of 759 acres. WDZ-J is located primarily within the Middle Beaver watershed, with a portion in the Palo Duro watershed, and an edge crossing into the Lower Beaver watershed (Table 3.15-31). The northernmost point of the zone extends over the Beaver River and the southwest extent of the zone reaches Palo Duro Creek, but these are the only points where the two primary drainage features of the watersheds are at or in the zone. As shown in Table 3.15-32, WDZ-J encompasses about 26.2 miles of perennial streams, 285.0 miles of intermittent streams, and 164 acres of reservoirs, lakes, and ponds, of which 25 percent are identified as only intermittent waterbodies. The miles of perennial streams are the second highest of any of the WDZs and the miles of intermittent streams are the highest. There are no 100-year or 500-year floodplains mapped in this WDZ.

3.19.5.8.1.11 WDZ-K

The NWI database documents approximately 736 acres of wetlands within this development zone. The wetlands within this development zone include 326 acres of farmed wetlands and 251 acres of lake shoreline wetlands. WDZ-K is located primarily within the Lower Beaver watershed, with a small amount of the southwestern periphery extending into the Middle Beaver watershed (Table 3.15-31). The Beaver River, the primary drainage feature for both watersheds, does not run through the zone. As shown in Table 3.15-32, WDZ-K encompasses about 6.3 miles of perennial streams, 220.2 miles of intermittent streams, and 487 acres of reservoirs, lakes, and ponds, of which 88 percent are identified as only intermittent waterbodies. The miles of intermittent streams are the second highest of any of the WDZs. There are no 100-year or 500-year floodplains mapped in this WDZ.

3.19.5.8.1.12 WDZ-L

The NWI database documents approximately 5,214 acres of wetlands within this development zone. This total of approximately 5,200 acres of wetlands includes about 3,135 acres of lake shoreline wetlands, and another 711 acres of farmed wetlands. WDZ-L is located primarily within the Upper Wolf watershed, with a small amount of the western periphery extending into the Palo Duro watershed (Table 3.15-31). Wolf Creek, the primary drainage feature of the Upper Wolf watershed, runs through the northeastern portion of the zone; Palo Duro Creek, the primary drainage feature of the other watershed does not run through the zone. As shown in Table 3.15-32, WDZ-L encompasses about 31.6 miles of perennial streams, 190.6 miles of intermittent streams, and 3,868 acres of reservoirs, lakes, and ponds, of which 83 percent are identified as only intermittent waterbodies. The miles of perennial streams are the highest of any of the WDZs. The acreage of both perennial and intermittent reservoirs, lakes, and ponds are also the highest of any of the WDZs; however, WDZ-L has the largest land area of any of the zones. There are no 100-year or 500-year floodplains mapped in this WDZ.

3.19.5.8.2 Optima Substation

The land cover in the future Optima Substation location is primarily grassland herbaceous, with some shrub/scrub and developed, open space. There are no structures or existing infrastructure on the 160-acre site, although there are roads and an operating wind farm nearby. Irrigated cropland is also in the vicinity. No wetlands, floodplains, or riparian areas are documented for this site.

3.19.5.8.3 TVA Upgrades

The ROI for the direct assignment facilities (which are included in the Applicant Proposed Project) would occur within the Tennessee Converter Station Siting Area and more specifically within the Shelby Substation. The ROI for the network upgrades, and in particular TVA's future 500kV transmission line, cannot be fully determined at this time. The new 500kV transmission line would be constructed in western Tennessee. The upgrades to existing facilities would mostly be in western and central Tennessee. Upgrades to existing infrastructure would include upgrading terminal equipment at three existing 500kV substations and six existing 161kV substations; making appropriate upgrades to increase heights on 16 existing 161kV transmission lines to increase line ratings, and replacing the conductors on eight existing 161kV transmission lines. Where possible, general impacts associated with the required TVA upgrades are discussed in the impact sections that follow.

3.19.6 Impacts to Wetlands, Floodplains, and Riparian Areas

3.19.6.1 Methodology

3.19.6.1.1 Environmental Protection Measures

The Applicant has developed a comprehensive list of EPMs that would avoid and minimize impacts to wetlands, floodplains, and riparian areas. Implementation of these EPMs is assumed throughout the impact analysis that follows for Project. A complete list of EPMs for the Project is provided in Appendix F; those EPMs that would specifically allow for the avoidance and/or minimization of potential adverse impacts in wetlands, floodplains, and riparian areas are listed below:

General EPMs:

- GE-1: Clean Line will train personnel on health, safety, and environmental matters. Training will include practices, techniques, and protocols required by federal and state regulations and applicable permits.
- GE-3: Clean Line will minimize clearing vegetation within the ROW, consistent with a Transmission Vegetation Management Plan (TVMP) filed with NERC, and applicable federal, state, and local regulations. The TVMP may require additional analysis under NEPA depending on whether and under what conditions DOE decides to participate in the Project.
- GE-5: Any herbicides used during construction and operations and maintenance will be applied according to label instructions and any federal, state, and local regulations.
- GE-6: Clean Line will restrict vehicular travel to the ROW and other established areas within the construction, access, or maintenance easement(s).
- GE-7: Roads not otherwise needed for maintenance and operations will be restored to preconstruction conditions. Restoration practices may include decompacting, recontouring, and re-seeding. Roads needed for maintenance and operations will be retained.
- GE-9: Clean Line will avoid and/or minimize damage to drainage features and other improvements such as ditches, culverts, levees, tiles, and terraces; however, if these features or improvements are inadvertently damaged, they will be repaired and or restored.
- GE-13: Emergency and spill response equipment will be kept on hand during construction.
- GE-14: Clean Line will restrict the refueling and maintenance of vehicles and the storage of fuels and hazardous chemicals within at least 100 feet from wetlands, surface waterbodies, and groundwater wells, or as otherwise required by federal, state, or local regulations.
- GE-15: Waste generated during construction or maintenance, including solid waste, petroleum waste, and any potentially hazardous materials will be removed and taken to an authorized disposal facility.
- GE-21: Clean Line will maintain construction equipment in good working order. Equipment and vehicles that show excessive emissions of exhaust gasses and particulates due to poor engine adjustments or other inefficient operating conditions will be repaired or adjusted.
- GE-27: Clean Line will minimize compaction of soils and rutting through appropriate use of construction equipment (e.g., low ground pressure equipment and temporary equipment mats).

Soils and Agriculture EPMs:

- AG-1: Clean Line will avoid or minimize adverse effects to surface and subsurface irrigation and drainage systems (e.g., tiles). Clean Line will work with landowners to minimize the placement of structures in locations that would interfere with the operation of irrigation systems.

- GEO-1: Clean Line will stabilize slopes exposed by its activities to minimize erosion.

Vegetation EPMs:

- FVW-1: Clean Line will identify environmentally sensitive vegetation (e.g., wetlands, protected plant species, riparian areas, large contiguous tracts of native prairie) and avoid and/or minimize impacts to these areas.
- FVW-2: Clean Line will identify and implement measures to control and minimize the spread of non-native invasive species and noxious weeds.
- FVW-3: Clean Line will clearly demarcate boundaries of environmentally sensitive areas during construction to increase visibility to construction crews.

Water EPMs:

- W-1: Clean Line will avoid and/or minimize construction of access roads in special interest waters.
- W-2: Clean Line will identify, avoid, and/or minimize adverse effects to wetlands and waterbodies. Clean Line will not place structure foundations within the Ordinary High Water Mark of Waters of the United States.
- W-3: Clean Line will establish streamside management zones within 50 feet of both sides of intermittent and perennial streams and along margins of bodies of open water where removal of low-lying vegetation is minimized.
- W-4: If used, Clean Line will selectively apply herbicides within streamside management zones.
- W-5: Clean Line will construct access roads to minimize disruption of natural drainage patterns including perennial, intermittent, and ephemeral streams.
- W-6: Clean Line will not construct counterpoise or fiber optic cable trenches across waterbodies.
- W-7: Clean Line will locate spoil piles from foundation excavations and fiber optic cable trenches outside of streamside management zones.
- W-8: Dewatering will be conducted in a manner designed to prevent soil erosion (e.g., through discharge of water to vegetated areas and/or the use of flow control devices).
- W-9: Clean Line will design converter station sites to avoid adverse changes to the base flood elevation within the 100-year floodplain.
- W-10: Clean Line will minimize fill for access roads and structure foundations within 100-year floodplains to avoid adverse changes to the base flood elevation.
- W-11: Clean Line will locate and minimize impacts to groundwater wells and springs within the construction ROW.
- W-14: Clean Line will ensure that there is no off-site discharge of wastewater from batch plant sites.

In addition, Clean Line will prepare the following plans to provide guidance for work activities during the construction and operations and maintenance phases of the proposed Project:

- Transportation and Traffic Management Plan: This plan will describe measures designed to avoid and/or minimize adverse effects associated with the existing transportation system.
- Restoration Plan: This plan will describe post-construction activities to reclaim disturbed areas.
- Spill Prevention, Control and Countermeasures (SPCC) Plan: This plan will describe the measures designed to prevent, control, and clean up spills of hazardous materials.
- Storm Water Pollution Prevention Plan (SWPPP): This plan, consistent with federal and state regulations, will describe the practices, measures, and monitoring programs to control sedimentation, erosion, and runoff from disturbed areas.

- Transmission Vegetation Management Plan (TVMP): This plan, to be filed with the NERC, will describe how Clean Line will conduct work on its right-of-way to prevent outages due to vegetation. The TVMP may require additional analysis under NEPA depending on whether and under what conditions DOE decides to participate in the Project.

Finally, DOE will prepare a Statement of Findings as required by 10 CFR 1022.14 and Executive Orders 11988 and 11990. The Project, through appropriate use of EPMs and BMPs would avoid and/or minimize impacts to wetlands, floodplains, and riparian areas.

3.19.6.1.2 Construction Impacts Common to All Alternatives

3.19.6.1.2.1 Wetlands

The potential impacts to wetland resources were calculated using the NWI database (GIS Data Source: USFWS 2014g). The 200-foot-wide representative ROWs for Project elements (e.g., AC collection system, the Applicant Proposed Route, and the HVDC alternative routes) were evaluated according to their respective widths and lengths as they intersected specific NWI-mapped wetland features. These intersections of ROW with wetland resources yielded an acreage estimate for potential impacts. It should be noted that these impact estimates do not account for implementation of the EPM's listed in Section 3.19.6.1.1. In many cases, the use of EPMs would greatly diminish or, in some cases, eliminate the potential for impact altogether. In the case of the converter stations and AC interconnection siting areas, GIS was used to determine the acreage of intersection between siting area footprints and NWI-mapped wetland resources to yield acreage of potential impact to wetland resources. All estimated impact numbers have been rounded to the nearest acre. Impact estimates for acreage and mileage have been rounded to the tenths place (e.g., 0.1 mile, 2.5 acres, etc.).

The potential short-term impacts to wetlands from construction activities could include:

- Mechanical damage/crushing of wetland vegetation from use of heavy machinery
- Compaction of wetland soils, which could reduce the soil's water-holding capacity
- Sedimentation and turbidity from construction activities adjacent to wetlands
- Alteration of hydrology from access road construction, excavations for structure foundations, dewatering activities, or blasting
- Contamination from herbicide runoff and from accidental spills of hazardous substances, such as fuels, lubricants, and that may be accidentally released into wetlands or which could reach wetlands through overland runoff paths

The potential long-term impacts to wetlands from Project construction may include:

- Placement of fill into wetlands at foundation footprint locations or for permanent access roads
- Long-term conversion of forested wetlands to shrubby or herbaceous cover type within the ROW
- Changes to wetland hydrology from any permanent access roads constructed through wetlands
- Introduction of invasive species from construction equipment (Clean Line 2013)

The potential impacts to wetlands from specific construction activities and proposed avoidance and minimization measures are discussed in the following sections.

Clearing and Grading

Construction of the Project would require the removal of some wetland vegetation for the purposes of equipment access, safe construction processes, and for long-term electrical safety clearances. The removal of wetland vegetation may reduce water retention capacity of affected wetland ecosystems. Vegetation removal may also impair individual wetlands' ability to filter sediments. Soil and water temperatures in wetland ecosystems could increase where shading is diminished by vegetation removal. Wetland habitat suitability would be altered where forested wetland vegetation or scrub-shrub wetland vegetation types are removed during construction and are replaced with palustrine emergent wetland vegetation (wetlands typically dominated by grasses, sedges, and rushes).

The grading of soils in wetlands has the potential to change existing topographic contours. This alteration may change flow regimes through these ecosystems, resulting in increased erosion, additional loss of vegetation, and potential for sedimentation downstream/downgradient of the affected wetlands.

To address the short-term and potentially long-term direct and indirect impacts of the clearing of wetland vegetation, clearing of vegetation would be minimized during construction within the representative 200-foot-wide ROW, consistent with a TVMP (EPM GE-3). Vegetation removed during clearing would be disposed of according to federal, state, and local regulations (EPM GE-4).

Herbicide Use

Herbicides would be used selectively to minimize regrowth of certain trees and woody species in the ROW as needed during construction activities. Herbicides may have adverse impacts on wetland vegetation, potentially causing both short-term and long-term loss of living tissue as well as changes in growth and reproduction. Use of herbicides also carries the threat of harm to non-target organisms if the active ingredient is mobilized in semi-aquatic or aquatic ecosystem such as wetlands. All herbicides used during construction would be applied according to labeled instructions and any federal, state, and local regulations (EPM GE-5).

Structure Placement within Wetlands

If structural foundations were placed in wetlands, that action could constitute fill under the CWA, and as such, would require permitting through the appropriate regulatory office of the USACE. If realized, this type of impact would constitute a long-term loss of wetland acreage because the structures would remain for the life of the Project. The Applicant would avoid or minimize foundations and foundation spoil piles in wetlands (EPM W-2 and EPM W-7). If final siting of structures is determined to be planned for areas identified as potential wetlands or other waters of the United States, then these resources should be formally delineated prior to construction to establish true wetland/upland boundaries and to determine acreage of potential impact.

Construction Equipment Usage in Wetland Areas

The Applicant would use low ground-pressure equipment and temporary equipment mats and mat boards when activity is required within the boundaries of wetland ecosystems (EPM GE-27). If construction equipment is driven through wetlands, it can result in mechanical damage to or loss of vegetation and it may lead to compacted wetland soils. Soil compaction reduces the ability of a wetland to retain water. When temporary crossings (e.g., matting) of wetlands is necessary and unavoidable, these crossing materials would be removed following construction activities. The use of construction equipment in wetlands and use of construction matting would require permit verification with the USACE. The Applicant would restrict vehicular travel to the ROW and other established areas within the construction, access, or maintenance easements (EPM GE-6). Roads traversing wetland areas not otherwise needed for maintenance and operations would be restored to preconstruction contours and reseeded (EPM GE-7). The Applicant would prepare and implement a Restoration Plan that would describe post-construction activities to reclaim disturbed areas, including wetlands.

Excavation and Dewatering

Construction of AC and HVDC transmission structure foundations, trenches for buried counterpoise wire and fiber optic cables, and any excavation needed at converter station locations (i.e., for structural foundation installation and for installation of electrical raceways and grounds) may temporarily accumulate water either from groundwater intrusion or from precipitation. The excavations and trenches may need to be dewatered periodically to allow for proper and safe construction. In areas where the Applicant encounters groundwater during excavation, impacts to the water table may occur if excavations require dewatering, which could affect hydrology of adjacent wetlands. These indirect impacts would be temporary and localized. The Applicant would minimize the amount of time that any excavations remain open (EPM GE-30) to minimize the amount of dewatering required. Dewatering would be conducted in a manner designed to prevent soil erosion (e.g., through discharge of water to vegetated areas and/or the use of flow control devices) (EPM W-8). The implementation of the SWPPP would control erosion, sedimentation, and runoff in areas affected by dewatering. The Applicant would not construct counterpoise or fiber optic cable trenches across waterbodies (EPM W-6). It is anticipated that excavation and dewatering impacts would be minor in intensity and short-term in duration.

Blasting

The use of blasting techniques may be required in some locations, such as transmission line structure foundations. The Applicant would not place structure foundations within the Ordinary High Water Mark of waters of the United States (EPM W-2). Blasting in or adjacent to Waters of the United States, including wetlands, is not anticipated. The Applicant would avoid such blasting; however, if blasting is required within 150 feet of a spring or groundwater well, the Applicant would conduct preconstruction monitoring of yield and water quality in cooperation with the landowner (EPM W-12). The Applicant would develop and implement a Blasting Plan in the unlikely event blasting is required. This plan would describe measures designed to minimize adverse effects due to blasting. No impact to wetlands from blasting is anticipated.

Hazardous Materials Handling

Accidental spills of fluids used during construction, such as fuel, insulating oil, lubricants, antifreeze, detergents, paints, solvents, and herbicides, could contaminate wetland vegetation, waters, and soils. To minimize the potential for these short-term and long-term direct and indirect impacts, the Applicant would restrict the refueling and maintenance of vehicles and the storage of fuels and hazardous chemicals to areas outside of a 100-foot buffer from wetlands, or as otherwise required by federal, state, or local regulations (EPM GE-14). The Applicant would maintain construction equipment in good working order (EPM GE-21). Emergency and spill response equipment would be kept on hand during construction (EPM GE-13). It is anticipated that these impacts would be generally minor and temporary, or short term.

Wastewater Discharge from Concrete Batch Plants

Temporary concrete batch plants may be required at multi-use construction yards. If left uncontrolled, process wastewater and contaminated stormwater runoff from the temporary concrete batch plants could potentially wash into wetlands, resulting in short-term direct and indirect impacts. To minimize the potential for these impacts, the Applicant would ensure that there is no off-site discharge of wastewater from temporary batch plant sites (EPM

W-14). Waste generated during construction, including solid waste, petroleum waste, and any potentially hazardous materials, would be removed and taken to an authorized disposal facility (EPM GE-15).

3.19.6.1.2.2 Floodplains

The potential impacts to floodplain resources were calculated using FEMA floodplain data for 100-year floodplains (GIS Data Source: FEMA 2014). No 500-year floodplain data were available in this most recent FEMA national flood hazard layer for any portion of the planned Project ROWs. FEMA has not delineated 500-yeard floodplains in the most current data set and these areas are thus considered non-special flood hazard areas. The planned ROWs for Project elements (e.g., AC collection system, the Applicant Proposed Route, and the HVDC alternative routes) were evaluated according to their respective widths and lengths as they intersected specific FEMA-mapped floodplain features. These intersections of ROW with floodplain resources yielded an acreage estimate for potential impacts. In the case of the converter station and AC interconnection siting areas, GIS was used to determine the acreage of intersection between siting area footprints and FEMA-mapped floodplain resources to yield acreage of potential impact to floodplain resources. All impact values have been rounded to the nearest acre. For those floodplain impact estimates where the value derived from GIS data was less than 0.5 acre, values in the impact tables have been reported as <1 acre. Values between 0.5 and 0.9 acre are reported as 1 acre in the impact tables.

The construction activities that could affect floodplains include placing long-term structures such as AC and HVDC transmission structures, converter station foundations, and permanent above-grade access roads within a floodplain and driving heavy equipment within a floodplain resulting in soil compaction. The quantity of impact from construction related activities on floodplains was calculated using GIS and has been rounded to the nearest tenth of an acre.

Structure Placement within Floodplains

The placement of structure foundations within 100-year floodplains would be avoided; however, placement of some structures in 100-year floodplains would be necessary in some areas (e.g., the Mississippi River floodplain) (EPM W-10). Transmission line structures would not prohibit the flow of water within floodplains, because water can flow around structure foundations.

Placing converter stations within a floodplain would increase impermeable surfaces within the floodplain and reduce water absorption, and could change the grade of the floodplain, limiting the ability of water to spread during high-flow events. The Applicant would not construct a converter station within 100-year floodplains, if practicable. If impacts to a floodplain are unavoidable, the design of the converter station sites would seek to avoid adverse changes to the base flood elevation (EPM W-9). Impacts are anticipated to be minor in intensity, and temporary in duration.

Driving Heavy Equipment within a Floodplain

The addition of new access roads within a floodplain can result in soil compaction, an increase in impervious surfaces, and reduction in water absorption. Access roads can also change the gradient of the floodplain, limiting the ability of water to spread during high-flow events. To address these potential long-term impacts, the Applicant would limit building new access roads within 100-year floodplains to the extent practicable (EPM W-10). The Applicant would utilize low ground-pressure equipment and temporary equipment mats (EPM GE-27) as practicable. A Restoration Plan would detail measures the Applicant would implement to minimize long-term impact from compaction.

3.19.6.1.2.3 Riparian Areas

Riparian systems may be broadly defined as transitional areas between surface water systems and purely upland areas. Riparian areas share some of the same characteristics of hydrology, hydric soils, and hydrophytic vegetation with wetlands and surface water resources, but they also may feature more mesic soils and vegetation. Given this diversity, riparian areas are ecologically significant in any landscape where they occur and they tend to provide important ecosystem services, such as wildlife habitat, flood flow attenuation, and sediment retention. The impacts that take place in wetlands and floodplains may impact riparian areas, especially those wetlands and floodplains associated with perennial creeks and rivers that are intersected by the ROW.

Riparian areas have not been specifically mapped, nor field verified for environmental impacts. No specific database concerning riparian resources was identified during desktop analysis. In order to provide an assessment of potential impacts for riparian areas, data developed for perennial streams, intermittent streams, and other surface waterbodies (ponds, lakes, reservoirs, etc.) have been reproduced from Section 3.15. These data come from the National Hydrography Dataset. These data, while not definitive in identifying riparian areas specifically, do provide a measure of understanding concerning their potential to exist and to be impacted within a given Project component ROW or siting area footprint. The data were obtained using GIS and include estimates of the mileage that national hydrography dataset-mapped perennial and intermittent streams cross ROWs or siting areas, as well as estimates of the acreage for ponds, lakes, and reservoirs that are intersected by ROWs or siting areas.

The construction activities that could affect riparian areas includes short–term loss of vegetation due construction vehicle access through riparian corridors, plus long-term loss of vegetation due to placement of structures such as AC and HVDC support structures, converter station foundations, and permanent above-grade access roads. Riparian areas may also incur soil compaction from the use of heavy construction equipment in more hydric areas.

3.19.6.1.3 Operations and Maintenance Impacts Common to All Alternatives

This section details potential impacts to wetlands, floodplains and riparian areas from the operation and maintenance of the converter stations and interconnections, the HVDC and AC transmission lines, access roads, and fiber optic regeneration stations.

3.19.6.1.3.1 Wetlands

Wetland ecosystems may be impacted by the operations and maintenance activities associated with vegetation maintenance, herbicide use, driving vehicles within wetlands, and hazardous materials handling during inspections and maintenance work. Impacts are expected to be minor and short-term.

Vegetation Maintenance

The Applicant would maintain a 150- to 200-foot-wide ROW (typical) during operation in accordance with a TVMP. Maintenance may include the long-term direct impact of vegetation removal as well as the short-term impact of trimming or pruning of vegetation in wetland areas. Vegetation maintenance (i.e., trimming of woody vegetation) within wetlands could potentially decrease evapotranspiration rates and increase soil and water temperatures due to lack of shading. To minimize these potential impacts, the Applicant would minimize clearing of vegetation within the ROW, consistent with the TVMP and applicable federal, state, and local regulations (EPM GE-3). Vegetation impacts are projected to be long-term in some portions of the Project, especially the areas of forested and scrub-shrub wetlands cover types. Vegetation impacts in palustrine emergent wetlands would likely be minor and short-term. The Applicant would restrict vehicular travel to the ROW and other established areas within the access or maintenance easement(s) to avoid or minimize impacts to wetland resources (EPM GE-6).

Herbicide Use

The Applicant may selectively apply herbicides to minimize regrowth of certain trees and woody species in forested and scrub-shrub wetlands. Herbicides may be toxic to aquatic organisms depending on the type used and the concentration. Any herbicides used during operations and maintenance would be applied according to labeled instructions and any federal, state, and local regulations (EPM GE-5). To minimize potential short-term and direct impacts, the Applicant would selectively apply herbicides to protect wetland and other water resources.

Equipment Usage in Wetland Areas

It may be necessary to drive operations and maintenance equipment across wetlands when dry, or to establish temporary crossings using mat boards when soils are saturated. Driving equipment across wetlands could compact or rut wetland soils as well as cause sedimentation in wetlands and increased turbidity in surface waters. The Applicant would minimize compaction of soils and rutting through appropriate use of equipment (e.g., low ground-pressure equipment and temporary equipment mats) (EPM GE-27). Following removal of the temporary crossings, wetlands would be restored to pre-disturbance conditions. Any impacts associated with driving construction vehicles in wetlands would be minor and temporary. Dredge or fill of wetlands may occur during the operations and maintenance phase of the Project; however, any impacts would be subject to permit requirements at the time.

During operations and maintenance, the Applicant would restrict vehicular travel to the ROW and other established areas within the access or maintenance easement(s) (EPM GE-6).

Hazardous Materials Handling

Inadvertent spills of fluids, such as fuel, insulating oil, lubricants, antifreeze, detergents, paints, solvents, and herbicides used during operations and maintenance along the HVDC or AC transmission line ROWs, or at the converter stations, could contaminate wetland soils and vegetation. While spills of insulating fluid at converter stations could potentially contaminate wetlands, standard design of the facilities would include secondary containment to minimize potential impact. Industry-standard equipment and vehicles used by employees and used for operations and maintenance activities also could be a source of inadvertent minor spills. The Applicant would implement EPMs GE-13, GE-14, GE-15, and GE-21 to minimize potential impacts and would implement an SPCCP. Impacts to wetlands from hazardous materials handling should be minor in intensity and temporary in duration.

3.19.6.1.3.2 Floodplains

It is anticipated that unpaved roads or two-track access would be used for maintenance. This usage would result in long-term but low intensity impact in the form of soil compaction in floodplains. Vehicular travel would be restricted to the ROW and other established areas within the access and maintenance easement where operations and maintenance are necessary (EPM GE-6). No additions of impervious surfaces or changes to grade within the ROW would be made during operations and maintenance. The Applicant would not conduct operations and maintenance activity during flooding conditions in any floodplain unless emergency conditions warrant.

3.19.6.1.3.3 Riparian Areas

Riparian areas are predicted to experience only minor, short-term impacts during the operations and maintenance phase of the Project. The impact types are likely to include minor clearing of wetland and floodplain vegetation to satisfy line safety considerations or to keep access roads passable. The occasional use of access roads may result in minor soil compaction where they cross riparian zones. There is a potential for drift or runoff of selective herbicide applications in riparian areas that could cause damage or loss of riparian vegetation and for accidental spills of small quantities of hazardous materials, such as fuels and lubricants. Such spills could cause damage to or loss of riparian area vegetation.

3.19.6.1.4 Decommissioning Impacts Common to All Alternatives

Transmission line and converter station decommissioning could occur at the end of the useful life of the facilities. Decommissioning for the Project would include the dismantling and removal of conductors, insulators, and support structures as well as removal of the converter and regeneration stations. The Applicant would decommission access roads that were solely designed and built to provide maintenance crews with access to the Project infrastructure. The Applicant may decommission access roads before the end of the transmission line's useful life if it determined the roads were no longer necessary. The Applicant would consult with landowners to assess whether landowners wish to keep the access roads.

Decommissioning of the Project could result in impacts to wetlands, floodplains, and riparian vegetation very similar to those incurred during construction (e.g., mechanical damage or loss of wetland and riparian vegetation, increased sedimentation and turbidity, erosion, soil compaction, damage or loss of wetland and riparian vegetation from drift or runoff of herbicides, and damage or loss of wetland and riparian vegetation from spills of hazardous materials.

Assuming that the ROW is allowed to revert to preconstruction conditions and unnecessary access roads are removed, many of the long-term impacts resulting from construction (e.g. loss of forested and scrub-shrub wetlands, establishment of permanent access roads in through floodplains and wetlands) could be reversed, resulting in beneficial impacts.

A Decommissioning Plan would be developed prior to decommissioning, but given the uncertainty of future technology and unknown future environmental requirements, the contents and requirements of such a plan cannot be known at this time. Any plan document would follow appropriate governing requirements in place at the time the plan is drafted.

3.19.6.2 Impacts Associated with the Applicant Proposed Project

3.19.6.2.1 Construction Impacts

Impacts to wetlands, floodplains, and riparian areas during construction of the converter stations may vary from minor and short term to long term and potentially permanent loss of wetland, floodplain, and riparian acreage. Impacts to wetlands and other waters of the United States would need to be permitted under Section 404 of the CWA. Typically those impacts totaling more than one-tenth of an acre would require a preconstruction notification to the appropriate regulatory office of the USACE. In Arkansas, the counties crossed by the Project are all within the so-called Fayetteville shale play area. Any level of impacts to wetlands and other waters of the United States in the Fayetteville shale play require permit verification to be evaluated by the USACE. Verification could be accomplished through the nationwide permits, but also with other types of permits, as required. Additional permitting may be required from local jurisdictions for changes or adverse impacts to floodplains. Construction of a single converter station is estimated to take 32 months.

3.19.6.2.1.1.1 Oklahoma Converter Station Siting Area and AC Interconnection Siting Area

The Oklahoma Converter Station and AC Interconnection Siting Areas are dominated by grassland/herbaceous vegetation (605 acres). Desktop analysis, including a review of NWI data and NLCD data, has not identified wetland resources within the estimated siting areas. Based on the desktop analysis, it is not anticipated that there would be adverse impacts to wetland ecosystems from construction of the converter station or the AC interconnection.

No 100-year floodplains are mapped for the Oklahoma Converter Station and AC Interconnection Siting Areas, and thus no impacts to mapped floodplain resources are estimated.

Potential impacts to riparian areas associated with construction of the converter station and AC interconnections are unlikely. Limited surface water features consisting of less than 2 miles of intermittent stream beds, no perennial streams, and no major waterbodies are present within the Oklahoma Converter Station Siting Area. Similarly, surface water features are limited in the AC Interconnection Siting Area. The Applicant would adhere to EPM FVW-1 to avoid and/or minimize impacts to areas with sensitive vegetation resources such as wetlands and riparian areas. The Applicant would also avoid open water ecosystems such as intermittent and perennial streams, and other open water bodies such as ponds, lakes, and reservoirs (EPM W-3).

3.19.6.2.1.1.2 Tennessee Converter Station Siting Area and AC Interconnection Tie

The Tennessee Converter Station Siting Area and AC Interconnection Tie include approximately 2.7 acres of palustrine forested wetlands according to the NWI database.

Construction that causes dredge or fill impacts in wetlands and other waters of the United States would require permitting under the CWA Section 404 program. The construction effort would avoid wetlands and waters of the United States to the extent practicable. Where impacts appear unavoidable, those wetland sites would receive a formal wetland delineation and appropriate consultation with the USACE.

Approximately 38.6 acres of floodplains are mapped for the Tennessee Converter Station Siting Area and AC Interconnection Tie. There are 1.5 miles of intermittent and 0.2 mile of perennial streams within the converter station siting area. No other surface waterbodies are present within the Tennessee Converter Station Siting Area and AC Interconnection Tie. Potential impacts to riparian areas associated with construction of the converter station and AC interconnection tie are unlikely.

3.19.6.2.1.2 Operations and Maintenance Impacts

3.19.6.2.1.2.1 Oklahoma Converter Station Siting Area and AC Interconnection Siting Area

The Oklahoma Converter Station and AC Interconnection Siting Areas have been determined not to contain wetlands based on desktop analysis, including a review of NWI data. For this reason, it is not anticipated that there would be adverse impacts to wetland ecosystems from operation and maintenance of the Oklahoma Converter Station. In addition, no data exist to identify 100-year floodplains in the siting areas. Riparian areas are likely very limited in the siting area and unlikely to be impacted by operations and maintenance.

3.19.6.2.1.2.2 Tennessee Converter Station Siting Area and AC Interconnection Tie

As stated in the construction impacts section for the Tennessee converter station, the siting area may contain 2.7 acres of wetlands and/or waters of the United States. If these areas can be avoided during construction activity, then they should also be avoided during all operation and maintenance activities. Field reconnaissance and potentially wetland delineation should be conducted prior to construction to identify exact locations and sizes of wetlands in the siting area. Potential impacts that result in fill of a wetland would be permitted under Section 404 of the CWA prior to construction. Operations and maintenance activities would adhere to all restrictions and conditions that are established as part of the permitting process.

3.19.6.2.1.3 Decommissioning Impacts

The decommissioning impacts related to the Project would be similar in nature to the set of temporary impacts resulting from initial construction. These temporary impacts would involve use of construction machinery at each of the two converter stations (i.e., Oklahoma and Tennessee), as well as the ROW areas that would have been used for AC interconnection. The specific acreages for the footprints of the two converter stations total a projected maximum of 120 acres that would be reclaimed and revegetated according to the details that would be written into the Decommissioning Plan.

3.19.6.2.2 AC Collection System

3.19.6.2.2.1 Construction Impacts

Impacts to wetlands, floodplains, and riparian areas during construction of the AC collection system routes may vary from minor and short term to long term and potentially permanent loss of wetland acreage. The duration of construction for the complete AC collection system will be approximately 24 months from mobilization to restoration.

The following discussion of potential impacts is specific to the 200-foot-wide representative ROW within the overall 2-mile-wide ROI.

3.19.6.2.2.1.1 Route E-1

The construction of AC Collection System Route E-1 has been estimated to potentially result in as much as 8.4 acres of impacts to wetlands. Wetland impacts are predicted for a total of seven wetlands from five different wetland types (Table 3.19-45).

Table 3.19-45:
Potential Construction Impacts to Wetlands in AC Collection System Route E-1

Wetland Type	Number of Wetlands	Acreage of Potential Impact
PEM	2	2.8
PFO	1	2.9
PSS	2	2.1
R2UB	1	0.5
R2US	1	0.1
Totals	7	8.4

GIS Data Source: USFWS (2014g)

One 100-year floodplain totaling 1.0 acre exists within the ROW for AC Collection System Route E-1 and could be impacted.

As shown in Table 3.15-5, AC Collection System Route E-1 encompasses about 0.2 mile of perennial streams, 1.6 miles of intermittent streams, no major waterbodies, and 0.5 acre of reservoirs, lakes, and ponds. Riparian areas may be associated with many, if not all, of these surface water features.

3.19.6.2.2.1.2 Route E-2

Construction of AC Collection System Route E-2 could result in a total of up to 7.8 acres of impacts to wetlands. The representative ROW for AC Collection System Route E-2 features nine wetlands in five different types (Table 3.19-46).

Table 3.19-46:
Potential Construction Impacts to Wetlands in AC Collection System Route E-2

Wetland Type	Number of Wetlands	Acreage of Potential Impact
PEM	4	1.6
PFO/PSS	1	0.8
PSS	2	4.2
R2UB	1	0.3
R2US	1	0.9
Totals	9	7.8

GIS Data Source: USFWS (2014g)

Two 100-year floodplains totaling 54.6 acres are present in the ROW that could be impacted by construction along AC Collection System Route E-2.

As shown in Table 3.15-5, the AC Collection System Route E-2 includes approximately 0.4 mile of perennial streams, 2.2 miles of intermittent streams, 0.1 mile of major waterbodies, and 1.0 acres of reservoirs, lakes, and ponds. Riparian areas may be associated with many, if not all, of these surface water features.

3.19.6.2.2.1.3 Route E-3

Construction of AC Collection System Route E-3 could result in a total of up to 2.8 acres of impacts to wetlands in the ROW. Route E-3 features a total of three wetlands representing three different wetland types (Table 3.19-47).

Table 3.19-47:
Potential Construction Impacts to Wetlands in AC Collection System Route E-3

Wetland Type	Number of Wetlands	Acreage of Potential Impact
PSS	1	0.8
R2UB	1	0.3
R2US	1	1.7
Totals	3	2.8

GIS Data Source: USFWS (2014g)

Two 100-year floodplains totaling 6.8 acres may be impacted by construction along AC Collection System Route E-3.

The AC Collection System Route E-3 includes approximately 0.1 mile of perennial streams, 2.4 miles of intermittent streams, less than 0.1 mile of major waterbodies, and 0.3 acre of reservoirs, lakes, and ponds (Table 3.15-5). The length of intermittent streams is the highest of any of the AC collection system routes. Riparian areas may be associated with many, if not all, of these surface water features.

3.19.6.2.2.1.4 Route NE-1

Construction of AC Collection System Route NE-1 could potentially result in a total of 3.4 acres of impacts to wetlands within the ROW. Wetland impacts could occur in five wetlands representing four types (Table 3.19-48).

Table 3.19-48:
Potential Construction Impacts to Wetlands in AC Collection System Route NE-1

Wetland Type	Number of Wetlands	Acreage of Potential Impact
PEM/PSS	1	0.6
Pf	1	1.3
R2UB	1	0.7
R4SB	2	0.8
Totals	5	3.4

GIS Data Source: USFWS (2014g)

Two 100-year floodplains totaling 19.1 acres could potentially be impacted by construction along AC Collection System Route NE-1.

The AC Collection System Route NE-1 includes approximately 0.4 mile of perennial streams, 0.3 mile of intermittent streams, 0.1 mile of major waterbodies, and no acreage of reservoirs, lakes, and ponds (Table 3.15-5). The length of perennial streams is the second highest of any of the AC collection system routes. Riparian areas may be associated with many, if not all, of these surface water features.

3.19.6.2.2.1.5 Route NE-2

Construction of AC Collection System Route NE-2 could potentially result in a total of approximately 20.1 acres of impacts to wetlands in the representative ROW. AC Collection System Route NE-2 ROW contains 14 wetlands representing seven wetland types (Table 3.19-49).

Table 3.19-49:
Potential Construction Impacts to Wetlands in AC Collection System Route NE-2

Wetland Type	Number of Wetlands	Acreage of Potential Impact
L2EM	1	9.3
PEM/PSS	2	1.1
PEM	6	8.1
PSS	1	0.8
R2UB	1	0.4
R2US	2	0.1
R4SB	1	0.3
Totals	14	20.1

GIS Data Source: USFWS (2014g)

One 100-year floodplain totaling approximately 24.3 acres within the ROW may be impacted by construction of AC Collection System Route NE-2.

The AC Collection System Route NE-2 includes approximately 0.2 mile of perennial streams, 1.3 miles of intermittent streams, 0.1 mile of major waterbodies, and 2.0 acres of reservoirs, lakes, and ponds (Table 3.15-5).Riparian areas may be associated with many, if not all, of these surface water features.

3.19.6.2.2.1.6 Route NW-1

Construction of AC Collection System Route NW-1 could potentially result in a total of 1.0 acre of total impact to a set of two wetlands in the ROW (Table 3.19-50).

Table 3.19-50:
Potential Construction Impacts to Wetlands in AC Collection System Route NW-1

Wetland Type	Number of Wetlands	Acreage of Potential Impact
PEM	1	0.7
R4SB	1	0.3
Totals	2	1.0

GIS Data Source: USFWS (2014g)

Two 100-year floodplains totaling 32.8 acres within the ROW could be impacted by construction for AC Collection System Route NW-1.

The AC Collection System Route NW-1 includes approximately 0.2 mile of perennial streams, 2.0 miles of intermittent streams 0.1 mile of major waterbodies, and no acreage of reservoirs, lakes, and ponds (Table 3.15-5). Riparian areas may be associated with many, if not all, of these surface water features.

3.19.6.2.2.1.7 Route NW-2

The construction of AC Collection System Route NW-2 could result in a total of approximately 4.1 acres of impacts to wetlands in the ROW. A total of nine wetlands distributed through four types are represented in the ROW (Table 3.19-51).

Table 3.19-51:
Potential Construction Impacts to Wetlands in AC Collection System Route NW-2

Wetland Type	Number of Wetlands	Acreage of Potential Impact
PEM/PSS	1	0.6
PEM	1	0.2
R2UB	1	0.7
R4SB	6	2.6
Totals	9	4.1

GIS Data Source: USFWS (2014g)

One floodplain totaling 19.1 acres could be impacted by construction along AC Collection System Route NW-2.

The AC Collection System Route NW-2 includes approximately 0.5 mile of perennial streams, 1.0 mile of intermittent streams, 0.2 mile of major waterbodies, and less than 0.1 mile of reservoirs, lakes, and ponds (Table 3.15-5). Riparian areas may be associated with many, if not all, of these surface water features.

3.19.6.2.2.1.8 Route SE-1

The ROW for AC Collection System Route SE-1 contains eight wetlands from four wetland types (Table 3.19-52). The construction of AC Collection System Route SE-1 could potentially result in a total of approximately 4.9 acres of impacts to these wetlands.

Table 3.19-52:
Potential Construction Impacts to Wetlands in AC Collection System Route SE-1

Wetland Type	Number of Wetlands	Acreage of Potential Impact
L2EM	1	0.2
PEM	3	2.8
Pf	1	0.1
PSS	3	1.8
Totals	8	4.9

GIS Data Source: USFWS (2014g)

Two floodplains totaling 54.6 acres could be impacted by construction along AC Collection System Route SE-1.

The AC Collection System Route SE-1 includes approximately 0.4 mile of perennial streams, 2.1 miles of intermittent streams, less than 0.1 mile of major waterbodies, and 2.6 acres of reservoirs, lakes, and ponds (Table 3.15-5). The area of reservoirs, lakes, and ponds is the second highest of any of the AC collection system routes. Riparian areas may be associated with many, if not all, of these surface water features.

3.19.6.2.2.1.9 Route SE-2

No wetlands are documented by NWI mapping in the representative ROW for AC Collection System Route SE-2. Based on the NWI data there would be no expected impacts to wetlands within the representative ROW. However, the data should be verified in the field prior to construction to avoid potential impacts if wetlands are present that were not included in the NWI mapping.

No mapped 100-year floodplains are present within this ROW.

The AC Collection System Route SE-2 encompasses no perennial streams, 0.3 mile of intermittent streams, no major waterbodies, and 0.4 acre of reservoirs, lakes, and ponds (Table 3.15-5). Riparian areas may be associated with many, if not all, of these surface water features.

3.19.6.2.2.1.10 Route SE-3

Construction of AC Collection System Route SE-3 could affect 13 total wetlands representing six wetland types for a combined potential acreage of impact of approximately 14.3 acres within the ROW (Table 3.19-53).

Table 3.19-53:
Potential Construction Impacts to Wetlands in AC Collection System Route SE-3

Wetland Type	Number of Wetlands	Acreage of Potential Impact
PEM	4	2.6
Pf	4	5.5
PFO/PSS	1	0.8
PSS	2	4.2
R2UB	1	0.3
R2US	1	0.9
Totals	13	14.3

GIS Data Source: USFWS (2014g)

Two floodplains are predicted to be impacted within the ROW by construction of AC Collection System Route SE-3 for a total of 54.6 acres.

The AC Collection System Route SE-3 includes approximately 0.4 mile of perennial streams, 2.1 miles of intermittent streams, 0.1 mile of major waterbodies, and 1.0 acre of reservoirs, lakes, and ponds (Table 3.15-5). The area of reservoirs, lakes, and ponds is the highest of any of the AC collection system routes. Riparian areas may be associated with many, if not all, of these surface water features.

3.19.6.2.2.1.11 Route SW-1

Desktop analysis, including a review of NWI data and NLCD data, has not identified wetland resources within the ROW for AC Collection System Route SW-1. Based on this level of analysis, it is not anticipated that there would be adverse impacts to wetland ecosystems from construction of SW-1.

No 100-year floodplains are mapped within this alternative's ROW.

The AC Collection System Route SW-1 includes no perennial streams, 0.9 mile of intermittent streams, no major waterbodies, and no reservoirs, lakes, or ponds (Table 3.15-5). Riparian areas may be associated with many, if not all, of these surface water features.

3.19.6.2.2.1.12 Route SW-2

Construction of AC Collection System Route SW-2 is predicted to impact less than 1 acre of a single palustrine emergent wetland that would be crossed.

Two floodplains are predicted to be impacted within the ROW by construction of AC Collection System Route SW-2 for a total of 16.6 acres.

The AC Collection System Route SW-2 includes approximately 0.1 mile of perennial streams, 2.9 miles of intermittent streams, 0.1 mile of major waterbodies, and 0.2 acre of reservoirs, lakes, and ponds (Table 3.15-5). Riparian areas may be associated with many, if not all, of these surface water features.

3.19.6.2.2.1.13 Route W-1

No wetlands are documented in the representative ROW for AC Collection System Route W-1, so no impacts are anticipated to wetlands from construction.

Two floodplains could be impacted by construction along the representative ROW for AC Collection System Route W-1 for a total of 15.2 acres.

The AC Collection System Route W-1 includes approximately 0.2 mile of perennial streams, 1.1 miles of intermittent streams, 0.1 mile of major waterbodies, and 0.5 acre of reservoirs, lakes, and ponds (Table 3.15-5). The area of reservoirs, lakes, and ponds is the lowest of any of the AC collection system routes. Riparian areas may be associated with many, if not all, of these surface water features.

3.19.6.2.2.2 Operations and Maintenance Impacts

Impacts related to operations and maintenance may result from use of heavy machinery through wetlands, floodplains, and riparian areas. These impacts can cause soil compaction and mechanical damage or removal of vegetation. These operations and maintenance impacts are anticipated to cover a range from temporary and minor to potentially more severe and long-term/permanent. The estimated acreage of each resource type (wetlands, floodplains, and riparian areas) by alternative, are provided in the previous subsections of 3.19.6.2.2.1.

The use of vegetation management would be necessary to protect the Project infrastructure and enhance safety. However, the trimming, mowing, or removal of vegetation can cause changes to plant diversity and function in all three ecosystem types (i.e., wetlands, floodplains, and riparian areas). Vegetation maintenance in wetlands and riparian areas should be kept to a minimum. Additionally, the use of herbicides can cause minor to severe impacts to vegetation in areas where they are applied. If used, the Applicant would selectively apply herbicides within streamside management zones.

3.19.6.2.2.3 Decommissioning Impacts

The decommissioning impacts related to the Project would be similar in nature to the set of temporary impacts resulting from initial construction. These temporary impacts would involve use of construction machinery at the various locations where there is AC collection system infrastructure, (e.g., the lattice structures, tubular structures, H-frame structures, fiber optic infrastructure, etc.) which would involve removal of aboveground material, and foundation material where required. Use of construction machinery would have the potential to crush or remove vegetation (primarily in grasslands or croplands), but these areas would be reseeded following removal of infrastructure. No long-term effects are judged to be likely from the decommissioning phase of the Project. Revegetation for wetlands, floodplains, and riparian areas would be guided by the Project’s Decommissioning Plan and by the conditions set forth in any CWA permitting that would be required.

3.19.6.2.3 HVDC Applicant Proposed Route

3.19.6.2.3.1 Construction Impacts

Impacts to wetlands, floodplains, and riparian areas during construction of the Applicant Proposed Route may vary from minor and short term to long term and potentially permanent loss of acreage. In Arkansas, the counties crossed by the Project are all within the Fayetteville Shale Play area. Any level of impacts to wetlands and other waters of the United States in the Fayetteville Shale Play are required to be reported to the USACE under regional conditions for nationwide permitting. Additional permitting may be required from local jurisdictions for changes or adverse impacts to floodplains.

Impacts presented for the Applicant Proposed Route represent impacts to the amount of wetlands, floodplains, and riparian areas estimated to exist within the 200-foot-wide representative ROW.

Changes to impacts due to route variations and adjustments developed in response to public comments on the Draft EIS are described at the end of applicable sections.

3.19.6.2.3.1.1 Region 1

Construction of the Applicant Proposed Route in Region 1 could cause impacts to six wetland types totaling approximately 22.1 acres within the ROW. Table 3.19-54 provides the number of wetlands by type with the associated prediction of impact acreage. No route variations were proposed in Region 1.

Table 3.19-54:
Potential Construction Impacts to Wetlands within the ROW of the Applicant Proposed Route—Region 1

Wetland Type	Number of Wetlands	Acreage of Potential Impact
PEM	11	3.1
Pf	3	9.4
PFO	2	0.6
PSS	5	5.4
PUS	5	2.3
R2UB	1	1.3
Totals	27	22.1

GIS Data Source: USFWS (2014g)

Two 100-year floodplains within Region 1 would be crossed by the construction of the Applicant Proposed Route in its representative ROW. These crossings may result in the potential for 52.4 acres of impact. No floodplains are anticipated to be crossed by the Applicant Proposed Route in this region.

As shown in Table 3.15-4, the 200-foot-wide corridor of the Applicant Proposed Route in Region 1 includes approximately 0.9 mile of perennial streams, 5.9 miles of intermittent streams, less than 0.1 mile of major waterbodies and 9.9 acres of reservoirs, lakes, and ponds. Riparian areas may be associated with many, if not all, of these surface water features.

3.19.6.2.3.1.2 Region 2

The Applicant Proposed Route in Region 2 could result in construction impacts to eight wetland types and approximately 14 total acres within the ROW. Table 3.19-55 provides the number of wetlands by type, and the associated estimate for potential impact acreage.

Two route variations to the Applicant Proposed Route were developed in Region 2 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.2. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route. Link 1, Variation 1, would have no predicted impacts to wetland, floodplain, or riparian area resources. Link 2, Variation 2, would add 1 acre of non-forested wetland in the ROW involving one crossing of more than 1,000 feet through this feature as compared to the original Applicant Proposed Route.

Table 3.19-55:
Potential Construction Impacts to Wetlands within the ROW for the Applicant Proposed Route—Region 2

Wetland Type	Number of Wetlands	Acreage of Potential Impact
PEM/PSS	2	0.8
PEM	8	2.5
PFO	4	2.6
PSS	1	0.2
PUB	6	2.3
PUS	8	1.0
R2UB	1	0.6
R2US	2	3.6
Totals	32	13.6

GIS Data Source: USFWS (2014g)

Five 100-year floodplains within Region 2 would be crossed by the construction of the Applicant Proposed Route. These crossings could account for a potential of 157.0 acres of impact.

The 200-foot-wide corridor of the Applicant Proposed Route in Region 2 includes approximately 1.4 miles of perennial streams, 3.8 miles of intermittent streams, less than 0.1 mile of major waterbodies, and 1.9 acres of reservoirs, lakes, and ponds (Table 3.15-8). Riparian areas may be associated with many, if not all, of these surface water features.

3.19.6.2.3.1.3 Region 3

Construction of the Applicant Proposed Route in Region 3 could result in as much as 61 acres of impacts to wetlands within the representative ROW. Table 3.19-56 provides the number of wetlands by type and the associated estimate of potential impact acreage within the ROW.

Table 3.19-56:
Potential Construction Impacts to Wetlands within the ROW of the Applicant Proposed Route—Region 3

Wetland Type	Number of Wetlands	Acreage of Potential Impact
L1UB	1	0.6
PEM	6	0.3
PFO/PEM	1	0.1
PFO	20	24.6
PEM/PSS	1	1.2
PSS	1	0.5
PUB	110	27.9
PUS	8	2.2
R2UB	3	3.4
Totals	151	60.8

GIS Data Source: USFWS (2014g)

Twenty 100-year floodplains within Region 3 would be crossed by the construction of the Applicant Proposed Route. These crossings could account for as much as 293.8 acres of impact to floodplains in the ROW.

The 200-foot-wide corridor of the Applicant Proposed Route in Region 3 includes approximately 10.5 miles of perennial streams, 7.8 miles of intermittent streams, 0.2 mile of major waterbodies, and 39.5 acres of reservoirs, lakes, and ponds (Table 3.15-12). Riparian areas may be associated with many, if not all, of these surface water features.

Five route variations to the Applicant Proposed Route were developed in Region 3 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.3. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the original Applicant Proposed Route Links 1, 2, 4, and 5 as follows. Link 1, Variation 2, would have fewer miles of streams. Links 1 and 2, Variation 1, differs from the Applicant Proposed Route Link 1 in having approximately one-half the mileage of streams within the ROW, a decrease in floodplains encountered and floodplain acreage that would be crossed, and a decrease in the total number of waterbodies encountered. It should be noted that a route adjustment was made for HVDC Alternative Route 3-A to maintain an end-to-end route with the Links 1 and 2 variations. The route adjustment for HVDC Alternative Route 3-A would not result in additional numbers of, or acreages for, wetlands, floodplains, or riparian areas impacted compared with the original HVDC Alternative Route 3-A. Link 4, Variation 1, would have a very slight increase in stream mileage, and an increase in the number of total waterbodies encountered by the variation. Link 4, Variation 2, would not result in additional numbers of, or acreages for, wetlands, floodplains, or riparian areas impacted. Link 5, Variation 2, would result in a very slight increase of stream mileage and a small increase in the number of surface waterbodies impacted.

3.19.6.2.3.1.4 Region 4

Construction of the Applicant Proposed Route in Region 4 could cause impacts to as many as seven wetland types totaling 22.8 acres of wetlands within the representative ROW. Table 3.19-57 provides the number of wetlands by type and the associated potential impact acreage.

Table 3.19-57:
Potential Construction Impacts to Wetlands within the ROW for the Applicant Proposed Route—Region 4

Wetland Type	Number of Wetlands	Acreage of Potential Impact
L1UB	1	5.3
PEM	3	1.8
PFO	8	8.6
PSS	1	0.0
PUB	19	4.6
R2UB	4	2.1
R2US	2	0.4
Totals	38	22.8

GIS Data Source: USFWS (2014g)

Thirty-two 100-year floodplains within Region 4 would be crossed by construction of the Applicant Proposed Route. These crossings could account for a potential of up to 545.7 acres of impact to floodplains in the ROW.

As shown in Table 3.15-16, the 200-foot-wide corridor of the Applicant Proposed Route in Region 4 includes approximately 3.5 miles of perennial streams, 9.0 miles of intermittent streams, 0.2 mile of major waterbodies, and 16.1 acres of reservoirs, lakes, and ponds. Riparian areas may be associated with many, if not all, of these surface water features.

A 100-foot buffer was applied to each side of the centerline of the Lee Creek Variation in order to calculate potential impacts to wetland and floodplain resources in a 200-foot-wide ROW. Results of potential impacts to NWI wetland resources include 0.44 acres of riverine, unconsolidated bottom (R2UB) wetlands and less than 0.1 acre of riverine, unconsolidated shore (R2US) wetlands. There is a potential for riparian area impacts associated with these riverine wetland types. 100-year floodplains impacts for the Lee Creek Variation were calculated at 7.7 acres within the 200-foot-wide ROW. As noted in Section 3.15.5.4.2, the Lee Creek Variation within the Applicant Proposed Route avoids the 300-foot buffer zone established around Lee Creek Reservoir by the city of Fort Smith, Arkansas.

Seven route variations to the Applicant Proposed Route were developed in Region 4 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.4. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the original Applicant Proposed Route Links 3, 6, and 9 as follows. Link 3, Variation 1, would involve a very small increase in stream mileage crossed. It would result in decreases in the number of, and acreage for, forested wetlands. There would also be a decrease in floodplain acreage. Link 3, Variation 2, would avoid wetland resources. Variation 2 would also result in decreases in stream mileage crossed, the number and acreage of floodplains crossed, and the number of designated waterbodies crossed. Link 3, Variation 3, has the same wetland, floodplain, and riparian area resources. Link 6, Variation 1, has the same wetland, floodplain, and riparian area resources. Link 6, Variation 2, would have a decrease in stream mileage and floodplain acreage. Link 6, Variation 3, would result in a decrease in the number of crossings of surface waterbodies. Link 9, Variation 1, would have a decrease in stream mileage and floodplain acreage crossed and would avoid surface waterbodies.

3.19.6.2.3.1.5 Region 5

Construction of the Applicant Proposed Route in Region 5 could result in impacts to four wetland types and totaling approximately 12 total acres within the ROW. Table 3.19-58 provides the number of wetlands by type and the associated potential impact acreage.

Table 3.19-58:
Potential Construction Impacts to Wetlands within the ROW of the Applicant Proposed Route—Region 5

Wetland Type	Number of Wetlands	Acreage of Potential Impact
PEM	3	1.3
PFO	5	4.8
PUB	7	1.7
L2UB	2	3.8
Totals	17	11.6

GIS Data Source: USFWS (2014g)

Fourteen 100-year floodplains within Region 5 could be impacted by construction of the Applicant Proposed Route. The floodplain crossings could account for a potential of up to 111.1 acres of impact.

The 200-foot-wide corridor of the Applicant Proposed Route in Region 5 includes approximately 2.2 miles of perennial streams, 9.3 miles of intermittent streams, 0.2 mile of major waterbodies, and 17.3 acres of reservoirs, lakes, and ponds (Table 3.15-20). Riparian areas may be associated with many, if not all, of these surface water features.

Five route variations to the Applicant Proposed Route were developed in Region 5 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.5. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the original Applicant Proposed Route Links 1, 2, 3, 4, and 7 as follows. Link 1, Variation 2, would have increases in stream mileage crossed as well as increases in mileage and acreage of forested wetland crossed. Link 1, Variation 2, would have decreases in the number of non-forested wetlands crossed and the number of waterbodies crossed. Link 2, Variation 2, would have a small increase in stream mileage. Links 2 and 3, Variation 1, would result in a decrease in stream mileage and floodplain acreage crossed. It should be noted that a route adjustment was made for HVDC Alternative Route 5-B to maintain an end-to-end route with Links 2 and 3, Variation 1. HVDC Alternative Route 5-B would result in a very slight increase in floodplain acreage. Links 3 and 4, Variation 2, would result in a small decrease in stream mileage crossed. A route adjustment was made for HVDC Alternative Route 5-E to maintain an end-to-end route with Links 3 and 4, Variation 2. This route adjustment would cross one fewer floodplain than the original HVDC Alternative Route 5-E. Link 7, Variation 1, would cross one additional waterbody.

3.19.6.2.3.1.6 Region 6

Construction of the Applicant Proposed Route in Region 6 could cause impacts to five wetland types totaling approximately 13.5 acres within the representative ROW. Table 3.19-59 provides the number of wetlands by type and the associated potential impact acreage.

Table 3.19-59:
Potential Construction Impacts to Wetlands within the ROW of the Applicant Proposed Route—Region 6

Wetland Type	Number of Wetlands	Acreage of Potential Impact
PEM	12	3.2
PFO	4	5.1
PSS	1	0.1
PUB	2	2.8
R2UB	2	2.3
Totals	21	13.5

GIS Data Source: USFWS (2014g)

Five 100-year floodplains within Region 6 could be impacted by construction of the Applicant Proposed Route. The floodplain crossings could account for a potential of up to 335.5 acres of impact in the representative ROW.

The 200-foot-wide corridor of the Applicant Proposed Route in Region 6 includes approximately 0.8 mile of perennial streams, 3.5 miles of intermittent streams, 0.2 mile of major waterbodies, and 5.2 acres of reservoirs, lakes, and ponds (Table 3.15-24). Riparian areas may be associated with many, if not all, of these surface water features.

One route variation was developed in Region 6 in response to public comments on the Draft EIS to parallel more parcel boundaries to minimize impacts to agricultural operations and is shown in Exhibit 1 of Appendix M. This variation represents a minor adjustment to the original Applicant Proposed Route Link 2. Link 2, Variation 1, would produce small increases in stream mileage and forested wetland acreage crossed and would add one crossing of a >1,000-foot forested wetland. This variation would also have a small decrease in non-forested wetland acreage to be crossed. It should be noted that a route adjustment was made for HVDC Alternative Route 6-A to maintain an end-to-end route with Link 2, Variation 1. The route adjustment for HVDC Alternative Route 6-A would cross fewer non-forested and forested wetland acres compared with the original alternative route.

3.19.6.2.3.1.7 Region 7

Construction of the Applicant Proposed Route in Region 7 could cause impacts to five wetland types and 42 total acres within the ROW. Table 3.19-60 provides the number of wetlands by type with the associated predicted impact acreage.

Table 3.19-60:
Potential Construction Impacts to Wetlands within the ROW of the Applicant Proposed Route–Region 7

Wetland Type	Number of Wetlands	Acreage of Potential Impact
PEM	3	1.8
PFO	14	17.7
PSS	1	2.6
PUB	3	2.8
R2UB	2	16.9
Totals	23	41.8

GIS Data Source: USFWS (2014g)

Twenty-five 100-year floodplains within Region 7 could be impacted by construction of the Applicant Proposed Route. These floodplain crossings account for a potential of 344.6 acres of impact within the ROW.

The 200-foot-wide corridor of the Applicant Proposed Route in Region 7 includes approximately 0.5 mile of perennial streams, 4.3 miles of intermittent streams, 0.6 mile of major waterbodies, and 2.4 acres of reservoirs, lakes, and ponds (Table 3.15-28). Riparian areas may be associated with many, if not all, of these surface water features.

Three route variations to the Applicant Proposed Route were developed in Region 7 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.7. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the original Applicant Proposed Route Links 1 and 5 as follows. Link 1, Variation 1, would result in an increase in stream mileage. Link 1, Variation 2, would cross fewer miles of streams, fewer acres of floodplain, and fewer surface waterbodies. This variation would cross more acreage of forested wetland, a larger number of non-forested wetlands, and a larger number of wetland crossings that are greater than 1,000 feet in width. Link 5, Variation 1, would have no predicted impacts to wetlands, floodplains, or riparian areas.

3.19.6.2.3.2 Operations and Maintenance Impacts

The operation and maintenance for the Applicant Proposed Route would involve routine and periodic vegetation management according to the TVMP. Impacts related to operations and maintenance may result from use of heavy machinery through wetlands, floodplains, and riparian areas. These impacts can cause soil compaction and mechanical damage or removal of vegetation. These operations and maintenance impacts are anticipated to cover a range from temporary and minor to potentially more severe and long term/permanent. The estimated acreage of each resource type (wetlands, floodplains, and riparian areas) by region is provided in the previous subsections of Section 3.19.6.2.3.1.

The use of vegetation management would be necessary to protect the Project infrastructure and enhance safety. However, the trimming, mowing, or removal of vegetation can cause changes to plant diversity and function in all three ecosystem types (i.e., wetlands, floodplains, and riparian areas). Vegetation maintenance in wetlands and riparian areas should be kept to a minimum to the extent practicable. Additionally, the use of herbicides can cause minor to severe impacts to vegetation in areas where they are applied. Great care would need to be used when applying herbicides in close proximity to wetlands and riparian areas. Herbicides may drift in windy conditions and cause impacts to non-target plants, so application should be avoided in these conditions. Label directions for herbicides typically advise the applicator as to whether a specific herbicide can be used in or near wetlands and waterways.

3.19.6.2.3.3 Decommissioning Impacts

The decommissioning impacts related to Project would be similar in nature to the set of temporary impacts resulting from initial construction. These temporary impacts would involve use of construction machinery at the various sites of infrastructure (e.g., the lattice structures, lattice crossing structures, monopole structures, guyed structures, fiber optic infrastructure, etc.) to remove aboveground material, and foundation material where required. Use of construction machinery would have the potential to crush or remove vegetation, but no long-term effects are anticipated to be likely from the decommissioning phase of the Project. Revegetation for wetlands, floodplains, and riparian areas would be guided by the Project's Decommissioning Plan and by the conditions set forth in any CWA permitting that would be required.

3.19.6.3 Impacts Associated with the DOE Alternatives

3.19.6.3.1 Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area

3.19.6.3.1.1 Construction Impacts

Although the exact location of the Arkansas converter station within the siting area has not yet been determined, construction of this converter station would convert 20 to 35 acres of undeveloped land to a utility land use. An additional 5 to 10 acres would be required for construction only. These areas would be used as laydown areas for equipment during construction. An additional 4.2 acres of undeveloped land would be converted to access roads (2.4 acres permanent, 1.8 acres temporary). The converter station siting area ROW includes 0.6 mile of intermittent streams, 43.8 acres of floodplains, and 2.6 acres of surface waterbodies (ponds/lakes). Construction that causes dredge or fill impacts in wetlands and waters of the United States would require permitting under the CWA Section 404 program. Wetland impacts would typically require a preconstruction notification filed with the applicable regulatory office of the USACE. In Arkansas, the counties crossed by the Project are all within the so-called Fayetteville Shale Play area. Any level of impacts to wetlands and other waters of the United States in the Fayetteville Shale Play are required to be reported to the USACE under regional conditions for nationwide permitting. The construction effort should avoid wetlands and waters of the United States to the extent practicable.

The Arkansas AC interconnect siting area is approximately 1,000 feet wide and the permanent ROW would be 150 to 200 feet wide and approximately 5 miles long with a total acreage of approximately 661.6 acres. The interconnection siting area ROW includes 1.5 miles of intermittent streams, 0.2 mile of perennial streams, 463.8 acres of floodplains, and 1.7 acres of other surface waterbodies (ponds/lakes). A new substation would be constructed to interconnect the AC interconnection transmission line with an existing 500 kV line. The site is adjacent to the existing transmission line and is primarily grassland with some wooded areas. The site contains two freshwater ponds and approximately 0.1 miles of streams. The substation would occupy 25 to 35 acres and would also temporarily disturb an additional 5 acres during construction. Any surface water features would be avoided.

3.19.6.3.1.2 Operations and Maintenance Impacts

The operation and maintenance of the Arkansas converter station would involve routine and periodic vegetation management according to the TVMP. Wetlands, floodplains and riparian areas associated with perennial streams have all been documented within the siting area, but ultimately only 25–45 acres of land would be disturbed. These resources should be avoided during siting so that no impacts would be incurred during operations and routine maintenance.

3.19.6.3.1.3 Decommissioning Impacts

The decommissioning impacts related to the Project would be similar in nature to the set of temporary impacts resulting from initial construction. These temporary impacts would involve use of construction machinery at the Arkansas converter station, as well as the ROW areas that would have been used for the AC interconnection. The specific acreage for the footprint of the converter station would total a projected maximum of 60 acres that would be reclaimed and revegetated according to the details that would be written into the Decommissioning Plan.

3.19.6.3.2 HVDC Alternative Routes

3.19.6.3.2.1 Construction Impacts

Impacts to wetlands during construction of the HVDC alternative routes would vary depending upon alternative chosen. Impacts may vary from no impact, to minor and short term to long term, and, potentially, permanent loss of wetland acreage. Impacts presented below represent the amount of wetlands, floodplains, and riparian areas estimated to exist within the 200-foot-wide representative ROW for the HVDC alternative routes. Riparian areas may be associated with many, if not all, of these surface water features listed for each alternative.

3.19.6.3.2.1.1 Region 1

3.19.6.3.2.1.1.1 Alternative Route 1-A

HVDC Alternative Route 1-A is 123.0 miles in length and corresponds to Applicant Proposed Route Links 2, 3, 4, and 5, which are a combined 113.6 miles in length.

HVDC Alternative Route 1-A could cause up to 15.1 acres of impacts in 30 wetlands within the representative ROW. Table 3.19-61 provides the number of wetlands by type with the associated estimate of potential impact acreage for HVDC Alternative Route 1-A. By comparison, Applicant Proposed Route Links 2, 3, 4, and 5 are predicted to potentially cause as much as 22 acres of impacts to wetlands.

Table 3.19-61:
Potential Construction Impacts to Wetlands within the ROW of HVDC Alternative Route 1-A

Wetland Type	Number of Wetlands	Acreage of Potential Impact
PEM	10	8.6
PFO	2	1.3
PSS	5	2.1
PUS	10	2.6
R2UB	2	0.4
R2US	1	0.1
Totals	30	15.1

GIS Data Source: USFWS (2014g)

One 100-year floodplain could be impacted by construction in the 200-foot-wide ROW of HVDC Alternative Route 1-A. The estimated potential impact for this floodplain crossing is 5.3 acres. Floodplain impacts for Applicant Proposed Route Links 2, 3, 4, and 5 include the crossing of two 100-year floodplains; the potential impact acreage for those crossings equals 52 acres.

As shown in Table 3.15-4, the 200-foot-wide ROW of HVDC Alternative Route 1-A includes approximately 0.8 mile of perennial streams, 8.6 miles of intermittent streams, less than 0.1 mile of major waterbodies, and 6.8 acres of reservoirs, lakes, and ponds. In comparison, the Applicant Proposed Route Links 2, 3, 4, and 5 feature approximately 0.9 mile of perennial streams, 5.9 miles of intermittent streams, less than 0.1 mile of major waterbodies, and 9.9 acres of reservoirs, lakes, and ponds.

3.19.6.3.2.1.1.2 Alternative Route 1-B

HVDC Alternative Route 1-B is 51.8 miles in length and corresponds to Applicant Proposed Route Links 2 and 3 which are a combined 53.8 miles in length.

HVDC Alternative Route 1-B could cause impacts to four wetland types that would equal as much as 2.8 total acres within the ROW. Table 3.19-62 provides the number of wetlands by type with the associated potential impact acreage for HVDC Alternative Route 1-B. The potential acreage of wetland impact for Applicant Proposed Route Links 2 and 3 is 14.9 acres located within 17 NWI-mapped wetlands.

Table 3.19-62:
Potential Construction Impacts to Wetlands within the ROW of HVDC Alternative Route 1-B

Wetland Type	Number of Wetlands	Acreage of Potential Impact
PEM/PSS	1	0.4
PSS	2	1.1
R2UB	1	0.3
R2US	1	1.0
Totals	5	2.8

GIS Data Source: USFWS (2014g)

Two 100-year floodplains could be impacted by construction in the 200-foot-wide ROW of HVDC Alternative Route 1-B. The estimated potential acreage of impact for these floodplain crossings is 6.0 acres. Floodplain impacts for

Applicant Proposed Route Links 2 and 3 include the crossing of two 100-year floodplains; the acreage for those crossings equals approximately 52.4 acres.

The 200-foot-wide ROW of HVDC Alternative Route 1-B includes approximately 0.1 mile of perennial streams, 3.0 miles of intermittent streams, less than 0.1 mile of major waterbodies, and 1.1 acres of reservoirs, lakes, and ponds (Table 3.15-4). In comparison, the corresponding Applicant Proposed Route Links 2 and 3 feature approximately 0.3 mile of perennial streams, 2.4 miles of intermittent streams, less than 0.1 mile of major waterbodies, and 1.1 acres of reservoirs, lakes, and ponds.

3.19.6.3.2.1.1.3 Alternative Route 1-C

HVDC Alternative Route 1-C is 52.0 miles in length. It corresponds to Applicant Proposed Route Links 2 and 3, which are a combined 53.8 miles in length.

HVDC Alternative Route 1-C could cause impacts to five wetland types and up to a total of 4.9 acres within the representative ROW. Table 3.19-63 provides the number of wetlands by type with the associated potential impact acreage for HVDC Alternative Route 1-C. The Applicant Proposed Route Links 2 and 3 could impact up to 14.9 acres within 17 NWI-mapped wetlands in the ROW.

Table 3.19-63:
Potential Construction Impacts to Wetlands within the ROW of HVDC Alternative Route 1-C

Wetland Type	Number of Wetlands	Acreage of Potential Impact
PEM	3	1.4
PFO	1	0.9
PSS	6	2.1
PUS	1	0.1
R2UB	2	0.4
Totals	13	4.9

GIS Data Source: USFWS (2014g)

One 100-year floodplain could be impacted by construction in the 200-foot-wide ROW of HVDC Alternative Route 1-C. The estimated acreage of impact for this floodplain crossing is 5.3 acres. Floodplain impacts for Applicant Proposed Route Links 2 and 3 include the crossing of two 100-year floodplains; the acreage for those crossings equals 52.4 acres.

The 200-foot-wide ROW of HVDC Alternative Route 1-C includes approximately 0.2 mile of perennial streams, 2.6 miles of intermittent streams, less than 0.1 mile of major waterbodies, and 1.2 acres of reservoirs, lakes, and ponds (Table 3.15-4). In comparison, the corresponding Applicant Proposed Route Links 2 and 3 feature approximately 0.3 mile of perennial streams, 2.4 miles of intermittent streams, less than 0.1 mile of major waterbodies, and 7.2 acres of reservoirs, lakes, and ponds.

3.19.6.3.2.1.1.4 Alternative Route 1-D

HVDC Alternative Route 1-D is 33.5 miles in length. It corresponds to Applicant Proposed Route Links 3 and 4, which are a combined 33.6 miles in length.

HVDC Alternative Route 1-D could impact up to three wetland types and a total of 1.7 acres within the ROW. Table 3.19-64 provides the number of wetlands by type with the associated prediction of impact acreage for HVDC Alternative Route 1-D. In comparison, there is 0.9 acre of potential impact to wetlands in the Applicant Proposed Route Links 3 and 4.

Table 3.19-64:
Potential Construction Impacts to Wetlands within the ROW of HVDC Alternative Route 1-D

Wetland Type	Number of Wetlands	Acreage of Potential Impact
PEM	1	0.1
PSS	1	1.4
PUS	1	0.2
Totals	3	1.7

GIS Data Source: USFWS (2014g)

No FEMA 100-year floodplains are mapped within the ROW for HVDC Alternative Route 1-D. The 200-foot-wide ROW of HVDC Alternative Route 1-D includes approximately 0.1 mile of perennial streams, 2.2 miles of intermittent streams, no major waterbodies, and 0.2 acre of reservoirs, lakes, and ponds (Table 3.15-4). In comparison, the corresponding Applicant Proposed Route Links 3 and 4 feature approximately 0.1 mile of perennial streams, 2.6 miles of intermittent streams, no major waterbodies, and 1.0 acre of reservoirs, lakes, and ponds.

3.19.6.3.2.1.2 Region 2

3.19.6.3.2.1.2.1 Alternative Route 2-A

HVDC Alternative Route 2-A is 57.2 miles in length. It corresponds to Applicant Proposed Route Link 2, which is 54.4 miles in length. HVDC Alternative Route 2-A features 11 land cover types.

HVDC Alternative Route 2-A could cause as many as 10.4 acres of impacts in 26 wetlands that NWI has mapped in the ROW of the alternative. Table 3.19-65 provides the number of wetlands by type with the associated potential impact acreage for HVDC Alternative Route 2-A. By comparison, there are predicted to be as many as 9.1 acres of wetlands that could be impacted within the ROW for Applicant Proposed Route Link 2.

Table 3.19-65:
Potential Construction Impacts to Wetlands within the ROW of HVDC Alternative Route 2-A

Wetland Type	Number of Wetlands	Acreage of Potential Impact
PEM	4	0.6
PFO	1	0.0
PSS	1	2.6
PUB	8	2.2
PUS	8	1.4
R2UB	1	0.8
R2US	3	2.8
Totals	26	10.4

GIS Data Source: USFWS (2014g)

One 100-year floodplain is predicted to be impacted by construction in the 200-foot-wide ROW along HVDC Alternative Route 2-A. The estimated acreage of impact for this floodplain crossing is 4.5 acres. Applicant Proposed Route Link 2 is not projected to cross floodplains within its ROW.

As shown in Table 3.15-8, the 200-foot-wide ROW of HVDC Alternative 2-A includes approximately 3.4 miles of perennial streams, 0.6 mile of intermittent streams, 0.1 mile of major waterbodies, and 6.5 acres of reservoirs, lakes, and ponds. In comparison, the corresponding Applicant Proposed Route Link 2 features approximately 1.3 miles of perennial streams, 1.8 miles of intermittent streams, less than 0.1 mile of major waterbodies, and 0.8 acre of reservoirs, lakes, and ponds.

3.19.6.3.2.1.2.2 Alternative Route 2-B

HVDC Alternative Route 2-B is 29.8 miles in length. It corresponds to Region 2, Applicant Proposed Route Link 3, which is 31.2 miles in length.

Three 100-year floodplains are predicted to be impacted by construction in the 200-foot-wide ROW along HVDC Alternative Route 2-B. The estimated total acreage of impact for these floodplain crossings is 83.0 acres. Applicant Proposed Route Link 3 would cross four 100-year floodplains, with an estimated total of 64.5 acres of impact within the 200-foot-wide ROW.

HVDC Alternative Route 2-B could cause impacts to five wetland types and 9.3 total acres within the ROW. Table 3.19-66 provides the number of wetlands by type with the associated potential impact acreage for HVDC Alternative Route 2-B. Twelve NWI wetlands (4.5 acres within the ROW) are present in Applicant Proposed Route Link 3.

The 200-foot-wide ROW of HVDC Alternative Route 2-B includes approximately 0.5 mile of perennial streams, 1.3 miles of intermittent streams, no major waterbodies, and 1.6 acres of reservoirs, lakes, and ponds (Table 3.15-8). In comparison, the corresponding Applicant Proposed Route Link 3 features approximately 0.1 mile of perennial streams, 1.9 miles of intermittent streams, no major waterbodies, and 1.1 acres of reservoirs, lakes, and ponds.

Table 3.19-66:
Potential Construction Impacts to Wetlands within the ROW of HVDC Alternative Route 2-B

Wetland Type	Number of Wetlands	Acreage of Potential Impact
PEM/PSS	1	0.5
PEM	11	6.1
PFO	1	0.5
PUB	3	0.9
PUS	4	1.3
Totals	20	9.3

GIS Data Source: USFWS (2014g)

3.19.6.3.2.1.3 Region 3

3.19.6.3.2.1.3.1 Alternative Route 3-A

HVDC Alternative Route 3-A is 37.6 miles in length. It corresponds to Applicant Proposed Route Link 1, which is 40.0 miles in length.

HVDC Alternative Route 3-A could cause impacts to four wetland types and up to 11.3 total acres within the ROW. Table 3.19-67 provides the number of wetlands by type with the associated potential impact acreage for HVDC Alternative Route 3-A. Applicant Proposed Route Link 1 features 14 NWI-mapped wetlands in its ROW. Impact for Region 3, Applicant Proposed Route Link 1 could be as many as 6.8 acres.

Table 3.19-67:
Potential Construction Impacts to Wetlands within the ROW of HVDC Alternative Route 3-A

Wetland Type	Number of Wetlands	Acreage of Potential Impact
PEM	1	0.4
PFO	5	2.2
PUB	7	4.4
PUS	22	4.3
Totals	35	11.3

GIS Data Source: USFWS (2014g)

Nine 100-year floodplains are predicted to be impacted by construction along the HVDC Alternative Route 3-A 200-foot-wide ROW. The estimated acreage of impact for these floodplain crossings equal 43.6 acres. Applicant Proposed Route Link 1 is predicted to cross six 100-year floodplains, with a total potential impact of 95 acres.

The 200-foot-wide ROW of HVDC Alternative Route 3-A includes approximately 3.6 miles of perennial streams, 1.3 miles of intermittent streams, no major waterbodies, and 9.6 acres of reservoirs, lakes, and ponds (Table 3.15-12). In comparison, the corresponding Applicant Proposed Route Link 1 features approximately 2.7 miles of perennial streams, 2.1 miles of intermittent streams, less than 0.1 mile of major waterbodies, and 4.0 acres of reservoirs, lakes, and ponds.

As described in Appendix M and summarized in Section 2.4.2.3, a route adjustment was developed for HVDC Alternative Route 3-A to maintain an end-to-end route with Applicant Proposed Route Link 1, Variation 2, and Links 1 and 2, Variation 1. The route adjustment would not include any perennial streams or intermittent streams, wetlands, floodplains, or other surface water bodies.

3.19.6.3.2.1.3.2 Alternative Route 3-B

HVDC Alternative Route 3-B is 47.7 miles in length. It corresponds to Applicant Proposed Route Links 1, 2, and 3, which are a combined 49.9 miles in length.

HVDC Alternative Route 3-B could cause impacts to as many as 49 wetlands totaling 16.8 acres within the representative ROW. Table 3.19-68 provides the number of wetlands by type with the associated potential impact acreage for HVDC Alternative Route 3-B. Applicant Proposed Route Links 1, 2, and 3 could cause as much as 9 total acres of impact in a set of 25 wetlands.

Table 3.19-68:
Potential Construction Impacts to Wetlands within the ROW of HVDC Alternative Route 3-B

Wetland Type	Number of Wetlands	Acreage of Potential Impact
PEM	1	0.4
PFO	7	4.1
PUB	19	7.7
PUS	22	4.6
Totals	49	16.8

GIS Data Source: USFWS (2014g)

Eleven 100-year floodplains are predicted to be impacted by construction in the 200-foot-wide ROW along HVDC Alternative Route 3-B. The estimated acreage of impact for these floodplain crossings equal 60.5 acres. Applicant Proposed Route Links 1, 2, and 3 are predicted to impact eight 100-year floodplains, totaling 123.5 acres in the ROW.

The 200-foot-wide ROW of HVDC Alternative Route 3-B includes approximately 4.7 miles of perennial streams, 1.3 miles of intermittent streams, less than 0.1 mile of major waterbodies, and 13.2 acres of reservoirs, lakes, and ponds (Table 3.15-12). In comparison, the corresponding Applicant Proposed Route Links 1, 2 and 3 feature approximately 4.1 miles of perennial streams, 2.1 miles of intermittent streams, less than 0.1 mile of major waterbodies, and 7.2 acres of reservoirs, lakes, and ponds.

3.19.6.3.2.1.3.3 Alternative Route 3-C

HVDC Alternative Route 3-C is 121.6 miles in length. It corresponds to Applicant Proposed Route Links 3, 4, 5, and 6, which are a combined 118.6 miles in length.

HVDC Alternative Route 3-C could cause 90.3 acres of impact to as many as 127 wetlands within the ROW. Table 3.19-69 provides the number of wetlands by type with the associated potential impact acreage for HVDC Alternative Route 3-C. Corresponding Applicant Proposed Route Links 3, 4, 5, and 6 could cause a total of 52.6 acres of impact to a group of approximately 130 wetlands within the representative ROW.

Table 3.19-69:
Potential Construction Impacts to Wetlands within the ROW of HVDC Alternative Route 3-C

Wetland Type	Number of Wetlands	Acreage of Potential Impact
L1UB	1	0.0
PEM	14	6.2
PFO/PSS	3	5.6
PFO	26	55.3
PEM/PSS	2	1.3
PUB	76	17.3
PUS	2	0.3
R2UB	1	1.3
R2US	2	3.0
Totals	127	90.3

GIS Data Source: USFWS (2014g)

Seventeen 100-year floodplains are predicted to be impacted by construction in the 200-foot-wide ROW along HVDC Alternative Route 3-C; the estimated acreage of impact equals 305.6 acres. Applicant Proposed Route Links 3, 4, 5, and 6 are predicted to cross 13 100-year floodplains, with a predicted impact total of 198.2 acres.

The 200-foot-wide ROW of HVDC Alternative Route 3-C includes approximately 5.6 miles of perennial streams, 8.8 miles of intermittent streams, 0.1 mile of major waterbodies, and 20.4 acres of reservoirs, lakes, and ponds (Table 3.15-12). In comparison, the corresponding Applicant Proposed Route Links 3, 4, 5 and 6 feature approximately 7.2 miles of perennial streams, 5.7 miles of intermittent streams, 0.1 mile of major waterbodies, and 32.3 acres of reservoirs, lakes, and ponds.

3.19.6.3.2.1.3.4 Alternative Route 3-D

HVDC Alternative Route 3-D is 39.3 miles in length. It corresponds to Applicant Proposed Route Links 5 and 6, which are a combined 35.1 miles in length.

HVDC Alternative Route 3-D could cause impacts to 66 wetlands totaling up to 37.9 acres within the representative ROW. Table 3.19-70 provides the number of wetlands by type and the associated potential impact acreage for HVDC Alternative Route 3-D. The corresponding Applicant Proposed Route Links 5 and 6 could cause 14.7 acres of impact in 39 NWI-mapped wetlands within the ROW.

Table 3.19-70:
Potential Construction Impacts to Wetlands within the ROW of HVDC Alternative Route 3-D

Wetland Type	Number of Wetlands	Acreage of Potential Impact
PEM	10	5.1
PFO/PSS	3	5.6
PFO	14	19.3
PEM/PSS	2	1.3
PUB	37	6.6
Totals	66	37.9

GIS Data Source: USFWS (2014g)

Seven 100-year floodplains are predicted to be impacted by construction in the 200-foot-wide ROW along HVDC Alternative Route 3-D; the estimated acreage of impact equals 91.5 acres. Applicant Proposed Route Links 5 and 6 are predicted to total approximately 41.6 acres of impact from the crossing of three 100-year floodplains.

The 200-foot-wide ROW of HVDC Alternative Route 3-D includes approximately 0.8 mile of perennial streams, 4.2 miles of intermittent streams, no major waterbodies, and 9.1 acres of reservoirs, lakes, and ponds (Table 3.15-12). In comparison, the corresponding Applicant Proposed Route Links 5 and 6 feature approximately 2.0 miles of perennial streams, 1.9 miles of intermittent streams, less than 0.1 mile of major waterbodies, and 7.1 acres of reservoirs, lakes, and ponds.

3.19.6.3.2.1.3.5 Alternative Route 3-E

HVDC Alternative Route 3-E is 8.5 miles in length. It corresponds to Applicant Proposed Route Link 6, which is 7.7 miles in length.

HVDC Alternative Route 3-E could cause impacts to 12 wetlands totaling 10.9 acres within the representative ROW. Table 3.19-71 provides the number of wetlands by type with the associated potential impact acreage for HVDC Alternative Route 3-E. The corresponding Applicant Proposed Route Link 6 could cause 1.8 acres of impact within seven NWI-mapped wetlands in its representative ROW.

Table 3.19-71:
Potential Construction Impacts to Wetlands within the ROW of HVDC Alternative Route 3-E

Wetland Type	Number of Wetlands	Acreage of Potential Impact
PFO/PSS	3	7.2
PFO	2	2.1
PUB	7	1.6
Totals	12	10.9

GIS Data Source: USFWS (2014g)

Two 100-year floodplains are predicted to be impacted by construction in the 200-foot-wide ROW along HVDC Alternative Route 3-E. The estimated acreage of impact for these 100-year floodplain crossings is predicted to be 21.2 acres.

The 200-foot-wide ROW of HVDC Alternative Route 3-E includes approximately 0.1 mile of perennial streams, 1.5 miles of intermittent streams, no major waterbodies, and 1.3 acres of reservoirs, lakes, and ponds (Table 3.15-12). In comparison, the corresponding Applicant Proposed Route Link 6 features no perennial streams, 0.8 mile of intermittent streams, no major waterbodies, and 1.5 acres of reservoirs, lakes, and ponds.

3.19.6.3.2.1.4 Region 4

3.19.6.3.2.1.4.1 Alternative Route 4-A

HVDC Alternative Route 4-A is 58.4 miles in length. It corresponds to Applicant Proposed Route Links 3, 4, 5, and 6, which are a combined 60.4 miles in length.

HVDC Alternative Route 4-A could cause impacts in as many as 27 NWI-mapped wetlands for a total of 11.3 acres within the representative ROW. Table 3.19-72 provides the number of wetlands by type with the associated potential impact acreage HVDC Alternative Route 4-A. Applicant Proposed Route Links 3, 4, 5, and 6 could have a total of approximately 13.6 acres of impact to wetlands in its representative ROW.

Table 3.19-72:
Potential Construction Impacts to Wetlands within the ROW of HVDC Alternative Route 4-A

Wetland Type	Number of Wetlands	Acreage of Potential Impact
PFO	2	1.8
PEM/PSS	1	1.3
PUB	22	6.8
L2US	2	1.4
Totals	27	11.3

GIS Data Source: USFWS (2014g)

Thirteen 100-year floodplains are predicted to be impacted by construction in the 200-foot-wide ROW along HVDC Alternative Route 4-A. The estimated acreage of impact for these floodplain crossings equals 130.2 acres. Applicant

Proposed Route Links 3, 4, 5, and 6 are predicted to total approximately 409.2 acres of temporary impact to 23 100-year floodplains within the ROW.

The 200-foot-wide ROW of HVDC Alternative Route 4-A includes approximately 1.4 miles of perennial streams, 4.3 miles of intermittent streams, 0.1 mile of major waterbodies, and 5.5 acres of reservoirs, lakes, and ponds (Table 3.15-16). In comparison, the corresponding Applicant Proposed Route Links 3, 4, 5, and 6 feature approximately 1.7 miles of perennial streams, 3.9 miles of intermittent streams, 0.2 mile of major waterbodies, and 4.4 acres of reservoirs, lakes, and ponds.

3.19.6.3.2.1.4.2 Alternative Route 4-B

HVDC Alternative Route 4-B is 78.6 miles in length. It corresponds to Region 4, Applicant Proposed Route Links 2–8, which are a combined 81.3 miles in length.

HVDC Alternative Route 4-B could cause impacts to 18 wetlands and 9.0 total acres within the representative ROW. Table 3.19-73 provides the number of wetlands by type with the associated potential impact acreage for HVDC Alternative Route 4-B. By comparison, construction of the Applicant Proposed Route Links 2–8 could result in approximately 13.7 acres of impact to 29 NWI-mapped wetlands in its ROW.

Table 3.19-73:
Potential Construction Impacts to Wetlands within the ROW of HVDC Alternative Route 4-B

Wetland Type	Number of Wetlands	Acreage of Potential Impact
PFO/PSS	1	0.7
PFO	1	2.0
PEM/PSS	1	1.3
PSS	1	0.1
PUB	12	4.1
L2UB	1	0.5
L2US	1	0.3
Totals	18	9

GIS Data Source: USFWS (2014g)

Twelve 100-year floodplains may be impacted by construction in the 200-foot-wide ROW along HVDC Alternative Route 4-B. These impacts are predicted to equal 104.4 acres. Applicant Proposed Route Links 2–8 are predicted to cross approximately 25 100-year floodplains, resulting in the potential for 413.4 acres of impact within the ROW.

The 200-foot-wide ROW would of HVDC Alternative Route 4-B encompasses includes approximately 1.6 miles of perennial streams, 5.9 miles of intermittent streams, 0.1 mile of major waterbodies, and 5.0 acres of reservoirs, lakes, and ponds (Table 3.15-16). In comparison, the corresponding Applicant Proposed Route Links 2, 3, 4, 5, 6, 7 and 8 feature approximately 2.5 miles of perennial streams, 4.8 miles of intermittent streams, 0.2 mile of major waterbodies, and 7.6 acres of reservoirs, lakes, and ponds.

3.19.6.3.2.1.4.3 Alternative Route 4-C

HVDC Alternative Route 4-C is 3 miles in length. It corresponds to Applicant Proposed Route Link 5, which is 2 miles in length.

No NWI-mapped wetlands are documented for the ROW in Alternative Route 4-C. Because NWI data is lacking for this alternative route, NLCD was also queried to estimate wetland acreage within this ROW. NLCD data also documented no wetlands in the ROW.

No 100-year floodplains are mapped in the 200-foot-wide ROW for HVDC Alternative Route 4-C.

The 200-foot-wide corridor of HVDC Alternative Route 4-C includes approximately 0.2 mile of perennial streams, 0.1 mile of intermittent streams, no major waterbodies, and 0.8 acre of reservoirs, lakes, and ponds (Table 3.15-16). In comparison, the corresponding Applicant Proposed Route Link 5 features approximately less than 0.1 mile of perennial streams, 0.2 mile of intermittent streams, no major waterbodies, and 0.3 acre of reservoirs, lakes, and ponds.

3.19.6.3.2.1.4.4 Alternative Route 4-D

HVDC Alternative Route 4-D is 25.3 miles in length. It corresponds to Applicant Proposed Route Links 4, 5 and 6, which are a combined 25.4 miles in length.

HVDC Alternative Route 4-D could cause impacts in two wetlands with a total of 0.3 acre of impacts within the ROW. In comparison, the Applicant Proposed Route Links 4, 5, and 6 could impact 0.1 acre of wetland in a single wetland that is crossed by its representative ROW.

Seven 100-year floodplains are predicted to be impacted by construction in the 200-foot-wide ROW along HVDC Alternative Route 4-D. The estimated acreage of impact for these floodplain crossings equal 47.9 acres. Applicant Proposed Route Links 4, 5 and 6 are predicted to total approximately 409.2 acres of impact from the crossing of 23 100-year floodplains.

The 200-foot-wide ROW of HVDC Alternative Route 4-D includes approximately 0.7 mile of perennial streams, 2.1-miles of intermittent streams, less than 0.1 mile of major waterbodies, and 3.1 acres of reservoirs, lakes, and ponds (Table 3.15-16). In comparison, the corresponding Applicant Proposed Route Links 4, 5, and 6 feature approximately 1.3 miles of perennial streams, 1.3 miles of intermittent streams, 0.1 mile of major waterbodies, 2.9 acres of reservoirs, lakes, and ponds.

3.19.6.3.2.1.4.5 Alternative Route 4-E

HVDC Alternative Route 4-E is 36.7 miles in length. It corresponds to Applicant Proposed Route Links 8 and 9, which are a combined 38.7 miles in length.

There are no documented NWI wetlands in the 200-foot-wide ROW along the route of HVDC Alternative 4-E or along the corresponding Applicant Proposed Route Links 8 and 9 in Region 4. Because NWI data is lacking for this alternative route, NLCD land cover data were also evaluated. That data set documented 0.09 acres of woody wetlands in the ROW. The corresponding Applicant Proposed Route Links 8 and 9 did not have documented wetland land cover within the representative ROW.

Nine 100-year floodplains are predicted to be impacted by construction in the 200-foot-wide ROW along HVDC Alternative Route 4-E for a total of 67.4 acres. Applicant Proposed Route Links 8 and 9 are predicted to total approximately 95.2 acres of impact in existing floodplains.

The 200-foot-wide corridor of HVDC Alternative Route 4-E includes approximately 0.6 mile of perennial streams, 3.8 miles of intermittent streams, 0.1 mile of major waterbodies, and 7.5 acres of reservoirs, lakes, and ponds (Table 3.15-16). In comparison, the corresponding Applicant Proposed Route Links 8 and 9 feature approximately 0.9 mile of perennial streams, 2.9 miles of intermittent streams, less than 0.1 mile of major waterbodies, and 3.2 acres of reservoirs, lakes, and ponds.

3.19.6.3.2.1.5 Region 5

3.19.6.3.2.1.5.1 Alternative Route 5-A

HVDC Alternative Route 5-A is 12.6 miles in length. It corresponds to Region 5, Applicant Proposed Route Link 1, which is 12.3 miles in length.

There are no NWI wetlands mapped in the representative ROW along the route of HVDC Alternative Route 5-A, nor is there NLCD wetland land cover documented in ROW. There are no predicted impacts to NWI wetlands documented within the representative ROW corresponding to Applicant Proposed Route Link 1.

Two 100-year floodplains are predicted to be impacted by construction in the 200-foot-wide ROW along HVDC Alternative Route 5-A for a total of 13.7 acres. Applicant Proposed Route Link 1 is predicted to total approximately 24.6 acres of impact to a single 100-year floodplain within its ROW.

The 200-foot-wide ROW of HVDC Alternative Route 5-A includes approximately 0.1 mile of perennial streams, 0.9 mile of intermittent streams, less than 0.1 mile of major waterbodies, and 0.5 acre of reservoirs, lakes, and ponds (Table 3.15-20). In comparison, the corresponding Applicant Proposed Route Link 1 features approximately 0.3 mile of perennial streams, 0.6 mile of intermittent streams, less than 0.1 mile of major waterbodies, and 0.9 acre of reservoirs, lakes, and ponds.

3.19.6.3.2.1.5.2 Alternative Route 5-B

HVDC Alternative Route 5-B is 71.0 miles in length. It corresponds to Applicant Proposed Route Links 3, 4, 5, and 6, which are a combined 67.1 miles in length. There are no NWI wetlands documented in the representative ROW along the route of Alternative Route 5-B; however, there are 4.3 acres of NLCD wetland land cover (woody wetlands) present in the ROW that could be impacted. Construction of Applicant Proposed Route Links 3, 4, 5, and 6 is not predicted to cause adverse impacts to wetland resources within the representative ROWs based on NWI data. However, NLCD data document a total of 9.3 acres of woody wetland land cover.

Eight 100-year floodplains are predicted to be impacted by construction in the 200-foot-wide ROW along HVDC Alternative Route 5-B for a total of 159.5 acres. Applicant Proposed Route Links 3, 4, 5, and 6 are predicted to impact a total of approximately 64.6 acres within nine 100-year floodplains in the ROW.

The 200-foot-wide ROW of HVDC Alternative Route 5-B includes approximately 1.2 miles of perennial streams, 8.6 miles of intermittent streams, 0.1 mile of major waterbodies, and 10.4 acres of reservoirs, lakes, and ponds (Table 3.15-20). In comparison, the corresponding Applicant Proposed Route Links 3, 4, 5 and 6 feature approximately 1.0 miles of perennial streams, 6.6 miles of intermittent streams, 0.1 mile of major waterbodies, and 13.8 acres of reservoirs, lakes, and ponds.

As described in Appendix M and summarized in Section 2.4.2.5, a route adjustment was developed for HVDC Alternative Route 5-B to maintain an end-to-end route with Applicant Proposed Route Links 2 and 3, Variation 1. The route adjustment would include no perennial or intermittent streams, no wetlands, two floodplains totaling approximately 4.9 acres, and no other surface waterbodies.

3.19.6.3.2.1.5.3 Alternative Route 5-C

HVDC Alternative Route 5-C is 9.2 miles in length. It corresponds to Applicant Proposed Route Link 6, which is approximately 9.4 miles in length.

There are no NWI wetlands mapped in the 200-foot-wide ROW along HVDC Alternative Route 5-C; however, there is 0.3 acre of NLCD wetland land cover (woody wetlands) documented in the ROW. There are no NWI wetlands documented within the representative ROW corresponding to Applicant Proposed Route Link 6; however, there are 8.2 acres of woody wetland land cover documented for the 200-foot-wide ROW for this link.

One 100-year floodplain is predicted to be impacted by construction in the 200-foot-wide ROW along HVDC Alternative Route 5-C for a total of 19.2 acres. Construction of Applicant Proposed Route Link 6 is predicted to cross one 100-year floodplain and total approximately 19.3 acres of temporary impacts in the ROW.

The 200-foot-wide ROW of HVDC Alternative Route 5-C includes under 0.4 mile of perennial streams, approximately 0.5 mile of intermittent streams, less than 0.1 mile of major waterbodies, and 0.4 acre of reservoirs, lakes, and ponds (Table 3.15-20). In comparison, the corresponding Applicant Proposed Route Link 6 features approximately 0.2 mile of perennial streams, 0.4 mile of intermittent streams, less than 0.1 mile of major waterbodies, and 1.3 acres of reservoirs, lakes, and ponds.

3.19.6.3.2.1.5.4 Alternative Route 5-D

HVDC Alternative Route 5-D is 21.7 miles in length. It corresponds to Applicant Proposed Route Link 9, which is 20.5 miles in length. HVDC Alternative Route 5-D could cause impacts to 15 wetlands totaling 12.4 total acres within the representative ROW. Table 3.19-74 provides the number of wetlands by type with the associated potential impact acreage for HVDC Alternative Route 5-D. Construction of Applicant Proposed Route Link 9 may result in impacts totaling 11.5 acres in 17 wetlands within its representative ROW.

Table 3.19-74:
Potential Construction Impacts to Wetlands within the ROW of HVDC Alternative Route 5-D

Wetland Type	Number of Wetlands	Acreage of Potential Impact
PEM	2	1.0
PFO	2	4.7
PUB	9	3.0
R2UB	2	3.7
Totals	15	12.4

GIS Data Source: USFWS (2014g)

One 100-year floodplain is predicted to be impacted by construction in the 200-foot-wide ROW along HVDC Alternative Route 5-D for a total of 4.1 acres. Construction of Applicant Proposed Route Link 9 is predicted to result in 1.3 acres of impact within one mapped floodplain.

The 200-foot-wide ROW of HVDC Alternative Route 5-D includes approximately 0.4 mile of perennial streams, 1.7 miles of intermittent streams, 0.1 mile of major waterbodies, and 1.6 acres of reservoirs, lakes, and ponds (Table 3.15-20). In comparison, the corresponding Applicant Proposed Route Link 9 features approximately 0.3 mile of perennial streams, 1.4 miles of intermittent streams, 0.1 mile of major waterbodies, and 2 acres of reservoirs, lakes, and ponds.

3.19.6.3.2.1.5.5 Alternative Route 5-E

HVDC Alternative Route 5-E is 36.3 miles in length. It corresponds to Applicant Proposed Route Links 4, 5, and 6, which are a combined 33.1 miles in length.

There are no predicted impacts to NWI wetlands in the representative ROW along HVDC Alternative Route 5-E. NLCD wetland land cover does document 0.1 acre of woody wetlands within the 200-foot-wide ROW. No NWI wetlands were documented for the representative ROW for the corresponding Applicant Proposed Route Links 4, 5, and 6. However, the NLCD database does document 8.2 acres of woody wetlands within Link 6.

Five 100-year floodplains are predicted to be impacted by construction in the 200-foot-wide ROW along HVDC Alternative Route 5-E for a total of 93.1 acres. Construction of Applicant Proposed Route Links 4, 5, and 6 are predicted to result in the crossing of six 100-year floodplains, with a predicted total of 42.6 acres of impacts.

The 200-foot-wide corridor of HVDC Alternative Route 5-E includes approximately 0.5 mile of perennial streams, 4.3 miles of intermittent streams, less than 0.1 mile of major waterbodies, and 3.2 acres of reservoirs, lakes, and ponds (Table 3.15-20). In comparison, the corresponding Applicant Proposed Route Links 4, 5 and 6 feature approximately 0.4 mile of perennial streams, 3.3 miles of intermittent streams, less than 0.1 mile of major waterbodies, and 7.0 acres of reservoirs, lakes, and ponds.

As described in Appendix M and summarized in Section 2.4.2.5, a route variation was developed for HVDC Alternative Route 5-E in response to public comments on the Draft EIS to maintain continuity with Applicant Proposed Route Links 3 and 4, Variation 2. The route adjustment would include no perennial or intermittent streams, no wetlands, one floodplain totaling approximately 0.3 acre, and one surface waterbody (pond or lake).

3.19.6.3.2.1.5.6 Alternative Route 5-F

HVDC Alternative Route 5-F is 22.3 miles in length. It corresponds to Applicant Proposed Route Links 5 and 6, which are a combined 18.7 miles in length.

There are no mapped wetland resources within the representative ROW for either HVDC Alternative Route 5-F or Applicant Proposed Route Links 5 and 6. NLCD data reveal 0.1 acre of woody wetland land cover within the 200-foot-wide ROW for Alternative Route 5-F, and also document 8.2 acres of woody wetland land cover for the ROW for Link 6 of the Applicant Proposed Route.

Three 100-year floodplains are predicted to be impacted by construction along HVDC Alternative Route 5-F for a total impact acreage of 74.7 acres. Construction of Applicant Proposed Route Links 5 and 6 are predicted to result in 38.1 acres of impacts four 100-year floodplains crossed by this ROW.

The 200-foot-wide ROW of HVDC Alternative Route 5-F includes under 0.3 mile of perennial streams, approximately 2.6 miles of intermittent streams, less than 0.1 mile of major waterbodies, and 0.7 acre of reservoirs, lakes, and ponds (Table 3.15-20). In comparison, the corresponding Applicant Proposed Route Links 5 and 6 feature approximately 0.3 mile of perennial streams, 2.1 miles of intermittent streams, less than 0.1 mile of major waterbodies, and 3.4 acres of reservoirs, lakes, and ponds.

3.19.6.3.2.1.6 Region 6

3.19.6.3.2.1.6.1 Alternative Route 6-A

HVDC Alternative Route 6-A is 16.2 miles in length. It corresponds to Region 6, Applicant Proposed Route Links 2, 3, and 4, which are a combined 17.7 miles in length.

HVDC Alternative Route 6-A could cause impacts to 18 wetlands and 25.9 total acres within the representative ROW. Table 3.19-75 provides the number of wetlands by type with the associated potential impact acreage for HVDC Alternative Route 6-A. In comparison, construction of Applicant Proposed Route Links 2, 3 and 4 could result in as much as 3.4 acres of impacts to a set of eight wetlands.

Table 3.19-75:
Potential Construction Impacts to Wetlands within the ROW of HVDC Alternative Route 6-A

Wetland Type	Number of Wetlands	Acreage of Potential Impact
PEM	2	0.4
PFO	11	19.7
PSS	1	1.6
PUB	2	3.2
R2UB	2	1.0
Totals	18	25.9

GIS Data Source: USFWS (2014g)

One 100-year floodplain is predicted to be impacted by construction in the 200-foot-wide ROW along HVDC Alternative Route 6-A for a total of 232.5 acres. Applicant Proposed Route Links 2, 3, and 4 are predicted to cross one 100-year floodplain with a potential to cause 103.2 acres of impacts.

The 200-foot-wide ROW of HVDC Alternative Route 6-A includes approximately 0.3 mile of perennial streams, 2.2 miles of intermittent streams, less than 0.1 mile of major waterbodies, and 0.4 acre of reservoirs, lakes, and ponds (Table 3.15-24). In comparison, the corresponding Applicant Proposed Route Links 2, 3 and 4 feature approximately 0.3 mile of perennial streams, 2.2 miles of intermittent streams, less than 0.1 mile of major waterbodies, and 1.9 acres of reservoirs, lakes, and ponds.

As described in Appendix M and summarized in Section 2.4.2.6, a route adjustment was developed for HVDC Alternative Route 6-A to maintain an end-to-end route with Applicant Proposed Route Link 2, Variation 1. The route adjustment would include no perennial or intermittent stream mileage, 21.2 acres of forested wetlands, 0.2 acre of non-forested wetlands, one floodplain totaling approximately 129.4 acres, and six other surface waterbodies.

3.19.6.3.2.1.6.2 Alternative Route 6-B

HVDC Alternative Route 6-B is 14.1 miles in length. It corresponds to Region 6, Applicant Proposed Route Link 3, which is 9.6 miles in length.

HVDC Alternative Route 6-B could cause impacts to 10 wetlands and 15.8 total acres within the ROW. Table 3.19-76 provides the number of wetlands by type with the associated potential impact acreage for HVDC Alternative Route 6-B. In comparison, construction of Applicant Proposed Route Link 3 is predicted to result in 3.1 acres of impacts in four wetlands within its representative ROW.

Table 3.19-76:
Potential Construction Impacts to Wetlands within the ROW of HVDC Alternative Route 6-B

Wetland Type	Number of Wetlands	Acreage of Potential Impact
PFO	6	13.2
PSS	1	1.0
PUB	3	1.6
Totals	10	15.8

GIS Data Source: USFWS (2014g)

No 100-year floodplains are predicted to be crossed by HVDC Alternative Route 6-B in its 200-foot-wide ROW.

The 200-foot-wide ROW of HVDC Alternative Route 6-B includes approximately 0.2 mile of perennial streams, 1.5 miles of intermittent streams, no major waterbodies, and 2.4 acres of reservoirs, lakes, and ponds (Table 3.15-24). In comparison, the corresponding Applicant Proposed Route Link 3 features less than 0.1 mile of perennial streams, 1.9 miles of intermittent streams, less than 0.1 mile of major waterbodies, and 0.9 acre of reservoirs, lakes, and ponds.

3.19.6.3.2.1.6.3 Alternative Route 6-C

HVDC Alternative Route 6-C is 23.1 miles in length. It corresponds to Applicant Proposed Route Links 6 and 7, which are a combined 24.8 miles in length.

There are no NWI-mapped wetlands in the representative ROW for either HVDC Alternative Route 6-C, or for Applicant Proposed Route Links 6 and 7. However, NLCD data show that there are 9.4 acres of woody wetland land cover in HVDC Alternative Route 6-D, and Applicant Proposed Route Links 6 and 7 have a combined total of 45.9 acres of woody wetland and emergent herbaceous wetland land cover.

Four 100-year floodplains are predicted to be impacted by construction in the 200-foot-wide ROW along HVDC Alternative Route 6-C for a total of 94.6 acres. Applicant Proposed Route Links 6 and 7 are predicted to cross two 100-year floodplains with a resultant potential for 170.2 acres of wetland impacts in the ROW.

The 200-foot-wide ROW of HVDC Alternative Route 6-C includes approximately 0.4 mile of perennial streams, 1.1 miles of intermittent streams, 0.1 mile of major waterbodies, and 1.6 acres of reservoirs, lakes, and ponds (Table 3.15-24). In comparison, the corresponding Applicant Proposed Route Links 6 and 7 feature approximately 0.3 mile of perennial streams, 1.0 miles of intermittent streams, 0.1 mile of major waterbodies, and 0.1 acre of reservoirs, lakes, and ponds.

3.19.6.3.2.1.6.4 Alternative Route 6-D

HVDC Alternative Route 6-D is 9.2 miles in length. It corresponds to Region 6, Applicant Proposed Route Link 7, which is 8.6 miles in length.

There are no NWI-mapped wetlands in the representative ROW for either HVDC Alternative Route 6-D or for Applicant Proposed Route Link 7. However, NLCD data show that there are 22.1 acres of woody wetland land cover in HVDC Alternative Route 6-C, and Applicant Proposed Route Links 6 and 7 have a combined total of 45.9 acres of woody wetland and emergent herbaceous wetland land cover.

Two 100-year floodplains are predicted to be impacted by construction in the 200-foot-wide ROW along HVDC Alternative Route 6-D for a total of 108.8 acres. In contrast, Applicant Proposed Route Link 7 is predicted to cross one 100-year floodplain, resulting in the potential for 151.0 acres of impact.

The 200-foot-wide ROW of HVDC Alternative Route 6-D includes approximately 0.3 mile of perennial streams, 0.3 mile of intermittent streams, 0.1 mile of major waterbodies, and no acreage of reservoirs, lakes, and ponds (Table 3.15-24). Riparian areas may be associated with many, if not all, of these surface water features. In comparison, the corresponding Applicant Proposed Route Link 7 features approximately 0.1 mile of perennial streams, 0.2 mile of intermittent streams, 0.1 mile of major waterbodies, and no acreage of reservoirs, lakes or ponds.

3.19.6.3.2.1.7 Region 7

3.19.6.3.2.1.7.1 Alternative Route 7-A

HVDC Alternative Route 7-A is 43.2 miles in length. It corresponds to Region 7, Applicant Proposed Route Link 1, which is 28.6 miles in length.

HVDC Alternative Route 7-A could cause impacts in 10 wetlands totaling 26.6 acres within the representative ROW. Table 3.19-77 provides the number of wetlands by type with the associated potential impact acreage for HVDC Alternative Route 7-A. Construction of Applicant Proposed Route Link 1 could result in up to 38.3 acres of impacts to 19 wetlands.

Table 3.19-77:
Potential Construction Impacts to Wetlands within the ROW of HVDC Alternative Route 7-A

Wetland Type	Number of Wetlands	Acreage of Potential Impact
PEM	1	1.9
PFO	7	10.0
L2UB	2	14.7
Totals	10	26.6

GIS Data Source: USFWS (2014g)

Eight 100-year floodplains are predicted to be impacted by construction in the 200-foot-wide ROW along HVDC Alternative Route 7-A for a total of 314.4 acres. Applicant Proposed Route Link 1 is predicted would cross 10 mapped 100-year floodplains resulting in an estimated 247.9 acres of impacts.

As shown in Table 3.15-28, the 200-foot-wide ROW of HVDC Alternative Route 7-A includes approximately 1.8 miles of perennial streams, 4.7 miles of intermittent streams, 0.9 mile of major waterbodies, and 2.4 acres of reservoirs, lakes, and ponds. In comparison, the corresponding Applicant Proposed Route Link 1 features approximately 0.3 mile of perennial streams, 2.7 miles of intermittent streams, 0.6 mile of major waterbodies, and 1.5 acres of reservoirs, lakes or ponds.

3.19.6.3.2.1.7.2 Alternative Route 7-B

HVDC Alternative Route 7-B is 8.6 miles in length. It corresponds to Applicant Proposed Route Links 3 and 4, which are a combined 8.4 miles in length.

HVDC Alternative Route 7-B could cause impacts to five wetland types and 2.6 acres within the ROW. Table 3.19-78 provides the number of wetlands by type with the associated potential impact acreage. In comparison, construction of Applicant Proposed Route Links 3 and 4 could result in approximately 1.4 acre of impacts in a set of two wetlands.

Table 3.19-78:
Potential Construction Impacts to Wetlands within the ROW of HVDC Alternative Route 7-B

Wetland Type	Number of Wetlands	Acreage of Potential Impact
PFO	3	2.0
PSS	1	0.5
PUB	1	0.1
Totals	5	2.6

GIS Data Source: USFWS (2014g)

Three 100-year floodplains are predicted to be impacted by construction in the 200-foot-wide ROW along HVDC Alternative Route 7-B for a total of 50.4 acres. Applicant Proposed Route Links 3 and 4 would cross nine 100-year floodplains with a resultant potential for 47.9 acres of impact.

The 200-foot-wide ROW of HVDC Alternative Route 7-B includes approximately 0.1 mile of perennial streams, 0.6 mile of intermittent streams, no major waterbodies, and no acreage of reservoirs, lakes, and ponds (Table 3.15-28). In comparison, the corresponding Applicant Proposed Route Links 3 and 4 feature approximately 0.1 mile of perennial streams, 0.8 mile of intermittent streams, no major waterbodies, and 0.1 acre of reservoirs, lakes, or ponds.

3.19.6.3.2.1.7.3 Alternative Route 7-C

HVDC Alternative Route 7-C is 23.8 miles in length. It corresponds to Region 7, Applicant Proposed Route Links 3, 4 and 5, which are a combined 13.2 miles in length.

HVDC Alternative Route 7-C could cause impacts to as many as 22 wetlands totaling 16.9 total acres within the ROW. Table 3.19-79 provides the number of wetlands by type with the associated potential impact acreage. Construction of Applicant Proposed Route Links 3, 4, and 5 could result in approximately 3.5 acres of impacts in four wetlands within its ROW.

Table 3.19-79:
Potential Construction Impacts to Wetlands within the ROW of HVDC Alternative Route 7-C

Wetland Type	Number of Wetlands	Acreage of Potential Impact
PEM	2	0.5
PFO	11	12.9
PSS	3	0.5
PUB	6	3.0
Totals	22	16.9

GIS Data Source: USFWS (2014g)

Fifteen 100-year floodplains are predicted to be impacted by construction in the 200-foot-wide ROW along HVDC Alternative Route 7-C for a total impact acreage of 160.2 acres. Applicant Proposed Route Links 3, 4, and 5 would cross 13 100-year floodplains with a potential for 69.9 acres of total impact.

The 200-foot-wide ROW of HVDC Alternative Route 7-C includes approximately 0.4 mile of perennial streams, 1.9 miles of intermittent streams, less than 0.1 mile of major waterbodies, and 0.9 acre of reservoirs, lakes, and ponds (Table 3.15-28). In comparison, the corresponding Applicant Proposed Route Links 3, 4 and 5 feature approximately 0.2 mile of perennial streams, 1.6 miles of intermittent streams, no major waterbodies, and 0.9 acre of reservoirs, lakes or ponds.

3.19.6.3.2.1.7.4 Alternative Route 7-D

HVDC Alternative Route 7-D is 6.5 miles in length. It corresponds to Applicant Proposed Route Links 4 and 5, which are a combined 6.4 miles in length.

HVDC Alternative Route 7-D could cause impacts to four wetlands and 7.3 total acres within the representative ROW. Table 3.19-80 provides the number of wetlands by type with the associated potential impact acreage. Construction of Applicant Proposed Route Links 4 and 5 could result in approximately 2.3 acres of impacts in a total of three wetlands within its representative ROW.

Table 3.19-80:
Potential Construction Impacts to Wetlands within the ROW of HVDC Alternative Route 7-D

Wetland Type	Number of Wetlands	Acreage of Potential Impact
PFO	3	7.3
PUB	1	0.1
Totals	4	7.4

GIS Data Source: USFWS (2014g)

Nine 100-year floodplains are predicted to be impacted by construction in the 200-foot-wide ROW along HVDC Alternative Route 7-D for a total of 56.2 acres. Applicant Proposed Route Links 4 and 5 would cross seven 100-year floodplains and could potentially impact 43.2 acres within the ROW.

The 200-foot-wide ROW of HVDC Alternative Route 7-D includes approximately 0.3 mile of perennial streams, 0.9 mile of intermittent streams, no major waterbodies, and no acreage of reservoirs, lakes, and ponds (Table 3.15-28). In comparison, the corresponding Applicant Proposed Route Links 4 and 5 feature approximately

0.1 mile of perennial streams, 1.0 mile of intermittent streams, no major waterbodies, and 0.8 acre of reservoirs, lakes, or ponds.

3.19.6.3.2.2 Operations and Maintenance Impacts

The operation and maintenance of the HVDC transmission line in the alternative routes would involve routine and periodic vegetation management according to the TVMP. Impacts related to operations and maintenance may result from use of heavy machinery through wetlands, floodplains, and riparian areas. These impacts can cause soil compaction and mechanical damage or removal of vegetation. These operations and maintenance impacts are anticipated to cover a range from temporary and minor to potentially more severe and long-term/permanent. The estimated acreage of each resource type (wetlands, floodplains, and riparian areas) for each route, is provided in the previous subsections of 3.19.6.3.2.1.

The use of vegetation management would be necessary to protect the Project infrastructure and enhance safety. However, the trimming, mowing, or removal of vegetation can cause changes to plant diversity and function in all three ecosystem types (i.e., wetlands, floodplains, and riparian areas). Vegetation maintenance in wetlands and riparian areas should be kept to a minimum to the extent practicable. Additionally, the use of herbicides can cause minor to severe impacts to vegetation in areas where they are applied. If used, the Applicant would selectively apply herbicides within streamside management zones.

3.19.6.3.2.3 Decommissioning Impacts

The decommissioning impacts relative to the alternative routes would be similar in nature to the set of temporary impacts resulting from initial construction. These temporary impacts would involve use of construction machinery at the various sites of infrastructure (e.g., the lattice structures, lattice crossing structures, monopole structures, guyed structures, fiber optic infrastructure, etc.) to remove aboveground material, and foundation material where required. Use of construction machinery would have the potential to crush or remove vegetation, but no long-term effects are judged to be likely from the decommissioning phase of the Project. Revegetation would be guided by the Project’s Decommissioning Plan and by any conditions of a CWA permit, where applicable.

3.19.6.4 Best Management Practices

The Applicant has developed a comprehensive list of EPMs that avoid and minimize impacts to wetlands, floodplains, and riparian areas. A complete list of EPMs for the Project is provided in Appendix F; those EPMs that would specifically minimize the potential for an impact on wetlands, floodplains, and riparian areas are summarized in Section 3.19.6.1. DOE, in consultation with the USACE, has identified the following BMPs to avoid or minimize impacts on wetlands, floodplains, and riparian areas:

- In addition to protection of intermittent and perennial streams, ephemeral streams would also be included in the Applicant’s streamside management zones. This BMP would add to EPM W-3.
- In addition to minimization of clearing vegetation within the ROW (GE-3), it is recommended that where tree removal is necessary in the ROW, this removal should be accomplished at ground level leaving root wads in place to aid in the stabilization of soils.
- Limit, to the extent practicable, the amount of vegetation removed along streambanks and minimizing the disruption of natural drainage patterns.

- All permanent and temporary crossings of waterbodies would be suitably culverted, bridged, or otherwise designed and constructed to maintain low flows to sustain the movement of aquatic species. The crossings would also be constructed to withstand expected high flows. The crossings would not restrict or impede the passage of normal or high flows.
- Excavated trenches that are to be backfilled should separate the upper 12 inches of topsoil from the rest of the excavated material. The topsoil should be used as the final backfill.

3.19.6.5 Unavoidable Adverse Impacts

Unavoidable adverse impacts to wetlands, floodplains, and riparian areas from the Project may include, but are not necessarily limited to, the following elements:

- Removal of vegetation in the footprints of new transmission line support structures, access roads, converter stations, and other associated infrastructure, some of which may be wetland vegetation, or vegetation present in floodplains or riparian zones
- Conversion of vegetation structure (e.g., floodplain/riparian forest conversion to grassland/herbaceous or shrub/scrub land cover)
- Changes to species diversity within wetlands, floodplains, and/or riparian areas
- Changes in total cover percentage in wetland, floodplain, and riparian zone vegetation

3.19.6.6 Irreversible and Irretrievable Commitment of Resources

The potential permanent loss or alteration of wetlands, floodplains, and riparian areas would last throughout the life of the Project; however, gradual recovery of these resources is expected after decommissioning. It is reasonable to assume that some wetlands, floodplains, and riparian areas may be irreversibly and irretrievably impacted.

3.19.6.7 Relationship between Local Short-term Uses and Long-term Productivity

The Project would result in a short-term disturbance to wetlands, floodplains, and riparian areas; however, these impacts should not affect the long-term productivity of these resources.

3.19.6.8 Impacts from Connected Actions

3.19.6.8.1 Wind Energy Generation

3.19.6.8.1.1 Construction Impacts

Construction of wind farms in the Oklahoma and Texas Panhandle regions would be expected to involve potential impacts to wetlands, floodplains, and riparian areas similar to those described in Section 3.19.6.1 for common construction activities. The potential short-term impacts from construction activities for wind energy generation could include mechanical damage/crushing of vegetation from use of heavy machinery, compaction of soils, sedimentation and turbidity from construction activities adjacent to these resources, alteration of hydrology from access road construction, dewatering activities, and contamination from accidental spills of hazardous substances such as fuels and lubricants. The potential long-term impacts to wetlands, floodplains, and riparian resources from construction in wind development zones could include removal of vegetation during excavations for structure foundations, electrical collection lines, or during permanent access road construction, conversion of forested wetlands and riparian areas to shrubby or herbaceous cover types within the ROW, changes to hydrology from permanent access roads construction, and the introduction of invasive species from construction equipment.

Section 3.19.5.8.1 provides an estimate of the wetlands and floodplains that could potentially be affected in each of the twelve WDZs. Based on the maximum capacity of the Project and information from wind energy developers, it is estimated that 20–30 percent of the potentially suitable land, as identified in Section 2.5.1, would actually be developed for wind energy facilities using transmission capacity from the Project. It is further estimated that during the construction phase, approximately 2 percent of land within a wind energy facility, would be affected (Denholm et al. 2009). That would reduce to 1 percent of the land that would remain disturbed during operations and maintenance of the wind energy facilities.

Wind turbines and associated facilities are typically located outside of wetlands, floodplains, and riparian areas to the extent practicable. Wind lease agreements typically include provisions to minimize the impacts to wetlands, floodplains and riparian areas, including minimizing soil compaction and revegetating temporary work areas.

3.19.6.8.2 Optima Substation

No wetlands, floodplains, or riparian areas are documented for this site. No impacts to wetlands, floodplains, or riparian areas would be expected.

3.19.6.8.3 TVA Upgrades

Much of the following discussion is relevant for the new 500kV transmission line, or for certain upgrades associated with the 161kV transmission lines. The required TVA upgrades to existing facilities (including existing transmission lines and existing substations) would likely have no impact to wetlands, floodplains or riparian areas. The construction, operation, and maintenance of the new 500kV transmission line, would have impacts similar to the Project although on a smaller scale. These impacts to wetlands, floodplains, and riparian areas may be largely avoided or minimized by spanning these resource areas. On average, the construction of new TVA transmission lines during the last decade has affected 0.7 acre of wetlands per mile of new line, including 0.4 acre of forested wetlands per mile. Potential impacts from constructing the new transmission line through or adjacent to wetlands, floodplains and riparian areas may include sedimentation and turbidity, placement of fill or dredging, alteration of hydrology, contamination from herbicide runoff or accidental, long-term conversion of forested vegetation types to shrubby or herbaceous cover types within the ROW, changes in flood grade or elevation, mechanical damage/crushing of vegetation, compaction of soils potentially reducing soil’s water-holding capacity, and introduction of invasive species from construction equipment.

3.19.6.9 Impacts Associated with the No Action Alternative

Under the No Action Alternative, DOE assumes for analytical purposes that the Project would not be constructed. No impacts on wetlands, floodplains, or riparian areas would occur. The existing diversity, structure, and function of these areas within the ROW would be expected to remain consistent within their current parameters.

This page intentionally left blank.

Contents

Tables

3.20 Wildlife, Fish, and Aquatic Invertebrates

3.20.1 Wildlife

3.20.1.1 Regulatory Background

In general, statutes and regulations that influence the evaluation of wildlife resources in the areas crossed by the Project are implemented by the USFWS and state wildlife agencies. The state agencies applicable to this Project include the ODWC, AGFC, TWRA, and TPWD. The wildlife regulations relevant to this Project are presented in Table 3.20.1-1.

Table 3.20.1-1:
Relevant Regulations for Wildlife Species

Regulation	Regulatory Agency	Summary
Endangered Species Act (ESA), (16 USC § 1531 *et seq.*; 50 CFR Part 402)	USFWS	Establishes lists of threatened or endangered species and their designated critical habitats; requires federal agencies to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of listed species or result in adverse modification to designated critical habitat.
Migratory Bird Treaty Act (MBTA) (16 USC §§ 703–712)	USFWS	Prohibits take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or the parts, nests, or eggs of such a bird unless expressly permitted by federal regulations or authorized under a MBTA permit.
Executive Order 13186, “Responsibilities of Federal Agencies to Protect Migratory Birds”	USFWS	Directs executive departments and agencies to take certain actions to protect and conserve migratory birds. It provides broad guidelines on conservation responsibilities and requires the development of more detailed guidance in Memoranda of Understanding (MOU).
Bald and Golden Eagle Protection Act (BGEPA), (16 USC §§ 668–668d; 50 CFR Part 22)	USFWS	Prohibits the “take” of bald and golden eagles as defined: pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb without a BGEPA Permit.
Oklahoma Statutes 29-5-412.1 Oklahoma Administrative Code Title 800, “Department of Wildlife Conservation”	ODWC	Establishes list of threatened or endangered species within Oklahoma. Describes the function, organization, powers and duties of the Oklahoma Department of Wildlife Conservation with respect to managing fish and wildlife resources.
Texas Administrative Code 31-65.171–65.177	TPWD	Establishes list of threatened or endangered wildlife within Texas; prohibits the taking, possession, transportation, or sale of threatened or endangered species within the issuance of a permit.
Arkansas Code Annotated 15-45-301–306	AGFC[1]	Prohibits imports, transportation, sale, purchase, hunting, harassment, or possession of threatened or endangered wildlife or their parts.
Tennessee Administrative Code 70-1-101 *et seq*.	TWRA	Establishes a list of threatened or endangered wildlife within Tennessee; prohibits the take, attempt to take, possession, transportation, export, processing, selling, offering to sell, shipment of, or knowing receipt of shipment of threatened or endangered wildlife.

1 Arkansas does not have an endangered species law, but does maintain a list of Species of Special Concern.

3.20.1.2 Data Sources

Data sources included a desktop analysis of relevant information; research findings; reports available to the public; a database that includes GIS data from government agencies as well as non-governmental organizations; and information received from both regulatory agencies and stakeholders during the DOE scoping process. All data sources used for this analysis were limited to those that were open source and readily available to the public (i.e., the public may assess them without restrictions). As a result, comprehensive state wildlife agency databases regarding designated habitats types (e.g., extent of big game ranges), species presence, or wildlife use of habitats (e.g., raptor nest or bat hibernacula locations) were not used in this assessment due to data sharing restrictions (i.e., DOE could not ensure the state agencies that these data would not be released to the public without the DOE's consent). The lack of comprehensive state wildlife data used in this assessment would constitute "incomplete or unavailable" data per CEQ regulations at 40 CFR 1502.22. Because comprehensive state wildlife data were not used in this assessment, it was assumed that wildlife were present or used habitats if their range overlapped an area and suitable habitats were present (i.e., due to the lack or more robust data, a conservative estimate of species use was used for this assessment). The data sources available to DOE during this analysis are summarized in Table 3.20.1-2.

Table 3.20.1-2:
Summary of Data Sources Wildlife

Resource	Data Source
Representative common wildlife species within each vegetative cover type in the ROI	NatureServe Explorer (http://explorer.natureserve.org/) ODWC WMA Fact Sheets (http://www.wildlifedepartment.com/facts_maps/wmastate.htm) ANHC (http://www.naturalheritage.com/) TDEC Division of Natural Areas (http://www.state.tn.us/environment/natural-areas/natural-areas/) TPWD (http://www.tpwd.state.tx.us/)
Important commercial or recreation species in the ROI	Stakeholder Outreach
Migratory birds	National Audubon Society Important Bird Areas (IBAs) Interactive Map (NAS 2013) USFWS Migratory Bird Program (http://www.fws.gov/migratorybirds/dmbmdbhc.html) Oklahoma Breeding Bird Atlas (http://suttoncenter.org/pages/oklahoma_breeding_bird_atlas) Arkansas Breeding Bird Atlas (http://birdatlas.cast.uark.edu) Tennessee Breeding Bird Atlas (http://www.tnbirds.org/birdatlas.htm) Texas Breeding Bird Atlas (http://txtbba.tamu.edu/)

3.20.1.3 Region of Influence

The ROIs used for the evaluation of potential impacts to wildlife from the Project and connected actions are identical to the ROIs described in Section 3.1.1.

3.20.1.4 Affected Environment

As discussed in Section 3.18, the Project would cross multiple ecoregions that individually support diverse vegetation communities. Overall, the Project is within the Great Plains and Eastern Temperate Forests Level I Ecoregions (EPA 2012). From the western end of the Project (in the Oklahoma Panhandle) moving eastward (across Oklahoma, Arkansas, and western Tennessee), the vegetation changes from arid and semi-arid grasslands to forests, river valleys, and coastal plains. This change in vegetation type results as precipitation and elevation change from west to east. Because of this variation in vegetation type across the seven regions, a variety of wildlife species (both terrestrial and aquatic) are expected to occur within the habitats found within the ROI. The highest species diversity can be expected to occur in areas of greater habitat diversity (Recher 1969; MacArthur and Wilson 1967), such as transitional zones between one habitat type and another (the highest diversity in habitats mostly occurs within Regions 3, 4, and 5). The following sub-sections provide regional descriptions of common resident and migratory species including important recreation species, migratory birds, reptiles, amphibians, and mammals known to occur or that have the potential to occur within the ROI based on habitat associations and known range information. It should be noted that the following is not a comprehensive list of every wildlife species that could occur in the region, but rather it is only a list of the more common species typically found in the region.

It should be noted that several route variations to the Applicant Proposed Route in Regions 2–7 were developed in response to public comments on the Draft EIS; they are described in detail within Appendix M and summarized in Sections 2.4.2.1–2.4.2.7. These variations are presented graphically in Exhibit 1 of Appendix M, and are included in the affected environment discussion.

3.20.1.4.1 Important Recreation Species

Areas managed either wholly or in part for recreational opportunities, such as hunting and fishing, include public and private lands such as WMAs, Public Hunting Areas, Game Management Areas, Wildlife Management Units, various USACE lands, conservation easements, National Recreational Areas, and NWRs. Recreational areas within the ROI are described in detail within Section 3.12.

Texas

Big game species potentially within the ROI for the AC collection system in Texas include white-tailed deer (*Odocoileus virginianus*), mule deer (*Odocoileus hemionus*), and pronghorn (*Antilocapra americana*) (TPWD 2013).

Small game species potentially within the ROI for the AC collection system in Texas include cottontail (*Sylvilagus* spp.) and jackrabbits (*Lepus* spp.).

Bird species that are hunted within the state (and potentially within the ROI for the AC collection system in Texas) include the white-winged dove (*Zenaida asiatica*), mourning dove (*Zenaida macroura*), as well as various species of duck, pheasant, and quail (TPWD 2013).

Oklahoma

Big game species potentially within the Project's ROI in Oklahoma include white-tailed deer, elk *(Cervus elaphus),* and pronghorn. White-tailed deer hunting occurs statewide. Within the ROI, elk hunting occurs in Sequoyah and Muskogee counties. Pronghorn hunting (referred to as "antelope" by ODWC) occurs in Texas County, west of State Highway 136 (ODWC 2013).

Small game species potentially within the Project's ROI in Oklahoma include squirrels *(Sciurus* spp. *and Tamiasciurus* spp.), cottontail, and jackrabbits. Furbearers hunted in Oklahoma include bobcat *(Lynx rufus),* raccoon *(Procyon lotor),* river otter *(Lontra canadensis),* gray fox *(Urocyon cinereoargenteus),* and red fox

(Vulpes vulpes). Additionally, year-round seasons are open statewide for coyote *(Canis latrans),* beaver *(Castor canadensis),* nutria *(Myocastor coypus*), and striped skunk *(Mephitis mephitis*) (ODWC 2013).

Bird species that are hunted within the state (and potentially within the Project's ROI in Oklahoma) include the ring-necked pheasant *(Phasianus colchicus),* wild turkey *(Meleagris gallopavo),* northern bobwhite *(Colinus virginianus),* scaled quail *(Callipepla squamata),* sora *(Porzana carolina),* Virginia rail *(Rallus limicola),* common snipe *(Gallinago gallinago),* mourning dove *(Zenaida macroura),* Canada goose *(Branta canadensis),* American woodcock *(Scolopax minor),* common gallinule *(Gallinula galeata)* (previously "moorhen"), and 16 waterfowl species (ODWC 2013).

Arkansas

Big game species potentially within the Project's ROI in Arkansas include white-tailed deer, elk, American alligator (*Alligator mississippiensis),* and American black bear (*Ursus americanus*) (AGFC 2013c).

Small game species that potentially occur within the Project's ROI in Arkansas include squirrels (red and fox) and rabbits (eastern cottontail [*Sylvilagus floridanus*] and swamp rabbit [*Sylvilagus aquaticus*]*)* (AGFC 2013c). Furbearers harvested within the state include beaver, bobcat, coyote, gray fox, mink *(Neovison vison),* muskrat *(Ondatra zibethicus),* nutria, opossum *(Didelphis virginiana),* raccoon, red fox, river otter and striped skunk (AGFC 2013c).

Bird species that are hunted within the state (and potentially within the Project's ROI in Arkansas) include the common gallinule, common snipe, Virginia rail, purple gallinule (*Porphyrio martinica*), mallards (*Anas platyrhynchos*), American woodcock, Eurasian collared-dove (*Streptopelia decaocto),* mourning dove, northern bobwhite, sora, wild turkey, blue-winged teal *(Anas discors),* green-winged teal *(Anas crecca),* cinnamon teal *(Anas cyanoptera),* Canada goose, snow goose *(Chen caerulescens;* also referred to as blue goose depending on the color morph), Ross's goose *(Chen rossii),* greater white-fronted goose *(Anser albifrons),* American coot *(Fulica americana),* and 21 other species of duck (AGFC 2013a, 2013b).

Tennessee

Big game species potentially within the Project's ROI in Tennessee include white-tailed deer, wild turkey, and American black bear.

Small game species that potentially occur within the Project's ROI in Tennessee include nine-banded armadillo (*Dasypus novemcinctus*), bullfrog, Eurasian collared-dove, ruffed grouse (*Bonasa umbellus*), quail, rabbit, squirrel, beaver, bobcat, coyote, fox, groundhog (*Marmota monax*), mink, muskrat, opossum, river otter, raccoon, skunk, and various weasel species (TWRA 2013a, 2013b).

Bird species that are hunted within the state (and potentially within the Project's ROI in Tennessee) include the American coots, common crow (*Corvus brachyrhynchos*), purple gallinules, Virginia rail, mourning dove, Wilson snipe, American woodcock, Canada goose, greater white-fronted goose, Ross's goose, snow goose, and thirteen species of duck (TWRA 2013a).

3.20.1.4.2 Migratory Birds

The regulatory use of the term "migratory bird" refers to any bird native to the United States that is protected by the MBTA (USFWS 2011), but does not typically include upland game birds (e.g., pheasants), because they are typically managed at the state level. Section 3.20.1.1 defines the MBTA. As of November 2013, the MBTA protects more than 1,000 species of native birds, hundreds of which have the potential to be present in the Project's ROI (78 FR 65843, November 1, 2013). Species composition and abundance vary by geography, habitat, and time of year; but migratory birds may occur in the ROI either during their migration or throughout the year (Table 3-10 in the Applicant's *Fish, Wildlife, and Vegetation Technical Report* [Clean Line 2013] lists the migratory birds that could potentially occur in the area).

Migratory birds use general north-south flyways, which are main transit corridors between southern wintering grounds and northern breeding areas (USFWS 2009). The Project's ROI crosses both the Central and the Mississippi Flyways. The Central Flyway encompasses the Great Plains west of the Mississippi River Valley as well as the Rocky Mountains of the central United States (Regions 1 through 3 of the Project) (USFWS 2009). The Mississippi Flyway reflects a general path of migration along the Mississippi River and extends across Arkansas and Tennessee (Regions 4 through 7 of the Project).

Along these flyways, the National Audubon Society has identified specific Important Bird Areas (IBAs), which are considered "vital to birds and other biodiversity" (NAS 2013). Two Audubon-designated IBAs are in the ROI for the Project: the Ozark National Forest Global IBA (which is located within the ROI for the Applicant Proposed Route in Region 4) and the Cache-Lower White Rivers Global IBA (which is located in the ROI for the Project in Region 6). The extreme southern edge of the Ozark National Forest IBA intersects the northern extent of the ROI for the Applicant Proposed Route, east of Hagerville (Region 4). The ROI traverses the northernmost extension of the Cache-Lower White Rivers IBA in Region 6, in conjunction with the crossing of the Cache River and associated riparian forest. A third Audubon-designated IBA, the Selman Ranch IBA, occurs 10 miles north of the ROI for HVDC Alternative Route 1-A in Harper County, Oklahoma in Region 1 (NAS 2013). No other IBAs occur within 15 miles of the ROI for the Project.

3.20.1.4.3 Reptiles and Amphibians

Two hundred nineteen common reptile and amphibian species are known to occur or have the potential to occur within the ROI. Species composition and abundance of reptile and amphibian species vary by geography, habitat, and time of year, but reptiles and amphibians may occur in all habitat types found within the Project's ROI throughout the year. The common reptiles and amphibian species are identified by state in Appendix L.

3.20.1.4.4 Mammals

Because the Project is centrally located in the United States, species from the Rocky Mountains, the Great Plains, the eastern deciduous forests, the Southeastern and Gulf Coastal Plain, and the arid Southwest compose the mammalian fauna potentially present within the Project's ROI in Regions 1 through 7 (Caire et al. 1989; Sealander and Heidt 1990). Within the jurisdictional counties of the four states crossed, 81 common mammal species are known to occur or have the potential to occur within the ROI. Species composition and abundance of mammal species varies by geography, habitat, and time of year, but mammals may occur in the Project's ROI throughout the year. The common mammal species, by state, are summarized in Appendix L.

3.20.1.5 Regional Description

As described in Section 3.20.1.4 above, numerous terrestrial wildlife species are known to occur or have the potential to occur within the ROI. A summary of the terrestrial wildlife species and habitat occurrence by Project region is provided in the sections below.

3.20.1.5.1 Region 1

Region 1 is referred to as the Oklahoma Panhandle Region and includes the Oklahoma Converter Station and AC Interconnection Siting Area, AC collection system routes, the Applicant Proposed Route, and the HVDC Alternative Routes I-A through I-D.

The wildlife species that occur in the Project's ROI are adapted to dry or seasonally dry habitat conditions of the semi-arid eastern Oklahoma Panhandle. As described in Section 3.10, the dominant land cover in the ROI of Region 1 is grasslands (i.e., grassland/herbaceous). Other less dominant land cover types in this region include croplands (i.e., cultivated crops; primarily center-pivot irrigated with some dryland areas), and shrub/scrub. Wetland areas that may be used by wildlife in this region are described in detail in Section 3.19.

As discussed in Section 3.12, wildlife areas that are managed for recreation within Region 1 include the Optima NWR, Optima WMA, and the Schultz WMA.

- Optima NWR is managed as a woody wetland and mixed-grass prairie, containing cottonwoods, big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), and indiangrass (*Sorghastrum nutans*). Wildlife species known to occur at Optima NWR include white-tailed deer, coyotes, Rio Grande wild turkeys (*M.g.intermedia*), quail species, and numerous migratory birds that use the NWR as a stopover location during migration. Optima NWR is located within the ROI for the AC Collection System Route E-1.
- The Optima WMA contains similar habitats as the Optima NWR, and is managed for recreational hunting (see Section 3.12). The following wildlife species are hunted at Optima WMA: pheasant, quail species, white-tailed and mule deer, Rio Grande wild turkey, rabbit species, coyote, bobcat, raccoon, dove species, and numerous waterfowl species. The Optima WMA is not in the ROI for the Project, but is located 3 miles east of the AC Collection System Route NE-2 centerline.
- The Schultz WMA and State Park is managed by the Oklahoma Department of Wildlife Conservation (ODWC 2014). Game species include various species of pheasant, quail, deer, rabbit, and coyote. Habitat at this WMA consists of a mixture of uplands and floodplain habitats, with side oats and buffalo grass common on upland areas and salt cedar and cottonwood dominating the lowlands. The ROIs associated with AC Collection System Routes E-3, SE-1, SE-3, and E-2 would cross the edges of the Schultz WMA and State Park.

Major rivers often serve as stopover habitats or migratory corridors for migrating birds. As discussed in Section 3.15, portions of the Beaver River and its tributaries are located within the ROI for Region 1. This river and its tributaries are within the ROI associated with the HVDC transmission line routes, as well as the ROI for the AC collection system routes.

No route variations were proposed in Region 1.

3.20.1.5.2 Region 2

Region 2 is referred to as the Oklahoma Central Great Plains Region and includes the Applicant Proposed Route as well as Alternative Routes 2-A and 2-B.

The wildlife species that occur in the Project's ROI in Region 2 are adapted to dry or seasonally dry habitat conditions of the semi-arid eastern Oklahoma Panhandle. As described in Section 3.10, the dominant land cover in the ROI of Region 2 is grasslands. Other less dominant land cover types in this region include croplands (primarily center-pivot irrigated with some dryland areas). Wetland areas that may be used by wildlife in this region are described in detail in Section 3.19.

As discussed in Section 3.12, wildlife areas that are managed for recreation within Region 2 include the Major County WMA (which is located within the ROI associated with the HVDC Alternative Route 2-A). Habitat in this WMA consists of mixed grass uplands dissected by deep canyons that support several hardwood tree species including American elm, bur oak, chinquapin oak, Eastern red cedar. Game species known to occur at Major County WMA include northern bobwhite, white-tailed deer, Rio Grande wild turkey, rabbit species, coyote, bobcat, and raccoon.

Major rivers often serve as stopover habitats or migratory corridors for migrating birds. As discussed in Section 3.15, portions of the Cimarron River are located within the ROI for Region 2 (as well as other various creeks/waterbodies). The Cimarron River would be crossed by the Applicant Proposed Route as well as Alternative Route 2-A.

Two route variations to the Applicant Proposed Route were developed in Region 2 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.2. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route. Link 1, Variation 1, as well as Link 2, Variation 2, would cross through similar types of vegetation and habitat compared to the original Applicant Proposed Route.

3.20.1.5.3 Region 3

Region 3 is referred to as the Oklahoma Cross Timbers Region and includes the Applicant Proposed Route and Alternative Routes 3-A through 3-E.

The wildlife species that occur in the ROI in Region 3 are adapted to the semi-arid conditions of northwestern Oklahoma and the mesic conditions of north-central Oklahoma. As described in Section 3.10, the dominant land cover in the ROI is grasslands. Other less dominant land cover types in this region include deciduous forests and pasture/hay. Wetland areas that may potentially be used by wildlife in this region are described in detail in Section 3.19.

As discussed in Section 3.15, portions of the Cimarron River are located within the ROI for Region 3 (as well as various creeks/waterbodies). The Cimarron River would be crossed by the Applicant Proposed Route in Payne County, Oklahoma; the route would also occur close to the Arkansas River (the river is located approximately 0.5 mile north of the Applicant Proposed Route in Muskogee County, Oklahoma, at its nearest point).

Five route variations to the Applicant Proposed Route were developed in Region 3 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.3. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant

Proposed Route. Links 1 and 2, Variation 1; Link 1, Variation 2; Link 4, Variation 1; and Link 5, Variation 2, would cross through similar types of vegetation and habitats compared to the original Applicant Proposed Route. Although forests are found in the ROI for all of these routes (both the route variations and applicable portion of the Applicant Proposed Routes), forested habitats are more common along the following route variations compared to the ROI for the Applicant Proposed Route: Link 1, Variation 2; Link 4, Variation 2; and Link 5, Variation 2. Also, Link 4, Variation 1, would cross through some undeveloped land (which include forested habitats), while the ROI for the original Applicant Proposed Route in this location crosses a quarry operation and would entirely avoid forested habitats.

3.20.1.5.4 Region 4

Region 4 is referred to as the Arkansas River Valley Region and includes the Applicant Proposed Route, including the Lee Creek Variation, and Alternative Routes 4-A through 4-E.

The wildlife species that occur in the ROI of Region 4 are adapted to the mesic conditions of north-central Oklahoma and north-central Arkansas. As described in Section 3.10, the dominant land cover in the ROI is pasture/hay. Other less dominant land cover types in this region include deciduous forest and evergreen forest. As the ROI moves west to east, the percentage of evergreen forests within the ROI increases. Wetland areas that may be used by wildlife in this region are described in detail in Section 3.19.

As discussed in Section 3.12, wildlife areas that are managed for recreation within Region 4 include the Ozark National Forest WMA, Ozark Lake WMA, and Frog Bayou WMA:

- The Ozark National Forest WMA would be crossed by the ROI associated with HVDC Alternative Route 4-B and Applicant Proposed Route Link 9. Habitat within this WMA consists of upland hardwood of oak-hickory with scattered pine and a brushy undergrowth, dominated by such various species of dogwood, maple, redbud, and serviceberry. Game species known to occur at this WMA include white-tailed deer, black bear, quail species, rabbit, squirrel, and crow.
- The Ozark Lake WMA would be crossed by the ROI associated with the Applicant Proposed Route Link 6. The majority of this WMA area consists of moist soil lowlands with a small amount of vegetated uplands. Much of the area is within levees, containing old fields. Game species known to occur at this WMA include white-tailed deer, quail species, rabbit, squirrel, and crow.
- The Frog Bayou WMA would be crossed by the ROI associated with the Applicant Proposed Route Link 6. This WMA was a former farm that has been restored to a wetland habitat. Game species known to occur at this WMA include white-tailed deer, quail species, rabbit, squirrel, and crow.

As discussed in Section 3.15, portions of the Arkansas River and Lower Illinois River are located within the ROI for Region 4 (as well as various creeks/waterbodies).

The ROI associated with the HVDC Alternative Route 4-B crosses the Ozark-St. Francis National Forests. The ROI for the Applicant Proposed Route also crosses the Ozark National Forest Global IBA (as discussed in Section 3.20.1.4.2).

It should be noted that Region 4 also contains the “Lee Creek Variation,” which is a variation of the Applicant Proposed Route. The Lee Creek Variation is 3.4 miles long and none of the route is parallel to existing infrastructure. The land cover in the 200-foot-wide representative ROW is 94.4 percent forest land.

Seven route variations to the Applicant Proposed Route were developed in Region 4 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.4. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route. Link 3, Variation 1; Link 3, Variation 3; Link 6, Variation 1; Link 6, Variation 2; Link 6, Variation 3; and Link 9, Variation 1, would cross through similar types of vegetation and habitats compared to the original Applicant Proposed Route. Applicant Proposed Route Link 3, Variation 2, would parallel almost four times the length of existing infrastructure compared to the original Applicant Proposed Route, and would cross through areas that contain fewer wetland and waterbody features compared to the original Applicant Proposed Route.

3.20.1.5.5 Region 5

Region 5 is referred to as the Central Arkansas Region and includes the Applicant Proposed Route and Alternative Routes 5-A through 5-F.

The wildlife species that occur in the ROI are adapted to the mesic conditions of north-central Arkansas. As described in Section 3.10, the dominant land cover in the ROI is deciduous forest. Other less dominant land cover types in this region include pasture/hay and evergreen forest. As the ROI moves west to east, the percentage of evergreen forests within the ROI increases. Wetland areas that may be used by wildlife are described in detail in Section 3.19.

The Cherokee WMA is located in the ROI associated with the Applicant Proposed Route, Links 2 and 5. Habitat within this WMA varies from upland hardwood, mixed pine/hardwood, to pine habitats. Game species found within this WMA include various species of turkey, deer, bear, quail, rabbit, squirrel, and crow.

Five route variations to the Applicant Proposed Route were developed in Region 5 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.5. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route. Link 1, Variation 2; Link 2, Variation 2; Links 2 and 3, Variation 1; Links 3 and 4, Variation 2; and Link 7, Variation 1, would cross through similar types of vegetation and habitats compared to the original Applicant Proposed Route.

3.20.1.5.6 Region 6

Region 6 is referred to as the Cache River and Crowley’s Ridge Region and includes the Applicant Proposed Route and Alternative Routes 6-A through 6-D.

The wildlife species that occur in the ROI of Region 6 are adapted to the mesic conditions of northeastern Arkansas. As described in Section 3.10, the dominant land cover in the ROI of Region 6 is croplands. Other less dominant land cover types in this region include deciduous forest. Wetland areas that may be used by wildlife are described in detail in Section 3.19.

As discussed in Sections 3.12, wildlife areas that are managed for recreation within Region 5 include the Singer Forest Natural Area/St. Francis Sunken Lands WMA and portions of USFWS acquisition areas associated with the Cache River NWR.

- The Singer Forest Natural Area/St. Francis Sunken Lands WMA is within the ROI associated with the Applicant Proposed Route Link 7. Habitats within this WMA include upland forest and forested wetland habitat. This area is managed for recreationally hunted wildlife species, such as waterfowl, wild turkey, white-tailed deer, quail, rabbit, and squirrel.
- A section of approved acquisition area for the Cache River NWR occurs within the ROI associated with HVDC Alternative Route 6-B near Amagon, Arkansas, and by the ROIs associated with the Applicant Proposed Route Links 3 and 4, and HVDC Alternative Route 6-A north and west of Fisher, Arkansas. The Cache River NWR was specifically designated to provide protection for wetland habitats used by migratory birds as foraging and roosting areas during migration (USFWS 2014). This area contains a large amount of bottomland hardwood forests along the Cache River, White River, and Bayou Deview.

As discussed in Section 3.15, habitats used by wildlife species in Region 6 include sections of the White, Cache, L'Anguille, and St. Francis rivers. The ROI for the HVDC transmission line routes also cross the Cache-Lower White Rivers Global IBA (as discussed in Section 3.20.1.4.2).

One route variation to the Applicant Proposed Route in Region 6 (i.e., Applicant Proposed Route Link 2, Variation 1) was developed in response to public comments on the Draft EIS. This route variation is described in Appendix M and summarized in Section 2.4.2.6. The variation is illustrated in Exhibit 1 of Appendix M. This variation represents a minor adjustment to the Applicant Proposed Route. Link 2, Variation 1, would cross through similar types of vegetation and habitats compared to the original Applicant Proposed Route.

3.20.1.5.7 Region 7

Region 7 is referred to as the Arkansas Mississippi River Delta and Tennessee Region and includes the Applicant Proposed Route and Alternative Routes 7-A through 7-D.

The wildlife species that occur in the ROI are adapted to the mesic conditions of northeastern Arkansas and southwestern Tennessee. As described in Section 3.10, the dominant land cover in the ROI of Region 7 is croplands. Other less dominant land cover types in the region include deciduous forest, scrub/shrub, and pasture/hay. Wetland areas that may be used by wildlife are described in detail in Section 3.19.

As discussed in Section 3.15, portions of the St. Francis, Mississippi, and Loosahatchie rivers are located within the ROI for Region 7 associated with the HVDC transmission line routes.

Three route variations to the Applicant Proposed Route were developed in Region 7 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.7. The variations are illustrated in Exhibit 1 of Appendix M. Link 1, Variation 1; Link 1, Variation 2; and Link 5, Variation 1, would cross through similar types of vegetation and habitats compared to the original Applicant Proposed Route.

3.20.1.6 Connected Actions

3.20.1.6.1 Wind Energy Generation

Wind energy generation would likely occur within WDZs. The wildlife species that occur in WDZ-A, WDZ-B, WDZ-C, and WDZ-L are adapted to dry or seasonally dry habitat conditions of the semi-arid eastern Texas Panhandle. The wildlife species that occur in WDZ–D, WDZ-E, WDZ-F, WDZ-G, WDZ-H, WDZ-I, WDZ-J, and WDZ-K are adapted to dry or seasonally dry habitat conditions of the semi-arid eastern Oklahoma Panhandle. As described in Section 3.10, the dominant land cover in WDZ-A, WDZ–B, WDZ–E, WDZ–I, WDZ–K, and WDZ–L is croplands (primarily center-pivot irrigated with some dryland areas), while the dominant land cover in WDZ-C, WDZ-D, WDZ-F, WDZ-G, WDZ-H, and WDZ-J is grasslands. Other less dominant land cover types in WDZ-A, WDZ-B, WDZ-E, WDZ-I, WDZ-K, and WDZ-L include grasslands, and shrub/scrub, while less dominant land cover types in WDZ-C, WDZ-D, WDZ-F, WDZ-G, WDZ-H, and WDZ-J include croplands (primarily center-pivot irrigated with some dryland areas) and shrub/scrub habitats. Wetland habitats that may be used by wildlife in these areas are described in detail in Section 3.19.

3.20.1.6.2 Optima Substation

As discussed in Section 3.1, the future Optima Substation may be constructed just east of the Oklahoma Converter Station Siting Area and partially within the AC Interconnection Siting Area in Region 1. The location for the substation occurs on grassland habitats adjacent to croplands. The wildlife species that occur in this area are adapted to dry or seasonally dry habitat conditions of the semi-arid eastern Texas/Oklahoma Panhandle.

3.20.1.6.3 TVA Upgrades

The ROI for the direct assignment facilities (which are included in the Applicant Proposed Project) would occur within the Tennessee Converter Station Siting Area and more specifically within the Shelby Substation. The ROI for the network upgrades, and in particular TVA's future 500kV transmission line, cannot be fully determined at this time. The new transmission line would be constructed in western Tennessee. The upgrades to existing facilities would mostly be in western and central Tennessee. Upgrades to existing infrastructure would include upgrading terminal equipment at three existing 500kV substations and six existing 161kV substations; making appropriate upgrades to increase heights on 16 existing 161kV transmission lines to increase line ratings, and replacing the conductors on eight existing 161kV transmission lines. Where possible, general impacts associated with the required TVA upgrades are discussed in the impact sections that follow.

3.20.1.7 Impacts to Wildlife

3.20.1.7.1 Methodology

Within the ROI, Project activities were assessed that could potentially impact wildlife or their habitats. This wildlife assessment references the quantitative assessment of habitat impacts presented in Sections 3.10 and 3.17 (i.e., acres of disturbance listed in the Land Use and Vegetation sections, respectively), as well as the quantitative assessment of potential impacts to waterbodies as presented in Section 3.15 (i.e., waterbody crossings and impacts listed in the Surface Water section).

Wildlife resources that were evaluated in this assessment included important recreational species, migratory birds, reptiles, amphibians, and mammal species that are known to occur or have the potential to occur within the applicable ROI. The impact assessment addressed the following:

- Potential impacts from temporary or long-term displacement of wildlife species
- Potential impacts from fragmentation of wildlife habitat
- Potential disturbance to known populations and/or suitable habitat for wildlife species
- Potential impacts to wildlife movement, migratory birds and flyways (including the Mississippi Flyway, Audubon-designated IBAs, or other federal or state designated bird areas)
- Potential for avian collisions and/or electrocution
- Potential impacts of invasive plant species on wildlife habitats

The Applicant has developed EPMs that would be implemented during design/engineering, construction, and operations and maintenance. The complete list of EPMs is provided in Appendix F. Implementation of these EPMs is assumed throughout the impact analysis for the Project. During the initial construction phase of the Project, both general EPMs and those specific to wildlife resources would be implemented to avoid or minimize impacts to wildlife resources (as described below).

General EPMs for the Project that relate to wildlife resources include the following:

- GE-1: Clean Line will train personnel on health, safety, and environmental matters. Training will include practices, techniques, and protocols required by federal and state regulations and applicable permits.
- GE-2: Clean Line will design, construct, maintain, and operate the Project following current Avian and Power Line Interaction Committee guidelines to minimize risk of avian mortality.
- GE-3: Clean Line will minimize clearing vegetation within the ROW, consistent with a Transmission Vegetation Management Plan (TVMP) filed with NERC, and applicable federal, state, and local regulations. The TVMP may require additional analysis under NEPA depending on whether and under what conditions DOE decides to participate in the Project.
- GE-4: Vegetation removed during clearing will be disposed of according to federal, state, and local regulations.
- GE-5: Any herbicides used during construction and operations and maintenance will be applied according to label instructions and any federal, state, and local regulations.
- GE-6: Clean Line will restrict vehicular travel to the ROW and other established areas within the construction, access, or maintenance easement(s).
- GE-7: Roads not otherwise needed for maintenance and operations will be restored to preconstruction conditions. Restoration practices may include decompacting, recontouring, and re-seeding. Roads needed for maintenance and operations will be retained.
- GE-9: Clean Line will avoid and/or minimize damage to drainage features and other improvements such as ditches, culverts, levees, tiles, and terraces; however, if these features or improvements are inadvertently damaged, they will be repaired and or restored.
- GE-10: Clean Line will work with landowners to repair damage caused by construction, operation, or maintenance activities of the Project. Repairs will take place in a timely manner, weather and landowner permitting.
- GE-11: Clean Line will conduct construction, operation, and maintenance activities to minimize the creation of dust. This may include measures such as limitations on equipment, speed, and/or travel routes utilized. Water, dust palliative, gravel, combinations of these, or similar control measures may be used. Clean Line will implement measures to minimize the transfer of mud onto public roads.
- GE-13: Emergency and spill response equipment will be kept on hand during construction.

- GE-14: Clean Line will restrict the refueling and maintenance of vehicles and the storage of fuels and hazardous chemicals within at least 100 feet from wetlands, surface waterbodies, and groundwater wells, or as otherwise required by federal, state, or local regulations.
- GE-15: Waste generated during construction or maintenance, including solid waste, petroleum waste, and any potentially hazardous materials will be removed and taken to an authorized disposal facility.
- GE-20: Clean Line will conduct construction and scheduled maintenance activities on the facilities during daylight hours, except in rare circumstances that may include, for example, to address emergency or unsafe situations, to avoid adverse environmental effects, to minimize traffic disruptions, or to comply with regulatory or permit requirements.
- GE-21: Clean Line will maintain construction equipment in good working order. Equipment and vehicles that show excessive emissions of exhaust gases and particulates due to poor engine adjustments or other inefficient operating conditions will be repaired or adjusted.
- GE-22: Clean Line will impose speed limits during construction for access roads (e.g., to reduce dust emissions, for safety reasons, and for protection of wildlife).
- GE-25: Clean Line will turn off idling equipment when not in use.
- GE-27: Clean Line will minimize compaction of soils and rutting through appropriate use of construction equipment (e.g., low ground pressure equipment and temporary equipment mats).
- GE-28: Hazardous materials and chemicals will be transported, stored, and disposed of according to federal, state, or local regulations or permit requirements.
- GE-30: Clean Line will minimize the amount of time that any excavations remain open.

Fish, vegetation, and wildlife specific EPMs, or other EPMs that may aid to minimize or avoid impacts to fish and wildlife species, include the following:

- FVW-1: Clean Line will identify environmentally sensitive vegetation (e.g., wetlands, protected plant species, riparian areas, large contiguous tracts of native prairie) and avoid and/or minimize impacts to these areas.
- FVW-2: Clean Line will identify and implement measures to control and minimize the spread of non-native invasive species and noxious weeds.
- FVW-3: Clean Line will clearly demarcate boundaries of environmentally sensitive areas during construction to increase visibility to construction crews.
- FVW-4: If construction- and/or decommissioning-related activities occur during the migratory bird breeding season, Clean Line will work with USFWS to identify migratory species of concern and conduct pre-construction surveys for active nests for such species. Clean Line will consult with USFWS and/or other resource agencies for guidance on seasonal and/or spatial restrictions designed to avoid and/or minimize adverse effects.
- FVW-5: If construction occurs during important time periods (e.g., breeding, migration, etc.) or at close distances to environmentally sensitive areas with vegetation, wildlife, or aquatic resources, Clean Line will consult with USFWS and/or other resource agencies for guidance on seasonal and/or spatial restrictions designed to avoid and/or minimize adverse effects.
- FVW-6: Clean Line will avoid and/or minimize construction within 300 feet of caves known to be occupied by threatened or endangered species.
- W-2: Clean Line will identify, avoid, and/or minimize adverse effects to wetlands and waterbodies. Clean Line will not place structure foundations within the Ordinary High Water Mark of Waters of the United States.

- W-3: Clean Line will establish streamside management zones within 50 feet of both sides of intermittent and perennial streams and along margins of bodies of open water where removal of low-lying vegetation is minimized.
- W-4: If used, Clean Line will selectively apply herbicides within streamside management zones.
- W-5: Clean Line will construct access roads to minimize disruption of natural drainage patterns including perennial, intermittent, and ephemeral streams.
- W-6: Clean Line will not construct counterpoise or fiber optic cable trenches across waterbodies.
- W-7: Clean Line will locate spoil piles from foundation excavations and fiber optic cable trenches outside of streamside management zones.
- W-8: Dewatering will be conducted in a manner designed to prevent soil erosion (e.g., through discharge of water to vegetated areas and/or the use of flow control devices).
- W-9: Clean Line will design converter station sites to avoid adverse changes to the base flood elevation within the 100-year floodplain.
- W-10: Clean Line will minimize fill for access roads and structure foundations within 100-year floodplains to avoid adverse changes to the base flood elevation.

Additional site-specific EPMs may be developed as part of the ongoing consultation process between the Applicant and federal and state agencies.

The following plans would be developed and implemented by the Applicant to avoid or minimize impacts:

- Blasting Plan: This plan will contain measures designed to minimize adverse effects due to blasting.
- Restoration Plan: This plan will describe post-construction activities that would be implemented to reclaim disturbed areas.
- Spill Prevention, Control and Countermeasures (SPCC) Plan: This plan will contain the measures designed to prevent, control, and clean up spills of hazardous materials.
- Storm Water Pollution Prevention Plan (SWPPP): This plan, consistent with federal and state regulations, will describe the practices, measures, and monitoring programs to control sedimentation, erosion, and runoff from disturbed areas.
- Transmission Vegetation Management Plan (TVMP): This plan, to be filed with NERC, will describe how the Applicant will conduct work on its right-of-way to prevent outages due to vegetation. The TVMP may require additional analysis under NEPA depending on whether and under what conditions DOE decides to participate in the Project.
- Avian Protection Plan (APP): This plan, consistent with APLIC guidelines, will describe a program of specific and comprehensive actions that, when implemented, reduce risk of avian mortality. The Applicant would develop the APP in coordination with the USFWS and other applicable agencies.

3.20.1.7.2 Impacts Associated with the Applicant Proposed Project

This section identifies the potential impacts on wildlife and their habitat that could occur as a result of the Project. The discussion of potential impacts is broken out into the three phases of the Project: (1) construction; (2) operations and maintenance; and (3) decommissioning. The Applicant would conduct each phase of the Project in compliance with applicable state and federal laws, regulations, and permits related to environmental protection. Specific EPMs developed to avoid or minimize impacts are described in Section 3.20.1.7.1.

The impacts discussed in the subsections below are common to all aspects of the Project, while the impacts associated with specific portions of the Project (e.g., converter stations, AC collection system, HVDC routes, as well as their alternatives) are discussed separately following this general impact discussion. Both direct (i.e., impacts that result from the action and occur at the same time and place as the action) and indirect impacts (i.e., impacts that result from the action, but which occur later in time or farther in distance) are addressed. The impacts that could result from activities related to the Project would vary in duration. Some impacts would be temporary, with the resource returning to pre-disturbance conditions after the Project-related disturbance has ceased. Temporary impacts can be further defined as either short-term or long-term impacts. Short-term impacts could continue beyond the completion of construction and could last up to 5 years. Long-term impacts would last beyond 5 years (e.g., these impacts often relate to affected resources such as forests that require long recovery periods to return to pre-disturbance conditions), and may last for the duration of the Project life (i.e., 80 years). Permanent impacts result from activities that modify a resource to such an extent that it cannot return to pre-disturbance conditions even after the Project-related disturbance has ceased.

Construction Impacts

Mortality and Injury. Mortality, by definition, would constitute a permanent impact to an individual (i.e., the individual no longer exists); however, the magnitude of effect related to a single mortality on an entire wildlife population (i.e., the effects that a single mortality has to the entire group) can vary depending on the dynamics of the population. Small populations or those that have a low fecundity can be sensitive to individual mortalities (e.g., the death of a single Florida panther can have a major impact to the success rate of the entire population due to the low population number and slow reproduction rate of this species as described in Section 3.14). However, large and/or healthy populations are often less sensitive to the loss of an individual. In general, many small mammals, small birds, and amphibians (i.e., species that typically have a high birth rate and large population sizes) are less sensitive to individual mortality events compared to large mammals and large birds (e.g., raptors). Bats are an exception to this generality though, because although bats are small mammals, they typically bear only a single litter per year, produce one young at a time, and do not breed until their second year (Nagorsen and Brigham 1993).

Construction of the Project could result in the direct mortality or injury of wildlife species. Of the construction activities proposed, the clearing of vegetation and preparation of work sites would pose the greatest risk of injuring or killing wildlife. Although some individuals would move away from construction activities given the disruptive nature of these activities (see further discussion of wildlife disturbances in the "Disturbance" subsection below), some individuals would either attempt to hide within the path of disturbance (e.g., small mammals or reptiles may attempt to burrow underground or remain motionless within the vegetation during clearing) or would be unable to relocate away from the disturbed area (e.g., eggs and some juvenile birds would be killed if clearing was conducted during the breeding season). These mortalities/injuries can be minimized by timing the construction activities to avoid sensitive periods (e.g., the breeding seasons), and the Applicant has agreed to consult with the USFWS regarding the appropriate seasonal and/or spatial restrictions that should be applied (see EPM FVW-5); however, some mortality events would still occur even with the implementation of seasonal and spatial restrictions. Based on their life-histories, avian species and small mammals would likely constitute a large component of wildlife injuries and/or mortalities if construction was conducted during the breeding season. Large mammals would likely constitute a low component of wildlife injuries and/or mortalities that are a direct result of vegetation clearing, regardless of the timing of construction (e.g., Project-related large mammal injuries/mortalities would likely result from factors not directly related to vegetation clearing; see further discussion below).

Use of heavy equipment and vehicles during construction of the Project could result in additional wildlife injuries or mortalities (beyond those resulting from vegetation clearing) as wildlife can be struck or run over by vehicles. The likelihood of striking or running over wildlife increases if construction occurs during the night when visibility is limited, or if vehicles are operated at high speeds. In order to minimize this risk, the applicant would implement EPMs GE-6, GE-20, and GE-22.

Wildlife species can become sick or die if they are exposed to hazardous chemicals such as those that would be used during construction of the Project (e.g., oils and fuels that would be used while operating machinery, or herbicides that would be used to control vegetation and invasive species). Illness and/or mortality can result from direct contact with the toxin, or if the species is indirectly exposed through the food web. Improper use of these chemicals as well as accidental spills can expose wildlife to these chemicals; however, the Applicant would implement EPMs GE-1, GE-5, GE-13, GE-21, and GE-28, as well as the measures that would be outlined in the required SPCCP and SWPPP to minimize these risks. These EPMs include measures that would reduce the risks of accidental spills (e.g., GE-13, GE-21, GE-28), as well as measures that would ensure that the use of herbicides is conducted in accordance with labeled instructions and any federal, state, and local regulations (i.e., GE-5). In addition, a TVMP would be prepared and would address situations where herbicide use is necessary (e.g., the Applicant would evaluate herbicidal treatment options in consideration of site-specific ecological conditions, surrounding and underlying land uses, and any environmental sensitivities before selecting and applying a control). The Vegetation Program and TVMP would be developed to comply with federal, state, and local regulations and standards for reliability and ROW vegetation clearing and maintenance, including NERC Reliability Standard FAC-003 (NERC 2011). The Vegetation Program and TVMP would also comply with relevant regulations applicable to all lands, including, but not limited to the Clean Water Act (CWA) Sections 303(d) and 404 and the Endangered Species Act (ESA) of 1973 as amended in Section 7(a)(2). See Section 3.17 for a detailed discussion of the Vegetation Program and use of herbicides. The TVMP may require additional analysis under NEPA depending on whether and under what conditions DOE decides to participate in the Project.

Construction of the Project could result in the ignition of wildfires. For example, the hot undercarriage of construction vehicles can ignite the grasses found along access roads (see Section 3.8 for more details regarding fire risk). Although many wildlife species are adapted to dealing with fire to some degree (e.g., small mammals and reptiles may burrow underground, while birds and large mammals would move away from the affected area), wildfires could still result in some wildlife mortalities (especially for less mobile species or individuals or in habitats and regions not typically exposed to fire) (Smith 2000).

The Project's construction has the potential to increase the numbers of predators in the immediate area, due to the presence of trash in the work area. Trash created by construction personnel can attract predators like crows and raccoons (*Procyon lotor*). This would be a short-term impact that would end with the removal of the trash source. The Applicant would minimize the risk of attracting predators to the area through the implementation of EPM GE-15.

Concern has been expressed by the public that bats may collide with construction equipment during construction of the Project. This sort of collision is unlikely to occur as construction equipment would typically be present in the construction area during daylight hours when bats are not active (however, see further discussion below regarding the possibility of construction occurring at night). Furthermore, bats are capable of avoiding stationary structures via the use of echolocation, so they would likely be able to avoid any Project-related stationary structures that may be present at night; however, bats may collide with and be killed by the turbines found at the associated wind-farms during operation of the Project (see further discussion in the “Impacts from Connected Actions” section below). The greatest risk to bat species during construction of the Project is the potential clearing of trees that are used by bats for roosting habitats (resulting in direct mortality), or the potential disturbance of bats in hibernacula (see the discussion below in the “Disturbance” subsection).

Disturbance. The increased presence of humans as well as the noise and vibrations associated with construction activities could disturb wildlife in the vicinity of the Project. Disturbances associated with elevated noise levels would likely have a farther reaching affect compared to visual disturbances (i.e., depending on limited sight lines due to topography and/or visual screening, noise can potentially affect areas beyond the visual range of an individual). As discussed in Section 3.11, construction noise is typically made up of intermittent peaks and continuous lower levels of noise from equipment cycling through use. Noise levels associated with individual pieces of equipment would generally range between 55 and 85 dBA L_{max} (see Section 3.11). Maximum instantaneous construction noise levels could be as high as 95 dBA L_{eq} at 50 feet from any work site. Table 3.11-4 in Section 3.11 provides noise level data for Project-related construction activities.

The responses of wildlife to disturbances may include temporary habitat displacement or avoidance of the area, stress, and disorientation. This could have negative impacts by causing animals to move to less suitable areas, which could result in less available or lower quality forage, loss of access to preferred nesting/breeding sites, increased exposure to predation, and increased energy expenditure. Individual stress, habitat displacement, and avoidance association with disturbance can take time away from life history activities, including feeding, reproduction, and parental care resulting in a reduction of overall fitness. The resulting adverse impacts to adults would be expected to be temporary and short-term, occurring during active construction hours and ceasing after construction activities have moved from a given area (unless the habitat is degraded below its ability to support the species; see further discussion below). However, if adults abandon their young due to these disturbances (e.g., if the adult birds abandoned their nests), these disturbances could result in the death of young (see the “Mortality and Injury” subsection above).

The Applicant has indicated that they would conduct all construction activities during daylight hours to the extent practical (see EPM GE-20); however, EPM GE-20 indicates that nighttime construction may be required under certain conditions (e.g., to address emergency or unsafe situations). Wildlife would likely be more sensitive to disturbance during nighttime hours because natural background noise levels are typically lower at night compared to daylight hours (i.e., there would be a larger difference between background noise levels and construction noise at night, resulting in a greater disturbance affect to wildlife if work occurs at night). Furthermore, artificial lighting would be required to safely work at night. Migrating avian species could be attracted to the work areas during the night due to this artificial lighting, thereby exposing these species to increased risks of disturbance or injury. The artificial lighting could also attract insects to the area resulting in exposure of bat species (which feed on insects) to increased risks of disturbance or injury. Artificial lighting could also disrupt natural wildlife processes such as foraging, reproduction, and communication within areas that are artificially lit during nighttime construction.

All wildlife taxa have the potential for habitat displacement and avoidance due to Project-related disturbance. Many bat and bird species are highly sensitivity to disturbances, because disturbed birds may abandon their young (resulting in the death of the young), while roosting bats that are disturbed during the day may abandon hibernaculum thereby expending critical and limited energy resources (potentially resulting in the death of the bat). Big game species (i.e., large mammals) can also be sensitive to disturbance. For example, displacement of big game from both winter and parturition (birthing) areas could affect over-winter survival by causing animals to mobilize stored bodily energy reserves that are needed to survive seasons when food is scarce. This could also impact reproductive success on parturition ranges if females are sufficiently disturbed so as to not provide adequate care for their young.

Habitat Loss and Modification. Construction of the Project would result in the loss or modification of wildlife habitat. Affected habitats may be temporarily lost to wildlife during the construction phase of the Project (e.g., wildlife may not use these habitats during construction due to disturbance from construction activities), but use of the habitat could be restored once construction disturbances cease in the area and the habitat is restored. However, areas that are occupied by permanent Project features (e.g., towers, substations, etc.) would be permanently lost to wildlife. The Project would also convert some habitats from one type to another. For example, trees and tall shrubs would be cleared within the Project's ROW to prevent this tall vegetation from interfering with or damaging the Project's transmission line (see Section 3.17). Clearing the ROW would convert forested and riparian areas to a grassland and low shrub habitat type; subsequent vegetation management, as described below, would maintain these grassland and low shrub habitat types, resulting in a long-term impact. Conversion of habitats from one type to another could alter the composition of wildlife found within the affected habitat (e.g., shifting from an interior forested wildlife community to a grassland or forest-edge community within the affected area). It should be noted that the entire ROW would be cleared in forested habitats, but not in low vegetation types such as grasslands or croplands (where only areas needed for construction would be cleared as described in Section 3.17). As a result, the acreage of cleared land per mile of Project would be greatest in forested habitats compared to other habitats that contain only low vegetation types.

The amount of time necessary for temporarily impacted habitats to restore to pre-construction conditions would depend on the type and structure of the affected habitat. Grasslands and croplands would be capable of restoring to pre-disturbance levels in a short timeframe (defined as less than 5 years). As a result, impacts could be short-term within the grasslands and croplands habitats that are allowed to restore to pre-construction conditions following completion of construction (i.e., areas not encompassed by the footprint of the converter station, transmission line structures, access roads, etc.). However, forested and riparian areas can take many decades to restore to pre-disturbance conditions; as a result, habitat loss would have a long-term impact in forested and riparian areas (even for those forested and riparian areas that are allowed to restore to pre-construction conditions).

The Project could indirectly impact wildlife by decreasing habitat quality through habitat fragmentation. Although fragmentation of habitats would begin during construction, the majority of fragmentation related impacts would occur after construction; therefore, fragmentation is discussed below, under the "Operations and Maintenance Impacts" subheading.

The clearing of vegetation and disturbance to soils could promote the spread and or establishment of invasive plant species. Invasive plant species can reduce the quality of habitats for wildlife by competing with native plants for resources such as water and light, changing the community composition, eliminating or reducing native plants, or changing the vegetation structure. All habitat types are susceptible to establishment or invasion by invasive plant species. The Applicant would implement EPM FVW-2 to minimize the risk of spreading or creating new infestations of invasive plant species. Section 3.17 discusses in detail the potential effects of invasive plants species on native habitats, as well as the measures that would be taken to minimize the risk of these effects. The subsection "Mortality and Injury" above and Section 3.17 discuss the use of herbicides to control invasive plant species as well as the potential effects of this herbicide use on wildlife.

Operations and Maintenance Impacts

The direct and indirect effects on wildlife resources (e.g., mortality and/or injury, disturbance, habitat loss and/or modification) that would occur during the operations and maintenance phase of the Project would generally result from the presence of permanent Project structures, the presence of maintenance personnel and equipment in the area, and vegetation reclamation and maintenance activities that would be conducted. However, the magnitude of these effects would generally be less than what was described above for construction related impacts due to the periodic nature of the required maintenance and reclamation work (see Section 2.1.5 for a detailed description of the estimated operations and maintenance schedule).

Fragmentation refers to the breaking up of contiguous areas of vegetation or habitat into smaller patches. Many wildlife species require contiguous patches of suitable habitat of certain size and connectivity to carry out life functions such as foraging, finding a mate, and the dispersal of young to adjacent suitable habitat areas. For some species, the generally 14 to 16-foot-wide access roads associated with the Project (as well as the cleared ROW in forested and riparian areas) could serve as a barrier to movement, thereby isolating subpopulations and increasing the risk of local extirpation (this would be predominantly experienced by smaller species or those less likely to move through open areas that are either devoid of vegetation or contain modified vegetation). Although the Project may not serve as a barrier to movement for all species (e.g., the presence of access roads, the ROW, or the transmission line itself would not likely limit the movement of large mammals), roads can reduce habitat quality by promoting the spread or establishment of invasive plant species (discussed in detail above).

In addition, the presence of the transmission line itself could exclude some species from areas adjacent to the line or increase predation rates near the line, thereby contributing to the effect and magnitude of habitat fragmentation for some prey species. This is because the presence of the suspended powerline could become an attractant to raptors and ravens/crows for nesting and perching habitats. The numbers of ravens and crows that use existing transmission lines for perching habitat can become quite substantial (Engel et al. 1992), and the potential increase in raptor and raven/crows numbers along the Project could result in an increase in harassment and predation rates on prey species (e.g., small mammals or prey bird species) that are present at or adjacent to the Project (Stahlecker 1978; Steenhof et al. 1993; Manzer and Hannon 2005; Coates and Delehanty 2010). The effect of increased raptor and raven/crow predation rates on prey species would be most prominent where the Project is located in areas that do not contain other tall structures, such as existing transmission lines or trees. Fragmentation and the creation of a cleared ROW in forested and woodland habitats could also facilitate the movement and improve hunting efficiency for some mammalian predators. In forests, for example, coyotes are most abundant in areas of disturbance (Kays et al. 2008). They are also known to travel extensive distances on linear pathways, including transmission line ROWs (Way and Eatough 2006).

In addition to the general effects of fragmentation discussed above, forested and riparian habitats could experience a substantial edge effect. Edge effects result when two different types of habitat are adjacent to each other. Edge effects tend to be more pronounced with increasing differences in the structure, height, density, or complexity of the two adjacent habitat types (e.g., a mature forest adjacent to a grassland). A variety of impacts are associated with edge effects. For example, edge effects can affect wildlife and habitat quality by altering nutrient flows/cycling; increasing the rate of invasion by noxious weeds, invasive wildlife species, and pathogens; lowering the carrying capacity of a habitat/patch; and disrupting meta-population dynamics[1] (Saunders and Hobbs 1991). The creation of habitat edges within forests can impact microclimatic factors such as wind, humidity, and light, and can lead to a change in plant or animal species composition within the adjacent habitat (Murcia 1995). Compared to the interior of a forest, areas near edges receive more direct solar radiation during the day, lose more long-wave radiation at night, have lower humidity, and receive less short-wave radiation. Increased solar radiation and wind can desiccate vegetation by increasing evapotranspiration, can affect which plant species survive along the edge (typically favoring shade-intolerant species), and can impact soil characteristics; all of these factors can alter the composition of wildlife habitats and the species that inhabit them.

The impacts of fragmentation and edge effects do not affect all habitats, taxa, and species equally. Some species will avoid edge habitats, while others species preferentially select edge habitats. For example, crows, blue jays, raccoons, and brown-headed cowbirds are often associated with edge habitats (Masters et al. 2002). Edge habitats provide these species with a diversity of cover types and foraging/feeding opportunities. The creation of edge habitats by the Project in forested areas (primarily in Regions 4 and 5; as well as Regions 3 and 7 to a lesser extent) could result in the numbers of species that prefer edge habitats to increase along the ROW, while decreasing the number of species that prefer dense, continuous, unfragmented habitats. Also, the potential increase in brown-headed cowbirds could adversely affect other avian species in the areas, because this species parasitizes the nests of other birds (Lowther 1993). Fragmentation and edge effects can also affect grassland and other non-forested habitats as well. For example, the increased predation rates experienced along the Project (due to the consolidation of raptors and ravens/crows along the lines) could result in the fragmentation of grassland and other low-vegetation habitats crossed by the Project (see discussion above).

Some avian mortality may occur as a result of collisions with the transmission lines and Project features during operations (CEC 2005). A variety of factors influence the rate of avian collisions with powerlines or other anthropogenic features, including: configuration and location of powerlines; the tendency of certain species to collide with structures; and environmental factors such as weather, topography, and habitat (APLIC and USFWS 2005). Line placement with respect to other structures and topography can influence the collision rate of avian species at a given powerline. Collisions usually occur near water or migration corridors, and occur more often during inclement weather. Less agile birds, such as heavy-bodied birds or birds that travel in flocks, are more likely to collide with overhead lines because they lack the ability to quickly negotiate obstacles. As discussed in Section 3.20.1.5, rivers/waterbodies often serve as stopover habitats or migratory corridors for migrating birds. As a result, the highest rate of Project-related avian species mortalities due to collisions are likely to occur in areas where the transmission line spans waterbodies (Tables 3.15-4, 3.15-5, 3.15-8, 3.15-12, 3.15-16, 3.15-20, 3.15-24, and 3.15-28 provide a list the waterbodies that could potentially be crossed by the Project). As a result, points where the Project spans major rivers (such as the Mississippi or Cache rivers) could become areas along the line where increased rates of collisions and mortality occur (compared to other areas along the line). Furthermore, structures that use guys (i.e., thin wires that hold tall towers stable) have been found to be associated with higher avian mortality than un-guyed structures. The Applicant has proposed to use guyed structures in some circumstances (see Chapter 2). As a result, the guyed structures used for this Project would likely have higher rates of associated avian mortality compared to the un-guyed structures. To minimize the risk of avian collisions and mortalities, the Applicant would develop and implement an

[1] Meta-population dynamics refers to the interplay between source and sink populations. Meta-population dynamics are an important factor in gene flow between populations, and disruptions to this dynamic can alter or disconnect sub-populations.

APP (as described in Section 3.20.1.7.1) consistent with APLIC guidelines. The APP would be developed in coordination with the USFWS and other applicable agencies.

Avian species are also susceptible to electrocutions as a result of powerlines. In order for a bird to become electrocuted it needs to come into contact with two energized conductors at the same time. As a result, multiple factors influence the risk of avian electrocutions including: the spacing between energized conductors, the tendency of a species to perch along powerlines or fly near conductors, as well as the avian species body-size and wing-length. Of the avian species in the area, raptors have the highest likelihood of becoming electrocuted because raptors commonly perch along transmission lines and have relatively large bodies compared to other taxa of birds. Ravens/crows (which also perch on powerlines) and waterbirds (which do not typically perch on powerlines, but can have large wingspans and can potentially come into contact with two energized conductors if they fly close to the power-lines) are also at risk of electrocutions. As described in Appendix F, the spacing for the conductors as currently proposed would minimize the risk of avian species coming into contact with two energized conductors and/or becoming electrocuted. To further minimize the risk of avian electrocutions, the Applicant would develop and implement an APP (as described in Section 3.20.1.7.1) consistent with APLIC guidelines (see the APP discussion above).

Decommissioning Impacts

Decommissioning of the Project would involve methods similar to those that would be required to construct the Project. As a result, the impacts of decommissioning would be similar to those previously described for construction. The Applicant would follow the same general and resource-specific EPMs during decommissioning that would be implemented during construction. In addition, the Applicant would develop a Decommissioning Plan prior to any decommissioning actions for review and approval by the appropriate state and federal agencies.

Although decommissioning would have short-term adverse impacts to wildlife (similar to what was discussed for construction related impacts), it is assumed that decommissioning of the Project would generally have long-term beneficial impacts to wildlife species and their habitats because it would remove the Project and its related impacts from the environment. However, areas disturbed by the decommissioning activities would still take time to recover from this disturbance (with disturbances in grasslands and croplands likely recovering within 5 years or less, and recovery in forests taking many decades). Also, any wildlife that used the Project features during its operation (e.g., raptors that may perch along the line) may experience an adverse impact when the Project is decommissioned (e.g., loss of perching habitat for raptors).

3.20.1.7.2.1 Converter Stations and AC Interconnection Siting Areas

3.20.1.7.2.1.1 Construction Impacts

3.20.1.7.2.1.1.1 Oklahoma Converter Station Siting Area and AC Interconnection Siting Area

The Oklahoma Converter Station and AC Interconnection Sitting Areas are located within Region 1. As discussed in Sections 3.10 and 3.17, grasslands and croplands are the dominant habitat types found at the proposed site for the Oklahoma converter station and AC interconnection. As a result, the wildlife species that would be exposed to Project-related mortality or injury in this area would be those species that inhabit these types of habitats, i.e., those adapted to dry or seasonally dry habitat conditions of the semi-arid eastern Oklahoma Panhandle. Appendix L lists the wildlife species that inhabit this area and could be impacted by the Project.

Grasslands and croplands are capable of restoring to pre-disturbance levels in a short timeframe (defined as less than 5 years). As a result, the majority of Project-related impacts to grasslands and croplands habitats in Region 1 would be short term in nature (i.e., these areas would likely restore to pre-construction conditions within 5 years or less). However, some permanent loss of grassland and croplands habitats would also occur as a result of the Project's permanent footprint (i.e., some areas would be encompassed permanently by Project structures such as the converter station, transmission line structures, access roads, etc.). Sections 3.10 and 3.17 list the types of habitats that could be affected and the acres that could be impacted by the Oklahoma converter station and AC interconnection.

As currently proposed, the Oklahoma converter station and AC interconnection would be sited within and impact grassland and croplands habitats. Furthermore, the habitats found within Region 1 are relatively common throughout the ROI (i.e., grasslands and croplands dominate the entire area with very few other habitat types present); therefore, potential modifications to the location of the converter station or the route of the AC interconnection within the ROI in Region 1 would not likely substantially alter the types or magnitude of impacts that would occur to wildlife species or their habitats in this area.

3.20.1.7.2.1.1.2 Tennessee Converter Station Siting Area and AC Interconnection Tie

The Tennessee Converter Station Siting Area and AC Interconnection Tie are located within Region 7. The AC Transmission Interconnection Tie would occur entirely within the existing Shelby substation. As discussed in Sections 3.10 and 3.17, croplands and pasture lands are the dominant habitat types found at the proposed site for the Tennessee Converter Station Siting Area; however, hardwood forests and riparian areas are also present within the ROI for the Tennessee Converter Station Siting Area. As a result, the wildlife species that would be exposed to Project-related mortality or injury in this area would be those species that inhabit these types of habitats. This includes those adapted to the mesic conditions of northeastern Arkansas and southwestern Tennessee. Tables in Appendix L list the wildlife species that inhabit this area and could be impacted by the Project.

Croplands and pasture lands are capable of restoring to pre-disturbance levels in a short timeframe (defined as less than 5 years). As a result, the majority of Project-related impacts to these areas in Region 7 would be short-term in nature (i.e., these areas would likely restore to pre-construction conditions within 5 years or less). However, some permanent loss of habitats would still occur as a result of the Project's permanent footprint (i.e., some areas would be encompassed permanently by Project structures such as the converter station, access roads, etc.). Furthermore, because forests and riparian areas are also present with the ROI for the Tennessee Converter Station Siting Area, these types of habitats could also be potentially impacted as well. As previously discussed, forested and riparian areas could take decades to restore to pre-construction conditions if they are disturbed or cleared (i.e., impacts would be long-term in these habitat types). Sections 3.10 and 3.17 list the types of habitats that could be affected and the acres that could be impacted by construction of the Tennessee converter station.

As discussed above, impacts to wildlife would likely be less if the converter station were located within the crop and pasture lands, and would be greater if they were located in forested areas due to the effects of long-term habitat loss, the extensive time necessary for forests to regenerate to pre-disturbance conditions, and the impacts associated with edge effects in forested habitats.

3.20.1.7.2.1.2 Operations and Maintenance Impacts

3.20.1.7.2.1.2.1 Oklahoma Converter Station Siting Area and AC Interconnection Siting Area

Operation and maintenance activities would result in long-term impacts to the habitats around the converter station and AC Interconnection siting area (see Section 3.20.1.7.2 for a detailed discussion of potential impacts related to wildlife disturbance and habitat disruption). Furthermore, as discussed above, some permanent loss of habitat would occur as a result of the Project's permanent footprint (i.e., some areas would be encompassed permanently by Project structures such as the converter station, transmission line structures, access roads, etc.). Sections 3.10 and 3.17 list the types of habitats that could be affected and the acres that would be permanently impacted by the Oklahoma converter station and AC interconnection during operations and maintenance.

The permanent loss of habitat related to the Oklahoma converter station and AC interconnection (see Sections 3.10 and 3.17), is unlikely to have substantial long-term impacts to wildlife populations in the area because the type of habitats affected are common in the region and found elsewhere in the vicinity of the Project ROI (i.e., the affected grasslands and croplands are not limited on the landscape).

3.20.1.7.2.1.2.2 Tennessee Converter Station Siting Area and AC Interconnection Tie

Operation and maintenance activities would result in long-term impacts to the habitats around the converter station siting area (see Section 3.20.1.7.2 for a detailed discussion of potential impacts related to wildlife disturbance and habitat disruption). Furthermore, some permanent loss of habitat would occur as a result of the Project's permanent footprint (i.e., some areas would be encompassed permanently by Project structures such as the converter station, access roads, etc.). Sections 3.10 and 3.17 list the types of habitats that could be affected and the acres that would be permanently impacted by the Tennessee Converter Station Siting Area during operations and maintenance.

The permanent loss of habitat related to the converter station (see Sections 3.10 and 3.17), is unlikely to have substantial long-term impacts to wildlife populations in the area because the type of habitats affected are common in the region and found elsewhere in the vicinity of the Project ROI (i.e., the affected pasture and croplands are not limited on the landscape) unless forested habitats are impacted. As discussed above, forested areas are less common in this area, and impacts to these areas could have greater impacts to forested species compared to the more common pasture and cropland habitats).

3.20.1.7.2.1.3 Decommissioning Impacts

Impacts related to the decommissioning of the converter stations and AC interconnections would not substantially differ from the general discussion of decommissioning related to the Project in general (see Section 3.20.1.7.2).

3.20.1.7.2.2 AC Collection System

3.20.1.7.2.2.1 Construction Impacts

The AC collection system would be located entirely within Region 1. As discussed above, the habitat types found within Region 1 are relatively common throughout the ROI (e.g., grasslands and croplands dominate the entire area with very few other habitat types present); therefore, potential modifications to the routes of the AC collection system would not likely substantially alter the types of habitats that could be impacted. The species composition found along the AC collection system routes would be similar to what was discussed above for the Oklahoma Converter Station and the AC Interconnection Sitting Areas (as both of these Project components occur within the same region).

Table 3.20.1-3 lists the length of the various AC collection system routes, the total acreage within the AC collection system ROW (see Table 3.10-13 in Section 3.10 for more details), the predominant land cover found along each route, and any substantial differences regarding the impacts that would occur under any particular route compared to the other routes. As shown in Table 3.20.1-5, AC Collection System Routes E-1 and NE-2 would have a potentially greater risk of impacting wildlife compared to the other routes, due to these routes' position near important wildlife areas (i.e., both routes are located in close proximity to Optima NWR and Optima WMA[2]), which would elevated the risk of avian collision during the migration seasons (if birds use areas near the Project for stopover habitats). Although AC Collection System Routes NW-1, NW-2, and SE-3 would not have a differential impact to wildlife based on their position (i.e., the types of habitats that could be impacted), they could have a potentially greater impact to wildlife compared to the other routes due to their longer length compared to the other routes (e.g., more habitat would be impacted by these three routes compared to the other routes). It should be noted that these AC collection system routes are not Project alternatives (i.e., one route would not be selected over another as described in Section 2.1.2.3) and the comparison of impacts between these routes is only presented here for impact disclosure purposes.

Table 3.20.1-3:
Summary Information related to Wildlife Resources for the AC Collection System Routes during Construction

AC Collection System Alternatives	Length (miles)	Total Area within the AC ROW (acres)	Predominant Land Cover[1]	Impacts to Wildlife that would be Unique to this Route
E-1	29	708.0	Grasslands (574.2 acres, or 81.1 percent of the ROW)	E-1 would have an elevated risk of avian collision during the migration seasons compared to the other routes, as well as a higher potential for disturbances to important wildlife areas due to this route's proximity to important wildlife areas (i.e., Optima NWR and Optima WMA).
E-2	40	974.4	Grasslands (572.8 acres, or 58.8 percent of the ROW) and croplands (298.6 acres, or 30.6 percent of the ROW)	No substantial difference between this route and the other routes in regards to the types of wildlife impacts that would likely occur as a result of the route's location and position.
E-3	40	977.5	Grasslands (650.3 acres, or 66.5 percent of the ROW)	No substantial difference between this route and the other routes in regards to the types of wildlife impacts that would likely occur as a result of the route's location and position.
NE-1	30	729.8	Grasslands (291.1 acres, or 39.9 percent of the ROI) and croplands (247.2 acres, or 33.9 percent of the ROW)	No substantial difference between this route and the other routes in regards to the types of wildlife impacts that would likely occur as a result of the route's location and position.
NE-2	26	637.4	Grasslands (450.2 acres, or 70.6 percent of the ROW)	NE-2 would have an elevated risk of avian collision during the migration seasons compared to the other routes, as well as a higher potential for disturbances to important wildlife areas due to this route's proximity to important wildlife areas (i.e., Optima NWR and Optima WMA).

2 These areas are managed for wildlife species, including numerous migratory birds that may use the areas as potential stopover locations during migration

Table 3.20.1-3:
Summary Information related to Wildlife Resources for the AC Collection System Routes during Construction

AC Collection System Alternatives	Length (miles)	Total Area within the AC ROW (acres)	Predominant Land Cover[1]	Impacts to Wildlife that would be Unique to this Route
NW-1	52	1,265.4	Grasslands (609.5 acres, or 48.2 percent of the ROW) and developed, open space (540.2 acres, or 42.7 percent of the ROW)	No substantial difference between this route and the other routes in regards to the types of wildlife impacts that would likely occur as a result of the route's location and position; however, longer routes would likely have a greater impact due to the greater length and extent of areas impacted.
NW-2	56	1,365.0	Grasslands (629.3 acres, or 46.1 percent of the ROW), croplands (410.9 acres, or 30.1 percent of the ROW), and developed/open space (292.0 acres, or 21.4 percent of the ROW)	No substantial difference between this route and the other routes in regards to the types of wildlife impacts that would likely occur as a result of the route's location and position; however, longer routes would likely have a greater impact due to the greater length and extent of areas impacted.
SE-1	40	979.4	Grasslands (513.2 acres, or 52.4 percent of the ROI) and croplands (340 acres, or 34.7 percent of the ROI)	No substantial difference between this route and the other routes in regards to the types of wildlife impacts that would likely occur as a result of the route's location and position.
SE-2	13	325.4	Grasslands (169.9 acres, or 52.2 percent of the ROW) and croplands (130.6 acres, or 40.1percent of the ROW)	No substantial difference between this route and the other routes in regards to the types of wildlife impacts that would likely occur as a result of the route's location and position.
SE-3	49	1,193.6	Grasslands (565.7 acres, or 47.4 percent of the ROW) and croplands (483.9 acres, or 40.5 percent of the ROW)	No substantial difference between this route and the other routes in regards to the types of wildlife impacts that would likely occur as a result of the route's location and position; however, longer routes would likely have a greater impact due to the greater length and extent of areas impacted.
SW-1	13	325.6	Grasslands (312.8 acres, or 96.1 percent of the ROW)	No substantial difference between this route and the other routes in regards to the types of wildlife impacts that would likely occur as a result of the route's location and position.
SW-2	37	901.4	Grasslands (733.0 acres, or 81.3 percent of the ROW)	No substantial difference between this route and the other routes in regards to the types of wildlife impacts that would likely occur as a result of the route's location and position.
W-1	21	507.8	Grasslands (377 acres, or 74.2 percent of the ROW)	No substantial difference between this route and the other routes in regards to the types of wildlife impacts that would likely occur as a result of the route's location and position.

1 Source: Jin et al. (2013)

3.20.1.7.2.2.2 Operations and Maintenance Impacts

Table 3.20.1-4 lists the acreage of permanent habitat loss that would be experienced during operation of the AC collection system.

As discussed above, AC Collection System Routes E-1 and NE-2 would have a greater risk of directly impacting wildlife resources compared to the other routes. The elevated risk of avian collisions along these two routes would be experienced throughout the operational phase of the Project.

Table 3.20.1-4:
Summary Information related to Wildlife Resources for the AC Collection System Routes during Operation

AC Collection System Route	Estimated Footprint of Structures (acres)[1]
E-1	4.1
E-2	5.6
E-3	5.6
NE-1	4.2
NE-2	3.6
NW-1	7.3
NW-2	7.8
SE-1	5.6
SE-2	1.8
SE-3	6.9
SW-1	1.8
SW-2	5.2
W-1	2.9

1 The anticipated footprint of structures assumes seven lattice structures per mile, each of which would have a 28-foot by 28-foot foundation.

3.20.1.7.2.2.3 Decommissioning Impacts

Impacts related to the decommissioning of the AC collection system routes would not substantially differ from the general discussion of decommissioning related to the Project in general (see Section 3.20.1.7.2).

3.20.1.7.2.3 HVDC Applicant Proposed Route

3.20.1.7.2.3.1 Construction Impacts

The Applicant Proposed Route would pass through a variety of habitat types, ranging from grassland and cropland habitats to forested and riparian areas. The Applicant Proposed Route within Regions 1, 2, and 6 would cross predominantly through grassland and cropland habitats. Forested and riparian habitats become more prevalent within Regions 4 and 5 (as well as within Region 3 and 7 to a lesser extent). As discussed above, habitat-related impacts within grassland and croplands would be primarily short-term in nature (with the exception of areas encompassed by permanent Project features); however, habitat-related impacts would be long-term in nature within forested and riparian habitats. These long-term impacts in forested and riparian areas would be related to (1) the long timeframes necessary for forested and riparian areas to restore to pre-construction conditions; (2) the effects of fragmentation and edge effects experienced in dense habitat types; (3) the permanent habitat type conversion resulting from vegetation maintenance conducted within previously forested portions of the ROW; and (4) the elevated risk of wildlife mortalities that would be experienced during the extensive vegetation clearing necessary in forested and riparian areas[3] (see Section 3.20.1.7.2 for more details). As a result, the effects of potential impacts to wildlife related

[3] As discussed previously, the entire ROW would be cleared in forested habitats, but not in low vegetation types such as grasslands or croplands (where only areas needed for construction would be cleared; see Section 3.17). As a result, the acreage of cleared land per mile of Project would be greatest in forested habitats compared to other habitats that contain only low vegetation types.

to the construction of the Applicant Proposed Route would be greatest within Regions 4 and 5 (and to a lesser extent within Regions 3 and 7) compared to Regions 1, 2, and 6.

To minimize impacts to wildlife, the Applicant attempted to route the Project parallel to existing infrastructure when possible. By routing the Project parallel to existing infrastructure, the Project's impacts would be consolidated within areas that have already been impacted by existing infrastructure to some degree, as opposed to routing the Project though previously "un-impacted" areas.

Table 3.20.1-5 lists the approximate length of the Applicant Proposed Route in each region, the total acreage within the HVDC ROW, the predominant habitat type that could be impacted, and how much of the route is parallel to existing infrastructure; however, see Sections 3.10 for a more detailed description regarding the breakdown of vegetation types by acreage (i.e., Tables 3.10-15 through 3.10-21). A description of the dominant wildlife species that are likely to occur within each area is found in Section 3.20.1.4.

Table 3.20.1-5:
Summary Information related to Wildlife Resources for the Applicant Proposed Route

Region	Total Length of HVDC (miles)	Total Area within the HVDC ROW (acres)	Predominant Land Cover found along the HVDC[1]	Length of Route Parallel to Existing Infrastructure (miles)
1	115	2,822.3	Grasslands (1,742.3 acres) and croplands (748.8 acres)	Approximately 20 miles, or 18 percent of the route
2	106	2,586.7	Grasslands (1,299.9 acres) and croplands (788 acres)	Approximately 27 miles, or 25 percent of the route
3	162	3,945.5	Grasslands (1,339.5 acres), deciduous forest (1,098.2 acres), and pasture/hay (941.3 acres)	Approximately 21 miles, or 13 percent of the route
4	126	3,081.8	Pasture/hay (1,436.1 acres), deciduous forest (813.7 acres), and evergreen forest (404.7 acres)	Approximately 11 miles, or 9 percent of the route
5	113	2,753.8	Deciduous forest (810.8 acres), pasture/hay (773.4 acres), and evergreen forest (444.3 acres)	Approximately 15 miles, or 13 percent of the route
6	54	1,326.9	Croplands (1,056.5 acres)	Approximately 11 miles, or 20 percent of the route
7	43	1,045	Croplands (691.8) and deciduous forest (79.1 acres)	Approximately 7 miles, or 17 percent of the route

1 Source: Jin et al. (2013)

As noted above, several route variations to the Applicant Proposed Route in Regions 2–7 were developed in response to public comments on the Draft EIS; they are described in detail within Appendix M and summarized in Sections 2.4.2.1–2.4.2.7. Because these route variations mostly cross through similar types of vegetation and habitats compared to the original Applicant Proposed Route, impacts from most of these route variations on wildlife would be similar compared to what would occur as a result of the original Applicant Proposed Route. However, a few of the route variations could result in more long-term impacts to habitats given the extent of forested habitats or other sensitive areas that would be impacted.

- The following route variations would result in at least twice the acreage of impact to forested habitats (see Section 3.17), thereby potentially resulting in a larger extent of long-term impacts to wildlife and their habitats:

Link 1, Variation 2, for Region 3; Link 4, Variation 1, for Region 3; Link 4, Variation 2, for Region 3; and Link 5, Variation 2, for Region 3.

- The following route variations would result in at least half the acreage of impact to forested habitats compared to the original Applicant Proposed Route (see Section 3.17), thereby potentially resulting in fewer long-term impacts to wildlife and their habitats: Link 1, Variation 1, for Region 2; and Links 1 and 2, Variation 1, for Region 3.
- Link 4, Variation 1, for Region 3 could potentially cross more waterbodies compared to the original Applicant Proposed Route, thereby increasing the scope of potential impacts to avian species (e.g., as a result of collisions with wires that span waterbodies), riparian areas, and aquatic species.
- Link 3, Variation 2, in Region 4 would parallel almost four times the length of existing infrastructure compared to the original Applicant Proposed Route, thereby reducing the impacts to areas that have not already been impacted by existing infrastructure, and would cross through areas that contain fewer wetland and waterbody features compared to the original Applicant Proposed Route; however, both the original Applicant Proposed Route and the Applicant Proposed Route Link 3, Variation 2, in Region 4 are part of the current proposal.

3.20.1.7.2.3.2 Operations and Maintenance Impacts

The impacts of the HVDC portion of the Project's operations and maintenance on wildlife and their habitats would be similar to what was described in Section 3.20.1.7.2. As described above, the ongoing impacts related to permanent vegetation maintenance in the ROW, as well as the effects of fragmentation and edge effects, would be greatest in Regions 3, 4, 5, and 7 (due to the presence of forested and riparian areas within the ROW within these regions; see Section 3.20.1.7.2 for more details regarding these effects).

Although the exact placement of the Applicant Proposed Route in relation to waterbodies is unknown at this time, the Applicant Proposed Route in Regions 3, 4, and 5 would likely have a substantial number of waterbody crossings due to the extent of waterbodies in these regions (see Tables 3.15-12, 3.15-16, and 3.15-20). The extent of waterbodies near the HVDC portion of the Project is lower within the remaining regions (see Section 3.15; Tables 3.15-4, 3.15-5, 3.15-8, 3.15-12, 3.15-16, 3.15-20, 3.15-24, and 3.15-28), however, crossings are also likely to occur in these regions as well. As discussed in Section 3.20.1.7.2, there is an elevated risk for avian collisions and mortalities where the Project would span waterbodies.

As described in Section 3.20.1.4.2 above, Regions 1, 2, and 3 of the Applicant Proposed Route occur within the Central Flyway, while Regions 4 through 7 occurs within the Mississippi Flyway. The presence of the transmission structures and line within areas crossed by these flyways increases the risk that the Project would have an impact to migrating avian species. Migrating flocks could potentially occur within the area on an annual basis due to the Applicant Proposed Route's proximity to the:

- Optima NWR, Optima WMA, and Lake Schultz State Park in Region 1
- Major County WMA in Region 2
- Cimarron and Arkansas rivers in Region 3
- Ozark National Forest IBA in Regions 4 and 5
- Cache-Lower White rivers IBA in Region 6
- Various rivers and creeks found within each region (see Section 3.20.1.5 and Section 3.15)

No field studies have been conducted to identify the occurrence and avian use of the ROI; however, the presence of these IBAs implies that resident and migrating birds may use these areas, thereby increasing the risk of impacts to avian species (e.g., habitat disturbance, habitat loss, and risk of collisions with Project structures). The Applicant would develop and implement an APP, consistent with APLIC guidelines, that describes a program of specific and comprehensive actions that when implemented, would reduce risk of avian mortality. EPMs would also be implemented (FVW-2, GE-2, GE-20) as described in Section 3.20.1.7.1, to avoid or minimize impacts to wildlife resources (including avian species).

3.20.1.7.2.3.3 Decommissioning Impacts

Impacts related to the decommissioning of the HVDC portion of the Project would not substantially differ from the general discussion of decommissioning related to the Project in general (see Section 3.20.1.7.2).

3.20.1.7.3 Impacts Associated with the DOE Alternatives

3.20.1.7.3.1 Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area

3.20.1.7.3.1.1 Construction Impacts

The Arkansas Converter Station Alternative and AC Interconnection Siting Area are located within Region 5. As discussed in Section 3.10, the general area being considered for placement of the Arkansas converter station and AC interconnection is dominated by evergreen and deciduous forests as well as pasture/hay fields. In addition, the interconnection would also require a 25- to 35-acre substation near the tap with the existing Arkansas Nuclear One-Pleasant Hill 500kV line, with another 5 acres for material staging and equipment storage. The substation would be within the AC Interconnection Siting Area and contains the same types of habitat as the Arkansas Converter Station Alternative Siting Area (i.e., an area dominated by evergreen and deciduous forests as well as pasture/hay fields). As a result, the wildlife species that would potentially be exposed to Project-related mortality or injury in this area would be those species that inhabit these types of habitats. Tables provided in Appendix L list the wildlife species that inhabit the area and could be impacted by the Project in this area.

Given the potential for clearing forested habitats during the construction of this converter station, substation, and AC interconnection, the Project could result in long-term impacts to wildlife habitats (due to the timeframes necessary for these forests areas to restore to pre-construction conditions; see previous discussions above). Because the pasture/hay fields that could potentially be impacted are capable of restoring to pre-disturbance levels in a short timeframe (defined as less than 5 years), most impacts to these types of habitats would likely be short-term in nature (i.e., these areas could restore to pre-construction conditions within 5 years or less). However, some permanent loss of pasture/hay field habitats would still occur as a result of the Project's permanent footprint (i.e., some areas would be encompassed permanently by Project structures such as the converter station, transmission line structures, access roads, etc.). Sections 3.10 and 3.17 list the types of habitats that could be affected and the acres that could be impacted by the Arkansas converter station, substation, and AC interconnection.

The area considered for the Arkansas converter station, substation, and AC interconnection contains a variety of habitats that range from forested areas to pasture lands. As discussed above, impacts to wildlife would likely be less if the converter station, substation, and AC Interconnection were located within the pasture lands, and would be greater if they were located in forested areas (due to the effects of long-term habitat loss, the extensive time necessary for forests to regenerate to pre-disturbance conditions, and the impacts associated with edge effects in forested habitats).

3.20.1.7.3.1.2 Operations and Maintenance Impacts

Operation and maintenance activities would result in long-term impacts to the habitats around the converter station, substation, and AC interconnection (see Section 3.20.1.7.2 for a detailed discussion of potential impacts related to wildlife disturbance and habitat disruption). Furthermore, some permanent loss of habitat would occur as a result of the Project's permanent footprint (i.e., some areas would be encompassed permanently by Project structures such as the converter station, substation, transmission line structures, access roads, etc.). Sections 3.10 and 3.17 list the types of habitats that could be affected and the acres that would be permanently impacted by the Arkansas converter station, substation, and AC interconnection during operations and maintenance.

The permanent loss of habitat related to the Arkansas converter station, substation, and AC interconnection (see Sections 3.10 and 3.17) is unlikely to have substantial long-term impacts to wildlife populations in the area because the type of habitats affected are common in the region and found elsewhere in the vicinity of the Project ROI.

3.20.1.7.3.1.3 Decommissioning Impacts

Impacts related to decommissioning of the Arkansas converter station and AC interconnection would not substantially differ from the general discussion of decommissioning related to the Project in general (see Section 3.20.1.7.2).

3.20.1.7.3.2 HVDC Alternative Routes

3.20.1.7.3.2.1 Construction Impacts

Table 3.20.1-6 lists the approximate length of the HVDC alternative routes by region, the total acreage within the HVDC alternative route's ROW, the predominant habitat type that could be impacted (see Sections 3.10 and 3.17 for more details regarding the acres of impact that could occur), and any substantial impacts that would differ by alternative compared to the Applicant Proposed Route. A description of the dominant and/or common wildlife species that are likely to occur within each area is found in Section 3.20.1.4.

As described in Appendix M, route adjustments were developed for HVDC Alternative Route 3-A, Alternative Route 5-B, Alternative Route 5-E, and Alternative Route 6-A to maintain an end-to-end route with the Applicant Proposed Route and the new route variations. These route adjustments would cross through similar types of vegetation and habitats compared to the original alternative routes, with the exception of the route adjustment for HVDC Alternative Route 3-A, which would impact some forested habitats. This route adjustment would result in more long-term impacts to wildlife habitats (e.g.,, see previous discussions regarding the time necessary for forested habitats to restore to pre-disturbance conditions).

Table 3.20.1-6:
Summary Information Related to Wildlife Resources for the HVDC Alternative Routes

Region	Alternative Route	Total Length of Route (miles)	Total Area within the HVDC ROW (acre)[1]	Predominant Land Cover[2]	Impacts to Wildlife that would Differ Compared to the Proposed Route
1	1-A	123	3,003.1	Grasslands (2,265.4 acres)	This alternative compares to the Applicant Proposed Route Links 2, 3, 4, and 5. No substantial difference between the Applicant Proposed Route and this alternative because similar habitats would be impacted.
	1-B	52	1,268.4	Grassland (886.6 acres)	This alternative compares to the Applicant Proposed Route Links 2 and 3. No substantial difference between the Applicant Proposed Route and this alternative because similar habitats would be impacted.
	1-C	52	1,272.5	Grasslands (892.3 acres)	This alternative compares to the Applicant Proposed Route Links 2 and 3. No substantial difference between the Applicant Proposed Route and this alternative because similar habitats would be impacted.
	1-D	33.5	819.2	Grasslands (568.9 acres)	This alternative compares to the Applicant Proposed Route Links 3 and 4. No substantial difference between the Applicant Proposed Route and this alternative because similar habitats would be impacted.
2	2-A	57	1,396.3	Grasslands (833.5 acres)	This alternative compares to the Applicant Proposed Route Link 2. No substantial difference between the Applicant Proposed Route and this alternative because similar habitats would be impacted.
	2-B	30	727.7	Croplands (440.3 acres), grasslands (240.0 acres)	This alternative compares to the Applicant Proposed Route Link 3. No substantial difference between the Applicant Proposed Route and this alternative because similar habitats would be impacted.
3	3-A	38	919.1	Grasslands (497.3 acres) and deciduous forest (187.7 acres)	This alternative compares to the Applicant Proposed Route Link 1. No substantial difference between the Applicant Proposed Route and this alternative because similar habitats would be impacted.
	3-B	48	1,166.6	Grasslands (645.2 acres) and deciduous forest (219.0 acres)	This alternative compares to the Applicant Proposed Route Links 1, 2, and 3. No substantial difference between the Applicant Proposed Route and this alternative because similar habitats would be impacted.
	3-C	122	2,967.5	Grasslands (1,061.2 acres), deciduous forest (869.2 acres), and pasture/hay (773.4 acres)	This alternative compares to the Applicant Proposed Route Links 3, 4, 5, and 6. This route alternative would impact slightly more forested areas compared to the Applicant Proposed Route.
	3-D	39	958.8	Primarily pasture/hay (491.8 acres), grasslands (188.9 acres) and deciduous forest (184.3 acres) grasslands	This alternative compares to the Applicant Proposed Route Links 5 and 6. No substantial difference between the Applicant Proposed Route and this alternative because similar habitats would be impacted.

Table 3.20.1-6:
Summary Information Related to Wildlife Resources for the HVDC Alternative Routes

Region	Alternative Route	Total Length of Route (miles)	Total Area within the HVDC ROW (acre)[1]	Predominant Land Cover[2]	Impacts to Wildlife that would Differ Compared to the Proposed Route
	3-E	8.5	207.8	Pasture/hay (98.3 acres) and deciduous forest (74.1 acres)	This alternative compares to the Applicant Proposed Route Link 6. No substantial difference between the Applicant Proposed Route and this alternative because similar habitats would be impacted; however, Link 6 would have slightly more deciduous forest and pasture/hay.
4	4-A	58	1,426.0	Deciduous forest (624.0 acres) and pasture/hay (497.4 acres)	This alternative compares to the Applicant Proposed Route Links 3, 4, 5, and 6. No substantial difference between the Applicant Proposed Route and this alternative because similar habitats would be impacted.
	4-B	79	1,919.9	Deciduous forest (873.2 acres) and pasture/hay (459.6 acres)	This alternative compares to the Applicant Proposed Route Links 2–8. Approximately 102 acres of the federally owned land in the Ozark National Forest and an additional 157 acres of private land within the Ozark National Forest boundary (use unknown) are within the ROI for HVDC Alternative Route 4-B, compared to no federal land present in Links 2–8, although approximately 6 acres of state land are present in Link 6. The interspersed land ownership suggests that a variety of land uses may occur along the ROI, and a variety of wildlife species, common to both deciduous forests and pasture/hay land covers may occur. HVDC Alternative Route 4-B would cross into the Ozark National Forest IBA, potentially indirectly impacting wildlife species during construction, as a result of mortality and/or injury, sensory disturbance, and habitat loss or modification.
	4-C	3	82.6	Deciduous forest (32.4 acres) and pasture/hay (19.0 acres)	This alternative compares to the Applicant Proposed Route Link 5. No substantial difference between the Applicant Proposed Route and this alternative because similar habitats would be impacted.
	4-D	25	617.6	Pasture/hay (299.9 acres) and deciduous forest (179.6 acres)	This alternative compares to the Applicant Proposed Route Link 4. This route alternative would impact slightly more forested areas compared to the Applicant Proposed Route.
	4-E	37	897.2	Pasture/hay (395.5 acres) and evergreen forest (218.7 acres)	This alternative compares to the Applicant Proposed Route Links 8 and 9. No substantial difference between the Applicant Proposed Route and this alternative because similar habitats would be impacted.
5	5-A	13	308.5	Evergreen forest (130.4 acres) and deciduous forest (78.8 acres)	This alternative compares to the Applicant Proposed Route Link 1. No substantial difference between the Applicant Proposed Route and this alternative because similar habitats would be impacted.
	5-B	71	1,732.3	Pasture/hay (740.3 acres) and deciduous forest (479.5 acres)	This alternative compares to the Applicant Proposed Route Links 3, 4, 5, and 6. No substantial difference between the Applicant Proposed Route and this alternative because similar habitats would be impacted.

Table 3.20.1-6:
Summary Information Related to Wildlife Resources for the HVDC Alternative Routes

Region	Alternative Route	Total Length of Route (miles)	Total Area within the HVDC ROW (acre)[1]	Predominant Land Cover[2]	Impacts to Wildlife that would Differ Compared to the Proposed Route
	5-C	9	224.6	Deciduous forest (99.9 acres) and pasture/hay (70.9 acres)	This alternative compares to the Applicant Proposed Route Links 6 and 7. No substantial difference between the Applicant Proposed Route and this alternative because similar habitats would be impacted; however, Link 6 would have slightly more forested habitats.
	5-D	22	529.6	Deciduous forest (246.5 acres) and croplands (92.0 acres)	This alternative compares to the Applicant Proposed Route Link 9. No substantial difference between the Applicant Proposed Route and this alternative because similar habitats would be impacted; however, Link 9 would have more croplands.
	5-E	36	885.1	Pasture/hay (383.5 acres) and deciduous forest (249.3 acres)	This alternative compares to the Applicant Proposed Route Links 4, 5, and 6. No substantial difference between the Applicant Proposed Route and this alternative because similar habitats would be impacted.
	5-F	22	544.5	Pasture /hay (209.9 acres) and deciduous forest (153.2 acres)	This alternative compares to the Applicant Proposed Route Links 5 and 6. No substantial difference between the Applicant Proposed Route and this alternative because similar habitats would be impacted.
6	6-A	16	395.7	Croplands (328.6 acres)	This alternative compares to the Applicant Proposed Route Links 2, 3, and 4. No substantial difference between the Applicant Proposed Route and this alternative because similar habitats would be impacted.
	6-B	14	343.7	Croplands (272.1 acres) and woody wetlands (44.6 acres)	This alternative compares to the Applicant Proposed Route Link 3. No substantial difference between the Applicant Proposed Route and this alternative because similar habitats would be impacted.
	6-C	23	565.6	Croplands (410.6 acres)	This alternative compares to the Applicant Proposed Route Links 6 and 7. No substantial difference between the Applicant Proposed Route and this alternative because similar habitats would be impacted.
	6-D	9	223.6	Croplands (205.3 acres)	This alternative compares to the Applicant Proposed Route Link 7. No substantial difference between the Applicant Proposed Route and this alternative because similar habitats would be impacted.
7	7-A	43	1,052.0	Croplands (827.8 acres) and woody wetlands (110.5 acres)	This alternative compares to the Applicant Proposed Route Link 1. No substantial difference between the Applicant Proposed Route and this alternative because similar habitats would be impacted.
	7-B	9	209.9	Croplands (86.4 acres), deciduous forest (42.7 acres), pasture/hay (34 acres) and shrub/scrub (32.7 acres)	This alternative compares to the Applicant Proposed Route Links 3 and 4. No substantial difference between the Applicant Proposed Route and this alternative because similar habitats would be impacted; however, Link 4 would have no forests and more pasture/hay.

Table 3.20.1-6:
Summary Information Related to Wildlife Resources for the HVDC Alternative Routes

Region	Alternative Route	Total Length of Route (miles)	Total Area within the HVDC ROW (acre)[1]	Predominant Land Cover[2]	Impacts to Wildlife that would Differ Compared to the Proposed Route
	7-C	24	578.6	Croplands (350.6 acres), deciduous forest (58.4 acres), and pasture/hay (72.2 acres), and	This alternative compares to the Applicant Proposed Route Links 3, 4, and 5. No substantial difference between the Applicant Proposed Route and this alternative because similar habitats would be impacted; however, Links 3, 4, and 5 would have slightly more deciduous forest and shrub/scrub.
	7-D		159.5	Croplands (76.8 acres), pasture/hay (32.2 acres), and shrub/scrub (20.6 acres)	This alternative compares to the Applicant Proposed Route Links and 5. No substantial difference between the Applicant Proposed Route and this alternative because similar habitats would be impacted.

1 A more detailed breakdown of vegetation types that could be impacted by the HVDC Alternative Routes, by region, can be found in Tables 3.10-22 through 3.10-30 in Section 3.10. A more detailed description of the acreage of vegetation types that could be impacted along each of the Applicant Proposed Route's various links, by region, can be found in Tables 3.10-15 through 3.10-21 in Section 3.10.

2 Source: Jin et al. (2013)

3.20.1.7.3.2.2 Operations and Maintenance Impacts

Direct and indirect impacts to wildlife and their habitat from operations and maintenance of all of the HVDC Alternative Routes (except for 3-C, 4-B, and 4-D; which are discussed below) are anticipated to be similar to the operations and maintenance of the Applicant Proposed Route because the habitat composition is similar between the HVDC alternative routes and the Applicant Proposed Route. As a result, wildlife species occurrence and use of the ROWs along these route alternatives would likely also be similar.

HVDC Alternative Routes 3-C, 4-B, and 4-D would have a differential effect to wildlife and their habitats compared to the Applicant Proposed Route. As shown in Table 3.20.1-6, HVDC Alternative Route 4-B would cross into the Ozark National Forest IBA, potentially indirectly impacting wildlife species to a greater extent than the Applicant Proposed Route due to this route's proximity to an IBA. The interspersed land cover and land ownership along HVDC Alternative Route 4-B suggest that a variety of land uses may occur along the ROW, and a variety of wildlife species common to both deciduous forests and pasture/hay land covers may occur in this area (thereby potentially exposing more wildlife species to project related impacts compared to the Applicant Proposed Route). Furthermore, HVDC Alternative Routes 3-C and 4-D would impact slightly more forested areas compared to the Applicant Proposed Route, thereby increasing the extent of long-term impacts to forested habitat.

3.20.1.7.3.2.3 Decommissioning Impacts

Impacts related to the decommissioning of the HVDC portion of the Project would not substantially differ from the general discussion of decommissioning related to the Project in general (see Section 3.20.1.7.2).

3.20.1.7.4 Best Management Practices

The Applicant has developed a list of EPMs intended to avoid or minimize impacts to wildlife resources. A complete list of EPMs for the Project is provided in Appendix F. Those EPMs that would specifically minimize the potential for impacts to wildlife resources are summarized in Section 3.20.1.7.1. In addition to these EPMs, the following BMP could also be implemented to further minimize impacts to wildlife:

- All vegetation clearing should comply with both state and federal spatial and timing windows, and should not occur during the avian breeding season applicable to each respective Region.

The implementation of this BMP is suggested because without proper implementation of seasonal and spatial restrictions on construction activities (e.g., if vegetation clearing was conducted during sensitive breeding seasons), avian mortalities would be more likely to occur during construction.

3.20.1.7.5 Unavoidable Adverse Impacts

The Applicant would implement EPMs to avoid or minimize impacts. A BMP has been identified that could be implemented to further reduce impacts (see Section 3.20.1.7.4). However, some adverse impacts would occur even with the implementation of these measures. Construction and operations and maintenance of the Project would result in the death of some wildlife species. Mortalities could result from the vegetation clearing activities as well as avian collisions with Project structures during operation. These mortality events would likely be higher if vegetation clearing is conducted during the breeding season (see previous discussion above), as well as in areas where the Project spans waterbodies. Construction-related disturbances to habitats would also result in temporary loss of some wildlife habitats through noise and visual disturbances. Wildlife habitat also could be lost during operation and maintenance from the effects of fragmentation, edge effects, and invasive plant species. ROW maintenance in forested habitats as well as the footprint of Project structures would result in a permanent loss of habitats.

3.20.1.7.6 Irreversible and Irretrievable Commitment of Resources

The potential permanent loss or alteration of established trees in mature forests in the eastern Project area (in Regions 3, 4, 5, and 7) would last throughout the life of the Project; however, gradual recovery of habitat may occur once the Project has been decommissioned. Because the exact state of this recovery is not known (e.g., substantial changes related to climate, land-use, and/or weeds or pathogens may occur during the 80-year lifespan of the project), and mature forests are subject to long-term climatic regimes, it is reasonable to assume that some portions of the wildlife habitat in these forests would be irreversibly and irretrievably impacted.

3.20.1.7.7 Relationship between Local Short-term Uses and Long-term Productivity

Both the Applicant Proposed Route and the HVDC alternative routes may result in a short-term disturbance to wildlife resources; however, these impacts should not affect the long-term productivity of populations of wildlife resources.

3.20.1.7.8 Impacts from Connected Actions

3.20.1.7.8.1 Wind Energy Generation

Section 3.1 contains a detailed discussion of how the general WDZs were developed as well as how the estimate of potential wind development related impacts was determined. It should be noted that the exact location of potential wind-farms is not known at this time. The assessment of wind energy generation found in this EIS does not constitute approval or official designation of any area for wind development (i.e., there is no assurance that these areas would be developed); nor does this EIS exert authority over the potential development of these areas.

This EIS assumes the development of multiple commercial-scale wind energy projects in the area, which are considered as connected actions. Although the exact placement or location of potential future wind-farms is unknown, for this assessment, it is assumed that these wind energy projects may be developed somewhere within the WDZs. It is assumed that each phase of a commercial-scale wind energy development in the WDZs would be conducted in such a way as to protect the quality of the environment. It is general industry standard for wind developers to comply with applicable state and federal wildlife regulations (see Table 3.20.1-1 above), implement worker safety policies, practice good housekeeping, manage waste properly, and maintain equipment in good working order, thereby minimizing and/or avoiding impacts on wildlife resources and their habitats.

Areas deemed generally unsuitable for commercial-scale wind energy development, including cities, open water, cemeteries, parks, federal lands, recreational areas, state wildlife management areas, lands within 2.5 miles of public use airports, and areas with sensitive environmental resources (such as native prairie, water bodies, and potential habitat for the lesser prairie-chicken) were excluded from the analysis of the WDZs, resulting in 1,082,000 acres of the 1,385,069 total acres in the 12 WDZs that could be considered potentially suitable for wind energy development. Based on the maximum capacity of the Project and information from wind energy developers, it is estimated that 20–30 percent of the potentially suitable land, or between 216,400 and 324,600 acres, could be developed for wind energy facilities using transmission capacity from the Project; however, it should be noted that this is just an estimate, and the exact locations of these wind projects' potential footprints are not known.

The impacts discussed below are common to the majority of wind energy development; however, it is unknown what wildlife species would occur within a given wind energy development zone without coordination and consultation with the future wind energy developer. Wind energy developers are expected to develop and construct wind energy projects based on guidance outlined by the USFWS Land-Based Wind Energy Guidance (USFWS 2012) and the APLIC guidelines (APLIC 2012), which may include the development of conservation strategies and which describe a program of specific and comprehensive actions that, when implemented, could reduce the risk of wildlife species and their habitats.

Short-term, impacts to wildlife resources during construction may include disturbance due to increased noise, dust, and traffic. Additionally, there is the potential for short-term indirect impacts to wildlife habitats as a result of the clearing of vegetation and soil disruption during construction. There is the potential for long-term, direct habitat loss related to construction of a wind energy development; however, the extent of that impact is unknown and dependent upon the competing land uses within a specific WDZ.

During the operations and maintenance phase of wind energy developments, approximately 1 percent or less of the land may be affected. For the 12 WDZs, assuming 20 to 30 percent build-out, between 2,164 and 3,246 acres may be temporarily impacted. Once construction has been completed, temporary construction areas would revert to their previous use over a period of time, depending on the habitat type impacted. Only turbine footprints, access roads, generation tie-lines (if necessary), substations, and operations and maintenance buildings would remain. Existing land uses, primarily agriculture and grazing, would be expected to return to almost all areas of the facilities, unless deemed incompatible with the operation of a wind energy development.

Operations and maintenance of wind energy developments are known to have direct impacts on some wildlife species, specifically avian and bat species, due to collisions with wind turbine blades, collisions and electrocutions associated with generation tie-lines, and barotrauma of bat species. Historically, the average number of avian and bat fatalities associated within operations and maintenance of a wind energy development has varied between developments and was considered a function of a number of factors, including the proximity to known maternity colonies, hibernacula, staging areas, winter ranges, nesting sites, migration stopovers or corridors, leks, or other areas of seasonal importance (USFWS 2012). Occurrence of avian and bat species within the WDZ and potential for direct impacts due to the operations and maintenance of the wind energy development would be documented by wind energy developers under the Land-Based Wind Energy Guidelines, and would be in accordance with appropriate state and federal regulations (including the USFWS BMPs, as provided in the Guidelines).

Limited publicly available post-construction mortality studies have been completed in Texas and Oklahoma, and no publicly available studies have been completed within or in the vicinity of the various WDZs. Therefore, conclusions of the direct impacts to avian and bat species related to operations and maintenance of wind energy developments are determined based on publicly available information for the southern Great Plains. A single study completed in Oklahoma at the Oklahoma Wind Energy Center, located approximately 60 miles east of WDZ-K, reports bat fatality estimates of 1.2 bat fatalities per turbine for the brief three-month study period (Piorkowski and O'Connell 2010). During the summer breeding season at the Oklahoma Wind Energy Center, Piorkowski (2006) reported an avian fatality rate of 0.04 to 0.12 birds per turbine.

Avian and bat mortality rates that occur at various wind energy developments, however, are dependent on multiple factors such as the position of the facility in related to the landscape (e.g., whether landscape features could funnel flight paths into the facility); the size of the facility (i.e., megawatts produced); the number and placement of the turbines; the height or the roto-sweep area; the season and timing of the facility's typical operation (generally, turbines are not continuously run at wind farms); the migratory paths of avian or bat species through the area; and the composition of avian and bat species in the area (not all species have the same tendencies to collide with wind energy facilities). Because no wind development facilities are currently planned in the WDZs, the average avian or bat mortality rates that could occur cannot be accurately calculated or estimated at this time. In other words, the factors listed above are not knowable at this time).

Table 3.20.1-7 lists the size of each of the 12 WDZs, the primary land cover type, and the estimated acres of impact assuming a 30 percent build-out with 5 percent of the land affected during construction and 1 percent affected during operation. Each of the WDZs is likely to have occurrence and use of bat and avian species potentially susceptible to direct impacts related to the operations and maintenance of wind energy developments; however, the occurrence and use of bat and avian in the area is not known (as the precise location of these potential wind facilities has not been determined).

Table 3.20.1-7:
Summary of the 12 WDZ in Regards to Wildlife Resources

WDZ	Total Size (acres)	Estimated Acres of Impact during Construction	Estimated Acres of Impact during Operation[1]
WDZ-A	109,747	659 acres of primarily croplands and grasslands	329 acres
WDZ-B	125,479	752 acres of primarily croplands and grassland	376 acres
WDZ-C	161,048	966 acres of primarily croplands and grasslands	483 acres
WDZ-D	69,189	415 acres of primarily grassland	204 acres
WDZ-E	47,092	282 acres of primarily croplands and grasslands	141 acres
WDZ-F	112,461	675 acres of primarily grasslands and croplands	337 acres
WDZ-G	187,315	1,124 acres of primarily grasslands and croplands	562 acres
WDZ-H	116,226	697 acres of primarily grasslands and croplands	349 acres
WDZ-I	105,203	631 acres of primarily grasslands and croplands	316 acres
WDZ-J	92,568	555 acres of primarily grasslands	278 acres
WDZ-K	92,893.9	557 acres of primarily grasslands and croplands	279 acres
WDZ-L	165,848	995 acres of primarily grasslands and croplands	498 acres

1 The estimated acres of impact assuming a 30 percent build-out with 2 percent of the land affected during construction and 1 percent affected during operation.

Once the decommissioning phase has concluded, wind energy developments would be restored to their pre-construction conditions. Permanent structures, including wind turbines and generation tie-lines, would be dismantled. Impacts associated with the construction, operations and maintenance of wind turbines, generation tie lines, and other permanent structures would be eliminated as these areas are restored to pre-construction conditions.

3.20.1.7.8.2 Optima Substation

As discussed above, the future Optima Substation may be constructed just east of the Oklahoma Converter Station Siting Area and partially within the AC Interconnection Siting Area in Region 1. The location for the substation occurs on grassland habitats adjacent to croplands. Approximately 160 acres would be disturbed as a result of this substation. Potential impacts to wildlife that would occur if this station were constructed would be similar to those that were discussed above for the Oklahoma Converter Station (see Section 3.20.1.7.2.1) and include habitat loss, disturbance, and mortality.

3.20.1.7.8.3 TVA Upgrades

The required TVA upgrades related to the construction of new electric transmission line could involve temporary or long-term displacement of wildlife species; fragmentation of wildlife habitat; potential disturbance to wildlife species and habitats as well as populations and/or habitats for species designated as candidate, threatened and endangered under the ESA; potential impacts to wildlife movement; and potential mortality events related to avian collisions and/or electrocution. The required TVA upgrades that would involve upgrades of existing facilities (i.e., project components where impacts from initial construction as well as operation of the facilities have already occurred or are ongoing) could result in temporary displacement of wildlife species, potential disturbance to wildlife species and habitats as well as populations and/or habitats for species designated as candidate, threatened and endangered under the ESA; and potential impacts to wildlife movement. Because the specific locations of the required TVA upgrades (including the new electric transmission line) are unknown at this time, the spatial and temporal (i.e., seasonal presence) distributions of wildlife populations and suitable habitats also are unknown at this time.

Existing TVA facilities would require fewer construction activities to complete upgrades than the new transmission line and would occur to existing facilities (where previous construction related impacts have already occurred). Existing TVA facilities have also already experienced operations and maintenance activities. As a result, potential impacts are expected to be less substantial in areas affected by upgrades to existing TVA facilities than in areas where the new electric transmission line could be constructed. Impacts to wildlife from the construction and operation of the new transmission line would be similar to those described in Section 3.20.1.7.2.

3.20.1.7.9 Impacts Associated with the No Action Alternative

Under the No Action Alternative, the Project would not be constructed or operated, and impacts to wildlife species and their habitats would be consistent with current levels of disturbance related to natural conditions in the environment, such as annual changes in climates, land use changes, and wildfires. No Project-related disturbances or impacts would occur to wildlife or their habitats under the No Action Alternative.

3.20.2 Fish and Aquatic Invertebrates

3.20.2.1 Regulatory Background

In general, statutes and regulations that influence the evaluation of fish and aquatic invertebrate species in the areas crossed by the Project are primarily implemented by the USFWS and state agencies. The state agencies applicable to the Project include the ODWC, AGFC, TWRA, and TPWD. The fish and aquatic invertebrate species laws and regulations relevant to the Project are discussed further in Section 3.14.2.

3.20.2.2 Data Sources

Data sources included a desktop analysis of relevant information; research findings; reports available to the public; a database that includes GIS data from government agencies as well as non-governmental organizations, and information received from both regulatory agencies and stakeholders during the DOE scoping process. All data sources used for this analysis were limited to those that were open source and readily available to the public (i.e., the public may assess them without restrictions). For general fish classifications within the ROI, the following data sources were reviewed:

- EPA National Rivers and Streams Assessment (http://water.epa.gov/type/rsl/monitoring/riverssurvey/index.cfm)
- USGS National Hydrography Dataset (GIS Data Source: USGS 2014a)
- NPS NRI (GIS Data Source: USGS 1996)

3.20.2.3 Region of Influence

The ROIs used for the evaluation of potential impacts to fish and aquatic invertebrate species from the Project and connected actions are identical to the ROIs described in Section 3.1.1.

3.20.2.4 Affected Environment

As discussed in Section 3.15, the Project would cross multiple watersheds that individually contain varying surface water features. Overall, the Project is within the Arkansas-White-Red and Lower Mississippi drainage systems. From the western end of the Project (in the Oklahoma Panhandle) moving eastward (across Oklahoma and into central Arkansas), the local streams may flow in different directions, but as they join larger streams, their overall progression is to the southeast. In the eastern portion of Arkansas, within the Lower Mississippi drainage system, drainage systems still flow east and southeast toward the Mississippi River, but the flow routes can be different. Throughout the drainage systems, the highest fish and aquatic invertebrate species diversity mostly occurs within Regions 4, 5, 6, and 7.

The following sections provide regional descriptions of common fish and aquatic invertebrate species, including important recreational species, known to occur or that have the potential to occur within the ROI based on habitat associations or documented presence information from the data sources identified in Section 3.20.2.2. It should be noted that the following is not a comprehensive list of every fish and aquatic invertebrate species that could occur in a given region, but rather only a list of the more common species typically found in a given region.

3.20.2.4.1 Oklahoma

There are multiple recreational fishing areas within the Oklahoma portion of the ROI, including the Cimarron River, the Arkansas River, Webbers Fall Reservoir, and the Illinois River. Other important recreational fishing areas located within 10 miles of the Oklahoma Converter Station include Frisco Creek, North Fork Frisco Creek, and Steji Lake (HookandBullet 2014a). Within the ROI for the AC collection system, important recreational fishing areas include Optima Lake, Sunset Lake, Schultz Lake, multiple creeks in Texas County, as well as Webb Lake (HookandBullet 2014a). In addition, although multiple creeks in Beaver County are within the ROI for the AC collection system, very few of them are used in a recreational capacity in this county.

Important recreational fish species potentially occurring in the ROI in Oklahoma include largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieu*), spotted bass (*Micropterus punctulatus*), striped bass (*Morone saxatilis*), white bass (*Morone chrysops*), channel catfish (*Ictalurus punctatus*), blue catfish (*Ictalurus furcatus*), flathead catfish (*Pylodictis olivaris*), white crappie (*Pomoxis annularis*), black crappie (*Pomoxis nigromaculatus*), bluegill (*Lepomis macrochirus*), rainbow trout (*Oncorhynchus mykiss*), brown trout (*Salmo trutta*), walleye (*Stizostedion vitreum*), sauger (*Sander canadensis*), saugeye (hatchery-produced hybrid cross between walleye and sauger), paddlefish (*Polyodon spathula*), and alligator gar (*Atractosteus spatula*) (ODWC 2014).

There are approximately 57 species of native freshwater mussels in the state of Oklahoma, with the species richness declining from the eastern to the western part of the state. Species with ranges that potentially overlap the ROI include, but are not limited to threeridge (*Amblema plicata*), flat floater (*Anodonta suborbiculata*), Wabash pigtoe or lake pigtoe (*Fusconaia flava*), Plain pocketbook (*Lampsilis cardium*), and yellow sandshell (*Lampsilis teres*) (Mather 2005). Other aquatic invertebrates with a range within the ROI include, but are not limited to, the White River crawfish (*Procambarus acutus acutus*) and the Ohio shrimp (*Macrobrachium ohione*) (USGS 2014).

Appendix L contains a representative listing of fish and aquatic invertebrate species potentially occurring in each state.

3.20.2.4.2 Arkansas

Important recreational fishing areas occur within the ROI in Arkansas, including multiple perennial creeks, the St. Francis River, the White River, and the Mississippi River. There is a reach of the Little Red River crossed in Region 5 in White County, which is officially designated “Trout Waters” from below Greers Ferry Dam to Searcy (Clean Line 2013b).

Important recreational fish species in Arkansas potentially occurring in the ROI include largemouth bass, smallmouth bass, spotted bass, striped bass, white bass, yellow bass (*Morone mississippiensis*), Ozark bass (*Ambloplites constellatus*), yellow bullhead catfish (*Ictalurus natalis*), channel catfish, blue catfish, flathead catfish, white crappie, black crappie, rainbow trout, brown trout, brook trout (*Salvenius fontinalis*), cutthroat trout (*Oncorhynchus clarkii*), walleye, bluegill, longear sunfish (*Lepomis megalotis*), redear sunfish (*Lepomis microlophus*), green sunfish (*Lepomis cyanellus*), warmouth (*Lepomis gulosus*), paddlefish, shovelnose sturgeon (*Scaphirhynchus platorynchus*), and alligator gar (AGFC 2011).

There are approximately 75 native mussel species in Arkansas, with many of these potentially found within the ROI (Harris et al. 2009). Recreational and commercial mussel species that potentially overlap the ROI include ebony (*Fusconaia ebena*), lake pigtoe or Wabash pigtoe, washboard (*Megalonaias nervosa*), river pigtoe or Ohio pigtoe (*Pleurobema cordatum*), and mapleleaf (*Quadrula quadrula*) (Anderson 2006; Harris et al. 2009). Other aquatic invertebrates with a range within the ROI include, but are not limited to, Cajun dwarf crayfish (*Cambarellus shufeldtii*), White River crawfish, red swamp crayfish, Mississippi grass shrimp (*Palaemonetes kadiakensis*), and Ohio shrimp (USGS 2014).

3.20.2.4.3 Tennessee

Within the Tennessee portion of the ROI, the Mississippi River is both the largest and most important recreational fishing area. Other important recreational fishing areas located within 10 miles of the Tennessee Converter Station Siting Area include multiple lakes, reservoirs, and creeks (HookandBullet 2014b).

Important recreational fish species potentially occurring in Tipton and Shelby counties include largemouth bass, smallmouth bass, channel catfish, bluegill, crappie, bullhead catfish (*Ameiurus* spp.), yellow perch (*Perca flavescens*), rainbow trout, and walleye (HookandBullet 2014b).

Recreational and commercial mussel species that potentially overlap the ROI include threeridge, elephant ear (*Elliptio crassidens*), ebony, lake pigtoe or Wabash pigtoe, washboard, river pigtoe or Ohio pigtoe, and mapleleaf (TWRA 2011; Clean Line 2013a). Other aquatic invertebrates with a range within the ROI include Cajun dwarf crayfish, White River crawfish, red swamp crayfish (*Procambarus clarkii*), Mississippi grass shrimp, and Ohio shrimp (USGS 2014).

3.20.2.4.4 Texas

Important recreational fishing areas are located within the ROI for the AC collection system, including in Sherman County (Steji Lake, Bryson Lake, Runyun Lake, Kenson Lake), in Hansford County (Palo Duro Reservoir, Venneman Lake, Miller's Lake), and in Ochiltree County (Middle Prong Wolf Creek, Deer Lake, Peckenpaugh Lake) (HookandBullet 2014c).

Important recreational fish species in Texas potentially occurring in the ROI include largemouth bass, smallmouth bass, spotted bass, white bass, yellow bass, striped bass, channel catfish, bluegill, crappie, gar, black bullhead catfish (*Ameiurus melas*) and yellow bullhead catfish (TPWD 2014a).

Recreational and commercial mussel species that potentially overlap the ROI include, but are not limited to threeridge, mapleleaf, pimpleback (*Quadrula* spp.), and bleufer (*Potamilus purpuratus*) (TPWD 2014a).

3.20.2.5 Regional Description

As described in Section 3.20.2.4 above, numerous fish and aquatic invertebrate species are known to occur or have the potential to occur within the ROI. A summary of the fish and aquatic invertebrate species and potential habitat occurrence by Project region is provided in the sections below. Information from ANHC Natural Areas and Focal Areas and state natural heritage program species occurrence records, including related waterbodies found by Project region, are included in Table 3.20.2-1. Federally designated candidate, threatened, and endangered fish, aquatic invertebrate, and amphibian species potentially occurring in the ROI by state, are included in Table 3.14.2-3. State designated threatened and endangered aquatic wildlife species by state, county, and region are included in Table 3.14.2-4.

Table 3.20.2-1:
State Natural Heritage Occurrences within the ROI or Waterbodies Crossed by the ROI

Common Name	Scientific Name	State Rank[1] or Status[2]	Waterbody	Project Region
Oklahoma				
Fish				
Pallid shiner	*Notropis amnis*	S1S2	Lee Creek	4
Red River shiner	*Notropis bairdi*	S3	Cimarron River	2, 3
Aquatic Invertebrates				
Crawfish species	*Orconectes palmeri longimanus*	S5	Ross Branch of Little Sallisaw Creek	4
Southern plains crayfish	*Procambarus simulans*	S5	Beaver River	1
White River crawfish	*Procambarus acutus*	S5	Beaver River	1
Arkansas				
Fish				
Autumn darter	*Etheostoma autumnale*	S2 / INV	Ten Mile Creek[4]	5
Sunburst darter	*Etheostoma mihileze*	S3 / INV	Mill Creek[4]	4
Aquatic Invertebrates				
A crayfish (no common name)	*Cambarus causeyi*	S1 / INV	Big Piney Creek[4]	4
Black sandshell	*Ligumia recta*	S2 / INV	Big Piney Creek[4], White River,[3,4] and Tyronza River[4]	4, 5, 7
Elktoe	*Alasmidonta marginata*	S3 / INV	Big Piney Creek[4]	4

Table 3.20.2-1:
State Natural Heritage Occurrences within the ROI or Waterbodies Crossed by the ROI

Common Name	Scientific Name	State Rank[1] or Status[2]	Waterbody	Project Region
Fat mucket	*Lampsilis siliquoidea*	S3 / INV	North Fork Cadron Creek[4]	5
Flutedshell	*Lasmigona costata*	S3 / INV	Frog Bayou[4], Big Piney Creek[4], and West Fork Point Remove Creek[4]	4
Isopod (no common name)	*Lirceus bicuspidatus*	S2 / INV	Unamed Spring[3] and Departee Creek[4]	4
Little spectaclecase	*Villosa lienosa*	S3 / INV	Big Piney Creek[4], West Fork Point Remove Creek[4] and St. Francis floodway ditch[5]	4, 6
Monkeyface	*Quadrula metanevra*	S3S4 / INV	White River[3] and St. Francis River[4]	5, 7
Ohio pigtoe	*Pleurobema cordatum*	S1 / INV	White River[3]	5
Ouachita kidneyshell	*Ptychobranchus occidentalis*	S3 / INV	White River[3]	5
Pondhorn	*Uniomerus tetralasmus*	S2 / INV	St. Francis floodway ditch[4]	6
Purple lilliput	*Toxolasma lividum*	S2 / INV	Frog Bayou[4], Illinois Bayou[4], West Fork Point Remove Creek[4], Jones Creek[3], and Tyronza River[3]	4, 5, 7
Pyramid pigtoe	*Pleurobema rubrum*	S2 / INV	White River[4], and St. Francis River[4], Tyronza River[4]	5, 7
Southern mapleleaf	*Quadrula apiculata*	S2 / INV	Bayou DeView[4]	6
Western fanshell	*Cyprogenia aberti*	S2 / INV	White River[3] and St. Francis River[4]	5, 7
Tennessee				
Fish				
Bigmouth shiner	*Notropis dorsalis*	S1 / D[5]	Bear Creek	7
Texas				
None				

1 State rank is a conservation rank used by State Heritage Programs and The Nature Conservancy that indicates the relative rarity of an element throughout the state. S1 = Critically imperiled; S2 = Imperiled; S3 = Vulnerable; S4 = Apparently secure; S5 = Secure in the state
2 State status: INV = Inventory Element.
3 Occurrence element located within the ROI.
4 Occurrence element located outside the ROI, but within a waterbody that is crossed by the Project.
5 D = Deemed in Need of Management
Sources: ODWC (2014, 2015), ANHC (2014), TDEC (2014), TPWD (2014a, 2014b)

3.20.2.5.1 Region 1

Region 1 is referred to as the Oklahoma Panhandle Region and includes the Oklahoma Converter Station Siting Area, AC collection system, the Applicant Proposed Route and the HVDC Alternative Routes I-A through I-D. This region includes Texas, Beaver, Harper, and Woodward counties in Oklahoma. The Cimarron River crosses Beaver, Harper, and Woodward counties in this region. Forested wetland areas crossed by the ROI in Region 1 include Palo Duro Creek, Clear Creek, Beaver River, and Skeleton Creek (Clean Line 2013b). There are many fish and aquatic species that potentially occur in these waterbodies that cross the ROI; fish and aquatic invertebrate species are listed in Appendix L. Although crossing locations within a given drainage vary between the Applicant Proposed Route and the HVDC Alternative Routes I-A through I-D, the potential occurrence of fish and aquatic species within the ROI would generally be similar.

No route variations were proposed in Region 1.

3.20.2.5.1.1 AC Collection System

A description of the AC collection system is provided in Section 2.1.2.3. The AC collection system routes are represented by a 2-mile-wide corridor for analysis purposes. The miles of perennial and intermittent streams, major waterbodies, and the acres of reservoirs, lakes, and ponds reported for each of the AC collection system routes are described in detail in Section 3.15. Wetland areas that may be used by aquatic species in this region are described in Section 3.19. In addition to reporting miles of perennial and intermittent streams, major waterbodies, acres of reservoirs, lakes, and ponds, and wetland areas for the 2-mile-wide corridor, Sections 3.15 and 3.19 also report values for the 200-foot-wide representative ROW because the ROWs for the AC collection system transmission lines would typically be 200 feet wide. Although the ROW is more typical, the 2-mile-wide corridor was used for fish and aquatic invertebrate analysis purposes to account for the various ranges of aquatic species, including the unique and varied habitat that each species potentially occupies, as well as the potential downstream transport of sediment and hazardous materials. NWI-mapped wetlands occur within the ROI, including both forested and non-forested wetlands (Clean Line 2013a). Riparian corridors may also exist along the Beaver River and Coldwater and Palo Duro creeks (Clean Line 2013a). Lake Schultz State Park in Oklahoma is within the 2-mile-wide corridor and is a part of the Schultz WMA (Clean Line 2013a). Forested wetland areas crossed by the AC collection system routes are mostly associated with Palo Duro Creek (Clean Line 2013b). Of the AC collection system routes, E-1, E-2, E-3, SE-1, SE-3, NE-1, NE-2, NW-1, and NW-2 may provide aquatic habitat to fish and aquatic invertebrate species.

AC Collection System Route SE-3 crosses Wolf Creek in Ochiltree County, Texas, a waterbody that has been designated as a high water quality, exceptional aquatic life, and high aesthetic value waterbody. It has diverse benthic macroinvertebrate and fish communities (Clean Line 2013b).

3.20.2.5.2 Region 2

Region 2 is referred to as the Oklahoma Central Great Plains Region and includes the Applicant Proposed Route and HVDC Alternative Routes 2-A and 2-B. This region includes Woodward, Major, and Garfield counties in Oklahoma. The Cimarron River crosses Woodward and Major counties in this region. Link 2 of the Applicant Proposed Route and HVDC Alternative Route 2-A cross the Cimarron River in Major County). Many fish and aquatic invertebrate species potentially occur in these waterbodies that cross the ROI; fish and aquatic species are listed in Appendix L. Although crossing locations on the Cimarron River vary between the Applicant Proposed Route and the HVDC Alternative Routes 2-A and 2-B, the potential occurrence of fish and aquatic species within the ROI would generally be similar.

Two route variations to the Applicant Proposed Route were developed in Region 2 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.2. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route. Link 1, Variation 1, as well as Link 2, Variation 2, would cross through similar types of wetlands and habitat compared to the original Applicant Proposed Route.

3.20.2.5.3 Region 3

Region 3 is referred to as the Oklahoma Cross Timbers Region and includes the Applicant Proposed Route and HVDC Alternative Routes 3-A through 3-E. This region includes Garfield, Kingfisher, Logan, Payne, Lincoln, Creek, Okmulgee, and Muskogee counties in Oklahoma. The Cimarron River crosses Logan, Payne, and Creek counties in this region. Link 4 of the Applicant Proposed Route and HVDC Alternative Route 3-C cross the Cimarron River in Payne County. Forested wetland areas crossed by the ROI in Region 3 include Stillwater Creek, the Cimarron River, Browns Creek, Snake Creek, Little Deep Fork Creek, Salt Creek, Pecan Creek, Beaver River, Anderson Creek, Butler Creek, and tributaries to both Cane Creek and Dirty Creek (Clean Line 2013b). Many fish and aquatic invertebrate species potentially occur in these waterbodies; fish and aquatic species are listed in Appendix L. Although crossing locations within a given drainage vary between the Applicant Proposed Route and the HVDC Alternative Routes 3-A through 3-E, the potential occurrence of fish and aquatic species within the ROI would generally be similar.

Five route variations to the Applicant Proposed Route were developed in Region 3 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.3. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route. Links 1 and 2, Variation 1; Link 1, Variation 2; Link 4, Variation 1; and Link 5, Variation 2, would cross through similar types of wetlands and habitats compared to the original Applicant Proposed Route. The number of waterbodies crossed decreases from three to zero in Links 1 and 2, Variation 1, while the number of waterbodies crossed increases from one to two in Applicant Proposed Route Link 1, Variation 2.

3.20.2.5.4 Region 4

Region 4 is referred to as the Arkansas River Valley Region and includes the Applicant Proposed Route, including the Lee Creek Variation, and Alternative Routes 4-A through 4-E. This region includes Muskogee and Sequoyah counties in Oklahoma, and Crawford, Franklin, Johnson, and Pope counties in Arkansas. The Applicant Proposed Route Link I crosses the Arkansas River in Muskogee County and the Illinois River in Sequoyah County (Clean Link 2013b). The Applicant Proposed Route Link 6 crosses the Mulberry River downstream of I-40 bridge at the Crawford-Franklin County line (Clean Link 2013b). HVDC Alternative Routes 4-A and 4-B, Applicant Proposed Route Link 3, and the Lee Creek Variation cross Lee Creek in Sequoyah County (Clean Line 2013b). HVDC Alternative Route 4-E and Applicant Proposed Route Link 9 cross Big Piney Creek in Pope County; however, the Applicant Proposed Route Link 9 parallels the Big Piney Creek in Pope County, while HVDC Alternative Route 4-E only crosses Big Piney Creek (Clean Line 2013b). The Mulberry River overlaps with HVDC Alternative Routes 4-A, 4-B, 4-D, and Applicant Proposed Route Link 6 near the Crawford-Franklin County line in Arkansas (Clean Line 2013b). In Oklahoma, one forested wetland area (Sallisaw Creek) is crossed by the ROI in Region 4 (Clean Line 2013b). In Arkansas, forested wetland areas crossed by the ROI in Region 4 include Short Branch, Cottonwood Slough, Spadra Creek, and Big Piney Creek (Clean Line 2013b). Many fish and aquatic invertebrate species potentially occur in these waterbodies that cross the ROI; lists of fish and aquatic species are provided in Appendix L. Although crossing locations within a given drainage vary between the Applicant Proposed Route and HVDC Alternative Routes 4-A through 4-E, the potential occurrence of fish and aquatic species within the ROI would generally be similar.

Seven route variations to the Applicant Proposed Route were developed in Region 4 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.4. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route. Link 3, Variation 1; Link 3, Variation 3; Link 6, Variation 1; Link 6, Variation 2; Link 6, Variation 3; and Link 9, Variation 1, would cross through similar types of wetlands and habitats compared to the original Applicant Proposed Route. Link 3, Variation 2, would parallel almost four times the length of existing infrastructure compared to the original Applicant Proposed Route and would cross through areas that contain fewer wetland and waterbody features compared to the original Applicant Proposed Route.

3.20.2.5.5 Region 5

Region 5 is referred to as the Central Arkansas Region and includes the Applicant Proposed Route and HVDC Alternative Routes 5-A through 5-F. This region includes Pope, Conway, Van Buren, Faulkner, Cleburne, White, and Jackson counties in Arkansas. The Applicant Proposed Route Link 9 and HVDC Alternative Route 5-D cross the White River in Jackson County (Clean Line 2013b). The Applicant Proposed Route Link 4 and HVDC Alternative Route 5-E cross Cadron Creek in Van Buren County, while HVDC Alternative Route 5-B crosses Cadron Creek in Faulkner County (Clean Line 2013b). HVDC Alternative Routes 5-B, 5-E, and 5-F cross East Fork Cadron Creek in Faulkner County (Clean Line 2013b). HVDC Alternative Route 5-D crosses a reach of the Departee Creek in Arkansas that is considered an Ecologically Sensitive Waterbody because of the presence of the flat floater mussel (*Anodonta suborbiculata*) (Clean Line 2013b). Applicant Proposed Route Link 7 and HVDC Alternative Route 5-C cross the Little Red River in White County, which is designated as "Trout Waters" from below the Greers Ferry Dam to Searcy (Clean Line 2013b). In Arkansas, forested wetland areas crossed by the ROI in Region 5 include West Fork Point Remove Creek, Briar Creek, Oats Creek, and tributaries to both Departee Creek and Mill Creek (Clean Line 2013b). Many fish and aquatic invertebrate species potentially occur in these waterbodies that cross the ROI; fish and aquatic species are listed in Appendix L. Although crossing locations within a given drainage vary between the Applicant Proposed Route and the HVDC Alternative Routes 5-A through 5-F, the potential occurrence of fish and aquatic species within the ROI would generally be similar.

Five route variations to the Applicant Proposed Route were developed in Region 5 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.5. The variations are illustrated in Exhibit 1 of Appendix M. These variations represent minor adjustments to the Applicant Proposed Route. Link 1, Variation 2; Link 2, Variation 2; Links 2 and 3, Variation 1; Links 3 and 4, Variation 2; and Link 7, Variation 1, would cross through similar types of wetlands and habitats compared to the original Applicant Proposed Route.

3.20.2.5.6 Region 6

Region 6 is referred to as the Cache River and Crowley's Ridge Region and includes the Applicant Proposed Route and HVDC Alternative Routes 6-A through 6-D. This region includes Jackson, Cross, and Poinsett counties in Arkansas. The Applicant Proposed Route Link 6 crosses a reach of the L'Anguille River in Cross County, while HVDC Alternative Route 6-C crosses the L'Anguille River in Poinsett County (Clean Line 2013b). HVDC Alternative Route 6-D runs parallel to the Straight Slough in Cross and Poinsett counties, then crosses Straight Slough in Poinsett County; the lower 10 miles of this waterbody is designated as an Ecologically Sensitive Waterbody because of the presence of the fat pocketbook mussel (Clean Line 2013b); which is a special status aquatic invertebrate species and discussed further in Section 3.14.2. Forested wetland areas crossed by the ROI in Region 6 include Bayou DeView, Caney Creek, L'Anguille River, and Ditches No. 10, 123, and 61 (Clean Line 2013b). Many fish and aquatic invertebrate species potentially occur in these waterbodies that cross the ROI; fish and aquatic species are listed in Appendix L. Although crossing locations within a given drainage vary between the Applicant Proposed Route and HVDC Alternative Routes 6-A through 6-D, the potential occurrence of fish and aquatic species within the ROI would generally be similar.

One route variation to the Applicant Proposed Route in Region 6 (i.e., Applicant Proposed Route Link 2, Variation 1) was developed in response to public comments on the Draft EIS. This route variation is described in Appendix M and summarized in Section 2.4.2.6. The variation is illustrated in Exhibit 1 of Appendix M. This variation represents a minor adjustment to the Applicant Proposed Route. Link 2, Variation 1, would cross through similar types of wetlands and habitats compared to the original Applicant Proposed Route and includes increased acreage of forested wetland habitat.

3.20.2.5.7 Region 7

Region 7 is referred to as the Arkansas Mississippi River Delta and Tennessee Region and includes the Applicant Proposed Route and HVDC Alternative Routes 7-A through 7-D. This region includes Poinsett and Mississippi counties in Arkansas and Tipton and Shelby counties in Tennessee. The Applicant Proposed Route Link 1 and HVDC Alternative Route 7-A cross the St. Francis River in Poinsett County, Arkansas, and the Mississippi River at the Arkansas-Tennessee state line (Clean Line 2013b). Applicant Proposed Route Link 1 and HVDC Alternative Route 7-A cross the Mississippi River in Tipton County; this waterbody is designated as an Exceptional Tennessee Water because of the presence of the pallid sturgeon and the blue sucker (Clean Line 2013b), both of which are special status fish species and discussed further in Section 3.14.2. In Arkansas, forested wetland areas crossed by the ROI in Region 7 include the Cache River and Ditches No. 1 and 47 (Clean Line 2013b). In Tennessee, forested wetland areas crossed by the ROI in Region 7 include the Mississippi River, Sullivan Lake and Big Slough, Dead Timber, Ditch No. 1, a tributary to Cole Creek, and tributaries to Big Creek (Clean Line 2013b). Many fish and aquatic invertebrate species potentially occur in these waterbodies that cross the ROI; fish and aquatic species are listed in Appendix L. Although crossing locations within a given drainage vary between the Applicant Proposed Route and HVDC Alternative Routes 7-A through 7-D, the potential occurrence of fish and aquatic species within the ROI would generally be similar.

Three route variations to the Applicant Proposed Route were developed in Region 7 in response to public comments on the Draft EIS. The route variations are described in Appendix M and summarized in Section 2.4.2.7. The variations are illustrated in Exhibit 1 of Appendix M. Link 1, Variation 1; Link 1, Variation 2; and Link 5, Variation 1, would cross through similar types of wetlands and habitats compared to the original Applicant Proposed Route. The number of waterbodies crossed potentially decreased by half in Link 1, Variation 2.

3.20.2.6 Connected Actions

3.20.2.6.1 Wind Energy Generation

Acres of woody wetland and emergent herbaceous wetlands that are provided below are from Section 3.10. The land cover in each WDZ is summarized in Section 3.10. Miles of perennial streams and acres of perennial reservoirs, lakes, and ponds are from Section 3.15. A summary of the fish and aquatic species and habitat occurrence by WDZ is provided in the sections below.

3.20.2.6.1.1 WDZ-A

The dominant land cover in WDZ-A is croplands and grasslands, with 19.1 acres of woody wetlands and 79.0 acres of emergent herbaceous wetlands (GIS Data Source: Jin et al. 2013). There are approximately 4.9 miles of perennial streams and 38 acres of perennial reservoirs, lakes, and ponds. WDZ-A intersects the Middle Beaver, Lower Beaver, Palo Duro, and Upper Wolf watersheds. Deer Lake and Peckenpaugh Lake both fall within WDZ-A and are important recreational fishing areas (HookandBullet 2014c). Important recreational fish species in the Texas Panhandle include largemouth bass, smallmouth bass, spotted bass, white bass, yellow bass, striped bass, channel catfish, bluegill, white crappie, and black crappie (TPWD 2014a). Recreational and commercial freshwater mussel species in Texas include threeridge, mapleleaf, pimpleback, and bleufer, among others (TPWD 2014a).

3.20.2.6.1.2 WDZ-B

The dominant land cover in WDZ-B is croplands and grasslands areas, with 15 acres of woody wetlands and 60 acres of emergent herbaceous wetlands. There are approximately 8 miles of perennial streams and 164 acres of perennial reservoirs, lakes, and ponds. WDZ-B intersects the Palo Duro watershed. A portion of the Palo Duro Reservoir, where recreational fishing occurs, is within WDZ-B. In addition, Venneman Lake and Miller's Lake are both within WDZ-B, and are also important recreational fishing areas (HookandBullet 2014c). Important recreational fish species in the Texas Panhandle include largemouth bass, smallmouth bass, spotted bass, white bass, yellow bass, striped bass, channel catfish, bluegill, white crappie, and black crappie (TPWD 2014a). Recreational and commercial freshwater mussel species in Texas include threeridge, mapleleaf, pimpleback, and bleufer, among others (TPWD 2014a).

3.20.2.6.1.3 WDZ-C

The dominant land cover in WDZ-C is grasslands areas and croplands, with 2 acres of woody wetlands and 4 acres of emergent herbaceous wetlands. There are approximately 6.4 miles of perennial streams and 125 acres of perennial reservoirs, lakes, and ponds. WDZ-C intersects the Coldwater watershed. WDZ-C includes Steji Lake and Bryson Lake, both important recreational fishing areas (HookandBullet 2014c). Important recreational fish species in the Texas Panhandle include largemouth bass, smallmouth bass, spotted bass, white bass, yellow bass, striped bass, channel catfish, bluegill, white crappie, and black crappie (TPWD 2014a). Recreational and commercial freshwater mussel species in Texas include threeridge, mapleleaf, pimpleback, and bleufer, among others (TPWD 2014a).

3.20.2.6.1.4 WDZ-D

The dominant land cover in WDZ-D is grasslands areas and croplands, with 52 acres of woody wetlands (occurring along Hackberry Creek within Lake Schultz Wildlife Management Area). There are approximately 12.7 miles of perennial streams and 57 acres of perennial reservoirs, lakes, and ponds. WDZ-D intersects the Coldwater, Middle Beaver, and Palo Duro watersheds. WDZ-D contains 313.6 acres of Oklahoma Waters of Recreational and/or Ecological Significance. Schultz Lake and Webb Lake both occur within WDZ-D and are important recreational fishing areas. Recreational fish species found in this area of the Oklahoma Panhandle include striped bass, smallmouth bass, largemouth bass, walleye, bluegill, brown trout, and rainbow trout (HookandBullet 2014d).

3.20.2.6.1.5 WDZ-E

The dominant land cover in WDZ-E is croplands and grasslands areas with 9 acres of woody wetlands. There are approximately 2.6 miles of perennial streams and 25 acres of perennial reservoirs, lakes, and ponds. WDZ-E intersects the Coldwater and Middle Beaver watersheds. Recreational fish species found in this area of the Oklahoma Panhandle include striped bass, smallmouth bass, largemouth bass, walleye, bluegill, brown trout, and rainbow trout (HookandBullet 2014d).

3.20.2.6.1.6 WDZ-F

The dominant land cover in WDZ-F is grasslands areas and croplands, with 21 acres of woody wetlands (occurring along the Beaver [North Canadian] River) and 18 acres of emergent herbaceous wetlands. There are approximately 13 miles of perennial streams and 24 acres of perennial reservoirs, lakes, and ponds. WDZ-F intersects the Coldwater and Upper Beaver watersheds. WDZ-F contains 5.8 miles of waters which have been designated by the state of Oklahoma as impaired pursuant to Section 303(d). Recreational fish species found in this area of the Oklahoma Panhandle include striped bass, smallmouth bass, largemouth bass, walleye, bluegill, brown trout, and rainbow trout (HookandBullet 2014d).

3.20.2.6.1.7 WDZ-G

The dominant land cover in WDZ-G is grasslands areas and croplands, with 146 acres of emergent herbaceous wetlands and 2 acres of woody wetlands. There are approximately 6.8 miles of perennial streams and 12 acres of perennial reservoirs, lakes, and ponds. WDZ-G intersects the Upper Beaver watershed. Recreational fish species found in this area of the Oklahoma Panhandle include striped bass, smallmouth bass, largemouth bass, walleye, bluegill, brown trout, and rainbow trout (HookandBullet 2014d).

3.20.2.6.1.8 WDZ-H

The dominant land cover in WDZ-H is grasslands areas and croplands, with 4 acres of woody wetlands and 2 acres of emergent herbaceous wetlands. There are approximately 19.9 miles of perennial streams and 8 acres of perennial reservoirs, lakes, and ponds. WDZ-H intersects the Upper Beaver watershed. Recreational fish species found in this area of the Oklahoma Panhandle include striped bass, smallmouth bass, largemouth bass, walleye, bluegill, brown trout, and rainbow trout (HookandBullet 2014d).

3.20.2.6.1.9 WDZ-I

The dominant land cover in WDZ-I is croplands and grasslands areas, with 49 acres of woody wetlands and 93 acres of emergent herbaceous wetlands. There are approximately 1.7 miles of perennial streams and 17 acres of perennial reservoirs, lakes, and ponds. WDZ-I intersects the Middle Beaver watershed. Recreational fish species found in this area of the Oklahoma Panhandle include striped bass, smallmouth bass, largemouth bass, walleye, bluegill, brown trout, and rainbow trout (HookandBullet 2014d).

3.20.2.6.1.10 WDZ-J

The dominant land cover in WDZ-J is grasslands areas and croplands, with 83 acres of woody wetlands (occurring along the Beaver [North Canadian] River and Fulton Creek). There are approximately 26.2 miles of perennial streams and 123 acres of perennial reservoirs, lakes, and ponds. WDZ-J intersects the Middle Beaver and Palo Duro watersheds. WDZ-J contains 2.3 miles of waters which have been designated by Oklahoma State as impaired pursuant to Section 303(d). Recreational fish species found in this area of the Oklahoma Panhandle include striped bass, smallmouth bass, largemouth bass, walleye, bluegill, brown trout, and rainbow trout (HookandBullet 2014d).

3.20.2.6.1.11 WDZ-K

The dominant land cover in WDZ-K is croplands and grasslands areas, with 50 acres of woody wetlands and 1 acre of emergent herbaceous wetlands. There are approximately 6.3 miles of perennial streams and 60 acres of perennial reservoirs, lakes, and ponds. WDZ-K intersects the Lower Beaver watershed. WDZ-K contains 9.2 miles of waters which have been designated by the state of Oklahoma as impaired pursuant to Section 303(d). Recreational fish species found in this area of the Oklahoma Panhandle include striped bass, smallmouth bass, largemouth bass, walleye, bluegill, brown trout, and rainbow trout (HookandBullet 2014d).

3.20.2.6.1.12 WDZ-L

The dominant land cover in WDZ-L is croplands, grasslands, and shrub/scrub areas, with 19 acres of woody wetlands (occurring along Wolf Creek within Wolf Creek County Park) and 2,286 acres of emergent herbaceous wetlands. There are approximately 31.6 miles of perennial streams and 650 acres of perennial reservoirs, lakes, and ponds. WDZ-L intersects the Upper Wolf watershed. WDZ-L contains 15.6 miles of Wolf Creek; a state of Texas designated Ecologically Unique River and Stream Segment. Wolf Creek is designated as a high quality/exceptional aquatic life/high aesthetic value waterbody. It is also used as a reference stream to develop the regionalized index of biotic integrity for Texas, with diverse benthic macroinvertebrate and fish communities. Fish species found within Wolf Creek include red shiner, sand shiner (*Notropis stramineus*), suckermouth minnow, plains killifish, western mosquitofish, green sunfish, longear sunfish, and largemouth bass (Linam et al. 2002). Wolf Creek and Deer Lake are both important recreational fishing areas within WDZ-L (HookandBullet 2014c). Important recreational fish species in the Texas Panhandle and potentially found in Deer Lake include largemouth bass, smallmouth bass, spotted bass, white bass, yellow bass, striped bass, channel catfish, bluegill, white crappie, and black crappie (TPWD 2014a). Recreational and commercial freshwater mussel species in Texas include threeridge, mapleleaf, pimpleback, and bleufer, among others (TPWD 2014a).

3.20.2.6.2 Optima Substation

As discussed in Section 3.1, the future Optima Substation may be constructed just east of the Oklahoma Converter Station and partially within the AC Interconnection Siting Area in Region 1. The location for the substation occurs on grassland habitats adjacent to croplands. Because there are no likely waterbodies within the future Optima Substation, no occurrences of fish and aquatic invertebrate species are likely.

3.20.2.6.3 TVA Upgrades

The ROI for the direct assignment facilities (which are included in the Applicant Proposed Project) would occur within the Tennessee Converter Station Siting Area and more specifically within the Shelby Substation. The ROI for the network upgrades, and in particular TVA's future 500kV transmission line, cannot be fully determined at this time. The new 500kV transmission line would be constructed in western Tennessee. The upgrades to existing facilities would mostly be in western and central Tennessee. Upgrades to existing infrastructure would include upgrading terminal equipment at three existing 500kV substations and six existing 161kV substations, making appropriate upgrades to increase heights on 16 existing 161kV transmission lines to increase line ratings, and replacing the conductors on eight existing 161kV transmission lines. Where possible, general impacts associated with the required TVA upgrades are discussed in the impact sections that follow.

3.20.2.7 Impacts to Fish and Aquatic Invertebrates

3.20.2.7.1 Methodology

The methodology for evaluating impacts on fish and aquatic resources included comparisons of impacts of the Applicant Proposed Route to impacts of the HVDC alternative routes. Within the applicable ROI, the analysis assessed Project activities that could potentially impact aquatic species and their habitats. Potential impacts to aquatic resources that were evaluated included stream crossings that fall within the ROI and soil disturbance with the potential to increase erosion and sedimentation into nearby waterbodies. The Project crosses or runs parallel to multiple surface water features (e.g., perennial and intermittent streams, major waterbodies, and reservoirs, lakes, and ponds), including special interest waterbodies, within each region. Because the Project crosses or runs parallel to multiple surface water features that may provide suitable aquatic habitat, the potential occurrence of fish and aquatic invertebrate species varies greatly across the Project. To assess potential occurrences of fish and aquatic invertebrate species and to evaluate potential downstream impacts from Project activities thoroughly and adequately, the 1,000-foot-wide ROI was used to identify potential occurrences of fish and aquatic invertebrate species. Considering the mobility of fish and larval mussels, and the potential transport of sediment and hazardous materials, the 1,000-foot-wide ROI was used for comparisons of impacts of the Applicant Proposed Route to impacts of the HVDC alternative routes. The ROI is extensive enough to account for the various ranges of fish and aquatic invertebrates, including the unique and varied habitat that each species potentially occupies, as well as the potential transport of sediment and hazardous materials. The final alignment within the ROI may have different overall effects depending on location as to the number and types of streams actually crossed or paralleled by Project access roads and transmission line clearings, as well as Project activities that could impact nearby waterbodies (within or outside of the ROI). Potential impacts on aquatic resources include the following and are further discussed for each phase of the Project:

- Potential impacts on aquatic species and their habitats from construction activities, vehicles, equipment, and access roads, including road crossings such as culverts, fords, and bridges, as well increased runoff and sedimentation
- Potential impacts from permanent and temporary removal of terrestrial vegetation or temporary mechanical damage to terrestrial vegetation
- Possible spread and/or introduction of invasive plants or animals or listed noxious weed species from the use of construction equipment at waterbody crossings
- Potential impacts associated with ROW terrestrial vegetation maintenance, including the use of herbicides on terrestrial vegetation during operation of the Project
- Potential for sediment loading and introduction of chemicals from spills into aquatic habitats, causing alterations to the habitat or the acute or chronic effects of hazardous chemicals
- Potential changes to stream morphology due to adjacent riparian clearing

The Applicant has developed a comprehensive list of EPMs that would cover the mitigation necessary to avoid or minimize impacts to fish and aquatic invertebrates. Implementation of these EPMs is assumed throughout the impact analysis that follows for the Project. A complete list of EPMs for the Project is provided in Appendix F. General EPMs for the Project that relate to fish and aquatic resources include the following:

- GE-1: Clean Line will train personnel on health, safety, and environmental matters. Training will include practices, techniques, and protocols required by federal and state regulations and applicable permits.
- GE-3: Clean Line will minimize clearing vegetation within the ROW, consistent with a Transmission Vegetation Management Plan filed with NERC, and applicable federal, state, and local regulations. The TVMP may require additional analysis under NEPA depending on whether and under what conditions DOE decides to participate in the Project.
- GE-5: Any herbicides used during construction and operations and maintenance will be applied according to label instructions and any federal, state, and local regulations.

- GE-7: Roads not otherwise needed for maintenance and operations will be restored to preconstruction conditions. Restoration practices may include decompacting, recontouring, and re-seeding. Roads needed for maintenance and operations will be retained.
- GE-9: Clean Line will avoid and/or minimize damage to drainage features and other improvements such as ditches, culverts, levees, tiles, and terraces; however, if these features or improvements are inadvertently damaged, they will be repaired and or restored.
- GE-10: Clean Line will work with landowners to repair damage caused by construction, operation, or maintenance activities of the Project. Repairs will take place in a timely manner, weather and landowner permitting.
- GE-11: Clean Line will conduct construction, operation, and maintenance activities to minimize the creation of dust. This may include measures such as limitations on equipment, speed, and/or travel routes utilized. Water, dust palliative, gravel, combinations of these, or similar control measures may be used. Clean Line will implement measures to minimize the transfer of mud onto public roads.
- GE-13: Emergency and spill response equipment will be kept on hand during construction.
- GE-14: Clean Line will restrict the refueling and maintenance of vehicles and the storage of fuels and hazardous chemicals within at least 100 feet from wetlands, surface waterbodies, and groundwater wells, or as otherwise required by federal, state, or local regulations.
- GE-15: Waste generated during construction or maintenance, including solid waste, petroleum waste, and any potentially hazardous materials will be removed and taken to an authorized disposal facility.
- GE-21: Clean Line will maintain construction equipment in good working order. Equipment and vehicles that show excessive emissions of exhaust gases and particulates due to poor engine adjustments or other inefficient operating conditions will be repaired or adjusted.
- GE-27: Clean Line will minimize compaction of soils and rutting through appropriate use of construction equipment (e.g., low ground pressure equipment and temporary equipment mats).
- GE-28: Hazardous materials and chemicals will be transported, stored, and disposed of according to federal, state, or local regulations or permit requirements.
- GE-30: Clean Line will minimize the amount of time that any excavations remain open.

Fish, vegetation, and wildlife EPMs for the Project that relate to fish and aquatic resources include the following:

- FVW-1: Clean Line will identify environmentally sensitive vegetation (e.g., wetlands, protected plant species, riparian areas, large contiguous tracts of native prairie) and avoid and/or minimize impacts to these areas.
- FVW-2: Clean Line will identify and implement measures to control and minimize the spread of non-native invasive species and noxious weeds.
- FVW-3: Clean Line will clearly demarcate boundaries of environmentally sensitive areas during construction to increase visibility to construction crews.
- FVW-4: If construction- and/or decommissioning-related activities occur during the migratory bird breeding season, Clean Line will work with USFWS to identify migratory species of concern and conduct pre-construction surveys for active nests for such species. Clean Line will consult with USFWS and/or other resource agencies for guidance on seasonal and/or spatial restrictions designed to avoid and/or minimize adverse effects.
- FVW-5: If construction occurs during important time periods (e.g., breeding, migration, etc.) or at close distances to environmentally sensitive areas with vegetation, wildlife, or aquatic resources, Clean Line will consult with USFWS and/or other resource agencies for guidance on seasonal and/or spatial restrictions designed to avoid and/or minimize adverse effects.

Water EPMs for the Project that relate to fish and aquatic resources include the following:

- W-1: Clean Line will avoid and/or minimize construction of access roads in special interest waters.
- W-2: Clean Line will identify, avoid, and/or minimize adverse effects to wetlands and waterbodies. Clean Line will not place structure foundations within the Ordinary High Water Mark of Waters of the United States.
- W-3: Clean Line will establish streamside management zones within 50 feet of both sides of intermittent and perennial streams and along margins of bodies of open water where removal of low-lying vegetation is minimized.
- W-4: If used, Clean Line will selectively apply herbicides within streamside management zones.
- W-5: Clean Line will construct access roads to minimize disruption of natural drainage patterns including perennial, intermittent, and ephemeral streams.
- W-6: Clean Line will not construct counterpoise or fiber optic cable trenches across waterbodies.
- W-7: Dewatering will be conducted in a manner designed to prevent soil erosion (e.g., through discharge of water to vegetated areas and/or the use of flow control devices).

In addition, the Applicant would develop and implement the following plans to avoid or minimize impacts:

- Blasting Plan—This plan will describe measures designed to minimize adverse effects due to blasting.
- Restoration Plan—This plan will describe post-construction activities to reclaim disturbed areas.
- Spill Prevention, Control and Countermeasures (SPCC) Plan—This plan will describe the measures designed to prevent, control, and clean up spills of hazardous materials
- Storm Water Pollution Prevention Plan (SWPPP)—This plan, consistent with federal and state regulations, will describe the practices, measures, and monitoring programs to control sedimentation, erosion, and runoff from disturbed areas.
- Transmission Vegetation Management Plan (TVMP)—This plan, to be filed with NERC, will describe how Clean Line will conduct work on its right-of-way to prevent outages due to vegetation. The TVMP may require additional analysis under NEPA depending on whether and under what conditions DOE decides to participate in the Project.

3.20.2.7.2 Impacts Associated with the Applicant Proposed Project

This section identifies the potential impacts on fish, aquatic invertebrates, and aquatic habitat that could occur as a result of the Project. The discussion of potential impacts is broken out into three phases of the Project: (1) construction, (2) operations and maintenance, and (3) decommissioning. The Applicant would conduct each phase of the Project in compliance with applicable state and federal laws, regulations, and permits related to environmental protection. Specific EPMs developed to avoid or minimize impacts are described in Section 3.20.2.7.1.

The impacts discussed in the sections below are common to all aspects of the Project; while the potential impacts associated with specific portions of the Project (e.g., converter stations, AC collection system, HVDC routes) are discussed separately following this general impact discussion. Both direct (i.e., impacts that result from the action and occurs at the same time and place as the action) and indirect (i.e., impacts that result from the action, but which occur later in time or farther in distance) impacts are addressed. The impacts that could result from activities related to the Project would vary in duration.

Construction Impacts

The general construction approach to the Project would be to span waterbodies, avoid placement of structures in riparian areas where possible, minimize in-water construction, and avoid or minimize the need for crossings of waterbodies with equipment or vehicles. The Applicant Proposed Project is described in Section 2.1.2 through 2.1.7. Specific EPMs developed to avoid or minimize impacts are described in Section 3.20.2.7.1.

The main cause of potential impacts on fish and aquatic resources would be ground disturbance linked to construction activities in or adjacent to rivers, streams, ponds, and wetlands. Direct construction impacts that could potentially affect fish and aquatic invertebrate species and their habitats include vegetation clearing, grading, access roads, herbicide use, and handling of fuel and lubricants at stream and river crossings. Indirect construction impacts that could potentially affect fish and aquatic invertebrate species and their habitats include vegetation clearing, grading, access roads, herbicide use, and handling of fuel and lubricants at locations where construction activities would result in sedimentation or contaminant runoff. Vegetation clearing has the potential to increase sedimentation and decrease cover. Increased sedimentation can directly or indirectly suffocate, bury, or limit feeding of fish and aquatic invertebrate species. Grading and access roads have the potential to increase sedimentation, decrease cover, and increase runoff. Increased runoff can alter stream and river hydrology and provide a mechanism for delivery of sediment, herbicides, and fuel and lubricants to streams and rivers. Inadvertent release of contaminants (e.g., oils, lubricants, and fuels that would be used while operating machinery, or herbicides that would be used to control vegetation and invasive species) introduces the potential for those contaminants to concentrate in body tissues of fish and filter-feeding mussels, which can result in death.

To avoid or minimize impacts during the construction phase of the Project, both general EPMs and those specific to fish and aquatic resources, as listed in Section 3.20.2.7.1, would be implemented. Specific to sedimentation and vegetation clearing, detailed EPMs for both construction and ROW maintenance would be in place prior to construction, specifically designed to ensure slope stability, prevent excessive soil erosion, prevent other hazardous runoff to waters, retain low-growing near-stream vegetation, and reduce sedimentation in streams (see Sections 3.14.2.7.1 and 3.20.2.7.1; see Appendix F for a complete list of EPMs). In addition, state permits would need to be obtained prior to construction, which would require that Project actions do not violate state water quality standards and further aid in the protection of aquatic resources, including food resources and spawning and rearing habitat. Furthermore, Clean Line would develop a SWPPP that would control sedimentation, erosion, and runoff, which would be consistent with the state and federal regulations. Specifically regarding increased sediment load from vegetation clearing, Clean Line has committed to maintaining a streamside management zone (EPM W-3, see Sections 2.1.7 and 3.20.2.7.1 and Appendix F of the EIS) of 50 feet on both sides of streams and waterbodies where removal of low-growing vegetation would be minimized, which would aid in protection of the stream environment and reduce the likelihood of excessive sediment loads reaching the streambed. Additionally, Clean Line would develop a TVMP, which would address how vegetation is to be managed in the ROW. The EPMs for both construction and ROW maintenance would be in place prior to construction and for which the Applicant would need approval through the state and federal permitting process. The approval process would ensure that actions with the potential to impact water and aquatic resources would be avoided or minimized.

Specific to spills and hazardous chemical exposures associated with herbicide use and handling of fuel and lubricants, the Applicant would implement EPMs GE-1, GE-5, GE-13, GE-21, and GE-28, as well as the measures that would be outlined in the required SPCCP and SWPPP to minimize these risks. These EPMs include measures that would reduce the risks of accidental spills (e.g., GE-13, GE-21, GE-28), as well as measures that would ensure that herbicides are used in accordance with labeled instructions and any federal, state, and local regulations (i.e., GE-5). In addition, a TVMP would be prepared and would address situations where herbicide use is necessary (e.g., the Applicant would evaluate herbicidal treatment options in consideration of site-specific ecological conditions, surrounding and underlying land uses, and any environmental sensitivities before selecting and applying a control). The Vegetation Program and TVMP would be developed to comply with federal, state, and local regulations and standards for reliability and ROW vegetation clearing and maintenance, including NERC Reliability Standard FAC-003-2 (NERC 2011). The Vegetation Program and TVMP would also comply with relevant regulations applicable to all lands, including, but not limited to the Clean Water Act (CWA) Sections 303(d) and 404 and the Endangered Species Act (ESA) of 1973, as amended in Section 7(a)(2). See Section 3.17 for a detailed discussion of the Vegetation Program and use of herbicides. The TVMP may require additional analysis under NEPA depending on whether and under what conditions DOE decides to participate in the Project. Furthermore, the USFWS and other resource agencies would be consulted if construction efforts occur during time periods that are important to a species (e.g., spawning) or near environmentally sensitive areas with important aquatic resources, to avoid or minimize impacts to species (EPM FVW-5). The Applicant would identify, avoid, and/or minimize adverse effects to wetlands and waterbodies (EPM W-2).

Mortality and Injury. Individual fish or aquatic invertebrates, including eggs, could suffer mortality or injury (be crushed) when in-stream excavation occurs or when vehicles or construction equipment travel through water features. Vehicular traffic at or in the vicinity of stream crossings could cause macroinvertebrates to be reduced in numbers, although they would be expected to recover post construction. To potentially avoid or minimize mortality/injury, the Applicant would minimize construction of access roads in special status waters as described in EPM W-1.

Spills of hazardous materials (e.g., diesel fuel, gasoline, oil, hydraulic fluids, cement water fluids, etc.) into aquatic habitats at crossings of the Project, including transport to downstream areas, could cause the loss or injury of individuals. In addition to direct impacts on fish or aquatic invertebrates, spilled hazardous substances could impact habitat quality and suitability. If hazardous materials reach the waterway, chemical residue could also enter the water column, resulting in hazardous conditions. To minimize the potential for direct discharge of fuels or hazardous materials into waterbodies, the Applicant would restrict refueling and maintenance of vehicles and the storage of fuels and hazardous chemicals within at least 100 feet from wetlands, surface waterbodies, and groundwater wells, or as otherwise required by federal, state, or local regulations as described under EPM GE-14.

Impacts could occur if herbicide application goes beyond its intended target through overspraying or drift with aerial applications, which could result in contact with aquatic areas. If these impacts occur at crossings of the Project, mortality of individual fish or aquatic invertebrate species could occur; likewise, if these impacts occur at downstream locations, mortality would be a potential concern. Herbicides that do not immediately enter a wetland or stream could still be transported downhill or underground into streams, rivers, or wetlands. To avoid overspray or drift, the Applicant would apply herbicides according to label instructions and any federal, state, and local regulations as described under EPM GE-5.

Short-term increases in sediment loads and turbidity within aquatic areas could result from ground disturbance due to construction, erosion, or runoff, and may potentially cause loss or injury of individual fish or aquatic invertebrate species sensitive to siltation during spawning or in other life stages. Sediment deposition in the substrate used for spawning could also alter egg development and survival. Increased sedimentation or erosion could result from in-stream excavation or work being done in adjacent uplands, affecting aquatic species at crossings of the Project or at downstream locations. Sediment entering the waterway would be deposited somewhere downstream of the construction area, and the extent of the effects would be dependent on current flow conditions, the individual river or stream path, and the composition of the substrate and soil disturbed. A SWPPP would be implemented by the Applicant that outlines corrective actions to minimize impacts related to increased sediment loads.

Clearing of forested vegetation adjacent to a waterway has the potential to increase stream temperature, which could potentially affect all stages of fish and aquatic invertebrates. Clearing of trees, shrubs, or other vegetation adjacent to or along a waterway, including in-water vegetation, can reduce the amount of cover available to species prone to hiding from prey, and could result in increased predation. The loss of vegetation along a waterway could affect the survival rate of affected fish and aquatic invertebrate species due to loss of cover (easy target for predators), loss of shade (increased water temperatures), and a decrease in food sources (loss of insect and organic matter deposition in water) (EPA 2003, 2014). Potential impacts associated with the loss of vegetation have the highest potential in Regions 3, 4, 5, and 7 where riparian vegetation is most prevalent.

Additionally, blasting associated with Project construction that occurs in or near streams has the potential to directly affect fish mortality. Fish can be affected even by blasting that does not occur directly in waterbodies. Blasting near water produces shock waves that can be lethal to fish, eggs, and larvae by rupturing swim bladders and addling egg sacs (TranBC 2000). Blasting underground produces two modes of seismic waves: 1) body waves that are propagated as compressional primary waves and shear secondary waves; and 2) surface waves produced when a body wave travels to the earth surface and is reflected back (ADF&G 1991). Seismic waves propagated from ground to water are likely less lethal to fish than those from in-water explosions because some energy is reflected or lost at ground-water interface (ADF&G 1991). To protect fish species, the best approach is to limit the instantaneous hydrostatic pressure change (resulting from nearby blasting) to levels below those known to be harmful to fish. ADF&G (1991) reported that a pressure change of 2.7 psi is the level for which no fish mortality occurs. Based on this information, ADF&G (1991) concluded that fish would sufficiently be protected from blasting on land by limiting overpressures to 2.7 psi.

Shallow bedrock is present throughout all regions of the Project, and blasting may be required in or near streams. However, if blasting is necessary, a Blasting Plan would be employed to minimize adverse effects. In addition, the Applicant would request guidance on seasonal and spatial restrictions for species in aquatic resources from the USFWS and other state resource agencies (EPM FVW-5) concerning blasting activities.

Sensory Disturbance. Direct impacts to fish and aquatic invertebrate species could occur as a result of disturbances caused by activities related to the Project. Sensory disturbances include ground vibration and visible activity, as well as any in-water work that creates pressure waves through the water, potentially injuring internal organs of fish. The presence of humans, vehicles, or equipment could cause fish and other mobile species to avoid suitable habitat by hiding under rocks or vegetation when disturbed, or cause stresses that would disrupt normal and essential life processes such as foraging and breeding. These impacts should be short-term and the aquatic species would likely resume normal behavior soon after any sensory disturbance. The Applicant would request guidance on seasonal and spatial restrictions for species in aquatic resources from the USFWS and other state resource agencies as described under EPM FVW-5.

Habitat Loss and Modification. Construction activities could cause a loss or modification of suitable habitat for foraging, spawning, and refuge habitats, all potentially impacting aquatic resources. A loss of native plants and substrates that are important to natural processes of aquatic species could result from in-stream disturbance and sediment deposition. Vegetation along streambanks provides cover for fish, stability for banks, shade, and an increase in food sources due to the deposition of insects and vegetation into the waterway. Riparian vegetation provides woody material deposited into waterways that fish can use as cover or can help form pools, and aid in stream sediment deposition and movement control. Although some habitat loss or modification would be unavoidable due to some construction activities (e.g., riparian vegetation removal) and installation of stream crossing structures (e.g., armored fords, culverts, bridges), to avoid or minimize the loss or modification of habitat, the Applicant would implement the measures described for EPMs FVW-1, FVW-2, FVW-3, and FVW-5.

If construction activities cause spills of hazardous materials and increased sediment loads, it could impact aquatic habitat. This could occur at or downstream of stream crossings, or downstream of sediment runoff from a nearby road into a stream. A spill of hazardous materials could impact water and soil conditions, thereby affecting the health of aquatic plants and nearby riparian vegetation. To avoid spills of hazardous materials, the Applicant would restrict refueling and maintenance of equipment and vehicles as described under EPMs GE-14 and GE-21. The Applicant would avoid or minimize impacts to environmentally sensitive areas as described under EPMs FVW-1, FVW-3, and FVW-5.

If herbicide application goes beyond its intended target through overspraying or drift with aerial applications, impacts could occur if contact with aquatic resources results in the damage or removal of native plants, which could cause isolated degradation of aquatic habitat. If aquatic vegetation is destroyed or altered, the essential life processes for fish and other aquatic species could be altered, including reproduction, foraging, and predator evasion. To avoid overspray or drift, the Applicant would apply herbicides according to label instructions and any federal, state, and local regulations as described under EPM GE-5.

Construction activities could cause the loss or degradation of riparian trees and herbaceous and shrubby vegetation on the banks of streams or ponds. The loss of vegetation could potentially affect habitat quality by raising the water temperature and increasing sediment loads through erosion, caused by the cutting and sloughing of banks. A considerable increase in both water temperature and the level of siltation in the water column or within the interstitial spaces of substrate could cause aquatic habitats to be suboptimal or inadequate for life processes such as breeding and result in long-term impacts. The Applicant would establish streamside management zones within 50 feet of both sides of intermittent and perennial streams and along margins of bodies of open water where removal of low-lying vegetation is minimized as described under EPM W-3.

Certain alterations of the physical condition of streambeds or banks during construction could cause changes in stream characteristics. This may result in the loss of pools or riffles, erosion of stream banks, and lessening the water quality. In-water structures and debris that normally provide cover from predators could be removed or destroyed, which could result in increased predation of aquatic species. Sedimentation could adversely affect macroinvertebrates, especially benthic organisms, through smothering, reduced filtering feeding rates, toxicity from anaerobic sediments, and increased drift rates. Turbidity within the waterbody could also result in reduced light intensity, as well as reduced dissolved oxygen levels and a change in the pH. The Applicant would avoid altering habitat to the extent practicable by following guidelines in EPMs W-1, W-2, W-3, W-5, W-6, and W-7.

Invasive Species. Construction activities could cause impacts on aquatic resources through the introduction of non-native aquatic plants and animals. Vehicles or equipment at stream crossings could potentially transfer invasive species between different streams during construction. The introduction of non-native plants could alter the habitat due to outcompeting of native plants, which are essential to the native aquatic resources. The introduction of non-native aquatic species (e.g., zebra mussels) could impact native species through competition for resources. In order to minimize impacts, the Applicant would identify, control, and minimize the spread of non-native invasive species to the extent practicable as described under EPM FVW-2. Section 3.17 discusses in detail the potential effects of invasive plant species on native habitats as well as the measures that would be taken to minimize the risk of these effects. The subsection "Construction Impacts" above and Section 3.17 discuss the use of herbicides to control invasive plant species as well as the potential effects of this herbicide use on fish and aquatic species.

Operations and Maintenance Impacts

The direct and indirect effects on fish and aquatic invertebrate resources (e.g., mortality and/or injury, disturbance, habitat loss and/or modification, invasive species) that would occur during the operations and maintenance phase of the Project would generally result from the presence of permanent Project structures, the presence of maintenance personnel and equipment in the area, and vegetation reclamation and maintenance activities that would be conducted. However, the magnitude of these effects would generally be less than what was described above for construction related impacts due to the periodic nature of the require maintenance and reclamation work (see Section 2.1.5 for a detailed description of the estimated operations and maintenance schedule).

During the operations and maintenance phase, the use of both access roads and the ROW for repair and maintenance activities could result in both direct and indirect impacts. In addition, the maintenance activity of ROW clearing in forested riparian areas could result in both direct and indirect impacts to habitat for fish and aquatic invertebrate species. The potential application of herbicides during operation of the Project could result in indirect impacts, and to a lesser extent, direct impacts. Both general EPMs and those specific to fish and aquatic resources as listed in Section 3.20.2.7.1, would be implemented to avoid or minimize impacts to fish and aquatic resources during the operations and maintenance phase of the Project. The subsection "Construction Impacts" above discusses sedimentation and vegetation clearing impacts and the EPMs that would be implemented to avoid or minimize impacts to fish and aquatic resources during the operations and maintenance phase of the Project.

Decommissioning Impacts

Decommissioning of the Project would involve methods similar to those that would be required to construct the Project. As a result, the impacts of decommissioning would be similar to those previously described for construction. The Applicant would follow the same general and resource-specific EPMs during decommissioning that would be implemented during construction. In addition, the Applicant would develop a Decommissioning Plan prior to any decommissioning actions for review and approval by the appropriate state and federal agencies.

Although decommissioning would have short-term adverse impacts to fish and aquatic invertebrate species (similar to what was discussed for construction related impacts), it is assumed that decommissioning of the Project would have long-term beneficial impacts to fish and aquatic invertebrate species and their habitats because it would remove the Project and its related impacts from the environment. However, areas disturbed by the decommissioning activities would still take time to recover from this disturbance (with disturbances in grasslands and croplands recovering within 5 years or less, and recovery in forests taking many decades).

3.20.2.7.2.1 Converter Stations and AC Interconnection Siting Areas

3.20.2.7.2.1.1 Construction Impacts

Construction impacts from the Oklahoma and Tennessee Converter Stations and associated AC Interconnection Siting Area and Tie should be minimal since no major waterbodies or streams are present within the footprint of these areas; however, there are multiple issues that could be a potential concern due to construction activities. If the converter station or AC interconnection siting area is upslope of any waterbodies, there is a potential for runoff to enter the waterway. There is a potential for weeds to spread due to vehicle usage, which could also impact waterbodies. The use of herbicides or an oil spill in areas upslope of a waterbody has the potential to enter the waterway, causing potential impacts to fish and aquatic invertebrate species (see Section 3.20.2.7.2 for a detailed discussion of potential impacts).

3.20.2.7.2.1.1.1 Oklahoma Converter Station Siting Area and AC Interconnection Siting Area

The Oklahoma Converter Station and AC Interconnection Siting Areas are located within Region 1, within the Coldwater watershed. As discussed in Sections 3.10 and 3.17, grasslands and croplands are the dominant habitat types found at these siting areas. As described in Section 3.15, no perennial streams and no major waterbodies are located within the Oklahoma Converter Station Siting Area. Coldwater Creek, a perennial stream, is within 1 mile of the Oklahoma Converter Station Siting Area. Two significant roadways are between the Oklahoma Converter Station Siting Area and Coldwater Creek. Increased sedimentation is not likely to affect Coldwater Creek due to distance and intervening infrastructure; however, if construction occurs near established intermittent waterways, there is the potential for sediment to travel downstream and cause potential impacts to fish and aquatic invertebrate species.

3.20.2.7.2.1.1.2 Tennessee Converter Station Siting Area and AC Interconnection Tie

The Tennessee Converter Station Siting Area is located within Region 7, with the AC Interconnection Tie contained entirely within the Tennessee converter station and the Shelby substation footprints. As discussed in Sections 3.10 and 3.17, croplands and pasture/hay lands are the dominant habitat types found at these siting areas. However, hardwood forests and riparian areas are also present within the ROI for the Tennessee Converter Station Siting Area. As described in Section 3.15, limited surface water features consisting of only a few drainage features, including only 0.21 mile of perennial streams, 1.5 miles of intermittent streams, and no major waterbodies are present within the Tennessee Converter Station Siting Area. Although not within the Tennessee Converter Station Siting Area, Big Creek, a perennial stream, listed as impaired in 2010 for aquatic resources (fish, shellfish, and wildlife values) borders the area.

The Tennessee converter station would be located immediately adjacent to the existing Shelby substation. Approximately 74 acres would be required for the Tennessee converter station (including access road) during construction; it is anticipated that any temporary construction areas would be contained within the footprint of the Tennessee converter station and the Shelby substation. The area contains a variety of habitats that include deciduous forest, pasture/hay, cultivated crops, and woody wetlands. Impacts to aquatic resources would likely be less if the converter station was located away from Big Creek within the croplands and pasture/hay lands, and would be greater if it was located near Big Creek in forested areas (due to the effects of long-term habitat loss from vegetation clearing; the extensive time necessary for forests to regenerate to pre-disturbance conditions and provide sediment retention, shade, and cover; and the impacts associated with edge effects in forested habitats that do not provide sedimentation retention, shade, and cover).

3.20.2.7.2.1.2 Operations and Maintenance Impacts

Potential impacts in the operations and maintenance phase of the Oklahoma and Tennessee converter stations and associated AC interconnection and tie would not substantially differ from the general discussion of operations and maintenance related to the Project, provided in Section 3.20.2.7.2. During the operations and maintenance phase, the use of both access roads and the ROW for repair and maintenance activities could result in both direct and indirect impacts.

3.20.2.7.2.1.2.1 Oklahoma Converter Station Siting Area and AC Interconnection Siting Area

Operation and maintenance activities would not result in long-term impacts to the habitats around the converter station and associated AC Interconnection siting area because no major waterbodies or perennial streams are within the siting area, and downslope streams are approximately one mile away.

3.20.2.7.2.1.2.2 Tennessee Converter Station Siting Area and AC Interconnection Tie

The operations and maintenance activities would result in permanent alteration of terrestrial habitat, but impacts to the aquatic environment could occur. The extent of impacts would depend on the location of the structures, roads, and clearing areas within the siting area. A perennial stream flows adjacent and downslope along the western side of the siting area. Placement of roads and structures that could result in increased sedimentation from operation and maintenance activities could result in long-term direct and indirect impacts to fish and aquatic invertebrate species or their habitat.

3.20.2.7.2.1.3 Decommissioning Impacts

The decommissioning of both converter stations and the AC interconnections would result in short-term impacts, especially in the form of increased sedimentation during structure and road removal, and surface re-contouring activities. Long-term impacts would benefit fish or aquatic invertebrate species and their habitat, by removing effects from operation and maintenance activities, as well as removal of road and cleared areas that impact hydrology and sedimentation. The Applicant would develop a Decommissioning Plan prior to the start of decommissioning that would be submitted for review and approval by the appropriate federal and state resources agencies.

3.20.2.7.2.2 AC Collection System

A detailed description of the AC collection system is provided in Section 2.1.2.3. Impacts for fish and aquatic invertebrate resources were evaluated for the 2-mile-wide ROI of the AC collection system routes. The 2-mile-wide ROI of the AC collection system routes was used to assess potential occurrences of fish and aquatic invertebrate species to evaluate potential downstream impacts from Project activities thoroughly and adequately. Considering the mobility of fish species with the potential to occur within the AC collection system routes, the 2-mile-wide ROI is extensive enough to account for the various ranges of fish species, including the unique and varied habitat that each species potentially occupies as well as the potential downstream transport of sediment and hazardous materials.

3.20.2.7.2.2.1 Construction Impacts

For the AC collection system routes, as stated in Section 3.20.2.7.1, the Applicant would implement EPMs to avoid or minimize effects to waterbodies, and therefore fish and other aquatic species, to the extent practicable. Table 3.20.2-2 details the miles of perennial and intermittent streams, major waterbodies, and the acres of reservoirs, lakes, and ponds found within the 2-mile-wide corridors in each of the AC collection system routes. Table 3.20.2-3 identifies the major waterbodies and associated fish species that may be encountered by each route.

Table 3.20.2-2:
Water Features Potentially Impacted within the 2-Mile-Wide Corridors of the AC Collection System Routes

AC Route Designation	Perennial Streams (miles)	Intermittent Streams (miles)	Major Waterbodies (miles)	Reservoirs, Lakes, and Ponds (acres)	Impacts to Fish that would be unique to this Route
E-1	9.17	100.18	0	33.83	Along with E-2, E-3, SE-1, and SE-3, crosses Palo Duro Creek, which is considered to have impaired dissolved oxygen for fish and wildlife propagation/warm water aquatic community
E-2	13.47	100.05	0.07	148.99	Along with E-1, E-3, SE-1, and SE-3, crosses Palo Duro Creek, which is considered to have impaired dissolved oxygen for fish and wildlife propagation/Warm water aquatic community
E-3	10.06	137.62	0.01	36.71	Along with E-1, E-2, SE-1, and SE-3, crosses Palo Duro Creek, which is considered to have impaired dissolved oxygen for fish and wildlife propagation/Warm water aquatic community
NE-1	24.11	32.97	0.12	141.04	Crosses Beaver River (North Canadian), OK, which is considered to have impaired dissolved oxygen for fish and wildlife propagation/Warm water aquatic community
NE-2	7.75	78.31	0.10	70.77	Crosses Beaver River (North Canadian), OK, which is considered to have impaired dissolved oxygen for fish and wildlife propagation/Warm water aquatic community
NW-1	13.05	110.93	0.09	167.26	Crosses Beaver River (North Canadian) and Coldwater (Frisco) Creek. Beaver Creek is considered to have impaired dissolved oxygen for fish and wildlife propagation/warm water aquatic community
NW-2	31.13	77.72	0.18	119.20	Crosses Beaver River (North Canadian), Goff Creek, and Coldwater (Frisco) Creek. Beaver Creek is considered to have impaired dissolved oxygen for fish and wildlife propagation/warm water aquatic community
SE-1	21.52	75.70	0.04	677.83	Along with E-1, E-2, E-3, and SE-1, crosses Palo Duro Creek, which is considered to have impaired dissolved oxygen for fish and wildlife propagation/warm water aquatic community
SE-2	0.80	26.67	0	97.95	No significant difference between this route and the other routes in regards to the types of fisheries impacts that would likely occur as a result of the route's location and position.
SE-3	14.47	98.54	0.07	768.03	Along with E-1, E-2, E-3, and SE-1, crosses Palo Duro Creek, which is considered to have impaired dissolved oxygen for fish and wildlife propagation/warm water aquatic community. Wolf Creek is crossed by the 2-mile corridor for this route and is designated as an "ecologically unique river or stream segment" and identifies as a reference stream for development of a regionalized index of biotic integrity for Texas and exhibiting high water quality and diverse benthic macroinvertebrate and fish communities
SW-1	0.97	58.06	0	14.24	No significant difference between this route and the other routes in regards to the types of fisheries impacts that would likely occur as a result of the routes' location and position.

Table 3.20.2-2:
Water Features Potentially Impacted within the 2-Mile-Wide Corridors of the AC Collection System Routes

AC Route Designation	Perennial Streams (miles)	Intermittent Streams (miles)	Major Waterbodies (miles)	Reservoirs, Lakes, and Ponds (acres)	Impacts to Fish that would be unique to this Route
SW-2	7.98	125.14	0.08	57.42	Crosses Coldwater (Frisco) Creek.
W-1	6.16	45.09	0.08	9.27	Crosses Coldwater (Frisco) Creek.

GIS Data Source: USGS (2014a)

Table 3.20.2-3:
Major Waterbodies and Potential Fish Species by AC Collection System Route

Major Waterbodies and Fish Species	AC Collection System Routes												
	E-1	E-2	E-3	NE-1	NE-2	NW-1	NW-2	SE-1	SE-2	SE-3	SW-1	SW-2	W-1
Palo Duro Creek— largemouth bass channel catfish blue catfish white crappie sunfish walleye	X	X	X					X		X			
Beaver (North Canadian) River— striped bass largemouth bass channel catfish bluegill walleye carp flathead catfish crappie white bass				X	X	X	X						
Coldwater (Frisco) Creek— striped bass walleye bluegill brown trout largemouth bass rainbow trout smallmouth bass				X	X	X	X					X	X
Goff Creek— striped bass walleye bluegill brown trout largemouth bass rainbow trout smallmouth bass							X						

Sources: TPWD (2014b), HookandBullet (2014d)

3.20.2.7.2.2.2 Operations and Maintenance Impacts

During the operations and maintenance phase for the AC collection system, potential impacts to fish and aquatic resources could occur. Potential impacts in the operations and maintenance phase would not substantially differ from the general discussion of operations and maintenance related to the Project in general in Section 3.20.2.7.2. During the operations and maintenance phase, the use of both access roads and the ROW for repair and maintenance activities could result in both direct and indirect impacts to fish and aquatic invertebrate species and their habitats.

Because the area is dominated by grasslands and croplands land cover types, shade impacts from vegetation clearing would likely be minimal; however, maintenance activities involving brush removal and road maintenance could impact streams through increases in sedimentation. The final placement of road-crossing and structures would dictate the level of potential effects operations and maintenance activities may have; highest impacts would be likely to occur where activities are adjacent to fish-bearing streams.

As discussed in Section 3.20.2.7.2.2.1, AC Collection System Route SE-3 includes a portion of Wolf Creek, which is state-designated as a Texas high quality water/exceptional aquatic life/high aesthetic value water. If an access road is required to cross Wolf Creek, additional requirements would be necessary to ensure no adverse impacts occurred while maintaining the access road during operations and maintenance.

3.20.2.7.2.2.3 Decommissioning Impacts

Potential short-term impacts in the decommissioning of the AC transmission lines would not substantially differ from the general discussion of decommissioning related to the Project, provided in Section 3.20.2.7.2. Long-term impacts would benefit fish or aquatic invertebrate species and their habitat by removing effects from operation and maintenance activities, as well as removal of road and cleared areas that impact hydrology and sedimentation. The Applicant would develop a Decommissioning Plan prior to the start of decommissioning that would be submitted for review and approval by the appropriate federal and state resources agencies.

During the decommissioning phase of the Project, all general EPMs and those specific to fish and aquatic resources that were implemented during the construction phase of the Project would continue to be enforced to avoid or minimize impacts to fish and aquatic resources (see Section 3.20.2.7.1 for relevant EPMs).

3.20.2.7.2.3 HVDC Applicant Proposed Route

3.20.2.7.2.3.1 Construction Impacts

The Applicant Proposed Route is described in Sections 2.1.2.2 and 2.4.2. The Applicant Proposed Route would pass through a variety of habitat types, ranging from grassland and croplands habitats to forested and riparian areas (Table 3.20.2-4). The Applicant Proposed Route within Regions 1, 2, and 6 would cross predominantly through grassland and croplands habitats. Forested and riparian habitats become more prevalent within Regions 4 and 5 (as well as within Region 3 and 7 to a lesser extent). Impacts for fish and aquatic invertebrate resources were evaluated within the ROI of the Applicant Proposed Route (1,000-foot-wide corridor). Impacts in Regions 4, 5, and, to a lesser extent, 3 and 7, associated with water temperature and sedimentation would be greater because they include forests and riparian areas with vegetation that would be cleared (Table 3.20.2-4). When considering numbers of stream crossings, stream sensitivity, or potential in-water works areas, Region 3 may have greater impacts than Regions 4 and 5 due to the miles and acres of waterbodies present.

Section 3.15 provides more details associated with perennial and intermittent streams located within the ROI that may necessitate temporary or permanent access stream crossings. Higher numbers of stream crossings increases the potential for sediment or contaminants to be introduced into waterbodies, resulting in potential impacts to aquatic areas where fish and other aquatic species may be present. In addition, Section 3.15 provides more details on the number and miles of special interest surface waters (e.g., National Wild and Scenic Rivers System, Nationwide Rivers Inventory, Oklahoma Outstanding Resource Waters, Oklahoma High Quality Waters, Oklahoma Waters of Recreational and/or Ecological Significance, Oklahoma Scenic River Areas, Arkansas Ecologically Sensitive Waters, Arkansas) that would be crossed or potentially impacted. Special interest surface waters have a high potential to provide aquatic habitat for fish and other aquatic species. These details (i.e., perennial and intermittent streams and special interest surface water) from Section 3.15 were used to develop Table 3.20.2-4 and in assessing and comparing potential impacts to fish and aquatic resources in each region and between the Applicant Proposed Project and DOE Alternatives.

As noted above, several route variations to the Applicant Proposed Route in Regions 2–7 were developed in response to public comments on the Draft EIS; they are described in detail within Appendix M and summarized in Sections 2.4.2.1–2.4.2.7. Because these route variations cross through similar types of habitats compared to the original Applicant Proposed Route, impacts from most of these route variations on fish and aquatic resources would be similar compared to what would occur as a result of the original Applicant Proposed Route. However, a few of the route variations could result in more long-term impacts to habitats given the extent of aquatic habitats or other sensitive areas that would be impacted:

- The following route variations would result in a larger area of impact to wetland habitats (see Section 3.17), thereby potentially resulting in a larger extent of long-term impacts to fish and aquatic resources and their habitats: Link 1, Variation 2, for Region 3; Link 2, Variation 1, for Region 6; and Link 1, Variation 2, for Region 7.
- The following route variations would result in a significant decrease in acreage of impact to wetland habitats compared to the original Applicant Proposed Route (see Section 3.17), thereby potentially resulting in fewer long-term impacts to fish and aquatic resources and their habitats: Link 3, Variation 1, for Region 4; Link 3, Variation 2, for Region 4; Link 1, Variation 2, for Region 5; and Link 1, Variation 2, for Region 7.
- The following route variations would potentially cross more waterbodies, thereby resulting in greater impacts to fish and aquatic resources and their habitats: Link 1, Variation 2, in Region 3 and Link 7, Variation 1, in Region 5.
- The following route variations would potentially cross fewer waterbodies, thereby resulting in fewer impacts to fish and aquatic resources and their habitats: Links 1 and 2, Variation 1, in Region 3; Link 9, Variation 1, in Region 4; Link 1, Variation 2, in Region 5; and Link 1, Variation 2, in Region 7.
- Link 3, Variation 2, in Region 4 would parallel almost four times the length of existing infrastructure compared to the original Applicant Proposed Route, thereby reducing the impacts to areas that have not already been impacted by existing infrastructure, and would cross through areas that contain fewer wetland and waterbody features compared to the original Applicant Proposed Route.

Table 3.20.2-4:
Water Features Potentially Impacted within the ROI for the Applicant Proposed Route

Region	Perennial Streams (miles)	Intermittent Streams (miles)	Major Water Bodies (miles)	Reservoirs, Lakes, Ponds (acres)	Predominant Land Cover	Surface Water Features of Special Interest Crossed
1	5.4	29.3	0.01	49.0	Grassland/herbaceous and croplands	Crosses the Beaver River and multiple tributaries
2	7.3	19.1	0.01	13.6	Grassland/herbaceous and croplands	The route crosses the Cimarron River in an area which is designated as critical habitat by USFWS and the state of Oklahoma. Also is adjacent to the North Canadian River, OK
3	55.3	36.8	0.15	214.8	Grasslands, deciduous forest, and pasture/hay	Crosses the Cimarron River, OK, and tributaries; Deep Fork, Arkansas River, OK; Lake Carl Blackwell, OK;, Eufaula Lake, OK; and Greenleaf Lake, OK
4	18.8	41.9	0.49	93.7	Pasture/hay, deciduous forest, and evergreen forest	Crosses Arkansas River, OK; Lower Illinois River, OK; Sallisaw Creek, OK; Little Lee Creek, OK; Lee Creek, OK; Briar Creek, OK; Lee Creek Reservoir, OK; source-water protection area in Robert S. Kerr Reservoir Watershed, OK; Mulberry River, AR; source-water protection area in Frog-Mulberry watershed, AR; Big Piney Creek, AR; source-water protection area in Dardanelle reservoir watershed, AR
5	11.7	46.6	0.23	70.7	Deciduous forest, pasture/hay, and evergreen forest	Illinois Bayou, AR; source-water protection area in Cadron watershed, AR; Cadron Creek, AR; source-water protection area in Little Red watershed, AR; Little Red River, AR; White River, AR
6	12.5	13.4	0.06	28.6	Croplands	Crosses Cache River and forested wetland areas include Bayou DeView, Caney Creek, L'Anguille River, and Ditches No. 10, 123, and 61, AR; and lower 10 miles of Straight Slough is designated as an Ecologically Sensitive Waterbody. AR
7	4.3	18.3	0.62	21.5	Croplands and deciduous forest	St. Francis River, AR; Mississippi River, TN

3.20.2.7.2.3.2 Operations and Maintenance Impacts

During the operations and maintenance phase for the Applicant Proposed Route, potential impacts to fish and aquatic resources could occur. Potential impacts in the operations and maintenance phase would not substantially differ from the general discussion of operations and maintenance related to the Project, provided in Section 3.20.2.7.2. The use of both access roads and the ROW for repair and maintenance activities could result in both direct and indirect impacts. In addition, the maintenance of ROW clearing in forested riparian areas could result in both direct and indirect impacts to habitat for fish and aquatic invertebrate species. The potential application of herbicides during operation of the Project could result in indirect impacts, and to a lesser extent, direct impacts. During the operations and maintenance phase of the Project, both general EPMs and those specific to fish and aquatic resources, would be implemented to avoid or minimize impacts to fish and aquatic resources. General EPMs for the Project that relate to fish and aquatic resources are defined in Section 3.20.2.7.1.

3.20.2.7.2.3.3 Decommissioning Impacts

Impacts related to the decommissioning of the HVDC portion of the Project would not substantially differ from the general discussion of decommissioning related to the Project in general (see Section 3.20.2.7.2). The short-term impacts during decommissioning of the Applicant Proposed Route would be similar to the impacts that would occur during the construction phase. Structure removal, road decommissioning, and removal of road crossings is likely to have potential impacts to fish and aquatic resources due to increased sedimentation from runoff of disturbed areas and direct impact of removal of in-stream crossing structures. The Applicant would follow the same general and resource-specific EPMs during decommissioning that would be implemented during construction. In addition, the Applicant would develop a Decommissioning Plan prior to any decommissioning actions for review and approval by the appropriate state and federal agencies.

Long-term impacts of Project decommissioning would benefit fish and aquatic invertebrate species due to removal of impacts from Project components, such as roads and road maintenance activities, as well as allowing the vegetation in any cleared ROW areas to regrow.

3.20.2.7.3 Impacts Associated with the DOE Alternatives

This section identifies the potential direct and indirect impacts on fish, aquatic invertebrates, and aquatic habitat related to the DOE Alternatives.

3.20.2.7.3.1 Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area

A detailed description of the Arkansas converter station and other terminal facilities is provided in Section 2.4.3.1. Impacts for fish and aquatic invertebrate resources were evaluated for the representative footprints of the converter station and the associated AC interconnection siting areas, as well as the designated ROI for fish and aquatic species.

3.20.2.7.3.1.1 Construction Impacts

The siting area for the Arkansas converter station and AC interconnection has been reduced since the Draft EIS, but still contains drainage features, including no perennial streams, 0.63 mile of intermittent streams, no major waterbodies, and 2.6 acres of reservoirs, lakes, and ponds. Although the siting area for the Arkansas converter station is different than that considered for the previously discussed Oklahoma and Tennessee converter stations, the ultimate footprint of the Arkansas station, if constructed, would be similar to the other stations. In addition, a new substation would be constructed that would interconnect the AC transmission line to an existing 500kV transmission line. This substation will be located near an existing transmission line in an area that is primarily grassland with some forest land. As indicated previously, the Applicant would avoid surface waters to the extent practicable for construction of the station and substation. The construction of the Arkansas converter station and AC interconnection, as well as the substation, would not likely result in any direct impacts to fish and aquatic invertebrate species or their habitat because no major waterbodies are located within the Arkansas Converter Station Alternative and AC Interconnection Siting Areas, as well as the substation. Indirect construction impacts from the Arkansas Converter Station Alternative and AC Interconnection, as well as the substation, should be minimal since no major waterbodies or perennial streams are present within the footprint of these areas; however, if either siting area is upslope of any waterbodies, there is a potential for runoff to enter the waterway. In addition, the use of herbicides or an oil spill in these areas upslope of a waterbody has the potential to enter the waterway, causing potential indirect impacts to fish and aquatic invertebrate species. To avoid overspray or drift, the Applicant would apply herbicides according to label instructions and any federal, state, and local regulations as described under EPM GE-5. To minimize the potential for direct discharge of fuels or hazardous materials into waterbodies, the Applicant would restrict refueling and maintenance of vehicles and the storage of fuels and hazardous chemicals within at least 100 feet from wetlands, surface waterbodies, and groundwater wells, or as otherwise required by federal, state, or local regulations as described under EPM GE-14.

3.20.2.7.3.1.2 Operations and Maintenance Impacts

The operations and maintenance of the Arkansas converter station and AC interconnection, as well as the substation, would not likely result in any direct impacts to fish and aquatic invertebrate species or their habitat because no major waterbodies are located within the footprint of the construction area, or within the interconnection area. During the operations and maintenance phase, if either siting area is upslope of any waterbodies, there is a potential for runoff to enter the waterway. In addition, the use of herbicides or an oil spill in these areas upslope of a waterbody has the potential to enter the waterway, causing potential indirect impacts to fish and aquatic invertebrate species. To avoid overspray or drift, the Applicant would apply herbicides according to label instructions and any federal, state, and local regulations as described under EPM GE-5. To minimize the potential for direct discharge of fuels or hazardous materials into waterbodies, the Applicant would restrict refueling and maintenance of vehicles and the storage of fuels and hazardous chemicals within at least 100 feet from wetlands, surface waterbodies, and groundwater wells, or as otherwise required by federal, state, or local regulations as described under EPM GE-14.

3.20.2.7.3.1.3 Decommissioning Impacts

The impacts during decommissioning of the Arkansas converter station and AC transmission line, as well as the substation, would be similar to the impacts occurring during the construction phase. Decommissioning would not likely result in any direct impacts to fish and aquatic invertebrate species or their habitat because no major waterbodies are located within the footprint of the construction area, or along the interconnection area. The Applicant would develop a Decommissioning Plan prior to the start of decommissioning that would be submitted for review and approval by the appropriate federal and state resources agencies.

3.20.2.7.3.2 HVDC Alternative Routes

Descriptions of the HVDC alternative routes are provided in Section 2.4.3.2. The impacts that could occur to fish and aquatic invertebrate species from construction and operation of the HVDC Applicant Proposed Route are discussed in Section 3.20.2.7.2.3. The expected types of impacts from construction and operation of the HVDC alternative routes in each region would be similar to those for the Applicant Proposed Route. However, because of differences in routing (i.e., location) the potential for impacts may be different (e.g., the route may be closer to or farther from an important stream or river crossing). The discussion in this section focuses on the differential impacts that could occur under each of the HVDC alternative routes compared to the Applicant Proposed Route. Data used in the impacts comparison comes from Section 3.15 and the Surface Water Technical Report (Clean Line 2013b).

3.20.2.7.3.2.1 Construction Impacts

This section describes construction impacts associated with the 1,000-foot-wide ROI of the HVDC alternative routes. Data used in the impacts comparison come from Section 3.15 and the Surface Water Technical Report (Clean Line 2013b). Surface water features are described within a 1,000-foot-wide corridor of the Applicant Proposed Route. The 1,000-foot-wide corridor is a conservative assessment based on potential impacts to surface water from access roads, which would likely extend beyond the ROW (Clean Line 2013b). Analyses are presented for the ROI in Regions 1 through 7. During the construction phase of the Project, the Applicant would implement the EPMs described in Section 3.20.2.7.1 to avoid or minimize impacts to fish and aquatic resources. Table 3.20.2-5 provides a comparison of water body crossings and stream lengths between the HVDC alternative routes and the corresponding links of the Applicant Proposed Route Section 3.15.5 provides for the values of stream lengths crossed by region.

As described in Appendix M, route adjustments were developed for HVDC Alternative Route 3-A, Alternative Route 5-B, Alternative Route 5-E, and Alternative Route 6-A to maintain an end-to-end route with the proposed variations to the Applicant Proposed Route. These route adjustments would cross through similar types of wetlands and habitats compared to the original HVDC alternative routes. HVDC Alternative Routes 5-E and 6-A potentially have a reduction in the number of floodplains from two to one for each route, potentially resulting in fewer impacts to fish and aquatic resources.

3.20.2.7.3.2.2 Operations and Maintenance Impacts

Direct and indirect impacts for the HVDC alternative routes would differ, depending on final location of road crossings, access roads and other ground-disturbing activities and extent of riparian clearing. Alternatives requiring maintenance riparian clearing adjacent to or crossing fish-bearing or perennial streams near fish-bearing streams are likely to have greater impacts than clearing further away from these waters. In addition, HVDC alternative routes with greater lengths of perennial and significant waterbodies within the ROW are likely to have more road-crossings once road and ROW locations have been identified. Alternatives with road locations near streams and at high grades would have greater impacts than those with roads further away and at lower grades due to increased risk of increased runoff and sediment inputs into nearby streams.

During the operations and maintenance phase of the Project, the Applicant would implement the applicable EPMs described in Section 3.20.2.7.1 to avoid or minimize impacts to fish and aquatic resources.

3.20.2.7.3.2.3 Decommissioning Impacts

Decommissioning impacts for the HVDC transmission line would be similar to general decommissioning impacts (see Section 3.20.2.7.2). Removal of infrastructure; including roads, structures, and road crossings, is likely to result in some short-term impacts due to increased sedimentation as a result of ground-disturbance. As is discussed in the general Project decommissioning impacts, long-term benefits such as allowing the vegetation to return to the ROW, removal of road and facility maintenance actions and risks, and removal of road crossings would have an overall benefit to the aquatic community relative to the Project during the operations and maintenance phase.

Table 3.20.2-5:
Summary Information related to Fish Resources for the HVDC Alternative Routes

Region	HVDC Alternative Route	Total Length of Route (miles)	Predominant Land Cover	Differences in Significant Water Body Crossings Between Alternatives and Proposed	Relative Comparison of Streamlengths within the Proposed and Alternative Routes
1	1-A	123	Grassland/ herbaceous	This alternative compares to the Applicant Proposed Route Links 2, 3, 4, and 5. Similar impacts to Applicant Proposed Route; however, includes Sand Creek (listed for DO impairment for Fish and Wildlife/Warm Water Aquatic Community), and does not include Clear Creek nor Otter Creek (both listed for Fish and Wildlife/Warm Water Aquatic Community—Benthic macroinvertebrate bioassessment). This alternative would not cross the impaired section Beaver River (North Canadian), OK—listed for lead impairments for fish consumption.	HVDC Alternative Route 1-A has the highest mileage of intermittent streams, but the lowest mileage of perennial streams compared to the other HVDC route alternatives and the Applicant Proposed Route. The corresponding links of the Applicant Proposed Route have a higher value for perennial streams and reservoirs, lakes, and ponds, but a lower value for intermittent streams and major waterbodies.
	1-B	52	Grassland/herb aceous	This alternative compares to the Applicant Proposed Route Links 2 and 3. Similar impacts to Applicant Proposed Route; however, does not include Clear Creek nor Otter Creek (both listed for Fish and Wildlife/Warm Water Aquatic Community—Benthic macroinvertebrate bioassessment), nor Beaver River (North Canadian), OK—listed for lead impairments for fish consumption.	HVDC Alternative Route 1-B has the lowest acreage of reservoirs, lakes, and ponds compared to the other HVDC route alternatives and the Applicant Proposed Route. The corresponding links of the Applicant Proposed Route have a higher value for intermittent streams, but a lower value for perennial streams, major waterbodies, and reservoirs, lakes, and ponds.
	1-C	52	Grassland/ herbaceous	This alternative compares to the Applicant Proposed Route Links 2 and 3. Similar impacts to Applicant Proposed Route; however, does not include Clear Creek nor Otter Creek (both listed for Fish and Wildlife/Warm Water Aquatic Community—Benthic macroinvertebrate bioassessment), nor Beaver River (North Canadian), OK—listed for lead impairments for fish consumption.	The corresponding links of the Applicant Proposed Route have a higher value for intermittent streams and major waterbodies, but a lower value for perennial streams and reservoirs, lakes, and ponds.
	1-D	33.5	Grassland/herb aceous	This alternative compares to the Applicant Proposed Route Links 3 and 4. Similar impacts to Applicant Proposed Route; however, does not include Otter Creek (listed for Fish and Wildlife/Warm Water Aquatic Community—Benthic macroinvertebrate bioassessment), nor Beaver River (North Canadian), OK—listed for lead impairments for fish consumption. Unlike the Applicant Proposed Route and other corresponding Alternatives, 1-D would not cross the impaired section of Palo Duro Creek, OK.	HVDC Alternative Route 1-D has the lowest mileage of intermittent streams compared to the other HVDC route alternatives and the Applicant Proposed Route. The corresponding links of the Applicant Proposed Route have a higher value for perennial streams, intermittent streams, and reservoirs, lakes, and ponds. Mileage of major waterbodies is equal for both the Applicant Proposed Route and HVDC Alternative Route 1-D.

Table 3.20.2-5:
Summary Information related to Fish Resources for the HVDC Alternative Routes

Region	HVDC Alternative Route	Total Length of Route (miles)	Predominant Land Cover	Differences in Significant Water Body Crossings Between Alternatives and Proposed	Relative Comparison of Streamlengths within the Proposed and Alternative Routes
2	2-A	57	Grassland/ herbaceous	This alternative compares to the Applicant Proposed Route Link 2. Alternative crosses additional impaired water bodies under the Fish and Wildlife Propagation/Warm Water Aquatic Community: Main Creek, OK; Griever Creek, OK; and Cottonwood Creek, OK. Unlike the Applicant Proposed Route, this Alternative would not cross the impaired sections of Buffalo Creek, OK (listed for Fish and Wildlife Propagation/Warm Water Aquatic Community—dissolved oxygen impairment), nor the impaired section of the Cimarron River, OK (Fish and Wildlife Propagation/Warm Water Aquatic Community—selenium impairment; Agriculture—sulfates, total dissolved solids, and chloride impairments).	HVDC Alternative Route 2-A has the highest mileage and acreage for perennial streams, major waterbodies, and reservoirs, lakes, and ponds compared to the other Region 2 alternatives and the Applicant Proposed Route, but the lowest mileage of intermittent streams. The corresponding links of the Applicant Proposed Route have a higher value for intermittent streams, but a lower value for perennial streams, major waterbodies, and reservoirs, lakes, and ponds. HVDC Alternative Route 2-A includes a portion of the Cimarron River, designated as critical habitat by the USFWS and the state of Oklahoma. If an access road were to be required within an area designated as critical habitat, the effects of such access road would be the subject of a consultation with USFWS pursuant to Section 7 of the ESA.
	2-B	30	Croplands	This alternative compares to the Applicant Proposed Route Link 3. Similar impacts to the Applicant Proposed Route; however, would not cross impaired section of Cimarron River, OK (Fish and Wildlife Propagation/Warm Water Aquatic Community—selenium impairment; Agriculture—sulfates, total dissolved solids, and chloride impairments).	The corresponding links of the Applicant Proposed Route have a higher value for intermittent streams, but a lower value for perennial streams and reservoirs, lakes, and ponds. Mileage of major waterbodies is equal for both the Applicant Proposed Route and Alternative Route 2-B. Unlike the Applicant Proposed Route and Alternative 2-A, this Alternative would not cross designated critical habitat on the Cimarron River.
3	3-A	38	Grassland/ herbaceous and deciduous forest	This alternative compares to the Applicant Proposed Route Link 1. Unlike the Applicant Proposed Route, this Alternative would not cross Cushing Lake, OK (Surface Water of Special Interest), nor would it cross the following impaired waterbody sections listed for Fish and wildlife impairments Skeleton Creek, Sillwater Creek. This Alternative crosses an additional Surface Water of Special Interest: Lake Carl Blackwell, OK.	The corresponding links of the Applicant Proposed Route has a higher value for intermittent streams and major waterbodies, but a lower value for perennial streams and reservoirs, lakes, and ponds. This Alternative has the highest mileage for perennial streams of any Alternative, but lowest mileage of intermittent streams (same value as 3-B).
	3-B	48	Grassland/ herbaceous and deciduous forest	This alternative compares to the Applicant Proposed Route Links 1, 2, and 3. Unlike the Applicant Proposed Route, this alternative would not cross Cushing Lake, OK (Surface Water of Special Interest), nor would it cross the following impaired waterbody sections listed for Fish and wildlife impairments: Skeleton Creek. This Alternative crosses an additional Surface Water of Special Interest: Lake Carl Blackwell, OK.	HVDC Alternative Route 3-B has the second highest mileage and acreage for perennial streams, and highest mileage for reservoirs, lakes, and ponds compared to the other Region 3 alternatives and the Applicant Proposed Route, but the lowest mileage for intermittent streams (same as 3-A) and major waterbodies. The corresponding links of the Applicant Proposed Route has a higher value for intermittent streams and major waterbodies, but a lower value for perennial streams and reservoirs, lakes, and ponds.

Table 3.20.2-5:
Summary Information related to Fish Resources for the HVDC Alternative Routes

Region	HVDC Alternative Route	Total Length of Route (miles)	Predominant Land Cover	Differences in Significant Water Body Crossings Between Alternatives and Proposed	Relative Comparison of Streamlengths within the Proposed and Alternative Routes
	3-C	122	Grassland/ herbaceous deciduous forest and pasture/hay	This Alternative compares to the Applicant Proposed Route Links 3, 4, 5, and 6. This Alternative would not cross the following impaired waterbody sections listed for Fish and wildlife impairments: Skeleton Creek, OK; Stillwater Creek, OK. This Alternative would cross the following additional stream sections listed fish and wildlife impairments: Butler Creek, OK; Dirty Creek, OK	HVDC Alternative Route 3-C has the highest mileage for intermittent streams compared to the other Region 3 alternative routes and the Applicant Proposed Route, but the lowest acreage of reservoirs, lakes, and ponds. The corresponding links of the Applicant Proposed Route has a higher value for perennial streams, major waterbodies, and reservoirs, lakes, and ponds, but a lower value for intermittent streams.
	3-D	39	Primarily pasture/hay and deciduous forest and grassland/ herbaceous	This Alternative compares to the Applicant Proposed Route Links 5 and 6. Unlike the Applicant Proposed Route, this Alternative would not cross Cushing Lake, OK (Surface Water of Special Interest). This Alternative would not cross the following impaired waterbody sections listed for Fish and wildlife impairments: Skeleton Creek, OK; Stillwater Creek, OK. This Alternative would cross the following additional stream sections listed fish and wildlife impairments: Butler Creek, OK; Dirty Creek, OK.	The corresponding links of the Applicant Proposed Route has a higher value for perennial streams and major waterbodies, but a lower value for intermittent streams and reservoirs, lakes, and ponds.
	3-E	8.5	Pasture/hay and deciduous forest	This Alternative compares to the Applicant Proposed Route Link 6. Unlike the Applicant Proposed Route, this Alternative would not cross Cushing Lake, OK (Surface Water of Special Interest). This Alternative would not cross Skeleton Creek, OK; listed for fish and wildlife impairments. This Alternative would cross the following additional stream sections listed fish and wildlife impairments: Dirty Creek, OK.	HVDC Alternative Route 3-E has the highest mileage of waterbodies compared to the other Region 3 alternatives and the similar mileage as the Applicant Proposed Route. The corresponding links of the Applicant Proposed Route has a lower value for perennial streams, intermittent streams, and reservoirs, lakes, and ponds. Mileage of major waterbodies is equal for both the Applicant Proposed Route and Alternative Route 3-E.
4	4-A	58	Deciduous forest and pasture/hay	This Alternative compares to the Applicant Proposed Route Links 3, 4, 5, and 6. Additional Surface Waters of Special Interest are crossed: Bushy Creek, OK; Webbers Creek, OK; and two additional source-water protection area crossings in the Frog-Mulberry watershed. It does not cross Briar Creek, OK or Lee Creek Reservoir, OK.	HVDC Alternative Route 4-A has the lowest total mileage of waterbodies compared to the other Region 4 alternatives and the Applicant Proposed Route. The corresponding links of the Applicant Proposed Route have a higher value for perennial streams, intermittent streams, major waterbodies, and reservoirs, lakes, and ponds.

Table 3.20.2-5:
Summary Information related to Fish Resources for the HVDC Alternative Routes

Region	HVDC Alternative Route	Total Length of Route (miles)	Predominant Land Cover	Differences in Significant Water Body Crossings Between Alternatives and Proposed	Relative Comparison of Streamlengths within the Proposed and Alternative Routes
	4-B	79	Deciduous forest and pasture/hay	This alternative compares to the Applicant Proposed Route Links 2–8. Additional Surface Waters of Special Interest are crossed: Bushy Creek, OK; and two additional source-water protection area crossings in the Frog-Mulberry watershed. It does not cross Briar Creek, OK; Lee Creek Reservoir, OK; or the source-water protection area crossing in the Robert S. Kerr Reservoir watershed.	HVDC Alternative Route 4-B has the lowest mileage and acreage of perennial streams and reservoirs, lakes, and ponds compared to the other Region 4 alternatives and the Applicant Proposed Route, but the highest mileage of intermittent streams. The corresponding links of the Applicant Proposed Route have a higher value for perennial streams, major waterbodies, and reservoirs, lakes, and ponds, but a lower value for intermittent streams.
	4-C	3	Deciduous forest and pasture/hay	This alternative compares to the Applicant Proposed Route Link 5. This alternative does not vary significantly in Surface Waters of Special Interest Crossed (does not crossing the source-water protection area crossing in the Robert S. Kerr watershed).	HVDC Alternative Route 4-C has the highest mileage of perennial streams and waterbodies compared to the other Region 4 alternatives and the Applicant Proposed Route. The corresponding links of the Applicant Proposed Route have a higher value for intermittent streams, but a lower value for perennial streams and reservoirs, lakes, and ponds. Mileage of major waterbodies is equal for both the Applicant Proposed Route and HVDC Alternative Route 4-C.
	4-D	25	Pasture/hay and deciduous forest	This alternative compares to the Applicant Proposed Route Link 4. This alternative does not vary significantly in Surface Waters of Special Interest Crossed; however it does have two additional crossings in the source-water protection area for the Frog-Mulberry watershed.	HVDC Alternative Route 4-D has the second-lowest mileage of perennial streams, but second highest mileage for reservoirs, lakes, and ponds, compared to the other Region 4 alternatives and the Applicant Proposed Route. The corresponding links of the Applicant Proposed Route has a higher value for perennial streams and major waterbodies, but a lower value for intermittent streams and reservoirs, lakes, and ponds.
	4-E	37	Pasture and evergreen forest	This alternative compares to the Applicant Proposed Route Links 8 and 9. This alternative has one additional crossing of a Surface water of special interest: a crossing of a source-water protection area intake stream in the Dardanelle Reservoir watershed.	HVDC Alternative Route 4-E has the lowest mileage of intermittent streams compared to the other Region 4 alternatives and the Applicant Proposed Route, but it the highest acreage of reservoirs, lakes, and ponds. The corresponding links of the Applicant Proposed Route have a higher value for perennial streams, intermittent streams, and major waterbodies, but a lower value for reservoirs, lakes, and ponds.
5	5-A	13	Evergreen forest and deciduous forest	This alternative compares to the Applicant Proposed Route Link 1. No significant difference in significant surface water crossings.	HVDC Alternative Route 5-A has the lowest mileage of waterbodies (along with HVDC Alternative Route 5-E) compared to the other Region 5 alternatives and the Applicant Proposed Route. The corresponding links of the Applicant Proposed Route have a higher value for perennial streams, major waterbodies, and reservoirs, lakes, and streams, but a lower value for intermittent streams.

Table 3.20.2-5:
Summary Information related to Fish Resources for the HVDC Alternative Routes

Region	HVDC Alternative Route	Total Length of Route (miles)	Predominant Land Cover	Differences in Significant Water Body Crossings Between Alternatives and Proposed	Relative Comparison of Streamlengths within the Proposed and Alternative Routes
	5-B	71	Pasture/hay and deciduous forest	This alternative compares to the Applicant Proposed Route Links 3, 4, 5, and 6. Additional crossings: East Fork Cadron Creek, AR; Cypress Creek, AR (fisheries impaired for copper and zinc), and West Fork Point Remove Creek, AR (Turbidity impairment).	HVDC Alternative Route 5-B has the highest mileage of perennial streams and intermittent streams compared to the other Region 5 alternatives and the Applicant Proposed Route. The corresponding links of the Applicant Proposed Route have a lower value for perennial streams, intermittent streams, major waterbodies, and reservoirs, lakes, and ponds.
	5-C	9	Deciduous forest) and pasture/hay	This alternative compares to the Applicant Proposed Route Links 6 and 7. No additional crossings of water bodies of special interest.	HVDC Alternative Route 5-C has the lowest mileage of perennial streams and intermittent streams compared to the other Region 5 alternatives and the Applicant Proposed Route, but the highest mileage of major waterbodies. The corresponding links of the Applicant Proposed Route have a higher value for perennial streams and intermittent streams, but a lower value for major waterbodies and reservoirs, lakes, and ponds.
	5-D	22	Deciduous forest and croplands	This alternative compares to the Applicant Proposed Route Link 9. Additional crossings: Departee Creek, AR.	HVDC Alternative Route 5-D has the highest acreage of reservoirs, lakes, and ponds compared to the other Region 5 alternatives and the Applicant Proposed Route. The corresponding links of the Applicant Proposed Route have a lower value for perennial streams, intermittent streams, major waterbodies, and reservoirs, lakes, and ponds.
	5-E	36	Pasture/hay and deciduous forest	This alternative compares to the Applicant Proposed Route Links 4, 5, and 6. Additional crossing: East Fork Cadron Creek, AR.	HVDC Alternative Route 5-E has the lowest mileage of major waterbodies (along with 5-A) and the lowest acreage of reservoirs, ponds, and lakes compared to the other Region 5 alternatives and the Applicant Proposed Route. The corresponding links of the Applicant Proposed Route have a higher value for major waterbodies and reservoirs, lakes, and ponds, but a lower value for perennial streams and intermittent streams.
	5-F	22	Pasture/hay and deciduous forest	This alternative compares to the Applicant Proposed Route Links 5 and 6. Additional crossings: East Fork Cadron Creek, AR.	The corresponding links of the Applicant Proposed Route have a higher value for major waterbodies and reservoirs, lakes, and ponds, but a lower value for perennial streams and intermittent streams.
6	6-A	16	Croplands	This alternative compares to the Applicant Proposed Route Links 2, 3, and 4. No significant difference from the Applicant Proposed Route.	HVDC Alternative Route 6-A has the lowest acreage of reservoirs, lakes, and ponds compared to the other Region 6 alternatives and the Applicant Proposed Route. The corresponding links of the Applicant Proposed Route have a higher value for perennial streams, intermittent streams, major waterbodies, and reservoirs, lakes, and ponds.

Table 3.20.2-5:
Summary Information related to Fish Resources for the HVDC Alternative Routes

Region	HVDC Alternative Route	Total Length of Route (miles)	Predominant Land Cover	Differences in Significant Water Body Crossings Between Alternatives and Proposed	Relative Comparison of Streamlengths within the Proposed and Alternative Routes
	6-B	14	Croplands and woody wetlands	This alternative compares to the Applicant Proposed Route Link 3. No significant difference from the Applicant Proposed Route.	HVDC Alternative Route 6-B has the highest acreage of reservoirs, lakes, and ponds compared to the other Region 6 alternatives and the Applicant Proposed Route. The corresponding links of the Applicant Proposed Route have a higher value for perennial streams and major waterbodies, but a lower value for intermittent streams and reservoirs, lakes, and ponds.
	6-C	23	Croplands	This alternative compares to the Applicant Proposed Route Links 6 and 7. This alternative would not cross the L'Anguille River, AR, which is listed on the National Park Service Nationwide Rivers Inventory.	HVDC Alternative Route 6-C has the lowest mileage of perennial streams, intermittent streams, and major waterbodies compared to the other Region 6 alternatives and the Applicant Proposed Route. The corresponding links of the Applicant Proposed Route have a higher value for perennial streams, intermittent streams, and major waterbodies, but a lower value for reservoirs, lakes, and ponds.
	6-D	9	Croplands	This alternative compares to the Applicant Proposed Route Link 7. No significant difference between from the Applicant Proposed Route.	HVDC Alternative Route 6-D has the highest mileage of perennial streams and intermittent streams compared to the other Region 6 alternatives and the Applicant Proposed Route. The corresponding links of the Applicant Proposed Route have a higher value for major waterbodies, but a lower value for perennial streams and intermittent streams. Acreage of reservoirs, lakes, and ponds is equal for both the Applicant Proposed Route and HVDC Alternative Route 6-D.
7	7-A	43	Croplands and woody wetlands	This alternative compares to the Applicant Proposed Route Link 1. No significant difference from the Applicant Proposed Route.	HVDC Alternative Route 7-A has the highest values for all of these areas compared to the other Region 7 alternatives and the Applicant Proposed Route. The corresponding links of the Applicant Proposed Route have a lower value for perennial streams, intermittent streams, major waterbodies, and reservoirs, lakes, and ponds.
	7-B	9	Croplands, deciduous forest, and pasture/hay and shrub/scrub	This alternative compares to the Applicant Proposed Route Links 3 and 4. No significant difference from the Applicant Proposed Route.	HVDC Alternative Route 7-B has the lowest mileage of perennial streams and intermittent streams compared to the other Region 7 alternatives and the Applicant Proposed Route. The corresponding links of the Applicant Proposed Route have a higher value for perennial streams, intermittent streams, and reservoirs, lakes, and ponds. Mileage of major waterbodies is equal for both the Applicant Proposed Route and HVDC Alternative Route 7-B.

Table 3.20.2-5:
Summary Information related to Fish Resources for the HVDC Alternative Routes

Region	HVDC Alternative Route	Total Length of Route (miles)	Predominant Land Cover	Differences in Significant Water Body Crossings Between Alternatives and Proposed	Relative Comparison of Streamlengths within the Proposed and Alternative Routes
	7-C	24	Croplands, pasture/hay, and deciduous forest	This alternative compares to the Applicant Proposed Route Links 3, 4, and 5. No significant difference from the Applicant Proposed Route.	HVDC Alternative Route 7-C has the lowest acreage of reservoirs, lakes, and ponds compared to the other Region 7 alternatives and the Applicant Proposed Route. The corresponding links of the Applicant Proposed Route have a higher value for perennial streams, and reservoirs, lakes, and ponds, but a lower value for intermittent streams. Mileage of major waterbodies is equal for both the Applicant Proposed Route and HVDC Alternative Route 7-C.
	7-D		Croplands, pasture/hay, and shrub/scrub	This alternative compares to the Applicant Proposed Route Links and 5. No significant difference from the Applicant Proposed Route.	The corresponding links of the Applicant Proposed Route have a higher value for intermittent streams and reservoirs, lakes, and ponds, but a lower value for perennial streams. Mileage of major waterbodies is equal for both the Applicant Proposed Route and HVDC Alternative Route 7-D.

This page intentionally left blank.

3.20.2.7.4 Best Management Practices

The Applicant has developed a list of EPMs intended to avoid or minimize impacts to fish or aquatic invertebrate species. A complete list of EPMs for the Project is provided in Appendix F; those EPMs that would specifically minimize the potential for impacts to fish or aquatic invertebrates are summarized in Section 3.20.2.7.1. In addition to these EPMs, DOE has identified a BMP that would expand EPM FVW-2 to include the following:

- The Applicant will identify, control, and minimize the spread of non-native, invasive species and noxious weeds to the extent practicable, including ensuring that in-water equipment and vehicles are cleaned between waterbodies to minimize the chance of transferring non-native species between waterbodies.

This BMP would be warranted because without proper implementation of EPM FVM-2, the spread of non-native, invasive species (e.g., zebra mussels) could cause adverse impacts through competition with native species for limited resources. The spread of non-native plants could cause habitat alteration if native plants are outcompeted; many of which are necessary to native aquatic fish and aquatic invertebrates. If in-water equipment and vehicles are not cleaned between use if different waterbodies, and non-native species are transferred between waterbodies, native species could be outcompeted for resources or lose habitat critical to their survival, and potentially be eliminated from a waterbody.

3.20.2.7.5 Unavoidable Adverse Impacts

The Applicant would implement EPMs to avoid or minimize impacts; however, some adverse impacts would occur even with the implementation of the measures. Unavoidable impacts include the potential loss or alteration of aquatic habitat in smaller streams that may require culverts or vehicle crossings, potential loss or disturbance to riparian vegetation along streams on private or public lands where the ROW is adjacent to the stream, and potential short-term sedimentation effects on aquatic resources as a result of vehicular traffic causing disturbances within or adjacent to streams. Although these impacts have the potential to occur, the likelihood of occurrence would be limited through implementation of the EPMs.

3.20.2.7.6 Irreversible and Irretrievable Commitment of Resources

The potential long-term loss or alteration of aquatic habitat in smaller streams that may require road crossings would last throughout the life of the Project, or at least through the duration of use of the access roads; however, gradual recovery of habitat may occur once the road crossing was removed and the stream restored to original conditions. There is the potential that the loss or alternative of aquatic habitat could be permanent because the exact state of recovery is not known (e.g., substantial changes related to climate, land-use, and/or watershed hydrology may occur during the 80 year lifespan of the Project), and aquatic habitat is subject to long-term climatic regimes and changes in land-use and watershed hydrology. Therefore, it is reasonable to assume that some portions of the aquatic habitat for fish and aquatic invertebrate species in these smaller streams would be irreversibly and irretrievably impacted.

3.20.2.7.7 Relationship between Local Short-term Uses and Long-term Productivity

The Project would result in a short-term disturbance to aquatic resources; however, these impacts should not affect the long-term productivity of populations of fish and other aquatic species. The short-term impact of introducing non-native invasive species would be negligible; however, over time, long-term productivity would be affected and species could be eliminated from their native habitat.

3.20.2.7.8 Impacts from Connected Actions

3.20.2.7.8.1 Wind Energy Generation

A wind farm has multiple possible components: wind turbine generators, underground collection cables, substations, generation tie lines, operations and maintenance buildings, meteorological towers, new permanent access roads, and temporary workspaces. The new access roads potentially cross streams, drainages, or waterways. Wind farm construction could require stormwater controls such as ditches, which could alter natural drainage patterns (Clean Line 2014). New culverts may be installed across small streams or natural drainages (Clean Line 2014). Construction of the access roads may also require the removal of vegetative cover, which could impact aquatic species and their habitats. The WDZs contains multiple perennial waterbodies in Oklahoma and Texas. Important recreational fish species and aquatic invertebrates potentially occur within the WDZs.

Impacts to aquatic resources could occur from construction activities including vegetation clearing, grading, construction and use of access roads, herbicide use, and fuel and lubricant handling. Potential impacts can be classified into three categories: mortality/injury, sensory disturbance, and habitat loss/modification. Impacts would be similar to general impacts from construction described above in Section 3.20.2.7.2.

3.20.2.7.8.2 Optima Substation

As there are no waterbodies within the location for the future Optima Substation, there would be no impacts to fish and aquatic invertebrate species.

3.20.2.7.8.3 TVA Upgrades

Potential impacts of concern to fish and aquatic invertebrate species from the required TVA upgrades, like the Project, could include mortality of individuals, sensory disturbance, and aquatic habitat disturbance or modification by construction or operations and maintenance activities associated with the new transmission line. Generally, the construction or operations and maintenance of the new 500kV transmission line, would have impacts similar to the Project, although on a smaller scale. These impacts may include mechanical damage and/or removal of vegetation by heavy machinery, potential introduction of invasive species from construction equipment or spread of existing invasive species, alteration of hydrology during road construction, which could affect fish and aquatic invertebrate species habitat, sedimentation from grading, access roads, and stream crossings, and contamination from herbicide drift or runoff or from accidental spills of fuels or lubricants that could cause mortality or injury of fish and aquatic invertebrate species. These potential impacts would be short term except for habitat loss at sites used for access (i.e., roads and stream crossings) and fish and aquatic invertebrate species mortality.

The required TVA upgrades to existing facilities (including existing transmission lines and existing substations) would require fewer construction activities to complete than the new 500kV transmission line. Existing TVA facilities already experience operations and maintenance activities. As a result, potential impacts would be expected to be less substantial in areas affected by upgrades to existing TVA facilities than in areas where the new 500kV transmission line would be constructed.

TVA would consider potential impacts to fish and aquatic invertebrate species and their habitats during the siting of the new 500kV transmission line and while planning the upgrades to existing transmission facilities. TVA would avoid impacts to these species and their habitats to the extent practicable.

3.20.2.7.9 Impacts Associated with the No Action Alternative

Under the No Action Alternative, DOE assumes for analytical purposes that the Project would not be constructed. Impacts to fish and aquatic invertebrate species and their habitats would be consistent with current levels of disturbance related to natural conditions in the environment, such as annual changes in stream flow, erosion, and wildfires. No disturbances would occur due to the Project, including disturbances in waterbodies that could affect fish and aquatic invertebrate species and their habitats. No disturbances related to construction vehicles, equipment, or access roads would affect aquatic resources. No impacts related to the Project would occur related to the removal of vegetation or the use of herbicides.

This page intentionally left blank.

Contents

Tables

Figures Presented in Appendix A

4. Cumulative Impacts

Cumulative impacts result from the "incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions"; they can result from "individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7). This chapter describes the identification of past, present, and reasonably foreseeable future actions and provides an evaluation of potential cumulative impacts. Because of the nature of the past, present, and reasonably foreseeable future actions identified, available quantitative data on their potential environmental impacts are limited and, as a result, primarily qualitative evaluations of potential cumulative impacts are presented in this chapter.

Section 4.1 provides broad criteria for identifying actions that could cause cumulative impacts when combined with those of the Project. Section 4.2 presents specific criteria used to identify projects of potential interest, which are then presented by the regions used to define and evaluate the Project in Chapter 3. Section 4.3 presents cumulative impacts, and an overview of the methodology for evaluating cumulative impacts is presented in Section 4.3.1. Sections 4.3.2 through 4.3.20 provide the cumulative impacts for each of the environmental resource areas evaluated in Chapter 3. Numbering of the resource area evaluations (Sections 4.3.2 through 4.3.20) corresponds with numbering of resource area evaluations in Chapter 3 (Sections 3.2 through 3.20) for ease of reference.

4.1 Physical and Temporal Boundaries of Cumulative Impacts

The potential for cumulative impacts depends on both spatial and temporal factors within the environment, which can vary among resource areas. For example, the geographical ROI for cumulative impacts could be limited to the area of disturbance for soil resources but include all vantage points for visual resources. The geographic ROI for cumulative impacts includes the locations in which direct and indirect impacts of the Project would occur on all resource areas; i.e., the locations of the ROIs described for each resource area in Chapter 3. The topic of cumulative impact ROIs and how they might compare with the Project ROIs is addressed further in Section 4.1.1.1. Because the Project ROIs vary by resource area and because the ROI for cumulative impacts can be more extensive than for just the Project, a conservatively large geographic area was evaluated using professional judgment when attempting to identify the past, present, and reasonably foreseeable future actions for the cumulative impacts evaluation.

The temporal boundaries of cumulative impacts are generally defined by the Project's construction phase and operations and maintenance phase (i.e., about 36 to 42 months for construction and an expected 80 years, or more, for operations and maintenance), which could begin as early as 2016. Past, present, and reasonably foreseeable future actions with elements coinciding or overlapping with that timeframe, as well as satisfying spatial criteria, would frame the actions with potential to have cumulative impacts with the Project. For most resource areas, the potential impacts evaluated in Chapter 3 are dominated by those that might occur during the Project's construction. If past, present, and reasonably foreseeable future actions are of a similar nature, with impacts occurring primarily during construction, then the temporal boundaries of primary interest for an applicable resource area generally would be when construction periods coincide or overlap. This approach requires flexibility because reasonably foreseeable future actions are often not associated with firm schedules. Even in the case of the Project, starting construction as early as 2016 is only an estimate. As a result, evaluations in this chapter make the reasonably conservative assumption that other actions could possibly coincide or overlap with those of the Project unless there is information to the contrary.

4.1.1 Overview of Project and Connected Actions

As described in Chapter 2, the Applicant Proposed Project would include an overhead ±600kV HVDC electric transmission system and associated facilities. This transmission system would have the capacity to deliver approximately 3,500–4,000 MW, primarily from renewable energy generation facilities in the Oklahoma and Texas Panhandle regions, to load-serving entities in the Mid-South and Southeast United States. This would require an interconnection with TVA in Tennessee and potentially include an interconnection with the Midcontinent Independent System Operator in Arkansas.

If the decision is made to construct the Applicant Proposed Project and DOE elects to continue its participation, DOE Alternatives include an Arkansas converter station and alternative route segments for the HVDC transmission line. This chapter uses "the Project" to refer to elements of the Applicant Proposed Project and/or DOE Alternatives when differentiation between the two is not necessary and recognizing that what would be built could be a combination of project elements.

Connected actions to the Applicant Proposed Project have been identified, as described in Section 2.5, and potential impacts related to these actions are addressed by each resource area in Chapter 3. One of these connected actions includes the construction and operation of reasonably foreseeable future wind energy generation facilities that would interconnect with the Applicant Proposed Project. These wind power facilities are anticipated to be located in parts of the Oklahoma Panhandle and Texas Panhandle within approximately 40 miles of the western converter station in Texas County, Oklahoma. Clean Line anticipates that electricity generated by these facilities would constitute the majority of the transmission capacity of the transmission line. Neither Clean Line nor DOE knows the exact location of wind projects that would be connected to the Project. Further, it is foreseeable that wind power would also be developed in areas not currently under analysis in this EIS. As a result, in an attempt to provide meaningful impacts analysis of wind energy generation that would connect to the Project, Chapter 3 includes a high-level analysis of impacts from wind energy generation within an area of approximately 40 mile radius surrounding the Oklahoma Converter Station Siting Area. Within this radius, wind development would be expected to occur in Oklahoma (Beaver, Cimarron, and Texas counties) and Texas (Hansford, Ochiltree, and Sherman counties).

In addition to the wind energy generation facilities, other connected actions involve facility additions and upgrades to third-party systems that would be required to accommodate the Project. As discussed in Section 2.5.2, TVA would need to make substation and transmission line upgrades to accommodate interconnection of the Project to the TVA transmission system in Tennessee. The eastern portion of the Project would interconnect to the existing substation operated by TVA in Shelby County, Tennessee. TVA would make the necessary upgrades to its system, which would include construction of approximately 37 miles of new 500kV transmission line in western Tennessee and upgrades to approximately 350 miles of existing transmission lines, mostly in central and western Tennessee, along with modifications to several substations. These upgrades are evaluated as connected actions in this EIS and the results are also presented in Chapter 3. In addition, a future substation, tentatively named Optima, would be needed at the western end of the HVDC transmission line and would be located within a few miles of the Oklahoma converter station and partially within the Oklahoma AC Interconnection Siting Area. Construction and operation of the future Optima substation is also evaluated as a connected action in this EIS with the results presented in Chapter 3.

4.1.1.1 Region of Influence

DOE used resource-specific ROI boundaries throughout this EIS (Section 3.1). For example, the ROI for the examination of air quality and climate change impacts (Section 3.3) of the Project goes beyond the Project boundaries to encompass residential areas and schools. DOE also used a resource-based ROI to consider the cumulative effects of the Project combined with other projects.

For this reason the ROI for cumulative impacts is generally defined by the same overall ROI as described in Section 3.1 for the Project. Since the intent of defining an ROI is to bound the geographic area that potentially could be impacted, any impacts of the Project outside of a resource-specific ROI would be expected to be minimal, with negligible cumulative impacts with other actions. There are exceptions or instances where an ROI considered for cumulative impacts could be larger than that for the Project, but the ROIs described in Section 3.1 for both the Applicant Proposed Project and the DOE Alternatives provide a baseline starting point.

Several of the resource sections of Chapter 3 include modifications to the ROI described in Section 3.1. The following statements describe instances where the resource-specific ROI varies from the description of the ROI in section 3.1. If the ROI for a resource is not included below, its ROI is the same as described in Section 3.1.

Air Quality and Climate Change. As identified in Section 3.3.3, the ROI for air quality impacts is conservatively estimated at approximately 300–500 feet from the principal construction activities that would be occurring within the baseline ROIs (Applicant Proposed Project or DOE Alternatives) identified in Section 3.1. This includes areas and populations sensitive to air emissions such as residential areas and higher populations of children or elderly. It is also noted that cumulative impacts of air pollutants can extend over a much wider area than the ROI mentioned in Section 3.1. For example, air pollutants can travel relatively large distances, and when the quantities are relatively large, measurable impacts can be identified several states away or even intercontinentally. However, for emissions on the scale of the Project and the previously identified present and reasonably foreseeable future actions, the evaluation of cumulative impacts for air quality planning is typically evaluated on the scale of air quality control regions (AQCRs), which are on the scale of one or more counties, or portions of counties. For GHGs, as noted in Section 3.3.3, the impacts are on a global scale.

Electrical Environment. As presented in Section 3.4.8, the electrical environment ROI considered in this document is a total of 300 feet on either side of centerline for the HVDC transmission lines (Applicant Proposed Route and HVDC alternative routes) and AC collection system routes. As described in Section 3.4.11, electrical effects associated with AC converter stations can be reduced or eliminated by the use of various equipment and construction methods, so they were not evaluated separately from the overhead transmission lines that enter and exit the stations.

Environmental Justice. As described in Section 3.5.3, the ROI for identifying low-income and minority populations consists of the Census Blocks or Census Block Groups within or intersected by the baseline ROIs (Applicant Proposed Project or DOE Alternatives) identified in Section 3.1.

Geology, Paleontology, Minerals, and Soils. For the evaluation of geology, paleontology, and minerals, Section 3.6.1.3 adds area to the baseline ROI identified in Section 3.1. Specifically, an additional 1,500-foot buffer was added to both sides of the 1,000-foot-wide Applicant Proposed Route or HVDC alternative routes creating a 4,000-foot-wide corridor for identifying oil and gas wells and mines and a 1,500-foot buffer was added on the

Oklahoma, Tennessee, and Arkansas Converter Station Siting Areas for potential expansion of oil, gas, and mineral extraction operations. The baseline ROI elements in Section 3.1 were used for the evaluation of soils.

Groundwater. For the purpose of identifying water wells, area was added to the baseline ROIs as described in Section 3.7.3.1 to account for possible effects of blasting should it be required during construction. Specifically, the groundwater ROI includes expanding the outer bounds of the Oklahoma, Tennessee, and Arkansas converter station siting areas by 150 feet on all sides, and expanding the 1,000-foot-wide corridors of the Applicant Proposed Route and the HVDC alternative routes by 150 feet on both sides to create 1,300-foot-wide corridors.

Historic and Cultural Resources. The ROI for the evaluation of historic and cultural resources contains the same baseline elements described in Section 3.1, but for evaluating potential visual effects to historic and cultural resources, Section 3.9.3 expands the HVDC and AC transmission line routes to a 1-mile-wide corridor (i.e., a 0.5-mile zone on either side of the proposed centerline) and for converter station locations, extends the ROI outward 0.5 mile from the site.

Socioeconomics. The ROI for socioeconomics, as presented in Section 3.13.3, encompasses 33 counties in the four states where the Project components (AC converter stations, HVDC transmission lines, and the AC collection system) would be located. Twenty-nine of the 33 counties are crossed by the HVDC transmission line routes; the other four counties are only crossed by one or more of the AC collection system routes. In some cases, particularly where larger communities are located in adjacent or nearby counties, impacts would also likely occur outside the 33 counties due to the availability of services, housing, and workers. To address such instances, an additional or secondary ROI is considered in the socioeconomic impact analysis that includes portions of counties where no components of the Project would be located. This additional area consists of six MSAs that are either partially included in or adjacent to the primary ROI. The potentially affected MSAs are (1) Oklahoma City MSA for Region 3, (2) Tulsa MSA for Region 3, (3) Fort Smith MSA for Region 4, (4) Little Rock-North Little Rock-Conway MSA for Region 5, (5) Jonesboro MSA for Region 6, and (6) Memphis MSA for Region 7.

Special Status Wildlife and Fish Species. For special status wildlife species, Section 3.14.1.3 adds the following to the baseline ROI elements described in Section 3.1:

- Lesser prairie-chicken—A 3-mile-wide addition from each edge of the 1,000-foot-wide corridor of the Applicant Proposed Route, HVDC alternative routes, and AC collection system when they coincide with the estimated occupied range of the LEPC or known occurrences of LEPC leks.
- Whooping crane—A 15-mile-wide buffer addition from each edge of the 1,000-foot-wide corridor of the Applicant Proposed Route and the HVDC alternative routes when they are within the mapped whooping crane 95 percent migration corridor.
- Protected bat species—A 1.5-mile-wide addition from each edge of the 1,000-foot-wide corridor of the Applicant Proposed Route and the HVDC alternative routes in proximity of known occurrences of bat species designated as candidate, threatened, or endangered under the ESA.
- Interior least tern—A 5-mile-wide addition from each edge of the 1,000-foot-wide corridor of the Applicant Proposed Route and the HVDC alternative routes in proximity of known occurrences of interior least tern nesting sites.

For special status fish, aquatic invertebrate, and amphibian species, Section 3.14.2.3 adds the following to the baseline ROI elements described in Section 3.1:

- A 3-mile buffer (1.5 miles upstream and 1.5 miles downstream) is added to the 1,000-foot-wide ROI of the Applicant Proposed Route and HVDC alternative routes along waterbodies that have known occurrences of candidate, threatened, or endangered species under the ESA.

Transportation. The description of the transportation ROI (Section 3.16.3.1) incorporates the baseline ROI elements described in Section 3.1, then makes modifications as follows:

- Roadway transportation resources—A 6-mile buffer is added to each side of the centerlines of the Applicant Proposed Route, HVDC alternative routes, and the AC collection system routes.
- Railroads—Identified based on the potential encroachment within the above expanded ROI.
- Airports and airstrips—Identified based on a 4-mile-wide corridor from the HVDC transmission line and AC collection system route centerlines.

Visual Resources. As described in Section 3.18.3, the ROI for visual resources includes the baseline ROI elements described in Section 3.1, but expands the corridors associated with the transmission line routes (i.e., the Applicant Proposed Route, AC collection system routes, and HVDC alternative routes) to 6 miles, 3 miles on either side of the referenced centerline. The ROI for visual resources also includes a 3 mile buffer from the boundary of the converter stations and interconnection siting areas.

The preceding discussion is focused on the ROIs considered in the Project's affected environment and impacts discussions of Sections 3.2 through 3.20, but cumulative impacts may encompass greater areas in some instances, based on professional judgment. Air quality and surface water are examples of resource areas that could have very large ROIs for cumulative impacts when consideration is given to the distances that pollutants may travel and comingle with those from other sources. But these are also resource areas for which the Plains & Eastern Project would be expected to have only minor, if any, impacts, and these impacts would be associated primarily with construction. These are also examples in which professional judgement had a primary role in determining the size of the ROI to consider for cumulative impacts.

4.2 Past, Present, and Reasonably Foreseeable Future Actions

Past actions are those actions that occurred within the geographic ROI of cumulative impacts and have shaped the current environmental conditions in the Project regions. For the purposes of this EIS, actions that have occurred in the past and their impacts are now part of the existing environment and are included in the affected environment described in Chapter 3. As such, they are included in the cumulative impact analysis. Past actions are identified in this chapter only if it appears they may have occurred after the timeframe captured in the Chapter 3 description of the affected environment.

The following sections summarize the present and reasonably foreseeable future actions that have been identified, which may possibly contribute to cumulative impacts. Present actions include those that are currently under construction and may impact any of the same resources as the Project and that would occur in the same space and time as identified by the Project. To avoid speculating about other future actions, reasonably foreseeable future actions for this evaluation are those that are actively proposed or planned and would occur in the same space and time as identified by the Project. Actions of possible interest were first identified by looking at a broad range of actions that are occurring or might reasonably occur in the same general area as components of the Project. Counties where components of the Project would be located, as well as adjacent counties, were often used to define the general area of review. Sources used to identify possible actions included the following:

- An action was identified during the public outreach or scoping process for this EIS or during preliminary public outreach efforts by the Applicant. Other projects in a position to attract public attention or publicity (i.e., high-profile) in the local region, such as relatively large bridge, highway, or oil and gas pipeline projects, also were considered.
- An action was identified by federal or state agencies or by county planning offices during the EIS scoping process.
- A permit application for an action has been submitted to an appropriate permitting agency such as a state or local air quality agency.
- State, federal, county, or local agencies or commercial entities have publically announced an action is moving forward into more detailed planning or design (this could include the preparation of environmental review documentation).

Considering the list of actions obtained from the above sources, DOE then screened the actions based on when they could possibly occur and whether they would be located where they could impact any of the same resources as the Project. The present and reasonably foreseeable future actions identified by region in the sections below were those that passed this screening. Actions identified through public outreach or scoping or based on their high-profile nature (the first bullet above) may be addressed even if they are outside the Project ROI. Many of the actions identified in this section consist of state-planned road work. For purposes of this evaluation, it is assumed that, unless identified otherwise, the state road projects in Oklahoma, Arkansas, and Tennessee, are maintenance or rehabilitation activities performed on existing roads and structures within existing ROWs and, accordingly, do not involve areas of new land use. The information available for these projects is often limited, consisting of little more than maps of planned work areas. However, the assumption is based on what would be expected from most road projects (more maintenance than new construction), titles of projects where available (e.g., pavement rehabilitation or widen and resurface), and maps showing work locations coinciding with existing roadways. Also, reviewed maps consistently have a unique designation for locations of new road construction.

The present and reasonably foreseeable future actions are identified and described by Project region (i.e., Regions 1 through 7). The locations of these actions are provided in Figure 4.2-1 (located in Appendix A). Section 4.3 provides the cumulative impacts information for each of the environmental resource areas evaluated in Chapter 3. Cumulative impacts analysis must be conducted within the context of the resource areas. The Council on Environmental Quality (CEQ) guidance regarding the consideration of cumulative effects states: “The magnitude and extent of the effect on a resource depends on whether the cumulative effects exceed the capacity of the resource to sustain itself and remain productive” (CEQ 1997). For each resource area, the section provides a summary of the cumulative impacts that could occur from the Project and present and reasonably foreseeable future actions. The individual resource area discussions include identification of the Project region where cumulative impacts would be greatest for that resource.

Tables 4.2-1a and 4.2-1b provide a summary listing of the present and reasonably foreseeable future actions described in more detail below and the resource areas for which cumulative impacts might be expected. The actions are identified by region. Table 4.2-1a presents the first 10 resource areas and Table 4.2-1b presents the remaining nine. In the instances where a resource area does not contain a check (is blank) for a specific action, no cumulative impact is expected to occur.

The discussion of present and reasonably foreseeable future actions that follows includes identification of several proposed pipeline projects; however, it does not specifically identify all potential actions associated with the expanding natural gas industry, which is described in Section 3.6.1, for portions of Oklahoma and Arkansas (particularly Regions 4 and 5). Because of the ongoing expansion of the industry, DOE expects that present and future actions in areas affected by the Plains & Eastern Project, will include activities such as natural gas exploration, including drilling, and well construction and that the number of wells identified in Section 3.6.1 will increase. The impacts from the Plains & Eastern Project on those expanding operations is expected to be similar to those described in Section 3.6.1.

4.2.1 Region 1—Present and Reasonably Foreseeable Future Actions

Region 1 is referred to as the Oklahoma Panhandle Region and includes the Applicant Proposed Route and HVDC Alternative Routes 1-A through 1-D, as well as the Oklahoma converter station and its associated AC interconnection. The AC collection system routes are also at the western end of Region 1. The region includes Texas, Beaver, Harper, and Woodward counties in Oklahoma; and Hansford, Ochiltree, and Sherman counties in Texas. The area is primarily rural; small towns are scattered throughout the region. The wind energy generation projects that would be connected to the Project via the AC collection system routes are analyzed as connected actions in each of the resource area discussions in Chapter 3 and, as a result, are not identified here as present and reasonably foreseeable future actions.

Oklahoma Gas and Electric—OG&E has two actions in Region 1 that could have cumulative impacts with the Project, and which are summarized as follows:

- *Hitchland-Woodward 345kV Transmission Line.* OG&E recently constructed about 100 miles of new 345kV transmission line from its Woodward District Extra High Voltage Substation, located south of Woodward, Oklahoma, north and west through the Oklahoma Panhandle to a Southwestern Public Service interconnection point at the Beaver-Texas County line. The 200-foot-wide ROW corridor has steel monopole structures with a typical height of up to 170 feet and 1,200-foot spans between structures (OG&E 2014a). The transmission line, put into service on May 1, 2014 (Xcel Energy 2014), runs the same path as the Applicant Proposed Route through Beaver County, then at a point about 2 miles east of the Beaver-Harper County line, veers to the southeast, away from the Applicant Proposed Route and toward the Woodward Substation. The impacts associated with the Hitchland-Woodward 345kV transmission line would be similar in nature to those impacts from the Project, but on a smaller scale, being restricted to a much shorter length of transmission line.
- *Beaver County Substation.* The OG&E Beaver County Substation is the western connecting point for the Hitchland-Woodward transmission line described above and was put into service on May 1, 2014, along with the transmission line (Xcel 2014). It is at the western edge of Beaver County and, like the transmission line in this area, is located within the ROI for the Applicant Proposed Route. The substation was proposed as a new 345kV terminal for interconnecting with a non-specific wind generating facility within OG&E's service territory (SPP 2013). The route for an interconnecting wind farm has not been proposed, but impacts of wind farm construction would be consistent with those already addressed in this document (Chapter 3) as a connected action.

Because the above transmission line and substation were completed prior to the initiation of the Project, the construction activities would not contribute to cumulative impacts, and any impacts have been captured in all areas of Chapter 3's characterization of the affected environment. In this evaluation of cumulative impacts, construction of these projects is considered to be a precursor to the Project, but their continued presence, operation, and maintenance are considered.

Oklahoma Department of Transportation—OKDOT is planning or has implemented several actions within the vicinity of Region 1 and the AC collection system. OKDOT actions that could have cumulative impacts with the Project are summarized as follows:

- *Hackberry Creek Bridge.* A new replacement bridge is proposed to be constructed over Hackberry Creek in Texas County, Oklahoma. The total length of the project is 0.25 miles, including the bridge and approaches. The OKDOT put out a bid request in September 2013. The proposed work involves concrete work, paving, saw cut, and excavation (Oklahoma Bid Network 2013). The activity is located on county road NS-107, 3.2 miles south of State Highway 3 and about 2.8 miles north of Link 2 of the Applicant Proposed Route. The location also lies between HVDC Alternative Routes 1-A/1-C, about 2.7 miles to the north, and HVDC Alternative Route 1-B, about 0.6 mile to the south.
- *OKDOT (8-Year) FFY-2014 through FFY-2021 Construction Work Plan.* The latest OKDOT 8-Year Construction Work Plan (OKDOT 2013a) was reviewed for possible road and bridge work in the Region 1 vicinity. According to the Work Plan, projects identified for completion in the first three years of the plan (i.e., federal fiscal year [FFY] 2014 through 2016) should be considered firm, or locked-in, with changes being made only through a formal program revision process; projects in the fourth year have low flexibility and are being prioritized and evaluated for transition into the "locked-in" group; and those in the last four planning years have moderate flexibility in terms of scope, schedule, and budget and have varying levels of project development. Region 1 is located entirely within OKDOT Division 6 and the Division 6 Construction Work Plan Map (OKDOT 2013b), with project locations, was the source of project-specific information used in this evaluation. OKDOT projects from the Work Plan documents considered to possibly coincide with ROIs of the Project are identified by location, moving generally from west to east, as follows:

    - SH-136 from Guymon south to the Oklahoma/Texas State Line. This 13-mile stretch of highway is more than 5 miles from the west end of the Applicant Proposed Route, but would be crossed by AC Collection System Routes NW-1, W-1, and SW-2 where they overlap. Planned activities on this highway segment include (1) grade, drain, and surface a 2.5-mile segment on the south side of Guymon (FFY 2020), (2) widen and resurface a 3.5-mile segment near the center of the 13-mile stretch (FFY 2019), (3) perform work on a bridge over Frisco Creek (FYY 2018), and (4) grade, drain, and surface a 5-mile segment north from the State line (FFY 2019/2020).
    - US-54/64 between Guymon and Hooker. This 20-mile stretch of highway is more than 10 miles northwest from the nearest segment of the Applicant Proposed Route, but would be crossed by AC Collection System Routes NE-1 and NW-2. Planned activities on this highway segment include (1) perform work on a bridge over Pony Creek (FFY 2016), (2) resurface about 5 miles of the road to the southwest of Hooker (FFY 2019), and (3) grade, drain, and surface more than 2 miles of the road on the northeast side of Guymon (FFY 2021).

Table 4.2-1a:
Summary of Present and Reasonably Foreseeable Future Actions and the Resource Areas of Potential Cumulative Impacts by Region

Present and Reasonably Foreseeable Future Action (Map ID Numbers, as Applicable)[1]	Resource Areas with Potential Cumulative Impacts (✓)									
	Agricultural Resources	Air Quality and Climate Change	Electrical Environment	Environmental Justice	Geology, Paleontology, Soils, and Minerals	Groundwater	Health, Safety, and Intentional Destructive Acts	Historical and Cultural Resources	Land Use	Noise
Region 1										
(1-1) OG&E Hitchland-Woodward 345kV Transmission Line	✓	✓	✓	✓[2]	✓	✓	✓	✓	✓	✓
(1-2) OG&E Beaver County Substation	✓	✓		✓[2]	✓	✓	✓	✓	✓	✓
(1-3) ODOT Hackberry Creek Bridge		✓		✓[2]		✓	✓			✓
ODOT Construction Work Plan – (1-4-1) State Highway 136 – (1-4-2) U.S. Highway 54/64 – (1-4-3) State. Highway 3 – (1-4-4) State Highway 23 – (1-4-5) State Highway 149 – (1-4-6) U.S. Highway 183		✓		✓[2]		✓	✓			✓
Region 2										
(2-1) OG&E Woodward-Thistle 345kV Transmission Line	✓	✓	✓	✓[2]	✓	✓	✓	✓	✓	✓
(2-2) Glass Mountain Crude Oil Pipeline	✓	✓		✓[2]	✓	✓	✓	✓	✓	✓
ODOT Construction Work Plan – (2-3-1) State Highway 50B – (2-3-2) U.S. Highway 60		✓		✓[2]		✓	✓			✓
(2-4) Mammoth Plains Wind Farm Project	✓	✓		✓[2]	✓	✓	✓	✓	✓	
Region 3										
ODOT Construction Work Plan – (3-1-1) State Highway 51 (Kingfisher and Logan counties) – (3-1-2) State Highway 51 (Western Payne County) – (3-1-3) State. Highway 33		✓		✓[2]		✓	✓			✓

Table 4.2-1a:
Summary of Present and Reasonably Foreseeable Future Actions and the Resource Areas of Potential Cumulative Impacts by Region

Present and Reasonably Foreseeable Future Action (Map ID Numbers, as Applicable)[1]	Resource Areas with Potential Cumulative Impacts (✓)									
	Agricultural Resources	Air Quality and Climate Change	Electrical Environment	Environmental Justice	Geology, Paleontology, Soils, and Minerals	Groundwater	Health, Safety, and Intentional Destructive Acts	Historical and Cultural Resources	Land Use	Noise
– (3-1-4) State Highway 99 – (3-1-5) State Highway 66 – (3-1-6) State Highway 16 – (3-1-7) U.S. Highway 75A – (3-1-8) U.S. Highway 75 – (3-1-9) U.S. Highway 62 – (3-1-10) U.S. Highway 69										
(2-2) Glass Mountain Crude Oil Pipeline	✓	✓		✓[2]	✓	✓	✓	✓	✓	✓
(3-2) USACE Bridge Replacement		✓		✓[2]		✓	✓			
(3-3) R.L. Jones Jr. Airport (Jones Riverside Airport)		✓		✓[2]		✓	✓			
(3-4) OG&E Seminole to Muskogee Transmission Line	✓		✓	✓[2]			✓		✓	✓
(3-5) Diamond Pipeline (crude oil)	✓	✓		✓[2]	✓	✓	✓	✓	✓	✓
Region 4										
ODOT Construction Work Plan – (4-1-1) State Highway 10A – (4-1-2) Interstate 40 (near Junction with State Highway 82) – (4-1-3) Interstate 40 (south side of Sallisaw, OK) – (4-1-4) U.S. Highway 64 – (4-1-5) U.S. Highway 59 – (4-1-6) State Highway 101		✓		✓[2]		✓	✓			✓
(4-2) Cherokee Nation Hydroelectric Power Plant	✓	✓		✓[2]	✓	✓	✓	✓	✓	

Table 4.2-1a:
Summary of Present and Reasonably Foreseeable Future Actions and the Resource Areas of Potential Cumulative Impacts by Region

Present and Reasonably Foreseeable Future Action (Map ID Numbers, as Applicable)[1]	Resource Areas with Potential Cumulative Impacts (✓)									
	Agricultural Resources	Air Quality and Climate Change	Electrical Environ-ment	Environ-mental Justice	Geology, Paleontology, Soils, and Minerals	Ground-water	Health, Safety, and Intentional Destructive Acts	Historical and Cultural Resources	Land Use	Noise
AHTD Status Map, District 4, Crawford County – (4-3-1) State Highway 59 bridge – (4-3-1) Interstate 40 – (4-3-1) Interstate 540 – (4-3-1) U.S. Highway 71 (deferred work)		✓		✓[2]		✓	✓			✓
AHTD Status Map, District 4, Crawford County – (4-3-1) U.S. Highway 71 (new construction)	✓	✓		✓[2]	✓	✓	✓	✓	✓	✓
AHTD Status Map, District 8, Johnson County – (4-3-2) Interstate 40		✓		✓[2]		✓	✓			✓
(3-5) Diamond Pipeline (crude oil)	✓	✓		✓[2]	✓	✓	✓	✓	✓	✓
Region 5										
AHTD Pope County – (5-1-1) State Highway 7 (Dover, AR bypass)	✓	✓		✓[2]	✓	✓	✓	✓	✓	✓
AHTD Status Map, District 8, Conway County – (5-1-2) State Highway 247 – (5-1-2) State Highway 92		✓		✓[2]		✓	✓			✓
AHTD Status Map, District 8, Van Buren County – (5-1-3) U.S. Highway 85		✓		✓[2]		✓	✓			✓
AHTD Status Map, District 8, Faulkner County – (5-1-4) State Highway 285		✓		✓[2]		✓	✓			✓
AHTD Status Map, District 5, Jackson County – (5-1-7) U.S. Highway 167		✓		✓[2]		✓	✓			✓
(5-2) Enable Central Arkansas Natural Gas Pipeline Enhancement Project	✓	✓		✓[2]	✓	✓	✓	✓	✓	
(3-5) Diamond Pipeline (crude oil)	✓	✓		✓[2]	✓	✓	✓	✓	✓	✓

Table 4.2-1a:
Summary of Present and Reasonably Foreseeable Future Actions and the Resource Areas of Potential Cumulative Impacts by Region

Present and Reasonably Foreseeable Future Action (Map ID Numbers, as Applicable)[1]	Resource Areas with Potential Cumulative Impacts (✓)									
	Agricultural Resources	Air Quality and Climate Change	Electrical Environ-ment	Environ-mental Justice	Geology, Paleontology, Soils, and Minerals	Ground-water	Health, Safety, and Intentional Destructive Acts	Historical and Cultural Resources	Land Use	Noise
Region 6										
AHTD Status Map, District 5, Jackson County — (6-1-1 through 6-1-4) State Highway 14 bridge work (4 bridges)		✓		✓[2]		✓	✓			✓
AHTD Status Map, District 1, Cross County — (6-4-1 through 6-4-4)State Highway 42 bridge work (4 bridges)		✓		✓[2]		✓	✓			✓
(6-5) Rebuild 161kV Transmission Line from Trumann to Trumann West, AR (Entergy Arkansas, Inc.)	✓	✓		✓[2]	✓	✓	✓	✓	✓	
(6-6) Highway 63, Poinsett Co., AR (includes new construction in new ROW)	✓	✓		✓[2]	✓	✓	✓	✓	✓	✓
Region 7										
AHTD Status Map, District 10, Poinsett County — (7-1-1) U.S. Highway 63 (at Marked Tree, AR)		✓		✓[2]		✓	✓			✓
AHTD Status Map, District 10, Mississippi County — (7-1-2) Interstate 55		✓		✓[2]		✓	✓			✓
(7-2) Great River Super Site, Osceola, AR (industrial park)	✓	✓		✓[2]	✓	✓	✓	✓	✓	✓
(7-3) Interstate 69 Extension, TN	✓	✓		✓[2]	✓	✓	✓	✓	✓	✓
(7-4) Green Meadows Development at Munford, TN (planned community)	✓	✓		✓[2]	✓	✓	✓	✓	✓	✓
(7-5) Southern Gateway Project, TN	✓	✓		✓[2]	✓	✓	✓	✓	✓	✓

1 Map ID numbers provided with project titles can be found on Figure 4.2-1 (located in Appendix A).
2 There could be cumulative impacts to low-income and minority populations, but none would be expected to rise to the “disproportionally high and adverse” level as described in Section 3.5.

Table 4.2-1b:
Summary of Present and Reasonably Foreseeable Future Actions and the Resource Areas of Potential Cumulative Impacts by Region

Present and Reasonably Foreseeable Future Action (Map ID Numbers, as Applicable)[1]	Resource Areas with Potential Cumulative Impacts (✓)								
	Recreation	Socio-economics	Special Status Wildlife and Fish Species	Surface Water	Trans-portation	Vegetation Communities	Visual Resources	Wetlands, Floodplains, and Riparian Areas	Wildlife and Fish
Region 1									
(1-1) OG&E Hitchland-Woodward 345kV Transmission Line		✓	✓	✓		✓	✓	✓	✓
(1-2) OG&E Beaver County Substation			✓	✓		✓	✓	✓	✓
(1-3) ODOT Hackberry Creek Bridge	✓	✓		✓			✓		
ODOT Construction Work Plan – (1-4-1) State Highway 136 – (1-4-2) U.S. Highway 54/64 – (1-4-3) State. Highway 3 – (1-4-4) State Highway 23 – (1-4-5) State Highway 149 – (1-4-6) U.S. Highway 183	✓	✓	✓	✓			✓		✓
Region 2									
(2-1) OG&E Woodward-Thistle 345kV Transmission Line	✓	✓	✓	✓		✓	✓	✓	✓
(2-2) Glass Mountain Crude Oil Pipeline	✓	✓	✓	✓		✓	✓	✓	✓
ODOT Construction Work Plan – (2-3-1) State Highway 50B – (2-3-2) U.S. Highway 60			✓	✓			✓		✓
(2-4) Mammoth Plains Wind Farm Project		✓	✓	✓		✓		✓	✓

Table 4.2-1b:
Summary of Present and Reasonably Foreseeable Future Actions and the Resource Areas of Potential Cumulative Impacts by Region

Present and Reasonably Foreseeable Future Action (Map ID Numbers, as Applicable)[1]	Resource Areas with Potential Cumulative Impacts (✓)								
	Recreation	Socio-economics	Special Status Wildlife and Fish Species	Surface Water	Trans-portation	Vegetation Communities	Visual Resources	Wetlands, Floodplains, and Riparian Areas	Wildlife and Fish
Region 3									
ODOT Construction Work Plan – (3-1-1) State Highway 51 (Kingfisher and Logan counties) – (3-1-2) State Highway 51 (Western Payne County) – (3-1-3) State. Highway 33 – (3-1-4) State Highway 99 – (3-1-5) State Highway 66 – (3-1-6) State Highway 16 – (3-1-7) U.S. Highway 75A – (3-1-8) U.S. Highway 75 – (3-1-9) U.S. Highway 62 – (3-1-10) U.S. Highway 69	✓		✓	✓			✓		✓
(2-2) Glass Mountain Crude Oil Pipeline	✓	✓	✓	✓		✓	✓	✓	✓
(3-2) USACE Bridge Replacement				✓					
(3-3) R.L. Jones Jr. Airport (Jones Riverside Airport)				✓					
(3-4) OG&E Seminole to Muskogee Transmission Line		✓	✓	✓		✓	✓	✓	✓
(3-5) Diamond Pipeline (crude oil)	✓	✓	✓	✓		✓	✓	✓	✓

Table 4.2-1b:
Summary of Present and Reasonably Foreseeable Future Actions and the Resource Areas of Potential Cumulative Impacts by Region

Present and Reasonably Foreseeable Future Action (Map ID Numbers, as Applicable)[1]	Resource Areas with Potential Cumulative Impacts (✓)								
	Recreation	Socio-economics	Special Status Wildlife and Fish Species	Surface Water	Trans-portation	Vegetation Communities	Visual Resources	Wetlands, Floodplains, and Riparian Areas	Wildlife and Fish
Region 4									
ODOT Construction Work Plan — (4-1-1) State Highway 10A — (4-1-2) Interstate 40 (near Junction with State Highway 82) — (4-1-3) Interstate 40 (south side of Sallisaw, OK) — (4-1-4) U.S. Highway 64 — (4-1-5) U.S. Highway 59 — (4-1-6) State Highway 101	✓			✓	✓		✓		
(4-2) Cherokee Nation Hydroelectric Power Plant									
AHTD Status Map, District 4, Crawford County — (4-3-1) State Highway 59 bridge — (4-3-1) Interstate 40 — (4-3-1) Interstate 540 — (4-3-1) U.S. Highway 71 (deferred work)	✓			✓	✓		✓		
AHTD Status Map, District 4, Crawford County — (4-3-1) U.S. Highway 71 (new construction)	✓	✓	✓	✓	✓	✓	✓	✓	✓
AHTD Status Map, District 8, Johnson County — (4-3-2) Interstate 40				✓	✓		✓		
(3-5) Diamond Pipeline (crude oil)	✓	✓	✓	✓		✓	✓	✓	✓
Region 5									
AHTD Pope County — (5-1-1) State Highway 7 (Dover, AR bypass)	✓	✓	✓	✓	✓		✓	✓	✓
AHTD Status Map, District 8, Conway County — (5-1-2) State Highway 247 — (5-1-2) State Highway 92				✓	✓		✓		

Table 4.2-1b:
Summary of Present and Reasonably Foreseeable Future Actions and the Resource Areas of Potential Cumulative Impacts by Region

Present and Reasonably Foreseeable Future Action (Map ID Numbers, as Applicable)[1]	Resource Areas with Potential Cumulative Impacts (✓)								
	Recreation	Socio-economics	Special Status Wildlife and Fish Species	Surface Water	Trans-portation	Vegetation Communities	Visual Resources	Wetlands, Floodplains, and Riparian Areas	Wildlife and Fish
AHTD Status Map, District 8, Van Buren County – (5-1-3) U.S. Highway 85				✓	✓		✓		
AHTD Status Map, District 8, Faulkner County – (5-1-4)State Highway 285	✓			✓	✓		✓		
AHTD Status Map, District 5, Jackson County – (5-1-7) U.S. Highway 167				✓	✓		✓		
(5-2) Enable Central Arkansas Natural Gas Pipeline Enhancement Project									
(3-5) Diamond Pipeline (crude oil)	✓	✓	✓	✓		✓	✓	✓	✓
Region 6									
AHTD Status Map, District 5, Jackson County – (6-1-1 through 6-1-4) State Highway 14 bridge work (4 bridges)	✓		✓	✓			✓		✓
AHTD Status Map, District 1, Cross County – (6-4-1 through 6-4-4) State Highway 42 bridge work (4 bridges)	✓		✓	✓			✓		✓
(6-5) Rebuild 161kV Transmission Line from Trumann to Trumann West, AR (Entergy Arkansas, Inc.)									
(6-6) Highway 63, Poinsett Co., AR		✓	✓	✓		✓	✓	✓	✓

Table 4.2-1b:
Summary of Present and Reasonably Foreseeable Future Actions and the Resource Areas of Potential Cumulative Impacts by Region

Present and Reasonably Foreseeable Future Action (Map ID Numbers, as Applicable)[1]	Resource Areas with Potential Cumulative Impacts (✓)								
	Recreation	Socio-economics	Special Status Wildlife and Fish Species	Surface Water	Trans-portation	Vegetation Communities	Visual Resources	Wetlands, Floodplains, and Riparian Areas	Wildlife and Fish
Region 7									
AHTD Status Map, District 10, Poinsett County – (7-1-1) U.S. Highway 63 (at Marked Tree, AR)				✓	✓		✓		
AHTD Status Map, District 10, Mississippi County – (7-1-2) Interstate 55	✓			✓	✓		✓		
(7-2) Great River Super Site, Osceola, AR (industrial park)	✓	✓	✓		✓	✓	✓	✓	✓
(7-3) Interstate 69 Extension, TN		✓	✓		✓	✓	✓	✓	✓
(7-4) Green Meadows Development at Munford, TN (planned community)		✓	✓		✓	✓	✓	✓	✓
(7-5) Southern Gateway Project, TN	✓	✓	✓		✓	✓	✓	✓	✓

1 Map ID numbers provided with project titles can be found on Figure 4.2-1 (located in Appendix A).

This page intentionally left blank.

- SH-3 from Guymon east to the Texas/Beaver County Line. This 30-mile stretch of highway would be crossed by AC Collection System Routes NE-1/NW-2, NE-2, and E-3, and its eastern end parallels Route E-3 and Routes 1-A/1-C, running 0.9 mile south of E-3 and 0.5 mile north of 1-A/1-C. Planned activities on this highway segment include (1) resurface 7 miles of the road beginning about 7 miles east of Guymon and running east (FFY 2020), and (2) resurface 3 miles of the road starting 9 miles west of the Texas/Beaver County Line and running east (FFY 2021). AC Collection System Route NE-2 would cross the larger road resurfacing; the smaller road resurfacing is in the proximity of E-3 and 1-A/1-C as identified above.
- SH-23 at the Oklahoma/Texas State Line. A planned activity to widen and resurface a 2-mile segment of the road starts 1 mile south of the State Line and runs north (FFY 2017). The northern extent of the planned activity is about 1 mile southeast of Link 2 of the Applicant Proposed Route.
- SH-149 between US-283 and State Highway 46. There is a planned activity to put a bridge over the Beaver River in this road segment (FFY 2014). The work area lies about 1.5 miles south of HVDC Alternative Route 1-A.
- US-183 from Buffalo south to the Harper/Woodward County Line. This 17-mile stretch of highway would be crossed by Link 5 of the Applicant Proposed Route and HVDC Alternative Route 1-A in Harper County. Planned activities on this highway segment include (1) grade, drain, bridge, and surface 5 miles of road beginning about midway in the stretch and running north (FFY 2021), (2) perform work on a bridge over Gyp Creek (FFY 2018), (3) grade, drain, bridge, and surface a 4-mile segment starting 4.6 miles north of the county line and running north (FFY 2016), and (4) widen and resurface a 4.6-mile segment starting at the county line and running north (FFY 2020). HVDC Alternative Route 1-A would cross the first activity's highway segment and the Applicant Proposed Route would cross over the fourth activity's highway segment.

4.2.2 Region 2—Present and Reasonably Foreseeable Future Actions

Region 2 is referred to as the Oklahoma Central Great Plains Region and includes the Applicant Proposed Route and HVDC Alternative Routes 2-A through 2-B. The region extends through Woodward, Major, and Garfield counties in Oklahoma. These counties are mostly rural; the largest communities are the towns of Woodward and Fairview.

Oklahoma Gas and Electric—The Region 2 OG&E planned activity that could have cumulative impacts with the Project is summarized as follows:

- *Woodward-Thistle 345kV Transmission Line.* OG&E is currently constructing new electric transmission facilities in west-central Oklahoma. The activity involves the construction of roughly 90 miles of new double-circuit 345kV transmission line connecting OG&E's Woodward District Extra High Voltage Substation with the Thistle Substation near the Oklahoma-Kansas border. The transmission line's alternative routes run north and east from south of Woodward, Oklahoma, to the Oklahoma-Kansas border about 2 miles southeast of Hardtner, Kansas. The structures consist of steel monopole with a typical height of 150 feet and approximately 1,200-foot spans between the structures. It is expected to be in service by December 2014. This new electrical transmission line crosses Link 1 of the Region 2 Applicant Proposed Route approximately 6 to 8 miles east of Mooreland, Oklahoma, and one of the OG&E line alternative routes in this area appears to be within the 1,000-foot-wideROI for HVDC Alternative Route 2-A for roughly 20 miles before veering to the northeast. The other OG&E alternative route in this area stays well north after crossing the Applicant Proposed Route (OG&E 2011).

The impacts associated with the Woodward-Thistle 345kV transmission line would be similar in nature to those impacts from the Project, but on a smaller scale, being restricted to a much shorter length of transmission line.

Glass Mountain Crude Oil Pipeline. The Glass Mountain Crude Oil Pipeline is a joint venture between SemGroup Corporation and Gavilon, LLC to build a 210-mile crude oil pipeline that extends through both Regions 2 and 3. The new pipeline was designed to have an initial capacity of approximately 140,000 barrels per day and 440,000 barrels of intermediate storage. The pipeline consists of two laterals: the first lateral originating near the town of Alva in Woods County, Oklahoma, and the second lateral originating near the town of Arnett in Ellis County, Oklahoma. The laterals intersect near Cleo Springs in Major County, Oklahoma, and the line continues east to Gavilon's Cushing (Oklahoma) facility (SemGroup 2014a). The constructed pipeline was put into service in February 2014 (SemGroup 2014b). Link 2 of the Region 2 Applicant Proposed Route and HVDC Alternative Route 2-A would cross the pipeline lateral from Alva in the area of the Woodward-Major county line. The pipeline from Cleo Springs to Cushing would be crossed several times by the Applicant Proposed Route and HVDC alternative routes within Region 3.

Oklahoma Department of Transportation. As described for Region 1, the latest OKDOT 8-Year Construction Work Plan (OKDOT 2013a) was reviewed for possible road and bridge work in the Region 2 vicinity. Region 2 is located within OKDOT Divisions 4 and 6 and the corresponding Construction Work Plan Maps (OKDOT 2013b, 2013c), with project locations, was the source of specific information for planned activities used in this evaluation. OKDOT planned activities from the Work Plan documents that could have cumulative impacts with the Project are summarized by location, moving generally from west to east, as follows:

- *SH-50B East of Woodward, Oklahoma.* OKDOT planned activities include a bridge and approach over Bull Creek on SH-50B almost 7 miles east of Woodward (FYY 2021). Link 1 of the Region 2 Applicant Proposed Route would run northwest-southeast about 0.2 to 0.3 mile west of the Bull Creek bridge location.
- *US-60 Southwest of Cleo Springs, Oklahoma.* There is a planned activity for a bridge and approaches at the Cimarron River about 2 miles southwest of Cleo Springs (FYY 2017). The work area lies as close as about 0.6 mile north of HVDC Alternative Route 2-A.

The above planned activities are those within about 2 miles of the Project routes and are both in OKDOT Division 6. Other OKDOT planned activities within about 2 to 6 miles of the Project include bridges and approaches over the North Canadian River on both State Highways 34 and 60 in Woodward and Major counties, respectively; bridge and road resurfacing work on SH-3/US-270 in southeast Woodward County and on US-412 in northwest Major County; widening and resurfacing of SH-8 in north-central Major County; and a bridge and approaches at Turkey Creek on SH-132, southwest of Enid, Oklahoma, in Garfield County (OKDOT District 4). The OKDOT 8-Year Construction Work Plan identifies numerous other road maintenance and bridge repair or replacement activities at greater distances from the Project, but these relatively small construction-type activities would have little potential for cumulative impacts at the greater distances (i.e., these relatively small construction-type activities would be expected to have an ROI similar to the Project and at the greater distance the ROIs would not overlap).

Mammoth Plains Wind Farm Project. The Mammoth Plains Wind Project would be located in Dewey and Blaine Counties, Oklahoma. It is a 199 MW proposed wind farm owned by NextEra Energy Resources of Juno Beach, Florida. A Power Purchase Agreement is in place as of November 2013 between NextEra and SPS, an Xcel Energy company (KEIN 2014). At its closest (the northeast corner), the property designated for this wind farm (Xcel Energy 2013) is approximately 14 miles south of Link 2 of the Region 2 Applicant Proposed Route. Xcel Energy describes the energy from the Mammoth Plains Wind Project as being targeted for its New Mexico and Texas customers (Amarillo Globe News 2013), so it would not be expected to use transmission lines associated with the Project and so is not considered a connected action.

4.2.3 Region 3—Present and Reasonably Foreseeable Future Actions

Region 3 is referred to as the Oklahoma Cross Timbers Region and includes the Applicant Proposed Route and HVDC Alternative Routes 3-A through 3-E. Region 3 extends through Garfield, Kingfisher, Logan, Payne, Lincoln, Creek, Okmulgee, and Muskogee counties in Oklahoma. Large communities in Region 3 include Stillwater, Cushing, Drumright, and Muskogee.

Oklahoma Department of Transportation. As described for Region 1, the OKDOT 8-Year Construction Work Plan (OKDOT 2013a) was reviewed for possible road and bridge work in the Region 3 vicinity. Region 3 is located within OKDOT Divisions (from west to east) 4, 3, 8, and 1 and the corresponding Construction Work Plan Maps (OKDOT 2013c, 2013d, 2013e, 2013f), with activity locations, was the source of specific information for planned activities used in this evaluation. OKDOT activities from the Work Plan documents that could have cumulative impacts with the Project are summarized by location, moving generally from west to east, as follows:

- *SH-51, East from US-81 in Kingfisher and Logan counties, Oklahoma.* There are a series of bridge activities planned for this 30-mile stretch of east-west highway in the northern portions of the two counties. The last five to the east, consisting of one in Kingfisher County and four in Logan County are over Skeleton Creek (FFY 2017), Bridge Creek (FFY 2018), West Beaver Creek (FFY 2017), Middle Beaver Creek (FFY 2017), and East Beaver Creek (FFY 2018). The Applicant Proposed Route, running northwest-southeast, would cross SH-51 about 1 mile east of the Skeleton Creek Bridge, then turn to the east, running about 5 miles south of the last four bridge activities. HVDC Alternative Route 3-A/3-B would cross SH-51 about midway between the Bridge Creek and West Beaver Creek bridges, about 2 miles from each, then turn to the east, running about 0.3 mile south of the last three bridge activities.
- *SH-51 Western Payne County, Oklahoma.* There is an OKDOT planned activity for a bridge and approaches on SH-51 at an unnamed creek about 5.5 miles east of the Logan-Payne county line (FYY 2017) HVDC Alternative Route 3-A/3-B would run about 0.3 mile southwest of the bridge location.
- *SH-33 at North Little Avenue in Payne County, Oklahoma.* An OKDOT planned activity to modify the intersection and rehabilitate pavement on SH-33 (FYY 2018) is about 2 miles east of Link 4 of the Region 3 Applicant Proposed Route.
- *SH-99 in Northeast Corner of Lincoln County, Oklahoma.* An OKDOT planned activity calls for bridges and approaches on SH-99 at Sand Creek and an unnamed creek to the north of Sand Creek (FYY 2021). Link 4 of the Region 3 Applicant Proposed Route would run east-west about 0.2 mile south of the Sand Creek Bridge and about 1.1 miles south of the unnamed creek.
- *SH-66 from Depew to Bristow, Creek County, Oklahoma.* The stretch of SH-66 from Depew to Bristow is to be graded, drained, and surfaced under two planned activities: (1) the first mile from Depew (FFY 2019), and (2) the rest of the way to the Bristow city limits (FFY 2021). HVDC Alternative Route 3-C would cross SH-66 near the dividing point between the two activities.
- *SH-16 East from SH-48, Creek County, Oklahoma.* There are several OKDOT planned activities along SH-16: (1) a widening and resurfacing activity for the stretch of road from SH-48 to 6 miles to the east (FFY 2020), (2) a bridge and approaches activity at Skull Creek near the east end of the 6-mile stretch (FFY 2014), and (3) a

bridge and approaches activity at Chicken Creek about 2 miles further east and south (FFY 2018). Link 4 of the Region 3 Applicant Proposed Route would be about 1 mile to the northeast of the first project's eastern extent and also about 1 mile to the northeast of both bridge activities.

- *US-75A from Beggs to the County Line (7.5 miles to the north), Okmulgee County, Oklahoma.* The stretch of US-75A is to be graded, drained, and surfaced (FFY 2016). Link 4 of the Region 3 Applicant Proposed Route would cross US-75A about 2 miles north of Beggs.
- *US-75 North of Okmulgee, Okmulgee County, Oklahoma.* Three activities are planned for this segment of US-75 that runs north from the community of Okmulgee across SH-16 to a point about 2 miles north of SH-16: (1) left turn lane intersection modifications from Okmulgee to about Preston (FFY 2020), (2) left turn lane intersection modifications from about Preston to 2 miles north of SH-16 (FFY 2017), and (3) bridge and approaches for the overpass over SH-16 (FFY 2016). Link 4 of the Region 3 Applicant Proposed Route would cross US-75 at about the northern extent of the third activity and would be about 1.6 miles to the northeast of the overpass location. HVDC Alternative Route 3-C would cross US-75 in the first activity's highway segment.
- *US-62, Northwest Corner of Muskogee County, Oklahoma.* OKDOT plans two bridge and approaches activities on US-62 at Cane Creek crossings: (1) about 1.3 miles south of where US-62 joins SH-72 and turns south (FFY 2015), and (2) about 1.6 miles east of SH-72 (FFY 2015). Link 5 of the Region 3 Applicant Proposed Route would cross US-62 about 0.1 mile north of the first activity and run parallel to and 1.5 miles south of the section of US-62 where the second activity is located.
- *US-69 North of Muskogee-McIntosh County Line, Oklahoma.* OKDOT plans a pavement rehabilitation project on 8.5 miles of US-69 north of the county line (FFY 2020). HVDC Alternative Route 3-C/3-D would cross US-69 about 1.2 miles north of the county line.

As with Region 2, the above planned activities are those within about 2 miles of the Project routes. The OKDOT 8-Year Construction Work Plan identifies more than 20 other road maintenance and bridge repair or replacement activities within about 2 to 6 miles of the Project routes, but these relatively small construction-type activities are judged to have little potential for cumulative impacts at the greater distances. In Kingfisher County, these other OKDOT planned activities include resurfacing and bridge work on SH-51. In Logan County, there are bridge activities on SH-74 and SH-74D. In Payne County, there are bridge activities on State Highways 51 and 33, and resurfacing on US-177 and SH-18. In Lincoln County, there are bridge activities on US-177 and SH-105, SH-18, and SH-99. In Creek County, there are two bridge activities on SH-16. In Okmulgee County, there is a bridge activity on US-62. In Muskogee County, there are bridge activities on SH-10 and US-62, US-69, and US-26, and surfacing activities on SH-10A and US-64.

Glass Mountain Crude Oil Pipeline. See the activity description in Section 4.2.2. The activity extends through both regions.

Bridge Replacement. The USACE is replacing the Highway 151 Bridge over the Keystone Dam. The construction started in October 2013 and will proceed for 13 months (USACE 2013). The road will be closed to traffic during that time. At its closest, Link 4 of the Region 3 Applicant Proposed Route would be about 17 miles southeast from this action. This action is outside the ROI but was evaluated because of its high-profile nature.

R.L. Jones Jr. Airport (Jones Riverside Airport). The Jones Riverside Airport in southwest Tulsa has been approved for several updates to occur over the 2014 to 2018 timeframe. Rehabilitation work is being completed at the Jones Riverside Airport. The planned activities include widening and asphalt overlays on runways and improvements to sewer, drainage, and roadway infrastructure (Arnold 2014). The airport, in Tulsa County, is located about 17 miles north of Link 4 of the Region 3 Applicant Proposed Route.

Oklahoma Gas and Electric. The Region 3 OG&E planned activity that could have cumulative impacts with the Project is summarized as follows:

- Seminole to Muskogee Transmission Line. OG&E has constructed or is constructing several new electric transmission facilities in east-central Oklahoma. This activity involved the construction of a new, double-circuit 345kV electrical transmission line connecting the existing OG&E Seminole Power Plant substation in Seminole County to the existing Muskogee Power Plant substation in Muskogee County. The activity is approximately 125 miles with a 150-foot-wide right-of-way corridor. The typical structure height is 90 feet with an 800-foot span between structures. The activity was completed in December 2013 (OG&E 2014b). The Applicant Proposed Route and the HVDC alternative routes cross this new transmission line in the area south-southeast of Muskogee, Oklahoma. Since this transmission line is already in service, its construction would not contribute to cumulative impacts with the Project, but impacts of the transmission line's presence, operation, and maintenance are considered. As described for two planned activities in Region 1 (Section 4.2.1), construction of the transmission line is considered a precursor to the Project and it is noted that impacts from its recent construction have been captured in the Chapter 3 affected environment.

Diamond Pipeline. In August 2014, Plains All American Pipeline announced its intention to construct the Diamond Pipeline to deliver crude oil from its Cushing, Oklahoma, terminal to the Valero Memphis Refinery in Tennessee (Plains All American 2014). Plains All American Pipeline has a long-term shipping agreement with Valero, which holds an option to become a partner in the Diamond Pipeline. The 440-mile, 20-inch pipeline would have a capacity of up to 200,000 barrels per day and is expected to be completed in early 2017 (Diamond Pipeline, LLC 2015). Portions of the proposed Diamond Pipeline's route from Cushing to Memphis would parallel the same general route as the Plains & Eastern transmission line in Regions 3, 4, and 5. The routes, or portions of the routes, appear to overlap in the center of Region 3, the eastern end of Region 4, and the western half of Region 5. The pipeline path veers to the south of the Plains & Eastern transmission line route in the area of the Oklahoma-Arkansas border, then swings back north before again veering south in the eastern side of Region 5 and staying well to the south of Regions 6 and 7 of the transmission line route on its continued path to Memphis.

4.2.4 Region 4—Present and Reasonably Foreseeable Future Actions

Region 4 is referred to as the Arkansas River Valley Region and includes the Applicant Proposed Route, including the Lee Creek Variation, and HVDC Alternative Routes 4-A through 4-E. Region 4 extends through Muskogee and Sequoyah counties in Oklahoma and through Crawford, Franklin, Johnson, and Pope counties in Arkansas. Large communities in the region include Sallisaw, Fort Smith, and Clarksville.

Oklahoma Department of Transportation. The OKDOT 8-Year Construction Work Plan (OKDOT 2013a) was reviewed for possible road and bridge work in the Oklahoma portion of Region 4, which is entirely within OKDOT Division 1. The corresponding Construction Work Plan Map (OKDOT 2013f), with activity locations, was the source of specific information for planned activities used in this evaluation. OKDOT activities from the Work Plan documents that could have cumulative impacts with the Project are summarized by location, moving generally from west to east, as follows:

- *SH-10A in Muskogee and Sequoyah Counties, Oklahoma.* An activity is planned to grade, drain, and surface the stretch of SH-10A that runs between SH-10 and SH-100. At its closest, Link 1 of the Region 4 Applicant Proposed Route would be about 1.7 miles southwest of the activity location.
- *I-40 near its Junction with SH-82, Sequoyah County, Oklahoma.* There are two OKDOT planned activities along this section of I-40: (1) a bridge and approach activity over Vian and Little Vian Creeks (FFY 2020), and (2) 6 miles of pavement rehabilitation (FFY 2019/2020). At its closest, Link 3 of the Region 4 Applicant Proposed Route would be about 1.5 miles northeast of this section of I-40.
- *I-40 along the South Side of Sallisaw, Sequoyah County, Oklahoma.* There are multiple OKDOT planned activities along this section of the highway: (1) 5 miles of pavement rehabilitation (FFY 2014), (2) a bridge and approach over Big Sallisaw Creek (FFY 2019), (3) a bridge and approach over a county road and railroad (FFY 2018), and (4) the I-40/US-64 interchange. This section of I-40 runs about 3 to 3.5 miles south of Link 3 of the Region 4 Applicant Proposed Route.
- *US-64 West of Sallisaw, Sequoyah County, Oklahoma.* OKDOT has a bridge and approaches activity at Big Sallisaw Creek (FFY 2014). The site is about 2.4 miles south of Link 3 of the Region 4 Applicant Proposed Route.
- *US-59 in Sallisaw, Sequoyah County, Oklahoma.* An activity is planned to grade, drain, and surface 3.5 miles of US-59, north from its intersection with US-64 (FFY 2016). Link 3 of the Region 4 Applicant Proposed Route would cross the highway location at about 2.6 miles north of US-64.
- *SH-101 East of Sallisaw, Sequoyah County, Oklahoma.* OKDOT has a bridge and approaches activity planned at an unnamed creek (FFY 2019). The proposed site is about 0.6 mile north of Link 3 of the Region 4 Applicant Proposed Route.

The above planned activities are generally those within about 2 miles of the Project routes. The exception is the group associated with the segment of I-40 running along the south side of Sallisaw. Although 3 or more miles away from the Applicant Proposed Route, activities in this section of roadway are identified specifically because concerns were raised during the EIS scoping process about potential impacts due to road construction on the US-64/I-40 interchange in this region. The OKDOT 8-Year Construction Work Plan identifies one other road maintenance activity within about 2 to 6 miles of the Project routes, but it would have little potential for cumulative impacts at the greater distances. This other planned activity is another pavement rehabilitation project on a 7.6-mile stretch of I-40 to the southeast of Sallisaw.

New Hydroelectric Power Plant. A new hydropower plant has been proposed by the Cherokee Nation, with a location on the Arkansas River at the existing W.D. Mayo Lock and Dam, south of Muldow (Dandridge 2012) and about 9 miles southwest of Fort Smith. Per a 2014 article (Maxwell 2014), a spokesman for the Cherokee Nation describes the power plant project as being only in the planning stage with no concrete plans yet developed. The 2014 article was triggered by the U.S. House of Representatives May 2014 release of a Water Resources Reform and Development Act Conference Report (U.S. House of Representatives 2014), which acted to lift "a federal halt on the Cherokee Nation's ability to construct, operate and market power for a hydropower facility on the W.D. Mayo Lock and Dam" (Maxwell 2014). The Water Resources Reform and Development Act of 2014, Public Law 113-121, was subsequently passed on June 10, 2014 and authorizes (in Section 1117) the Cherokee Nation of Oklahoma to design and construct one or more hydroelectric generating facilities at the W.D. Mayo Lock and Dam and to market the electricity generated from any such facility. The proposed hydropower plant site is approximately 12 miles south of Link 3 of the Region 4 Applicant Proposed Route.

Arkansas State Highway and Transportation Department. The AHTD publishes "Status of Improvement" maps (status maps) for each of its districts showing the status of roadway activities as "completed, under construction, programmed, or deferred" and, as applicable, new roadway construction. Most of the information presented here comes from these maps, which are in the form of individual maps for the counties within each district. Region 4 of the Applicant Proposed Route would pass through AHTD District 4 (Crawford and Franklin counties) and part of District 8 (specifically Johnson and Pope counties). This evaluation of cumulative impacts considered whether ROIs of the Project would cross or be in proximity to roadway activities either in the "programmed" or "deferred" categories, assuming those could be the activities occurring in the future. Roadway activities identified as "under construction" were not included in the evaluation because the activities, unless identified as new roadway construction, consist of maintenance or rehabilitation of existing structures. By their nature, they would be expected to be relatively short term and likely complete by the time the Project started. Once complete, impacts associated with use of the roads would be expected to be the same as before construction (i.e., consistent with the affected environment characterization). The maps contain no information on specific dates or detailed information on the nature of the roadway improvements, but those that could have cumulative impacts with the Project as well as planned activities identified through other sources are summarized by District and County as follows:

- *AHTD District 4, Crawford County, Arkansas.* Activities shown on the status map for Crawford County (AHTD 2014a) that could have cumulative impacts with the Project include (1) programmed bridge work on SH-59 at Lee Creek, (2) programmed work on I-40 from the Oklahoma-Arkansas state line east to just west of Dyer, (3) programmed road work on I-540 from Alma north to Mountainburg, (4) deferred work on US-71 from Alma north to a point southwest of Mountainburg, and (5) new construction of US-71 from Alma south, to the east of Kibler, and to the Arkansas River southeast of Fort Smith. HVDC Alternative Route 4-A would pass within about 2 miles south of the first activity. Link 6 of the Applicant Proposed Route would cross the second and fifth activity segments. HVDC Alternative Route 4-A/4-B/4-D would cross the third and fourth activity segments. A new section of US-71, south of the Arkansas River (i.e., south of the fifth activity above) and between US-22 and existing US-71, is currently under construction (to be completed in 2014) and almost 9 miles from the nearest segment of the Applicant Proposed Route (AHTD 2012).
- *AHTD District 4, Franklin County, Arkansas.* The status map for Franklin County (AHTD 2014a) shows no programmed or deferred activities being crossed by or adjacent to the Applicant Proposed Route or the alternative routes. The closest is programmed road work on SH-23 that begins over 4 miles to the north of HVDC Alternative Route 4-B and then extends northward.
- *AHTD District 8, Johnson County, Arkansas.* Activities shown on the status map for Johnson County (AHTD 2014b) that could have cumulative impacts with the Project are limited to programmed road work on I-40 from its junction with SH-164 east to just beyond where it crosses SH-352 (Wire Road). HVDC Alternative Route 4-E would roughly parallel this segment of I-40 at distances of 0.5 to 0.9 mile to the south until it veers to the north and crosses I-40 just east of the AHTD activity's eastern end.
- *AHTD District 8, Pope County, Arkansas.* The status map for Pope County (AHTD 2014b) shows no programmed or deferred activities being crossed by or adjacent to the Region 4 Applicant Proposed Route or the alternative routes. The closest is programmed road work on a short segment of SH-7 about 5 miles to the east of Link 9 of the Region 4 Applicant Proposed Route.

Diamond Pipeline. See the Diamond Pipeline description in Section 4.2.3. The path of the Diamond Pipeline appears to overlap portions of the Plains & Eastern transmission line route in Regions 3, 4, and 5.

4.2.5 Region 5—Present and Reasonably Foreseeable Future Actions

Region 5 is referred to as the Central Arkansas Region and includes the Applicant Proposed Route and HVDC Alternative Routes 5-A through 5-F and the Arkansas converter station alternative. Region 5 extends through Pope, Conway, Van Buren, Cleburne, White, and Jackson counties in Arkansas.

Arkansas State Highway and Transportation Department. As described in more detail in the Region 4 discussion, the AHTD “Status of Improvement” maps (status maps) were reviewed for roadway activities that could involve impacts cumulative with the Project. Region 5 of the Applicant Proposed Route would pass through AHTD District 8 (specifically Pope, Conway, Van Buren, and Faulkner counties) and District 5 (Cleburne, White, and Jackson counties). Road activities from the Status of Improvement maps or other sources that could have cumulative impacts with the Project are summarized by District and County as follows:

- *AHTD District 8, Pope County, Arkansas.* The status map for Pope County (AHTD 2014b) shows no programmed or deferred activities being crossed by, or adjacent to the Region 5 Applicant Proposed Route or the alternative routes. The closest is programmed road work on a short segment of SH-27 about 2.4 miles to the north of Link 1 of the Region 5 Applicant Proposed Route. Although not shown on the status map, the AHTD has announced plans to construct a Highway 7 bypass to the west of Dover (Crabtree 2013). At its closest, Link 1 of the Region 5 Applicant Proposed route would be about 3 miles to the north of the Highway 7 bypass.
- *AHTD District 8, Conway County, Arkansas.* Activities shown on the status map for Conway County (AHTD 2014b) that could have cumulative impacts with the Project include (1) programmed work on SH-247 from the Pope-Conway county line east to its junction with SH-213 and (2) programmed road work on SH-92 from 2.9 miles east of the junction with SH-9 east to the Conway-Van Buren county line. HVDC Alternative Route 5-B would run roughly parallel with the first activity as close as 0.8 mile to the south of the road. Link 3 of the Region 5 Applicant Proposed Route would run roughly parallel with the second activity as close as 0.9 mile to the south of the road.
- *AHTD District 8, Van Buren County, Arkansas.* Activities shown on the status map for Van Buren County (AHTD 2014b) that could have cumulative impacts with the Project are limited to programmed road work on US-65 from Bee Branch to about 3 miles south. At its nearest, Link 3 of the Region 5 Applicant Proposed Route would be about 1.7 miles to the south of the activity’s southern end.
- *AHTD District 8, Faulkner County, Arkansas.* Activities shown on the status map for Faulkner County (AHTD 2014b) that could have cumulative impacts with the Project are limited to programmed road work on SH-285 from its junction with SH-124 to about 4 miles south. At its nearest, HVDC Alternative Route 5-B would be about 1 mile to the north of the activity’s northern end.
- *AHTD District 5, Cleburne County, Arkansas.* The status map for Cleburne County (AHTD 2014c) shows no programmed or deferred activities being crossed by or adjacent to the Region 5 Applicant Proposed Route or the alternative routes.
- *AHTD District 5, White County, Arkansas.* The status map for White County (AHTD 2014c) shows no programmed or deferred activities being crossed by or adjacent to the Region 5 Applicant Proposed Route or the alternative routes.
- *AHTD District 5, Jackson County, Arkansas.* Potentially cumulative activities shown on the status map for Jackson County (AHTD 2014c) are limited to programmed road work on US-167 in the small segment of the road going through the western edge of the county. Link 9 of the Region 5 Applicant Proposed Route would cross the road segment.

Central Arkansas Natural Gas Pipeline Enhancement Project. CenterPoint Energy Gas Transmission Company, LLC is proposing the Central Arkansas Natural Gas Pipeline Enhancement Project for the transportation of natural gas to the central Arkansas cities and towns of Conway, Mayflower, Maumelle, North Little Rock, and Little Rock. After the pre-filing proceeding began CenterPoint Energy Gas Transmission Company, LLC changed its name to Enable Gas Transmission, LLC (Enable) effective July 30, 2013. As part of the Central Arkansas Natural Gas Pipeline Enhancement Project, Enable is proposing the installation of approximately 28 miles of 12-inch-diameter natural gas pipeline and ancillary facilities in Pulaski and Faulkner counties in Arkansas. The proposed pipeline, to be named Line BT-39, will be constructed primarily on a new alignment and will provide replacement transmission service for a portion of two existing natural gas pipelines (Lines B and BT-14). Construction was proposed to begin in March 2014 (CenterPoint Energy 2014), but the EA for the action was not released by FERC until mid-April 2014. FERC granted the requested authorizations with conditions in July 2014 (FERC 2014). Although Enable has not announced a new construction start date, it is assumed this action is still reasonably foreseeable and could occur at the same time as the Project of before the Project. The closest point of this new pipeline is approximately 16 miles south of the HVDC Alternative Route 5-B. The southern-most point of the proposed pipeline is more than 30 miles from the route. This action is outside the ROI but was evaluated because of its high-profile nature. Steps in the construction process include clearing, grading and trenching; stringing and welding pipe segments together; depositing the pipeline, backfilling and testing; and restoration (CenterPoint Energy 2013).

Diamond Pipeline. See the Diamond Pipeline description in Section 4.2.3. The path of the Diamond Pipeline appears to overlap portions of the Plains & Eastern transmission line route in Regions 3, 4, and 5.

4.2.6 Region 6—Present and Reasonably Foreseeable Future Actions

Region 6 is referred to as the Cache River and Crowley's Ridge Region and includes the Applicant Proposed Route and HVDC Alternative Routes 6-A through 6-D. Region 6 extends through Jackson, Cross, and Poinsett counties in Arkansas.

Arkansas State Highway and Transportation Department. As described in more detail in the Region 4 discussion, the AHTD "Status of Improvement" maps (status maps) were reviewed for roadway activities that could involve impacts cumulative with the Project. In Region 6, the Applicant Proposed Route would pass through AHTD District 5 (specifically Jackson County), District 10 (Poinsett County), and District 1 (Cross County). Planned activities from the status maps or other sources that could have cumulative impacts with the Project are summarized by District and County as follows:

- *AHTD District 5, Jackson County, Arkansas.* Activities shown on the status map for Region 6 in Jackson County (AHTD 2014c) that could have cumulative impacts with the Project are limited to programmed work on four bridge structures on SH-14 near the community of Amagon. Two of the bridge structures are at the Cache River crossing and the other two are about 1 mile to the east over wetlands areas on the west side of Amagon. HVDC Alternative Route 6-B would run adjacent to SH-14 along this same stretch of road and cross over or very near to these bridge structures.
- *AHTD District 10, Poinsett County, Arkansas.* The status map for Poinsett County (AHTD 2014d) shows no programmed or deferred activities being crossed by or adjacent to the Region 6 Applicant Proposed Route or the alternative routes. The closest activity is a short segment of SH-1 within the community of Harrisburg, which is more than 5 miles north of HVDC Alternative Route 6-C.

- *AHTD District 10, Craighead County, Arkansas.* Although not crossed by routes of the Project, Craighead County to the north of Poinsett County was identified as having several planned road tasks, primarily in the Jonesboro area, being recently completed or started. These included the US-67 extension at SH-226 intersection and the widening of Highway 226 east to US-49 (AHTD 2013). The reference identified these tasks as either being completed or starting construction in 2012. These road construction activities are more than 20 miles north of the Region 6 routes.
- *AHTD District 1, Cross County, Arkansas.* Planned activities shown on the status map for Region 6 in Cross County (AHTD 2014e) that could have cumulative impacts with the Project are limited to programmed work on four bridge structures on SH-42 between Hickory Ridge and Cherry Valley. Link 6 of the Region 6 Applicant Proposed Route would run roughly parallel to and 2 miles north of the eastern half of this road segment where two of the bridge activities are located. Programmed road work on SH-163 to the southeast of Cherry Valley doesn't get closer than about 3.5 miles from the Applicant Proposed Route.

Rebuild 161kV Transmission Line from Trumann to Trumann West, Arkansas. Entergy Arkansas, Inc. plans to rebuild the 161kV transmission line from Trumann to Trumann West by replacing the current wooden structures with steel monopoles. This transmission line replacement is proposed for 2021 (Entergy 2013). This transmission line runs generally north-south compared to the east-west direction of the Project. The nearest segment of the Trumann to Trumann West transmission line is approximately 10 miles north of the Applicant Proposed Route. Because the activity includes replacement of structures, the impacts associated with the transmission line rebuild would be similar to those anticipated for the Project, although on a smaller, more localized scale.

US-63, Poinsett County, Arkansas. The FHWA, in cooperation with the AHTD, is studying an access road located adjacent to US-63 between Marked Tree and Payneway, Arkansas, in Poinsett County. An Environmental Assessment was completed in January 2012 (FHWA and AHTD 2012). US-63 between I-55 to the southeast and Jonesboro to the northwest is to be converted to I-555 in the future. The section of Highway 63 has already been upgraded to meet interstate criteria with the exception of a short segment to the west of Marked Tree that crosses the St. Francis River floodway (designated the St. Francis Sunken Lands), which does not have access control. This highway access road will support local traffic by providing an alternative route across the floodway so that access to Highway 63 can be controlled and the conversion to I-555 completed. The FHWA and AHTD action includes six bridges, which will span the St. Francis River and numerous water bodies within the St. Francis Sunken Lands, and will require some new ROW over what has been established for Highway 63. The roadway typical cross-section consists of two 10-foot-wide travel lanes, one in each direction, with 4-foot-wide outside shoulders. The total length of the action is approximately 4.7 miles. At its closest, the proposed access road segments are more than 2 miles to the north of Link 8 of the Region 6 Applicant Proposed Route and about 4 miles from HVDC Alternative Routes 6-C/6-D. However, an access road segment is only about 0.8 mile to the northwest of to HVDC Alternative Route 7-A.

4.2.7 Region 7—Present and Reasonably Foreseeable Future Actions

Region 7 is referred to as the Arkansas Mississippi River Delta and Tennessee Region and includes the Applicant Proposed Route, HVDC Alternative Routes 7-A through 7-D, and the Tennessee converter station. Region 7 extends through Poinsett and Mississippi counties in Arkansas and Tipton and Shelby counties in Tennessee.

Arkansas State Highway and Transportation Department. As described in more detail in the Region 4 discussion, the AHTD "Status of Improvement" maps (status maps) were reviewed for roadway activities that could involve impacts cumulative with the Project. Region 7 of the Applicant Proposed Route would pass through AHTD District 10 (specifically Poinsett and Mississippi counties). Road activities from the status maps or other sources that could have cumulative impacts with the Project are summarized by District and County as follows:

- *AHTD District 10, Poinsett County, Arkansas.* Actions shown on the status map for Region 7 in Poinsett County (AHTD 2014d) that could have cumulative impacts with the Project are limited to programmed work on a short segment of US-63 within the community of Marked Tree. HVDC Alternative Route 7-A would be 0.7 mile to the southeast of the near end of the road segment.
- *AHTD District 10, Mississippi County, Arkansas.* Actions shown on the status map for Region 7 in Mississippi County (AHTD 2014d) that could have cumulative impacts with the Project are limited to programmed work on an almost 17-mile section of I-55 from the Mississippi-Crittenden county line north to a point between Marie and Keiser. Link 1 of the Region 7 Applicant Proposed Route would cross I-55 in the southern portion of this segment and HVDC Alternative Route 7A would run adjacent and parallel to a 3.5-mile segment of the I-55 segment before crossing it in the northern portion.

Great River Super Site, Osceola, Arkansas. The Great River Super Site in Osceola, Arkansas, is a 4,800-acre site owned by Entergy and private entities. This site is part of the State of Arkansas, Mississippi County Economic Development Area. All environmental clearances (i.e., Phase I Environmental Site Assessments) have been completed and the area is planned to be developed for heavy industry. The site has direct access to the Mississippi River. Anticipated industries to develop in this area include steel industries (Mississippi County Economic Development 2014). The northern-most point of HVDC Alternative Route 7-A would be only about 0.4 mile to the southwest of the 4,800-acre site; Link 2 of the Region 7 Applicant Proposed Route would be about 11 miles to the south.

I-69 Expansion, Tennessee. I-69 is a multi-state highway, planned to connect Canada and Mexico and its route includes western Tennessee. Segments of I-69 in north and south Tennessee have been completed, others are under construction, and the Tennessee Department of Transportation expects completion of some segments to stretch well into the future. Current construction work of segments in Union City will likely not be completed until the 2017 time frame and it may be a 10-year program to complete segments that would extend it south to Troy. That would leave only the middle 65-mile section between Dyersburg and Millington to complete Tennessee's portion of the route. There was no federal funding designated for this transportation project as of February 2013, so no schedule has been established, but the plans are still being considered by the TNDOT (Dyersburg State Gazette 2013). The middle section of the I-69 activity, from Dyersburg to Millington, would go through the ROI of the Project, which ends just to the northeast of Millington. Current plans show the I-69 route running to the west of US-51/SH-3 near Millington (TNDOT 2014) where it would cross Link 3 of the Region 7 Applicant Proposed Route as well as HVDC Alternative Routes 7-B and 7-C.

Green Meadows Development at Munford, Tennessee. Concerns were raised during the EIS scoping process that a housing development was planned that should be considered in the cumulative impacts for this EIS. This development (the Green Meadows Development) is a planned community being constructed by the Green Meadows Development Corporation in Munford, Tennessee. The planned community will eventually consist of 695 single family homes with multiple construction phases and varying lot and house sizes over a 370-acre parcel. The development will also include a small commercial district (e.g., retail and shopping center, restaurants, and professional space), community parks, several ponds, and a Green Belt walking trail system. A retirement community along with fitness center, tennis courts, and a pool is also planned as part of this planned community (Green Meadows 2014). It was reported in mid-2012 that building approvals had been obtained and Phase 1 construction, including utilities, would begin in 2013 (Epley 2012). However, Tipton County property assessment data for 2014 indicate there are still no water, sewer, or gas utilities serving the parcel, and it is still classified as a farm (Tipton County 2014), so it appears Phase 1, if started, is not yet complete. The 370-acre parcel appears to be about 0.2 mile away from the eastern end of HVDC Alternative Route 7-D and 2 miles from the east end of the Region 7 Applicant Proposed Route.

Southern Gateway Project, Tennessee. The TNDOT conducted broad studies to determine the feasibility of a new Mississippi River bridge in the metropolitan Memphis, Tennessee area. These studies included the Mississippi River Crossing Feasibility and Location Study (Wilbur Smith Associates 2006), which was completed in June 2006 and identified potential locations for a new bridge. These studies collected preliminary data on the existing highway transportation system, natural environment and socio-economic characteristics of the area. The feasibility study focused on highway corridors and several bridge locations were screened based on their potential environmental and community impacts, engineering issues and estimated cost. These studies determined that a new bridge is feasible and recommended how to move forward to the next level of detail.

The Southern Gateway Project is a continuation of these earlier studies and is being developed through a collaborative effort of multiple agencies, including TNDOT, AHTD, Mississippi Department of Transportation (MSDOT), Memphis and West Memphis Metropolitan Planning Organizations (MPOs), and the FHWA. One of the potential river crossing corridors considered in a 2011 “Purpose and Need” study (TNDOT 2011) for the Southern Gateway Project is designated Corridor V1-7 and crosses the Mississippi River in the area of the Tipton-Shelby county line in Tennessee. This is the northern-most of the crossing corridors described in the study and, from west to east, starts in Arkansas at the junction of I-55 and US-63 and proceeds eastward, with a slight loop to the north, then southeast to just west of Millington in Tennessee. Were this corridor selected, it would require a new bridge and connecting roadways plus about 1 mile of new rail line in the Millington area. An EIS for the Southern Gateway Project will be developed that will outline the anticipated costs, benefits, and impacts of the alternatives, and is expected to be completed in 2015 (TNDOT 2011). Corridor V1-7 goes as far north as about the Crittenden-Mississippi county line in Arkansas before dipping back to the southeast. At its northern-most extent, Corridor V1-7 appears to be about 3 miles south of Link 1 of the Region 7 Applicant Proposed Route and about 4 miles south at the respective river crossings. Corridor V1-7 would, however, likely cross HVDC Alternative Route 7-C before ending on the west side of Millington. Other possible corridors addressed in the Purpose and Need study are all in the immediate area of Memphis or to its south and no closer than about 8 to 10 miles from routes of the Project.

4.3 Resource Area Cumulative Impacts

4.3.1 Evaluation Methodology

4.3.1.1 Cumulative Impacts Presentation

Cumulative impacts within each of the Chapter 3 resource areas are discussed in the sections that follow. Each resource area includes a discussion of the potential impacts from the present and reasonably foreseeable future actions described in Section 4.2 that could be cumulative with those of the Project. Each resource area discussion first summarizes the Project’s potential impacts for the resource area, as were identified and described in the applicable methodology section of Chapter 3. If both the Project and the applicable present or reasonably foreseeable future actions would be expected to impact a resource, then there would be potential for cumulative impacts.

The discussion of potential cumulative impacts does not attempt to describe the impacts for every action for each region, because of the wide range of affected environments in Regions 1 through 7 and the large number of present and reasonably foreseeable future actions identified in Section 4.2. Rather, the evaluation and discussion follows DOE's graded approach by focusing on those projects within each region that would have the highest potential for significant impacts to the specific resource area. In addition, the nature of the information generally available for the actions identified in Section 4.2 limits the evaluation of cumulative impacts to qualitative analyses.

4.3.2 Agricultural Resources

Agricultural resource impacts of concern for the Project are associated with the potential for direct impacts to agricultural land and structures from construction and to agricultural operations given the long-term presence of Project components and their need for periodic maintenance. Also of concern are potential indirect impacts to agricultural production on adjacent lands due to the presence of transmission infrastructure changing aerial application patterns of fertilizers, insecticides, and herbicides; and economic impacts to farmers and ranchers due to the impacts to agricultural lands (such as reduced productivity).

To the extent that the present and reasonably foreseeable future actions described in Section 4.2 involve new disturbance of agricultural lands, their impacts could be additive with those of the Project. Impacts during construction could involve additional loss of vegetation and soil at construction sites and along travel routes; possible temporary loss of the use of structures such as barns, ponds, and silos; and possible curtailment of actions such as animal feeding operations. These types of construction-related impacts likely would be short term, although it is possible that loss of the use of structures could be long-term. During operations and maintenance, if the actions were for new electrical transmission lines, buried oil or natural gas pipelines, or similar actions, agricultural activities could resume to a large extent on most disturbed areas, but there would likely be some constraints and limitations. This could include land use limitations within ROWs, physical interference with agricultural equipment operations, and periodic loss of access during maintenance activities. Also during operations, permanent structures such as electric transmission structures and conductors could affect aerial spraying activities often used in agricultural areas. This could involve requiring the spraying to be performed at higher altitudes resulting in more chance for overspray or drift that could affect adjoining properties, or it could eliminate aerial spraying in some areas. There could also be effects on the economic value of livestock production by a combination of decreasing forage land available and by increasing management costs of controlling noxious and invasive vegetation species introduced during construction and costs of moving livestock around project-related structures and ROWs. All of these types of impacts could be cumulative with those of the Project if they were to occur within the same landowner's property or if measured in terms of the overall quantity of crops or livestock produced from the region.

Many of the actions identified in Section 4.2, particularly those associated with upgrades or maintenance actions for existing roadways, bridges, or airports, would not be expected to involve any substantial disturbance of agricultural lands and, accordingly, would be unlikely to affect agricultural resources.

As described in Sections 3.2.4 and 3.2.5, agriculture is the predominant land use in each of the seven regions. However, the counties in which Regions 1 and 2 are located have the highest percentages of agricultural land, averaging more than 90 percent, in comparison to the counties in other regions. Regions 3 and 6 are the next closest, with the counties averaging more than 70 percent agricultural land. The average amount of agricultural land in the other three regions varies from 36 to 49 percent. The actions identified in Section 4.2 for Regions 1 and 2 also include several projects that would involve new land disturbance. Therefore, the present and reasonably foreseeable future projects identified for Regions 1 and 2 would likely have a higher potential for impacts to agricultural resources that would be cumulative with impacts of the Project. As described in Sections 4.2.1 and 4.2.2, both regions have OG&E transmission line planned activities as well as a new OG&E substation in Region 1. Potential impacts to agricultural resources for these actions would be the same as summarized above and described in detail in Section 3.2.6 for the Project. The Glass Mountain Crude Oil Pipeline project in Region 2 would be expected to have impacts similar to a transmission line action in the sense that it has a linear construction and agricultural uses could resume to some extent after construction was complete. But, there would be greater ground disturbance expected for the oil pipeline action, which increases the potential for invasive weeds to establish.

Region 2 also contains the Mammoth Plains Wind Farm project and its potential impacts to agricultural resources would be similar to the connected action described in detail in Section 3.2.6.8. Some agricultural lands would be taken out of service during construction, but because of the large distance between wind turbines, the land taken out of service would be very small in comparison to the total wind farm area. After construction was complete and agricultural activities reestablished in the disturbed areas, only a minimal area of existing agricultural land would be permanently removed from production. As described in Section 3.2.6.8 for connected actions, wind farm developers are typically able to microsite turbines and other facility components to avoid displacing or damaging agricultural structures, including irrigation system components.

4.3.3 Air Quality and Climate Change

Air quality and climate change impacts of concern for the Project, as described in Section 3.3.6, are associated primarily with construction and include the following:

- Fugitive dust emissions
- Exhaust from construction equipment exhausts
- Portable concrete batch plant emissions
- Vehicle exhaust for work travel and movement of supplies

Air quality and climate change impacts during operations and maintenance of the Project would be limited to the emission of small amounts of pollutants associated with combustion of fossil fuels for work vehicles and maintenance equipment.

The present and reasonably foreseeable future actions described in Section 4.2 are similar to the Project in that the air emissions associated with the Section 4.2 actions would also be primarily from construction actions and would therefore result in effects similar to those listed above. None of the identified actions involve long-term operations with notable air emission sources. Based on available information, transportation related projects (i.e., roadway maintenance, bridge replacement, airport improvements, and even new road construction) are not anticipated to result in significant increases in traffic over what would occur without the activities. By its intended purpose, the Great River Super Site industrial park development in Region 7 is a possible exception to the earlier statement that the present and reasonably foreseeable future actions involve no notable long-term air emission sources. However, no specific future actions were identified for this site at the current time. Construction air emissions from the present and reasonably foreseeable future actions would be cumulative with those of the Project if they were to occur at the same time and in the same general area. However, most of the actions would involve air emissions, like the Project, characterized as intermittent and short term, with only minor temporary impacts on air quality in the vicinity of the construction activities.

As described in Section 3.3.5, the counties in the vicinity of the Memphis metropolitan area represent the only area along the general route of the Project that is currently classified as nonattainment with respect to any of the air quality standards. This area, consisting of Shelby County, Tennessee, Crittenden County, Arkansas, and the northern portion of De Soto County, Mississippi, is characterized as a marginal nonattainment area with respect to the 8-hour ozone standard. As a result, all actions occurring in this area that require some type of federal approval are subject to provisions of Transportation Conformity regulations (40 CFR 93 Subpart A) or General Conformity regulations (40 CFR 93 Subpart B), and sufficiently large actions are required to explicitly demonstrate conformity with State Implementation Plans (SIPs) for air quality; these regulatory requirements are in place specifically for the purpose of addressing cumulative impacts. Regions 6 and 7 of the Applicant Proposed Route are the closest of any of the regions to the nonattainment area and, therefore, might be considered the regions where cumulative air quality impacts could have the most serious adverse impacts. Present and reasonably foreseeable future actions in Regions 6 and 7 also happen to include some of the largest construction activities of any identified in Section 4.2. Specifically, US-63 access road construction in Region 6 and the I-69 extension and the Southern Gateway Project in Region 7 represent significant construction efforts. A construction date for the US-63 action was not available, but it is assumed it could be in the same time as the Project. Fugitive dust emissions would be localized; if construction overlapped between the US-63 action and the Project, short-term exhaust from vehicles and equipment could be additive but short-term and localized. It is unlikely that the two Region 7 actions (i.e., the I-69 extension and the Southern Gateway Project) would have construction impacts cumulative with the Project because neither of the actions have firm schedules; because of their large scale both are likely many years away. Also, based strictly on where most of the corridors for the Southern Gateway Project are being considered, its ultimate location, if implemented, will likely be south of the Project.

As was identified in Sections 3.3.5.3 through 3.3.5.5, air quality monitors in Regions 3, 4, and 5 show ozone levels that exceed NAAQS, so existing emissions sources that reach those monitors have a cumulative impact of exceeding the NAAQS. However, in several cases, the monitors nearest the Project were 30 or 40 miles away and were located much closer to urban centers (such as Oklahoma City and Little Rock). Monitors closer to the Project (e.g., those near Tulsa) are more relevant, yet are still well outside the ROI of the construction projects and are dominated by emissions from other sources. Therefore, while the combination of the Project and other actions would generate cumulative impacts on air quality near the Project, the Project itself would have a negligible contribution (and are also temporary and therefore do not contribute to air quality impacts on a continued basis).

For GHGs, as mentioned in Section 3.3.6.8, approximately 40 percent of national GHG emissions are from the power generation sector, and therefore actions such as the one connected to the Project—i.e., the development of wind farms for power generation, which emit almost no pollutants—can cumulatively have a significant positive impact by avoiding emissions (and are typically promoted for this very reason). In general and as identified in Section 3.3.6.8, actions connected to the Project—i.e., the development of wind farms—would generate relatively few emission during construction, and possibly more than the construction of the identified present and reasonably foreseeable future actions as well, although the locations of the emissions reductions may be completely different from the locations of the construction emissions.

Climate change is the modification of climate over time, whether due to natural causes or as a result of human activities. Climate change cannot be represented by single annual events or individual anomalies. For example, a single large flood event or particularly hot summer is not an indication of climate change. However, unusually frequent or severe flooding, or several consecutive years of abnormally hot summers over a large region, may be indicative of climate change.

The Intergovernmental Panel on Climate Change (IPCC) is the leading international, multi-governmental scientific body for the assessment of climate change. The United States is a member of the IPCC and participates in the IPCC working groups. IPCC's Fifth Assessment Report (AR5) has identified that "Consistent with the Fourth Assessment Report (AR4), it is assessed that more than half of the observed increase in global average surface temperature from 1951 to 2010 is very likely [90–100% probability] due to the observed anthropogenic increase in [well-mixed] GHG concentrations" (IPCC 2013). The leading United States scientific body on climate change is the U.S. Global Change Research Program (USGCRP). Thirteen federal departments and agencies (EPA, DOE, Department of Commerce, DOD, USDA, Department of the Interior, Department of State, DOT, Department of Health and Human Services, NOAA, National Science Foundation, Smithsonian Institution, and Agency for International Development) participate in the USGCRP, which began as a presidential initiative in 1989 and was mandated by Congress in the *Global Change Research Act of 1990* (Public Law 101–606).

The USGCRP issued its Third National Climate Assessment (NCA), *Global Climate Change Impacts in the United States,* in 2014, summarizing the impacts climate change has already had on the United States and what projected impacts climate change may have in the future. The report includes a breakdown of overall impacts by resource and impacts described for various regions of the United States.

The USGCRP has concluded that (USGCRP 2014):

- The "global climate is changing and this change is apparent across a wide range of observations. The global warming of the past 50 years is primarily due to human activities" (USGCRP 2014, p 20).
- "Carbon dioxide made up 84 percent of U.S. greenhouse gas emissions in 2011. Forty-one percent of these emissions were attributable to liquid fuels (petroleum), followed closely by solid fuels (principally coal in electric generation), and to a lesser extent by natural gas. The two dominant production sectors responsible for these emissions are electric power generation (coal and gas) and transportation (petroleum)." "If emissions from electric generation are allocated to their various end-uses, transportation is the largest CO_2 source, contributing a bit over one-third of the total, followed by industry at slightly over a quarter, and residential use and the commercial sector at around one-fifth each" (USGCRP 2014, p 652).
- Impacts extend beyond atmospheric climate change alone, and include changes to water resources, transportation, agriculture, ecosystems, and human health.

Climate change has modified the environment in the area around the Project and is projected to cause additional changes. The Second and Third NCAs identify climate change impacts that have occurred in the continental Great Plains and Southeast. Key messages of the Third NCA with respect to the Great Plains and Southeast include the following (Shafer et al. 2014; Carter et al. 2014):

- "Rising temperatures are leading to increased demand for water and energy. In parts of the region, this will constrain development, stress natural resources, and increase competition for water among communities, agriculture, energy production, and ecological needs" (Shafer et al. 2014).

- “Changes to crop growth cycles due to warming winters and alterations in the timing and magnitude of rainfall events have already been observed; as these trends continue, they will require new agriculture and livestock management practices” (Shafer et al. 2014).
- “Landscape fragmentation is increasing, for example, in the context of energy development activities in the northern Great Plains. A highly fragmented landscape will hinder adaptation of species when climate change alters habitat composition and timing of plant development cycles” (Shafer et al. 2014).
- “Communities that are already the most vulnerable to weather and climate extremes will be stressed even further by more frequent extreme events occurring within an already highly variable climate system” (Shafer et al. 2014).
- “The magnitude of expected changes will exceed those experienced in the last century. Existing adaptation and planning efforts are inadequate to respond to these projected impacts” (Shafer et al. 2014).
- “Sea level rise poses widespread and continuing threats to both natural and built environments and to the regional economy” (Carter et al. 2014).
- “Increasing temperatures and the associated increase in frequency, intensity, and duration of extreme heat events will affect public health, natural and built environments, energy, agriculture, and forestry” (Carter et al. 2014).
- “Decreased water availability, exacerbated by population growth and land-use change, will continue to increase competition for water and affect the region’s economy and unique ecosystems” (Carter et al. 2014).

4.3.4 Electrical Environment

Electrical environment impacts of concern for the Project, as described in Section 3.4.11, are associated with operation of AC and DC transmission lines and include the following:

- AC or DC electric fields that exists around charged objects (in this case, the transmission lines) and which are stronger near the charged object and decrease with distance
- AC or DC magnetic fields generated by an electric current, or flow of electrical charges (in this case, through the transmission lines), and which decrease in intensity with distance
- Audible noise cause by the natural phenomenon of electrical discharge, or corona, from energized surfaces such as a transmission line conductor
- Radio and television noise interference when electromagnetic energy from corona discharges includes the same frequencies as radio and television bands
- Ozone and air ions created by corona from a transmission line

The above effects are all associated with energized transmission lines so there would be no electrical effects of concern from potentially cumulative actions during construction.

The present and reasonably foreseeable future actions described in Section 4.2 include several for construction and operation of new electrical transmission lines. These are the only actions that potentially would involve electrical impacts cumulative with those of the Project. Present and reasonably foreseeable future actions with these traits are limited to Regions 1, 2, and 3. The Region 6 Trumann to Trumann West transmission line is outside of the electrical environment ROI and therefore too far to have additive effects with the Project. No electrical transmission line projects are identified for Regions 4, 5, or 7. In Regions 1, 2, and 3 the actions of interest are all OG&E transmission line actions: Hitchland-Woodward in Region 1, Woodward-Thistle in Region 2, and Seminole-Muskogee in Region 3. In Region 1, the OG&E line runs parallel to the Applicant Proposed Route through Beaver County. In Region 2, the OG&E line crosses Link 1 of the Applicant Proposed Route and one of the OG&E alternatives appears to parallel portions of HVDC Alternative Route 2-A. In Region 3, the OG&E line crosses the Applicant Proposed Route as well as the HVDC alternative routes.

These OG&E actions are all high voltage AC transmission lines, whereas the Project is an HVDC transmission line (with associated high voltage AC collector lines and interconnections). Transmission lines within the United States are operated either as DC (Direct Current or constant/static/fixed frequency of 0 Hertz) or AC (Alternating Current or alternating frequency of 60 Hertz). Static electric and magnetic fields (such as those created by HVDC transmission lines) are also naturally present in the earth's environment. For example, the earth creates a natural static electric field in fair weather and underneath clouds, and a natural static magnetic field allows compass needles to point to the magnetic North Pole. However, AC electric and magnetic fields only occur near AC electrical sources (such as AC transmission lines and electrical appliances). Electric and magnetic fields produced by AC electrical sources reverse direction at a frequency of 60 cycles per second (60 Hertz) whereas static fields are constant and do not change direction. Comparisons between DC and AC fields may therefore not be straightforward, especially when combining fields from both DC and AC sources.

The OG&E transmission lines have 345kV capacities and, individually, their electrical impacts would be expected to be similar to impacts from the 345kV double circuit AC interconnection line associated with the Oklahoma converter station described in Section 3.4.11.2.1 and the 345kV single circuit AC collection system routes described in Section 3.4.11.2.2. However, as described in Section 3.4.11, impacts at or near ground level can vary substantially based on the height of the structure and on the structure/line configuration as well as the electrical energy transmitted. The loading (or anticipated MW capacity) will specifically impact magnetic field levels.

Areas where transmission lines of the Project and present and reasonably foreseeable future actions would potentially have cumulative impacts are limited to crossing points and collocated stretches (with centerlines within about 600 feet of one another). The evaluation of impacts from the Project considered other transmission lines already present in the Project regions and, in Section 3.4.10, states that electrical effects from existing transmission lines may influence the electrical effects associated with the Project's transmission line and that those effects could be additive or subtractive. Section 3.4.10 then indicates that because the route for the HVDC transmission line has not yet been selected and because of the numerous existing transmission lines in the various regions, calculations of the combined electrical effects were not performed at this time. The same holds true for the newly identified transmission line actions. However, without performing calculations, it can be reasoned that locations where transmission line routes crossed would likely be sites of the highest cumulative impacts, but the affected area would be contained within the limits of the generated fields, which are relatively small as described in Section 3.4. On the other hand, collocated transmission line routes would require adequate separation so the magnitude of the cumulative effects would be less, but the area affected would be greater as described in Section 3.4.

4.3.5 Environmental Justice

Disproportionately high and adverse effects to low-income and minority populations can result if actions cause disproportionately high and adverse human health or environmental effects to minority or low-income populations. Section 3.5.5 identifies locations within the ROI for this resource where Census data indicate locations with a high percentage of minority or low-income residents. Minority populations include individuals who are Black or African American, American Indian and Alaska Native, Asian, Native Hawaiian and other Pacific Islander, other non-white race, or persons of two or more races and Hispanic or Latino (CEQ 1997). For the evaluation in this EIS, minority population areas of concern are those where 50 percent or more of the population within the Census Block is minority or if the percentage of the minority population is 10 percent or more above the minority population of the county as a whole. Low-income population areas of concern are those where 20 percent or more of the households within the Census Block Group have incomes below the poverty level.

For the impact evaluations of the Project (Section 3.5.6), it was concluded for each of the Project components that while there is potential for impacts, it is anticipated that such impacts would not be disproportionately high and adverse and would affect all populations in the ROI equally. Accordingly, the Project would not result in disproportionately high and adverse effects to minority or low-income populations. The significance of "disproportionately high and adverse effects" is identified in Section 3.5.1 and the methods used in evaluating potential impacts for the Project are presented in Section 3.5.6.1. The present and reasonably foreseeable future actions described in Section 4.2 could involve cumulative environmental justice concerns if, in combination with the Project, impacts were raised to a "disproportionately high and adverse" level as described in Section 3.5.6.1.

In the Section 3.5.6.2.3 discussion of impacts associated with the HVDC Applicant Proposed Route, it is noted that potential low-income and minority populations are identified in all of the counties crossed in Regions 4, 5, 6, and 7. In the other regions, only some of the counties have qualifying minority and low-income populations. Accordingly, Regions 4, 5, 6, and 7 would be most likely to present cumulative impacts that could raise environmental justice concerns. In the case of Regions 4, 5, and 6, identified present and reasonably foreseeable future actions are, with a single exception, limited to road maintenance plus a hydroelectric plant proposed in Region 4 that is 12 miles from the nearest Project route (although within a county affected by the Project), a natural gas pipeline project in Region 5 that is 16 miles from the nearest Project route, and a rebuilt transmission line in Region 6 that is 10 miles from the nearest Project route. The pipeline project is outside the counties affected by the Project and therefore not expected to contribute to impacts that would be cumulative with those of the Project. The roadway activities might be considered no more than short-term changes to an existing source of impacts (i.e., impacts associated with traffic and highway operations). Based on the best available information, it is not known whether the hydroelectric plant would result in disproportionately high and adverse effects to low-income and minority populations. Because the hydroelectric plant and the Project would affect different areas of the same county, separated by many miles, they would not affect the same individuals of the population. For these reasons, it is unlikely that impacts from any of these actions or activities could combine with those of the Project to reach disproportionately high and adverse levels.

The single Region 4 and 5 exception to the preceding is the Diamond Pipeline action, which would overlap with the Plains & Eastern Project in the center of Region 3, the eastern end of Region 4 and the western half of Region 5. Most impacts associated with the Diamond Pipeline action would occur during construction, as is the case with the Plains & Eastern Project. The impacts of both projects could affect the same population and that population could include a high percentage of minority or low income residents. If the combination of impacts from the two projects were raised to a "disproportionately high and adverse level," there could be cumulative environmental justice concerns. After construction, there could be similar cumulative land use concerns if ROW restrictions for the two projects impacted the same landowners.

In the case of Region 7, it has two of the largest scale present and reasonably foreseeable future actions of any of the regions (the I-69 expansion and the Southern Gateway Project). However, as described in Section 4.3.3 on cumulative air quality impacts, the two large projects (I-69 and Southern Gateway) currently do not have firm schedules so are unlikely to be constructed in the same time frame, and the Southern Gateway action is unlikely to be in the same area as the Project's construction so there would be little potential for cumulative impacts. Region 7 also has two development areas planned: an industrial park (Great River Super Site) and a housing community (Green Meadows). Based on the best available information, it is not known whether these development areas would result in impacts to low-income and minority populations. Because of the relatively small size and large distance between the Great River Super Site and the Project, disproportionately high and adverse cumulative impacts to low-income and minority populations are not anticipated. The Green Meadows development would occur in an area of Tipton County identified as farmland (Epley 2012), which is still classified as a farm in the Tipton County property assessment of 2014 (Section 4.2.7), and is, therefore, not anticipated to displace low-income and minority populations. As a result, disproportionately high and adverse cumulative impacts to low-income and minority populations from the development and the Project are not anticipated.

4.3.6 Geology, Paleontology, Minerals, and Soils

Consistent with the presentation of the affected environment and impacts in Chapter 3, this section's discussion is presented in two separate groupings: (1) geology, paleontology, and minerals; and (2) soils.

4.3.6.1 Geology, Paleontology, and Minerals

Geology, paleontology, and mineral impacts of concern for the Project, as described in Section 3.6.1.6, include the following:

- Geologic hazards in the form of seismicity, landslides, subsidence related to karst, and seismically induced liquefaction
- Paleontological resources and the potential for loss of important fossils as a result of the Project's ground-disturbing activities or from vandalism or unauthorized collection given the increased access generated by the Project
- Mineral resources and the potential for the Project to interfere with existing mineral extraction operations, reduce access to underlying minerals, and interfere with future mineral extraction operations

Most impact evaluations are performed to assess the effects of the Project on the site's natural conditions. For geology, however, an evaluation of concern is the potential for damage to the Project from the natural geological conditions or characteristics of the Project site. As such there would be no cumulative impacts from other present or reasonably foreseeable future actions because, like the Project, the actions described in Section 4.2 would not be expected to increase geologic hazards. Landslide hazards are the exception in that they are evaluated both for the possibility of adverse impacts to the Project and for the Project to aggravate natural conditions such that landslide risks are increased for other entities or properties. For the Project, the potential to impact landslide risks would occur only during construction and this would also be the expected case for present and reasonably foreseeable future actions. In addition, other actions would have to be quite close to the Project (i.e., within its ROI) to have cumulative impacts on landslide risks.

The Project's potential impact (Section 3.6.1.6) on mineral resources is addressed by identifying the following EPMs that would be implemented by the Applicant: (1) the Project would be designed to avoid crossing any active oil or gas well pads or impeding access to these such resources; (2) the Applicant would work with landowners and operators of active oil and gas wells, utilities, and other infrastructure to identify and verify the location of Project components and to minimize adverse impacts; and (3) the Applicant would coordinate with landowners to site access roads and temporary work areas to minimize impacts to existing operations and structures to the extent practicable. Since no adverse impacts to mineral resources were identified in the evaluation of the Project, there would be no contribution to cumulative impacts.

No known fossil bed sites have been identified within the ROI of the Project, but it is recognized that grading and excavation activities have the potential to uncover and impact paleontological resources. To minimize the potential for such impacts personnel will be trained in the practices, techniques, and protocols required by federal and state regulations and applicable permits (EPM GE-1 in Appendix F). In accordance with EPMs, construction footprints would also be minimized, which would reduce the potential for impact to paleontological resources. In this case, any present or reasonably foreseeable future action located within the ROI and involving ground-disturbance would be expected to have the same potential to impact paleontological resources as the Project. These impacts would be cumulative only to the extent that increases in the amount of ground disturbed might be expected to increase the probability for encountering paleontological resources. There is no means to evaluate how much the probability might change, but it would be expected to be minimal.

Considering the above limitations or conditions on what actions could be cumulative with those of the Project, it appears landslide-prone areas in the ROI could be locations where cumulative actions could occur. Regions 3, 4, 5, and 7 are the only regions identified in Section 3.6.1.6 with areas of moderate or high susceptibility for landslides and the Project would avoid sloped areas whenever practicable. It is assumed that the road maintenance work identified in Section 4.2 for Regions 3, 4, 5, and 7 would not involve areas of new ground disturbance, so landslide conditions would not be aggravated even if the work took place in areas of concern. With the road work eliminated, only the OG&E Seminole-Muskogee transmission line and the Diamond Pipeline actions in Region 3 would appear to involve construction action within the Project's ROI. However, since construction of the Region 3 OG&E transmission line has already been completed, its construction activities would not contribute to cumulative impacts (Section 4.2.3) and any crossed areas of landslide risk would have been stabilized to protect the equipment. The portion of the Diamond Pipeline action that appears to overlap the Plains & Eastern Project in Region 3 is outside the areas with moderate or high susceptibility for landslides. Therefore, no cumulative impacts with respect to increasing landslide risks would be expected.

In Region 4, the possible hydroelectric plant is well outside the Project's ROI and the only other construction actions are the new section of Highway 71 south from Alma, Oklahoma and the Diamond Pipeline. Link 6 of the Applicant Proposed Route crosses the path where the new road is planned but the applicable area to the south of Alma has only mild slopes, so no landslide risks would be expected. The Diamond Pipeline path appears to overlap or be very near HVDC Alternative Route 4-E at the eastern end of the region in an area of moderate susceptibility to, and low incidence of landslides, so landslide risks would be minor. In Region 5, two of the construction actions (the Highway 7 Dover bypass and the Enable Central Arkansas Natural Gas Pipeline Enhancement Project) are outside the Project's ROI; the third (the Diamond Pipeline) would be near the Plains & Eastern Project in the western half of Region 5, an area of moderate susceptibility to, and low incidence of landslides, so landslide risks would be minor.

Several of the present and reasonably foreseeable future actions in Region 7 involve construction actions; however, the Great River Site and the Green Meadows developments are both outside the Project's ROI. The I-69 Extension and the northern-most corridor (i.e., Corridor V1-7) being evaluated for the Southern Gateway Project would cross the Applicant Proposed Route or one of the HVDC alternative routes, but both in areas just outside of Millington, Tennessee, where there is farming and scattered housing developments, without significant slopes. Landslide risks would not be expected in these areas.

4.3.6.2 Soils

Soil impacts of concern for the Project, as described in Section 3.6.2.6 and which could involve cumulative impacts, include the following:

- Designated Farmlands—Construction disturbance could result in a decrease in productivity and quality of designated farmland and in places of permanent structures some farmland could be taken out of production.
- Soil Limitations—Site specific soil conditions could result in the following: (1) exposure of erosion-prone soil to conditions of increased erosion potential; (2) soil with high compaction potential would be susceptible to compaction from construction vehicles and equipment; and (3) disturbance of areas of steep slopes could cause increased erosion hazards.

Per the Section 3.6.2.6 evaluations, designated farmlands are present to some degree within the ROI of each of the Project's primary components, which includes the Applicant Proposed Route and the HVDC alternative routes in each of the regions. Similarly, soils with high compaction potential and with moderate to high wind erosion potential are present within each ROI and soil with high water erosion potential is present in most. With respect to designated farmland, the evaluations in Section 3.6.2.6 conclude that construction disturbance could result in a decrease in the productivity and quality of designated farmland. Because of the prevalence of designated farmland, the present and reasonably foreseeable future actions described in Section 4.2 that involve new ground disturbance would be expected to involve impacts that could be additive with those of the Project. Similarly with regard to the soil limitations of concern, other actions involving ground disturbance would be expected to have cumulative impacts. In this case, the cumulative impacts would be additional soil areas of increased erosion potential and of susceptibility to compaction.

Many of the actions identified in Section 4.2, particularly those associated with upgrades or maintenance actions for existing roadways, bridges, or airports, would be expected to involve minimal, if any, new disturbance of ground and, accordingly, would be unlikely to affect designated farmland or soil limitations. As has been noted in preceding evaluations, the transmission line and pipeline activities identified in Section 4.2 for Regions 1, 2, and 3, are representative of present and reasonably foreseeable future actions that could involve new ground disturbance within the ROI of the Project. Accordingly, these are the actions and regions most likely to involve cumulative impacts to designated farmlands and soil limitations. As mitigating factors, these Section 4.2 actions, like the Project, are linear (long, narrow) activities with relatively small amounts of ground disturbance considering the amount of area crossed. Also, once the construction is complete and disturbed ground has been recovered, use of the disturbed ground can be resumed to some extent and adverse impacts lessened.

4.3.7 Groundwater

Groundwater impacts of concern for the Project are associated with the potential for groundwater contamination, changes to infiltration rates, effects on water availability, and physical damage to well systems. As noted in the Section 3.7.6 discussion of impacts, these concerns would be limited primarily to the construction phase of the Project. The present and reasonably foreseeable future actions described in Section 4.2 for each of the regions would present similar concerns and, likewise, would appear to present possible concerns primarily during construction. Accordingly, there were no specific actions identified that would appear to involve long-term operations that could adversely affect groundwater, including no actions that would be expected to use large quantities of water during long-term operations.

The actions identified in Section 4.2 would be expected to involve the presence of the same type of potential contaminants (primarily fuels and lubricants in equipment) during construction and to implement the same type of measures to ensure those contaminants were not released. The actions would be expected to involve relatively minor changes to infiltration rates and, to decrease their own liability, would be expected to take precautions to ensure that equipment movement and excavations did not unknowingly damage well systems. As with typical construction activities, water likely would be needed for actions such as dust suppression, soil compaction, equipment cleaning, and concrete formulation. However, like the Project, these water demands would be relatively minor and short term. Potential impacts to groundwater from construction of the Project and from construction of the actions described in Section 4.2 would be minor.

Of the actions described in Section 4.2, it is estimated that Regions 3 and 7 could have the greatest potential for cumulative impacts with the Project. None of the specific actions identified in Section 4.2 would be expected to have high water use or high potential for groundwater contamination during operations and maintenance, so potential impacts during construction would be the primary concern and actions in Regions 3 and 7 appear to be associated with the greatest number and size of construction actions. Region 3 has many road tasks planned, an action to replace a dam bridge, an action to improve airport pavements, construction of another transmission line, and construction of two crude oil pipelines. Possibly the largest single action in the region, the dam bridge, is scheduled to be completed prior to the construction start of the Project. The road, transmission line, and pipeline actions involve only modest construction efforts, with relatively small disturbances scattered over a large area, just as with the Project.

Region 7 is the smallest region in terms of the length of the Applicant Proposed Route, but has some of the largest potential actions. Specifically, the I-69 extension and the Southern Gateway Project represent significant construction efforts. Also the Great River Super Site is being developed as an industrial park that could ultimately involve a wide range of industrial activities. However, it is likely that neither of the first two actions would have construction impacts cumulative with the Project. The I-69 extension in the area of the Project lacks a firm schedule and is likely many years away. The Southern Gateway Project may also be many years away since the EIS has yet to be completed and, based strictly on where most of the corridors are being considered, its ultimate location, if implemented, will likely be south of the Project. The Great River Super Site can only be identified as involving potential cumulative impacts because the reference material does not identify any specific actions currently being planned or initiated; it is simply being identified as a location where industrial actions may take place. Construction and operation of heavy industries, such as a steel industry, would be expected to include use of hazardous materials that could pose a threat of groundwater contamination if spilled or leaked, similar to the threat posed by fuels and lubricants that would be present during construction of the Project. Like the Project, any new heavy industry would be expected to incorporate the structures, plans, and procedures required by environmental regulations to minimize the potential to cause groundwater contamination. Heavy industries may also have high water demands, but being adjacent to the Mississippi River, it is likely that high volume uses such as for cooling would come from surface water rather than groundwater. The other action of note in Region 7, the Green Meadows housing development, is also outside of the ROIs for groundwater and would not be expected to involve impacts to groundwater other than contributing to consumptive uses.

4.3.8 Health, Safety, and Intentional Destructive Acts

As described in Section 3.8.5, the impact areas of potential concern from the Project in the category of health, safety, and intentional destructive acts include the following: (1) worker and public health and safety, including management of hazardous materials, (2) aircraft and rail operations, (3) fire hazards, (4) natural events and disasters, (5) intentional destructive acts, and (6) protection of children. The last item, protection of children, is addressed in a manner similar to what is described in Section 4.6.2 for environmental justice in that it addresses whether the Project could cause disproportionately high and adverse effects on child health and safety. Section 3.8.5 describes potential effects of the Project in these impact areas during construction, operations and maintenance, and decommissioning.

The above impact areas can only be addressed in very general terms or based on statistical records from previous implementation of similar actions (i.e., historical records). Regardless, adverse effects are not expected to worsen from any of the present and reasonably foreseeable future actions described in Section 4.2. Essentially any work action is associated with a certain level of risk to workers and to the public. Accordingly, the more work is being done, the higher the probability there will be injuries or even fatalities while that work is being performed. Restated, the greater the amount of work and the greater the number of workers involved, the greater the number of incidents that would be predicted, based on statistical records, for a given amount of time. In the sense that these numbers of predicted incidents would increase, then the Section 4.2 actions are cumulative, but more significantly there would be a high concern if expected rates of health and safety incidents for any action were expected to increase because of synergistic or proximity effects of another action. There is no reason to expect this type of cumulative impacts would occur. The impact area of natural events and disasters provides a good example of this reasoning. The more work and people in a single area, the greater the number of injuries that would be expected if hit by an intense earthquake or violent weather, but the probability or risk of an intense earthquake or violent weather striking that area does not change.

The impact area of aircraft operations might be considered an outlier to the preceding discussion because increasing the number of structures, such as for transmission lines, in any area might be considered as increasing the risk of collisions with individual aircraft. Similarly, helicopters may be used during the Project for surveying, structure installation, and line and conductor stringing. If other transmission line projects were to be constructed at the same time and in the same area, there could be an increased risk of aircraft accidents from such operations.

4.3.9 Historic and Cultural Resources

Historic and cultural resource impacts of concern for the Project are associated with following types of resources and applicable impacts:

- Archaeological sites—These sites are primarily vulnerable to soil-disturbing activities, but in rare cases the site's relationship to the surrounding environment is an essential characteristic and could be subject to visual impacts.
- Historic properties (buildings, structures, objects, and landscape features)—Assuming the Project would avoid any direct impacts to these properties, impacts could involve introduction of non-historic visual or, occasionally, auditory elements.
- Tribal lands or historic properties of religious and cultural significance to an Indian Tribe (as determined from background research and Indian Tribe consultations per Section 3.9.2)—These could be subject to impacts from direct physical disturbances or from changes to the visual surrounding, auditory field, or other characteristics of their setting.

Although sufficient information is available to complete this EIS, it is recognized in the Section 3.9.6 evaluation of impacts that detailed information on the historic and cultural resources that could be within the Project ROI is currently limited and that more detailed assessments will be made prior to construction.

The assessment of potential impacts for the Project is based on regional geography and archaeological, historic, and tribal resources available from background research, primarily of information on file with the respective SHPOs and the NPS. Based on the available information, Section 3.9.6.2.3.1 presents descriptions of the potential for construction activities to encounter historic and cultural resources within each region's ROI. Region 7 is described as having the potential for numerous historic and cultural resources, while Regions 3, 4, 5, and 6 contain a moderate number of resources. Region 7 contains 13 inventoried archaeological sites and 40 inventoried historic buildings (although none are on the NRHP), which is the most inventoried sites for any of the regions. This may be attributed to there being more surveys in the Region 7 area that happen to have some overlap with the Project ROI, but for purposes of this discussion it is assumed that actions in Region 7 would be most likely to involve cumulative impacts. Although regions are singled out in this discussion as having higher potential for adverse impacts, it should be noted that the evaluations of impacts in Section 3.9.6 conclude that with proper precautions, such as implementing appropriate cultural resource surveys and incorporating micrositing adjustments as needed in Project engineering, adverse impacts to cultural resources would be resolved by avoidance, minimization, or mitigation throughout all Project regions.

To the extent that the present and reasonably foreseeable future actions described in Section 4.2 involve new ground disturbance or changes in the visual or auditory characteristics of the area, their impacts on historic or cultural resources could be additive with those of the Project. However, unless ground disturbance areas overlapped or were in very close proximity to one another, visual changes were in the same viewshed, and sound changes were close enough to be additive, the impacts would be on different sites. Accordingly, as described for several other resource areas, cumulative impacts would be more likely to involve increased potential to adversely impact historic or cultural resources in general, rather than the same resource site.

The Section 4.2 actions in Region 7 include two of the largest scale present and reasonably foreseeable future actions of any of the regions (the I-69 expansion and the Southern Gateway project) as well as two development areas, one as an industrial park (Great River Super Site) and another as a housing community (Green Meadows). The only other action identified in Section 4.2 consists of road maintenance, which would not be expected to involve significant new ground disturbances. As described in Section 4.3.3 on cumulative air quality impacts, the two large actions are unlikely to be constructed in the same time frame as the Project's construction, and the Southern Gateway project is unlikely to be constructed in the same area, so there would be little potential for cumulative impacts. With regard to the two development areas, there could be cumulative impacts during construction, but nothing has been identified of specific consequence in either area and given their stage of development, both areas have likely been surveyed for resources.

4.3.10 Land Use

The evaluation of potential land use impacts associated with the Project is focused on the types of existing land uses within the transmission line ROWs, converter station construction sites, and other land areas that would change by being tied up for the operational life of the Project. It differentiates between those areas of fully dedicated Project use (e.g., sites of converter stations, structures, and permanent access roads) from ROW areas where existing land use may continue after construction, but with certain limitations. It also addresses potential effects of those land areas where Project use or disturbance would only occur during construction, including areas used for such things as equipment staging, temporary access roads, tensioning and pulling sites, and fly yards.

To the extent that the present and reasonably foreseeable future actions described in Section 4.2 involve new land uses, their impacts could be cumulative with those of the Project. Like the Project, impacts of the Section 4.2 actions could involve land use changes during construction that would be relatively short term and others that would last for the duration of the action. Other transmission line tasks, such as those identified for Regions 1, 2, and 3, would be expected to have a similar distribution of short- and long-term impacts to those of the Project.

Many of the actions identified in Section 4.2, particularly those associated with upgrades or maintenance actions for existing roadways, bridges, or airports, would be expected to involve minimal, if any, changes to existing land uses and, accordingly, would be unlikely to generate impacts that would be cumulative with the potential impacts from the Project. As has been noted in other evaluations, the transmission line actions identified in Section 4.2 for Regions 1, 2, and 3, may be the best examples of present and reasonably foreseeable future actions that could involve new ground disturbance and changes in land use within the ROI of the Project, which is the area where Project impacts, if more than negligible, would be expected to occur. Accordingly, these are the actions and regions most likely to involve cumulative impacts to land use. Potential impacts to land use for these actions would be very similar to those described in detail in Section 3.10.6 for the Project. Land uses in areas affected by the other transmission line actions would be expected to be similar, although with different distributions in percentages of land cover and development levels than described in Section 3.10.6 for the Project. The Section 4.2 actions, like the Project, are primarily long, narrow activities with relatively small amounts of ground disturbance considering the amount of area crossed, which tends to minimize the amount of land use changes on a regional basis. Also, once the construction is complete, much of the affected land could return to previous land uses such as agriculture (grazing and crops); however, there would be new restrictions on land uses that would be permitted in the future within the ROW including limitations on buildings or structures, on changes to grading and land contours, and on some infrastructure like fences and irrigation lines. Other transmission lines crossing or running adjacent to those of the Project could also exacerbate ROW-type limitations because of the odd shaped parcels or narrow bands of land created by the intersecting or parallel ROWs. Such parcels could be outside of the ROW and therefore have no land use restrictions, but their size or configuration could effectively limit the types of land use that would be feasible.

4.3.11 Noise

Noise impacts for the Project are identified at NSAs receiving unacceptably high levels of noise during construction or operations. For construction activities the evaluation in Section 3.11.6 uses limits set by the Federal Highway Administration of the U.S. Department of Transportation for its construction projects, which are 90 dBA L_{eq} for daytime activities and 80 dBA L_{eq} for nighttime activities. For operation and maintenance activities, the Project is evaluated against a guideline set by EPA of 55 dBA L_{dn}. The methodology in Section 3.11.6 used noise modeling techniques to determine critical distances from the noise sources, which are defined as the distance at which limits are first met. Examples of the critical distance values used in the Project evaluation include (1) for construction of HVDC transmission lines, within 100 feet would be at or above the daytime noise level limit of 90 dBA L_{eq} and 325 feet for the nighttime noise level limit of 80 dBA L_{eq}, and (2) the critical distance for operation and maintenance noise from the HVDC transmission lines would be 130 feet to be at or above the noise level limit of 55 dBA L_{dn}. Adverse impacts would be expected if NSAs are located within the critical distances of construction, which is assessed from the Project's representative ROW limit and of operation, which is assessed from the representative ROW centerline.

All of the present and reasonably foreseeable future actions described in Section 4.2 involve sources of noise that, when considered in conjunction with the Project, could result in potential cumulative noise impacts at the NSAs. The magnitude of potential cumulative noise impacts directly corresponds to the proximity of the actions described in Section 4.2 relative to the Project and the noise generated by the Section 4.2 actions. As a general rule, doubling the amount of sound energy at a location would increase received sound levels by 3 dBA. If one source is approximately 10 dBA louder than another source then it will dominate the other sound source. Also, doubling the distance from a linear noise source decreases the sound level by about 3 dBA and doubling the distance from a point source decreases the sound level by about 6 dBA.

In comparing the number of NSAs in Regions 1 through 7, Table 3.11-8 in Section 3.11.6.2.3 identifies Region 4 as having the greatest number of NSAs within daytime and nighttime critical distances (i.e., the distances within which NSAs would experience excessive noise levels) for construction of HVDC transmission lines. Based on this, it might be assumed that present and reasonably foreseeable future actions in Region 4 would have a greater potential for adverse cumulative impacts than in other regions. However, with the exception of the Diamond Pipeline action, most of the Section 4.2 actions in Region 4, consisting of numerous roadway projects and construction of a hydroelectric plant, are more than 0.5 mile from components of the Project, so cumulative noise impacts would be limited. Region 3 contains the next highest number of NSAs and Section 4.2 actions in Region 3 include multiple roadway and bridge maintenance actions that are within 0.5 mile of Project components (either segments of the Applicant Proposed Route or HVDC alternative routes) as well as a portion of the Diamond Pipeline action. In several instances, the Project routes cross the roadway segment identified for action, and in the central part of Region 3, the path of the Diamond Pipeline could overlap the Plains & Eastern Project. There are no implementation dates identified for the Arkansas road activities, but if the Project and an Arkansas road activity or the Diamond Pipeline action were to occur at the same time at a crossing point (a conservative assumption for cumulative impacts to occur), there are some approximations of construction noise that could be made with regard to potential impacts. If the roadway maintenance action or Diamond Pipeline action involved noise levels as high as those projected for construction of the Project, then the criteria evaluated in Section 3.11.6 would increase by up to 3 dBA. This would act to expand the critical distances beyond the 100 feet for the daytime noise level of 90 dBA L_{eq} and 325 feet for the nighttime noise level of 80 dBA L_{eq} and the increased area would potentially encompass additional NSAs into the area of potential adverse impacts. However, the expanded critical distances would be less than double those used for the Project, because doubling the distance would act to reduce noise levels by about 6 dBA. Accordingly, there would be potential for cumulative impacts, but they would not be expected to involve large numbers of additional NSAs. Moreover, the amount of time the Project would be a crossing point with some other action, such that noise sources would coincide, would be relatively small.

The Section 4.2 present and reasonably foreseeable future actions in Region 3 also include a transmission line activity that would be crossed by the Project. In this case the Seminole to Muskogee transmission line is already constructed, so associated noise would not be cumulative with the Project. Noise associated with operation and maintenance of the Seminole to Muskogee line could be cumulative with the Project, but would be expected to be minor.

4.3.12 Recreation

Potential recreation impacts of concern for the Project, as described in Section 3.12.6, include possible direct effects from construction such as the interruption of recreational activities (including hunting, fishing, wildlife viewing, hiking, camping, and canoeing) due to temporary closure of a recreational area or interruptions from noise, human activity, or visual disturbance in a recreational area. After construction, potential long-term impacts of concern include effects to the scenic landscape of a recreational area, both from the transmission lines and structures and from the changes in vegetation and habitat associated with the ROW, along with periodic interruption of recreational activities that might be caused by maintenance activities. Also of concern over the long-term would be the potential to cause indirect impacts such as decreased use of the recreation area from users opting for a similar recreation area without transmission lines or associated facilities. This last effect could be accompanied by increased visitation at other recreational sites in the area, which could be detrimental to other recreational sites (if overloaded). The impact evaluations in Section 3.12.6 conclude that no components of the Project would permanently preclude use of or access to any existing recreation areas.

To the extent that the present and reasonably foreseeable future actions described in Section 4.2 could involve similar effects on the same recreational sites, their impacts could be additive with those of the Project. For example, any other construction action in similar proximity to a recreation area could have the same potential for interruptive impacts (noise, visual disturbance, access restrictions) as the Project. Per the Section 3.12.5 descriptions of the seven regions, Region 4 appears to encompass the greatest number and variety of recreational areas, including the following Oklahoma and Arkansas areas (from Section 3.12.5.4):

- Robert S. Kerr Lake and Webber Falls Reservoir
- Ozark-St. Francis National Forest
- Ozark National Forest WMA
- Frog Bayou WMA
- Ozark Lake WMA
- Arkansas Scenic Byways: State Highway 540/Boston Mountains Scenic Loop; State Highway 23/Pig Trail Byway; and State Highway 21/Ozark Highlands Scenic Byway
- Arkansas Scenic Highways: State Highway 220, State Highway 59, Interstate Highway 40, U.S. Highway 71
- The Trail of Tears National Historic Trail
- Portions of the Lee and Little Lee creeks wild and scenic rivers managed by the OWRB and listed on the NRI

Therefore, it is assumed the present and reasonably foreseeable future actions identified for Region 4 would likely have the highest potential for recreation impacts that would be cumulative with impacts of the Project.

As was described in the preceding discussion of cumulative noise impacts, the Section 4.2 actions in Region 4 consist of numerous roadway activities, in both Oklahoma and Arkansas, construction of a hydroelectric plant, and construction of the Diamond Pipeline. However, the only Region 4 activities within 0.5 mile of the Project components are the road actions planned within Crawford County, Arkansas, and the Diamond Pipeline, which could overlap portions of the Plains & Eastern Project in Johnson and Pope counties, Arkansas. Of the road projects, two are crossed by the Applicant Proposed Route and two others are crossed by the HVDC alternative routes. Several of the recreation areas identified within Region 4 are located in Crawford County, so cumulative impacts on those areas would be possible. No implementation dates are identified for the Arkansas road actions, but if the Project and an Arkansas road action in Crawford County were to occur at the same time (a worse case assumption), there could be cumulative impacts. Since the applicable Section 4.2 actions are road activities, interruption of access to recreation areas could occur. The noise and visual disturbances associated with road maintenance or construction actions could also be cumulative impacts. Once road maintenance tasks were complete, no additional impacts of a cumulative nature would be expected. However, one of the Crawford County actions identified in Section 4.2 is for a new road, so its completion could represent a new long-term impact similar to the Project in that its presence could involve detrimental impacts to the scenic landscape. With regard to the Diamond Pipeline, similar cumulative impacts could occur, but of the Region 4 recreation areas identified above, only Big Piney Creek is located where there could be cumulative impacts with the Project, i.e., in the eastern portion of Region 4.

4.3.13 Socioeconomics

The socioeconomic impact analysis for the Project in Section 3.13.6 evaluated potential impacts to population, economic conditions, including the agricultural sector, housing, property values, community services, including law enforcement and fire protection, medical facilities and education, and tax revenues. Section 4.2 identifies a number of present and reasonably foreseeable future actions that could contribute to cumulative impacts, including other transmission lines, oil and natural gas pipelines, other energy facilities, and road and highway improvement activities.

In cases where other construction activities coincide in space and time with the Project, there would likely be an increase in the projected influx of temporary workers and increased demand for temporary housing resources and goods and services. Peak temporary increases in population for the Project are expected to range from less than 0.1 percent (Region 7) to 1.6 percent (Region 1) of the existing 2012 populations for the affected regions. These potential impacts and associated cumulative effects would be short term and temporary. Operation of the Project facilities would require an estimated permanent staff of about 87 workers spread across the different regions. This expected permanent employment would not likely have a noticeable effect on existing short- or long-term population trends and demand for housing and goods and services.

Local expenditures, employment, and construction-related earnings from the Project would have a positive impact on the local economy and employment for the duration of construction. These positive impacts would be increased if other ongoing and reasonably foreseeable future construction actions were to coincide in time with the Project. The resulting cumulative effects would be positive and short term. Long-term economic impacts from the Project would be primarily associated with operation and maintenance-related expenditures of materials and supplies and ad valorem tax revenues. Economic impacts associated with operation and maintenance would be small, especially when compared to the construction-related and ad valorem tax impacts, and the incremental addition of these impacts to other ongoing and reasonably foreseeable future actions would be relatively minor.

Viewed in conjunction with the Project, the combined impacts of the present and reasonably foreseeable future actions identified in Section 4.2 are unlikely to noticeably affect overall agricultural production and employment in the affected counties. Cumulative impacts could, however, be potentially significant for individual agricultural operations due to direct impacts to agricultural land and structures from construction and to agricultural operations given the long-term presence of Project components and their need for periodic maintenance, and as further discussed in Section 4.3.2.

A temporary influx of construction workers associated with other ongoing and reasonably foreseeable future construction actions that coincide in time with the Project could add to the demand for temporary housing resources and goods and services. Viewed in conjunction with the Project, this could result in shortages in housing for temporary construction workers in some locations depending on actual construction schedules (which would be affected by permitting processes, prevailing economic conditions, and the availability of construction contractors), as well as demand from other sectors of the economy, including the oil and gas and travel and tourism industries. This is especially likely to be the case in Region 1 where there is limited housing availability. Unlike other regions of the HVDC Applicant Proposed Route, there are no large communities within 2 hours commuting distance of Region 1 and economic development organizations in the Oklahoma Panhandle region have identified a potential shortage in permanent housing in and around the city of Guymon in Texas County. The potential for a shortage of temporary housing in Region 1 is increased by the fact that the Project includes multiple components (i.e., converter station, AC collection system, and HVDC transmission line) that could feasibly be under construction at the same time or with overlapping times. This potential issue is further exacerbated by the potential construction and operation of the future wind energy facilities in Region 1 that are evaluated as connected actions to the Project in Section 3.13.6.8.

The actions in Region 1 (Section 4.2) consist of two by OG&E (a transmission line and a substation) and several planned by the OKDOT. The OG&E actions are complete and in service, so cumulative impacts associated with housing demand would not be expected. Review of the latest OKDOT 8-Year Construction Work Plan (OKDOT 2013a) identified a number of potential road and bridge actions in Region 1. Currently planned to take place over multiple years (2014 through 2021), one or more of the planned actions could coincide in time with the Project and potentially add to the demand for temporary housing resources and goods and services in and around Region 1. Incremental additions in demand associated with planned OKDOT activities would be small compared to housing demand associated with the Project, with potential demand reduced if the planned work were performed by OKDOT employees or construction companies based in nearby areas. For the purpose of socioeconomic analysis and demand on resources, it is reasonably assumed local workers are already established within their communities and would not contribute to cumulative impact.

The temporary relocation of construction workers to the socioeconomic ROI would create increased demand for community services such as education, medical facilities, municipal services, police, and fire in addition to retail services. Other ongoing and reasonably foreseeable future construction actions that coincide in time with the Project could add cumulatively to this demand. These potential cumulative effects would be short term and temporary given the nature of construction associated with linear facilities. Workers would relocate to new locations once the majority of their work is completed in an area and they relocate to another segment of an activity. Construction associated with converter stations would occur in a given location and construction workers would not be considered transient in nature, although cumulative impacts would still be considered short term and temporary. Peak periods of cumulative impact would occur when transmission line and convertor station construction schedules coincide.

Construction of the Project would generate sales and use tax revenues through expenditures on construction supplies and equipment. Construction of the other reasonably foreseeable future actions identified in Section 4.2 would likely result in similar short-term increases in tax revenues, depending on the size and nature of the activity. This would also be the case with ad valorem revenues, with other activities potentially adding to the increase in ad valorem tax revenues in the affected counties.

4.3.14 Special Status Fish, Aquatic Invertebrate, and Amphibian Species

Consistent with the presentation of the affected environment and impacts in Chapter 3, this section's discussion is presented in two separate groupings: (1) special status terrestrial wildlife species, and (2) special status fish, aquatic invertebrate, and amphibian species.

4.3.14.1 Special Status Terrestrial Wildlife Species

Impacts of concern to special status wildlife species from the Project include mortality or injury of individuals (e.g., collisions, electrocution, or habitat clearing), temporary or long-term displacement by disturbance (i.e., human activity, noise), and habitat loss or fragmentation by Project construction or operation and maintenance activities. Because the spatial and temporal (i.e., seasonal presence) distribution of special status species varies by Project region, potential impacts also would vary by region. Special status species in the Project's ROI are discussed in Section 3.14.1.4 and distribution of these species by region is discussed in Section 3.14.1.5.

To the extent that the present and reasonably foreseeable future actions described in Section 4.2 involve mortalities or new disturbances of habitat used (e.g., for breeding, nesting, brood-rearing, wintering, or foraging) by special status wildlife species, impacts could be additive with those of the Project. Impacts during construction could include loss of habitat from land clearing, temporary disturbance displacement, and possible mortality or injury by vehicles and construction equipment. Most of these impacts would be short term except for habitat loss on sites used for Project structures or access (i.e., roads). During operations and maintenance of the Project, activities could impact special status wildlife species through periodic disturbance (i.e., human activity, noise) and habitat modification (e.g., mowing, cutting, or herbicide spraying of vegetation in ROWs). If present and reasonably foreseeable future actions involved the erection of aboveground structures such as transmission structures, powerlines, and wind turbines, mortality and injury of wildlife species from collisions and electrocutions could occur. Construction and operation and maintenance impacts could be cumulative with those of the Project.

Many of the actions identified in Section 4.2, particularly those for upgrades and maintenance for existing roadways, bridges, or airports would either not involve significant disturbances of new land or would be limited to disturbances along existing disturbed ROWs (e.g., road widening). Most of these types of actions also would not involve construction of aboveground structures that could pose a hazard to special status wildlife species. Therefore, many of these actions would not result in cumulative impacts.

As described in Sections 3.14.1.4 and 3.14.1.5, special status wildlife species occur in each of the seven regions. In Region 1, species that could be affected are the piping plover, whooping crane, lesser prairie chicken, bald eagle, and golden eagle. The reasonably foreseeable future bridge and road activities in Region 1 are unlikely to have cumulative impacts on these species as work would be limited to existing disturbances (i.e., road ROWs) or cause minor new disturbances adjacent to the existing ROWs (e.g., road widening). The Project could have cumulative impacts to other reasonably foreseeable future electrical transmission projects in Region 1, potentially impacting the lesser prairie chicken, whooping crane, and golden eagle. The lesser prairie chicken occupies the grassland/herbaceous vegetation that is common throughout Region 1. The primary migratory route for whooping cranes occurs to the east of Region 1. The golden eagle is a both a seasonal and year-around resident in Region 1.

The reasonably foreseeable future bridge and road actions in Region 2 are unlikely to have cumulative impacts on these species as work would be limited to existing disturbances (i.e., road ROWs) or cause minor new disturbances adjacent to the existing ROWs (e.g., road widening). Potential impacts to whooping cranes, interior least terns, lesser prairie chickens, and bald eagles from the Project could be cumulative with similar impacts from reasonably foreseeable future electrical transmission lines and wind energy projects in Region 2.

Special status species that could be potentially impacted in Region 3 include the gray bat, Sprague's pipit, piping plover, whooping crane, interior least tern, American burying beetle, and bald eagle. The reasonably foreseeable future bridge and road actions in Region 3 are unlikely to have cumulative impacts on these species as work would be limited to existing disturbances (i.e., road ROWs) or cause minor new disturbances adjacent to the existing ROWs (e.g., road widening). To the extent that these actions would not impact special status species, impacts from the Project would not be cumulative. The Glass Mountain and particularly the yet-to-be-completed Diamond Pipeline would involve new land disturbance and could involve cumulative impacts with those from the Plains & Eastern Project.

Four protected bat species, northern long-eared bat, Ozark big-eared bat, gray bat, and Indiana bat, and several protected bird species including the Sprague's pipit, interior least terns, piping plovers, and bald eagle potentially occur in the ROI in Region 4. In addition, the American burying beetle potentially occurs in the ROI. Considering that most of the reasonably foreseeable future actions in Region 4 consists of road and bridge tasks in eastern Oklahoma and in western Arkansas represent actions on existing disturbances (i.e., road ROWs), impacts of the Project are unlikely to be cumulative. One of the Region 4 road actions, however, is for construction of a new segment of US-71 and the Diamond Pipeline action would similarly involve new construction. Impacts of Project actions could be cumulative in specific areas of the new road and pipeline construction.

All four protected bat species, interior least tern, piping plover, and bald eagle potentially occur in the ROI in Region 5. Reasonably foreseeable future actions in Region 5 include road maintenance and construction, a gas transmission pipeline, and an oil pipeline. To the extent that the road actions would occur in existing disturbed ROWs, no cumulative impacts are expected. Any impacts of the Project could be cumulative with impacts from any new road or oil pipeline construction. No cumulative impacts are anticipated to the impacts of the gas transmission pipeline as the nearest point of construction is 16 miles.

In Region 6, three species of protected bats (northern long-eared bat, gray bat, and Indiana bat) potentially occur in the ROI. The interior least tern, piping plover, and bald eagle also occur with the ROI. With the exception of a potential new access road (4.7 miles) to be constructed along US-63 in Poinsett County, Arkansas, reasonably foreseeable future road and bridge actions in Region 6 would occur in or along existing disturbed road ROWs and no cumulative impacts are expected. The Project may have some cumulative impacts with construction of the access road in Poinsett County related to land clearing of vegetation.

Region 7 traverses eastern Arkansas to the termination of the Project in Shelby County, Tennessee. Two of the four protected species of bats potentially occur in the ROI as well as the interior least tern and bald eagle. The potential impacts of the Project could be cumulative with the impacts of several other reasonably foreseeable future actions in Region 7 (see Section 4.2.7). An industrial development in Osceola, Arkansas on 4,800 acres and a 370-acre residential and commercial development in Munford, Tennessee could have impacts to special status species from habitat loss and disturbance. The expansion of I-69 and the Southern Gateway Project in Tennessee could have impacts similar to the Project.

4.3.14.2 Special Status Fish, Aquatic Invertebrate, and Amphibian Species

Impacts of concern to special status fish, aquatic invertebrate, and amphibian species from the Project include mortality of individuals, sensory disturbance, aquatic habitat disturbance or modification by Project construction or operation and maintenance activities. Because the spatial distribution of special status species varies by Project region, potential impacts also would vary by region. Special status species in the Project's ROI are discussed in Section 3.14.2.4 and distribution of these species by Project region is discussed in Section 3.14.2.5.

To the extent that the present and reasonably foreseeable future actions described in Section 4.2 involve mortalities of special status species or new disturbances of aquatic habitat used by special status fish, aquatic invertebrate, and amphibian species, impacts could be additive with those of the Project. Impacts during construction could include loss of habitat or mortality from in stream disturbances and habitat degradation (e.g., sedimentation, vegetation clearing). Most of these impacts would be short term, although removal or modification of vegetation along stream banks or shorelines could cause longer term impacts. During operations and maintenance of actions, activities could impact special status fish, aquatic invertebrate, and amphibian species through in stream disturbance and habitat modification (e.g., sedimentation). Accidental spraying of herbicides in aquatic habitat or runoff of chemicals into waterbodies could cause mortalities.

Many of the actions identified in Section 4.2, particularly those for upgrades and maintenance for existing roadways and airports would not involve disturbances of aquatic habitats. Most of these types of projects also would not involve construction near aquatic habitats (e.g., stream banks or shorelines) and would not be a hazard to special status fish, aquatic invertebrate, and amphibian species. Therefore, many of these actions would not create cumulative impacts. Potential bridge actions may involve disturbances of aquatic habitats and could create cumulative impacts.

As described in Sections 3.14.2.4 and 3.14.2.5, special status fish, aquatic invertebrate, and amphibian species occur in each of the seven Regions. In Region 1 and 2, species that could be affected are the Arkansas darter and Arkansas River shiner. The bridge actions over the Beaver River on SH-149 (Region 1), Bull Creek on SH-50B (Region 2), and Cimarron River on SH-60 (Region 2) could have cumulative impacts on the Arkansas darter and Arkansas River shiner from potential habitat disturbance during construction but would be limited to the crossing locations. The Project could have cumulative impacts to other reasonably foreseeable future electrical transmission actions in Regions 1 and 2, but potential impacts would be limited to aquatic habitats crossed by the actions. Potential cumulative impacts are expected to be minor as disturbances to aquatic habitat would either not occur at river crossings or be short term and done under specific protocols to limit impacts, such as the EPMs and other measures described in Section 3.14.2.7.

Special status fish species that could be potentially impacted in Region 3 include the Arkansas River shiner and the Arkansas darter. Several reasonably foreseeable future bridge actions as well as the Diamond Pipeline are proposed in Region 3 (see Section 4.2.3). The Arkansas River shiner is known to occur in streams and rivers in Kingfisher, Logan, Payne, and Okmulgee counties; the Arkansas darter is expected to be outside the Region 3 ROI, and impacts from these actions, including the potential for increased sedimentation into streams and rivers during construction, would be of potential concern. Any impacts of the Project could be cumulative with potential impacts that could occur from the construction of bridges over, or pipelines across, streams and rivers in Region 3 that contain potential habitat for the Arkansas River shiner or Arkansas darter. The Project could have cumulative impacts to other reasonably foreseeable future electrical transmission actions in Region 3, but potential impacts would be limited to aquatic habitats crossed by the projects. Potential cumulative impacts are expected to be minor as disturbances to aquatic habitat would either not occur at river crossings or be short term and done under specific protocols to limit impacts.

Two special status fish species, the Arkansas darter and the Ozark cavefish, are known to occur north of the Region 4 ROI, but because of their mobility are also considered to be of potential concern in Region 4. Five protected aquatic invertebrate species, spectaclecase, speckled pocketbook, Neosho mucket, scaleshell mussel, and snuffbox potentially occur in the ROI in Region 4 in the state of Arkansas. The reasonably foreseeable future actions in Region 4 consist of road and bridge tasks in eastern Oklahoma and in western Arkansas that represent actions on existing disturbances (i.e., road ROWs) or bridges (SH-59, Lee Creek), so effects on aquatic habitats would be unlikely, but possible. The proposed Diamond Pipeline would involve new disturbances and would be in the same area as the Plains & Eastern Project in the eastern end of Region 4. Any adverse impacts from the road or pipeline actions would be limited to the crossing location and would be cumulative with impacts of the Project.

Nine protected fish and aquatic invertebrate species, yellowcheek darter, pink mucket, speckled pocketbook, scaleshell mussel, fat pocketbook, snuffbox, Curtis' pearlymussel, Ozark hellbender, and rabbitsfoot potentially occur in the ROI in Region 5 in Arkansas. Reasonably foreseeable future actions in Region 5 include road maintenance and construction, a gas transmission pipeline, and an oil pipeline. To the extent that the road projects would occur in existing disturbed ROWs and no construction or impacts would occur in aquatic habitats, no cumulative impacts are expected. Any impacts of the Project could be cumulative with impacts from any construction associated with new roads or the Diamond Pipeline. No cumulative impacts are anticipated to the impacts of the gas transmission pipeline as the nearest point of construction is 16 miles from the HVDC transmission line routes.

In Region 6, five protected aquatic invertebrate species, pink mucket, scaleshell mussel, fat pocketbook, snuffbox, and rabbitsfoot potentially occur in the ROI in Arkansas. Several actions involve work on existing bridge structures in Jackson and Cross counties. These would be unlikely to result in any disturbance or degradation of the aquatic habitat underneath the bridges, but if they did, the Project could have cumulative impacts with these actions. The bridge and road construction associated with Highway 63 in Poinsett County, Arkansas, could have impacts to aquatic invertebrates (fat pocketbook) where six bridges would be constructed to span the St. Francis River and associated waterbodies. The impacts of the Project could be cumulative with the potential impacts of the Highway 63 bridge and road construction.

The Project in Region 7 traverses eastern Arkansas, crosses the Mississippi River, to the end of the Project in Shelby County, Tennessee. Three protected species, the pallid sturgeon, fat pocketbook, and snuffbox potentially occur in the ROI. The potential impacts of the Project would not be cumulative with the impacts of several other reasonably foreseeable future actions in Region 7 (see Section 4.2.7). An industrial development in Osceola, Arkansas, on 4,800 acres and a 370-acre residential, commercial development in Munford, Tennessee, and I-69 expansion would not have impacts on the pallid sturgeon, the fat pocketbook mussel, or the snuffbox. The Project is unlikely to impact these species in Region 7. The fat pocketbook mussel occurs northwest of the ROI and construction across the Mississippi River would not affect the pallid sturgeon. The snuffbox mussel has the potential to occur in the ROI, but the closest documented occurrences are to the north of the ROI. Therefore, any impacts of the Southern Gateway Project in Tennessee (potential new bridge across the Mississippi) would not have impacts cumulative with the Project.

4.3.15 Surface Water

Surface water impacts of concern for the Project are associated with the potential for runoff and receiving water contamination, changes to runoff rates, disturbances to surface water or drainage channels, and effects on water availability. As noted in the Section 3.15.6 discussion of impacts, these concerns would be limited primarily to the construction phase of the Project. The present and reasonably foreseeable future actions described in Section 4.2 for each of the regions would present similar concerns and, likewise, would appear to present possible concerns primarily during construction. There were no specific actions identified that would appear to involve long-term operations that could adversely affect surface water. The possible new hydroelectric power plant identified in Region 4 would likely involve long-term impacts to surface water, but at 12 miles from the nearest segment of the Applicant Proposed Route (and farther from other Project components), it is unlikely that its impacts would be cumulative with those of the Project. The effect on water availability is the possible exception to there being long-term impacts, but even in this area of concern, the actions currently identified for evaluation of possible cumulative impacts include none that would be expected to involve use of large quantities of water during long-term operations.

The actions identified in Section 4.2 would involve typical construction activities and, compared to the Project, would be expected to involve the presence of the same type of potential contaminants (primarily fuels and lubricants in equipment) during construction and to implement the same type of measures to ensure those contaminants were not released. The actions would be expected to involve relatively minor changes to runoff rates and, to decrease their own liability and comply with Clean Water Act and other relevant regulations, would be expected to take precautions to minimize damage or alterations to surface water or drainage channels. As with typical construction activities, water would be needed for actions such as dust suppression, soil compaction, equipment cleaning, and concrete formulation. However, like the Project, these water demands would be relatively minor and short term. Potential impacts to surface water from construction of the Project and from construction of the actions described in Section 4.2 would be minor, even if they were to occur in the same time and place such that impacts were cumulative.

Of the actions described in Section 4.2, it is estimated that Regions 3 and 7 could have the greatest potential for cumulative impacts with the Project. As described in Section 3.15.5.4, Region 4 has the greatest number of surface waters of special interest, but the present and reasonably foreseeable future actions described in Section 4.2 for Region 4 are relatively minor, limited primarily to roadway maintenance.

Region 3 has many road actions planned, replacement of a dam bridge, improvement of airport pavements, construction of another transmission line, and construction of oil pipelines. Possibly the largest single action in the region, the dam bridge, is scheduled to be completed prior to the construction start of the Project and the road, transmission line, and pipeline actions involve only modest construction efforts, with relatively small disturbances scattered over a large area, just as with the Project.

Region 7 is the smallest region in terms of the length of the Applicant Proposed Route, but has some of the largest potential actions. Specifically, the I-69 extension and the Southern Gateway Project represent significant construction efforts. Also the Great River Super Site is being developed as an industrial park that could ultimately involve a wide range of industrial activities. However, it is likely that the I-69 and Southern Gateway actions would not have construction impacts cumulative with the Project. The I-69 extension in the area of the Project lacks a firm schedule and likely is many years away. The Southern Gateway Project may also be many years away since the EIS for that project has yet to be completed and, based strictly on where most of the corridors are being considered, its ultimate location, if implemented, will likely be well south of the Project. The Great River Super Site can only be identified as involving potential cumulative impacts because the reference material does not identify any specific projects activities being planned or initiated; it is simply being identified as a location where industrial actions may take place. Construction and operation of heavy industries, such as a steel industry, would be expected to include use of hazardous materials that could pose a threat of surface water contamination if spilled or leaked, similar to the threat posed by fuels and lubricants that would be present during construction of the Project. Like the Project, any new heavy industry would be expected to incorporate the structures, plans, and procedures required by environmental regulations to minimize the potential to cause surface water contamination. Heavy industries may also have high water demands and, because of the location adjacent to the Mississippi River, it is likely that high volume uses such as for cooling would come from surface water. The other action of note in Region 7, the Green Meadows housing development, is also outside of the ROI for surface water.

The present and reasonably foreseeable future actions identified for Regions 3 and 7, although possibly greater in scope than actions in other regions, are still typical, for the most part, because they present only minor potential for adverse impacts to surface water. The exception would be the possible construction of a new bridge over the Mississippi River that would be part of the Southern Gateway Project, which would likely involve significant work directly in the river. However, the Project would not involve any similar work in the Mississippi River and would not involve potential for similar river impacts. As a result, the Project would not pose cumulative impacts in this regard even if the actions were to occur at the same time and in close proximity to one another. Possibly the greatest threat to surface waters from the construction actions being considered would be from the accidental release of contaminants such as fuels or lubricants, or failed measures to control stormwater runoff that could then carry sediments from disturbed areas to receiving waters. Having multiple actions in the same area with similar potential for incidents might increase the probability for an accident to occur, but with properly managed construction sites and control measures, the probability would still be low.

4.3.16 Transportation

Transportation impacts of concern evaluated in Section 3.16.6 for the Project are as follows:

- Roadways—increases in traffic would result from workers commuting to work sites and from hauling materials and equipment, and could include incidental congestion and delays
- Railways—there would be potential for vehicle, railroad, or transmission line conflicts at railroad crossings
- Airports and airfields—transmission lines and the associated structures are a navigation issue and potentially hazardous if located too close to operating areas

The Section 3.16.6 evaluation of impacts from the Project does not identify any notable issues with regard to railway crossings or airports and airfields. Standard precautions and requirements would minimize concerns at railroad crossings and there were no airports or airfields identified in close enough proximity to Project components to present a particular concern. Impacts to roadway traffic are, therefore, the primary topic for this discussion of cumulative impacts.

The methodology used to evaluate potential impacts to roadway traffic from the Project consists primarily of developing LOS rankings representative of existing traffic conditions and traffic conditions with the Project during construction (the Project's period of highest traffic loading). These "before and after" rankings were developed for the roadways that would likely be used by the Project within the expanded ROI. As described in Section 3.16.4.1, these rankings measure the quality of service of a roadway and are set up comparable to academic grades with LOS-A indicating the best and LOS-F indicating the worst operation conditions. According to national guidelines, an LOS-C or better is acceptable on rural roadways and an LOS-D is considered the minimum acceptable within urban areas.

Evaluations for the Project, including the HVDC alternative routes, typically resulted in a LOS decrease of one-level for the evaluated roadways, although in some cases there was no LOS drop. (Also, there were drops of two levels in some of the connected action evaluations.) Locations of primary concern identified in this manner were roadway segments where Project traffic could result in LOS-D conditions (no LOS-F roadways were predicted). The LOS-D conditions were predicted for 12 roadway segments in Region 4 of the Applicant Proposed Route, one roadway segment in Region 5, and 10 roadway segments in Region 7. LOS-D conditions were also predicted in the Tennessee converter station evaluation, which considered the same roadways as the Region 7 evaluation. As would be expected, the evaluations of the HVDC alternative routes had the same or very similar results as the Applicant Proposed Route because they generally considered the same roadways.

Roadways in the vicinity of components of the Project that have existing LOS-C conditions are logically found in or near urban areas. Dropping those levels to LOS-D might still be considered acceptable levels of traffic based on national guidelines. It should be noted that local jurisdictions can establish specific guidelines and requirements that differ from the national guidelines. Based on the evaluation in Section 3.16.6, it is assumed that the most likely areas where there could be cumulative traffic impacts of concern are the areas of Regions 4, 5, and 7. This evaluation of cumulative impacts looks at Regions 4 and 7 because they had the highest number of roadway segments dropping to an LOS-D. Region 5 consists mostly of forested lands, open agricultural lands, and rural residential developments, so it is expected that potential impacts to roadway traffic would not be of major concern.

Although no traffic loading estimates are available, to the extent that the present and reasonably foreseeable future actions described in Section 4.2 involve traffic increases, their impacts could be additive with traffic increases of the Project. The Section 4.2 actions in Region 4 consist of numerous roadway actions in both Oklahoma and Arkansas, construction of a hydroelectric plant, and construction of an oil pipeline. The hydroelectric plant location is outside of the expanded roadway ROI, so it is not likely that the two actions would have significant traffic effects on the same roadway sections (i.e., the further apart, the more likely traffic associated with either action would be spread out over many roads, lessening impacts). However, all of the Region 4 roadway actions identified in Section 4.2 are within, or have portions within, the expanded ROI. Because these other actions consist primarily of road maintenance work, potential impacts to existing roadway traffic are compounded; the actions could involve added traffic moving to and from work sites as well as the congestion and delays inherent with the work. For the most part, the Region 4 roadway projects would be expected to be relatively small and occur over a number years. Since these are actions undertaken by the respective state transportation agencies, it is reasonable to assume they would be planned and implemented in a manner to minimize impacts on existing traffic flow. Further, because of the state agency's involvement, there should be mechanisms in place that would allow for coordination such that impacts to area traffic and the Project are minimized. The oil pipeline (Diamond Pipeline) route in Region 4 would only be near the potential routes of the Plains & Eastern Project in the eastern end of the region. However, within this region, there are two Arkansas communities (Ozark and Clarksville) where road segments would drop to LOS-D from the Plains & Eastern Project; therefore, transportation impacts of the oil pipeline action could be cumulative.

Similar to Region 4, the present and reasonably foreseeable future actions described in Section 4.2 for Region 7 do not include estimates of traffic loading. The Region 7 roadway maintenance actions would be expected to have the same type of concerns and potential impacts as described above for Region 4 if they were to occur at the same time as construction actions for the Project. The I-69 extension and the Southern Gateway Project in Region 7 represent significant construction efforts, but are potentially many years from construction. Both projects could reasonably involve increases to roadway traffic that would be cumulative with those of the Project were they to occur in the same general area, at the same time. However, neither action currently has a well-defined schedule and, based on where most of the corridors for the Gateway Project are being considered, its ultimate location, if implemented, would likely be well south of the Project. Other Region 7 present and reasonably foreseeable future actions include the two development areas: Great River Super Site for industrial and Green Meadows for housing. Increases in construction traffic and even commercial traffic in the case of the Great River Super Site could be cumulative with Project construction traffic if they occurred at the same, but no defined activities or schedules were identified to gauge the likelihood of this occurring.

4.3.17 Vegetation Communities and Special Status Plant Species

The Project's potential impacts of concern to vegetation communities and special status plant species are associated with several different types of activities. Project actions and potential impacts of concern are summarized in the following:

- Clearing and grading—Potential impacts include mechanical damage and/or removal of vegetation by heavy machinery, compaction of soils thereby reducing its water-holding capacity and inhibiting plant growth, and introduction of invasive species from construction equipment or spread of existing invasive species on newly cleared land.
- Placement of structural foundations—Potential impacts include mechanical damage and/or removal of vegetation.
- Access road construction—Potential impacts include alteration of hydrology, which could affect plant growth, mechanical damage, and/or removal of vegetation.
- Excavation for grounding wires, fiber optic regeneration cables, and transmission line structural foundations—Potential impacts include mechanical damage and/or removal of vegetation by heavy machinery, compaction of soils thereby reducing its water-holding capacity and inhibiting plant growth, long-term conversion of forested and shrublands to herbaceous cover type within ROWs, which includes effects of habitat fragmentation, and introduction of invasive species from construction equipment or spread of existing invasive species on newly cleared land.
- Blasting—Potential impacts include mechanical damage of vegetation.
- Herbicide use—Potential impacts include contamination from herbicide drift or runoff that could stunt plant growth or inhibit the onset of growth.
- Hazardous materials handling—Potential impacts include contamination from accidental spills of hazardous substances, such as fuels and lubricants, which could stunt plant growth or inhibit the onset of growth.

To the extent that the present and reasonably foreseeable future actions described in Section 4.2 involve new disturbance of vegetated lands, their impacts could be additive with those of the Project. Impacts during construction could involve additional loss of vegetation, damage or inhibition of native vegetation with potential for introduction of invasive or noxious species, and segmentation of habitat. Many of these construction-related impacts would be short term, but vegetation loss in areas of structures and access roads would be long-term. During operations and if the actions were for new electrical transmission lines, buried oil or natural gas pipelines, or similar actions, vegetation could reestablish on most disturbed areas. However, in ROWs vegetation would be managed so maintenance activities would not be affected, especially in forested areas where trees could restrict access or, in the case of transmission lines, adversely affect operations if allowed to reestablish. Similarly, woody vegetation (shrubs or trees) would be restricted above oil or natural gas pipelines to prevent root damage to the pipeline. As described in

Section 3.17.5, two federally-protected plant species have the potential to occur along the ROI of the Project and state-recognized special status plants may also occur. Special status plant species could be impacted the same as other vegetation unless, as described for the Project, plant surveys are carried out prior to construction activities and there is a commitment to mark special status species and avoid them to the maximum extent possible. All of these types of impacts could be cumulative with those of the Project if they were to occur within the same vegetation community.

Many of the actions identified in Section 4.2, particularly those associated with upgrades or maintenance actions for existing roadways, bridges, or airports, would be expected to involve only minor amounts, if any, of new disturbance to vegetation communities and, accordingly, would be unlikely to affect vegetation or special status plant species. Therefore, those projects would not create cumulative impacts to the Project and are not addressed further in the following discussions of individual regions.

In Regions 1 and 2, the Hitchland-Woodward and Woodward-Thistle Transmission Line actions, respectively, could have similar impacts of the Project, but on a smaller scale, being restricted to a much shorter length of transmission line. Impacts from the transmission lines could be cumulative with the impacts of the Project. The Mammoth Plains Wind Farm Project in Region 2 is 14 miles from the closest corridor of the Project, and therefore is unlikely to have cumulative impacts to vegetation. No federal or state threatened or endangered plant species are known to occur in the ROI in Regions 1 or 2. Therefore, the Project would have no cumulative impacts on any special status plant species.

No cumulative impacts would likely occur in Region 3 and no federal or state threatened or endangered plant species are known to occur in the ROI in Region 3.

Region 4 occurs in eastern Oklahoma and western Arkansas. The actions in Oklahoma and most in Arkansas would not involve cumulative impacts. No federal or state threatened or endangered plant species are known to occur in the ROI in the Oklahoma portion of Region 4. In Crawford County, of western Arkansas, and in Johnson and Pope counties, slightly farther to the east, new construction on Highway 71 and the Diamond Pipeline, respectively, could involve new disturbance of land and vegetation and impacts could be cumulative with those of the Project depending the selected alternative routes. Six different Arkansas state-listed threatened and endangered plant species are known to occur in one or more of Crawford, Johnson, and Pope counties (Table 3.17-4 in Section 3.17.5.4.2). Potential impacts to these species from the Project could be cumulative with potential highway and pipeline construction but could be mitigated by conducting surveys and avoiding known populations.

In Region 5, most present and reasonably foreseeable future actions would be unlikely to have impacts to vegetation that are cumulative with the Project. The Central Arkansas Natural Gas Pipeline Enhancement Project (natural gas pipeline) would be 16 miles from the nearest route alternative of the Project and would not have impacts cumulative with the Project. The Diamond Pipeline action, however, would follow the same general path in the western half of Region 5 as the Plains & Eastern Project. Thirteen special status plant species occur in Region 5. Potential impacts to these species from the Project could be cumulative with the pipeline construction, but could be mitigated by conducting surveys and avoiding known populations.

As was described in Section 4.3.3 with respect to air quality, the present and reasonably foreseeable future actions in Regions 6 and 7 include some of the largest construction activities of any identified in Section 4.2. Accordingly, it is assumed that Regions 6 and 7 actions could have the highest potential for vegetation community impacts that are cumulative with those of the Project. The US-63 access road construction in Region 6 and the I-69 extension and the Southern Gateway Project in Region 7 represent significant construction efforts. A construction date for the work on US-63 was not available, but it is assumed it could be in the same time as the Project. With regard to the two actions in Region 7, it is likely there would only be cumulative impacts on a general, regional basis (i.e., contribute to loss of vegetation in the region). The I-69 extension lacks a firm schedule and likely is many years away, and the Southern Gateway Project may also be many years away because the EIS has yet to be completed, but both actions could reasonably involve loss of regional vegetation that would be cumulative with vegetation losses associated with the Project as well as any other action that expands urban area. Also, based on where most of the corridors for the Gateway Project are being considered, its ultimate location, if implemented, would likely be well south of the Project. Other Region 7 actions include two development areas, one as an industrial park (Great River Super Site) and another as a housing community (Green Meadows) where loss of vegetation would be expected from construction, although in this case the land area being converted appears to consist mostly of agricultural land. Two special status plant species occur in Region 6 and the Arkansas portion of Region 7. Six special status plant species potentially occur in the ROI of the Tennessee portion of Region 7. Potential impacts to these species from the Project could be cumulative if populations of those species occur in areas impacted by the present and reasonably foreseeable future construction projects. Impacts could be mitigated by performing plant species surveys and avoiding any identified populations.

4.3.18 Visual Resources

The Chapter 3 evaluation of the Project's impacts on visual resources uses concepts and tools from the Bureau of Land Management's Visual Resource Management system on lands other than National Forest. The evaluation of visual impacts to National Forest land (applicable only to HVDC Alternative Route 4-B) follows the U.S. Forest Service's Scenery Management System to determine whether Scenic Integrity Objectives and landscape character goals would be met. The evaluation methodology is presented in Section 3.18.6.1 and, for areas not crossing National Forest land, entails a process of rating the existing scenic quality of the landscape and the sensitivity of the viewers, then evaluating impacts from the Project at key observation points (KOPs), which are selected based on a separate set of criteria. The evaluation results in assigning impact ratings ranging from low to high with several intermediate levels, including a central "moderate" rating. For purposes of this evaluation of cumulative impacts, the Chapter 3 evaluations identify "high impacts" where Project components would be dominant or readily apparent from KOPs and would introduce form, line, color, and texture changes inconsistent with the existing landscape. The overall impact ratings are a combination of visual, scenery, and sensitive viewer impacts that individually have the following criteria for when "high" impacts occur:

- Visual Impacts—Where Project components are dominant or readily apparent from KOPs. Project components would introduce form, line, color, and texture changes that are inconsistent with the existing landscape.
- Impacts to Scenery—Distinct or Common landscapes substantially altered by the Project (i.e., where similar facilities do not exist in the landscape).
- Impacts to Sensitive Viewers—Where the Project is dominant with a view and highly noticeable by the casual observer, or where the Project introduces a high level of contrast to the existing landscape.

Based on the Chapter 3 evaluations of potential impacts to visual resources, Region 4 could be characterized as having the highest combination of scenic landscape and viewer concern and, correspondingly, as the region that would experience the highest potential for visual impact from the Project. As described in Section 3.18.6.2.3, the Region 4 Applicant Proposed Route contains a high density of existing landscape of the highest scenic quality (i.e., Distinct), there are 44 KOPs in Region 4 compared to 17 for the next highest region (Region 5), and potential impacts from the Project are rated at “high” at 11 of the Region 4 KOPs compared to the next highest region (also Region 5), which would have only five “highly” impacted KOPs. The HVDC alternative routes within Region 4, evaluated in Section 3.18.6.3.2 contain similar characteristics and with regard to HVDC Alternative Route 4-B, segments of the Project would cross USFS land and would include areas that would not comply with Scenic Integrity Objectives. Based on these characteristics, it is reasonable to assume that present and reasonably foreseeable future actions within Region 4 would have a higher potential for adverse impacts to visual resources than other regions, which could then be cumulative with those of the Project. For that reason, the following discussion focuses primarily on potential cumulative impacts in Region 4 and also considers other Regions.

The actions described in Section 4.2.4 for Region 4 are primarily roadway actions in Oklahoma and Arkansas. The Cherokee Nation Hydroelectric Power Plant and the Diamond Pipeline action are the only non-road actions identified in Region 4. The hydroelectric project is about 12 miles from the nearest segment of the Applicant Proposed Route or HVDC alternative routes and likely would not be visible from any of the KOPs that could be affected by the Project. The Region 4 roadway and pipeline actions are within 2 to 3 miles of the Project routes and are all reasonably close to, and likely visible from, at least one KOP. For example, OKDOT road work on I-40 (near Highway 82) is near to Vian Lake and Highway 82 KOPs; and the OKDOT road work on the more eastern section of I-40, as well as Highways 64, 59, and 101 are all near the Sallisaw KOP. In Arkansas, AHTD road work on Highway 59 is near three KOPs (Fire Tower Lookout, Trail of Tears Route 59, and Route 220 Scenic Highway) and the road work on I-540 and Highway 71 (roughly parallel to one another) are near three other KOPs (Frog Bayou Creek, Route 71 Scenic Byway, and Alma). The path of the Diamond Pipeline would be in close proximity to the Plains & Eastern Project only in Johnson and Pope counties at the eastern end of the region; 13 KOPs have been identified in this portion of Region 4. Visual impacts from the roadway and pipeline actions to these and other KOPs in Region 4 would be cumulative with those from the Project if they occurred at the same time. Exceptions would be in those instances where an evaluated KOP indicated no impacts from the Project. For example, the OKDOT planned activity on Highway 10A extends to a point that is quite close (less than 2 miles) to the Tenkiller State Park KOP, but the overall impact of the Project (for either the Applicant Proposed Route or HVDC Alternative Route 4-A/4-B) at that location is “no impact.” As a result, the Project would have no cumulative visual impacts with the Highway 10A activity at that KOP.

Although the roadway and pipeline actions in Region 4 could involve visual impacts cumulative with those of the Project, with a single exception, these actions would be short-term visual intrusions involving construction vehicles, equipment, workers, and possibly visible dust, mostly in areas where viewers would be accustomed to seeing vehicle traffic. Also, as relatively short duration impacts, they would not be directly comparable to the overall impacts or ratings given to KOPs in Chapter 3 because those ratings are based on the long-term presence of structures (primarily transmission line structures) associated with the Project. Accordingly, the roadway and pipeline actions could have cumulative impacts with the Project, but they would not be expected to affect the overall impact ratings associated with long-term operations under the Project. The exception identified above for involving short-term impacts, is the roadway activity involving construction of a new section of Highway 71. This planned section of new road would start near the community of Alma and extend southward to loop around the east side of Kibler. In this segment, the new road would cross Link 6 of the Region 4 Applicant Proposed Route and be very near the Alma KOP. The overall impact rating at the Alma KOP from the Project is “moderate” (Table 3.18-12) and visual impacts of the new section of Highway 71 would be cumulative over the long-term with those of the Project.

Outside of Region 4, a majority of the present and reasonably foreseeable future actions described in Section 4.2 consist of road work or other actions not involving high structures and, as such, potential impacts to visual resources would likely be much more localized than those associated with the Project. Notable exceptions would be the transmission line actions and the wind farm development that involve tall structures like the Project. The Region 2 wind farm action is about 14 miles from the nearest component of the Project so cumulative visual impacts, if any, would be expected to be minor. With regard to other transmission line actions, the OG&E Hitchland-Woodward Transmission Line in Region 1 and the OG&E Seminole to Muskogee Transmission Line in Region 3 have both been recently completed and the Chapter 3 evaluation of visual impacts includes the presence of existing transmission lines in those areas when rating the impacts of the Project. There is no similar mention of existing transmission lines in Chapter 3 in the area that would be crossed by the OG&E Woodward-Thistle Transmission Line in Region 2 because it is still under construction.

4.3.19 Wetlands, Floodplains, and Riparian Areas

The Project's potential impacts of concern to wetlands, floodplains, and riparian areas are associated with several different types of activities. Project actions and potential impacts of concern include:

- Clearing and grading—Potential impacts include sedimentation and turbidity from activities adjacent to wetlands, alteration of hydrology, placement of fill or dredging in wetlands, and alteration of hydrology in floodplains and riparian areas.
- Herbicide use—Potential impacts include contamination from herbicide runoff that could reach wetlands or riparian areas through overland runoff paths.
- Placement of structural foundations—Potential impacts include alteration of hydrology, placement of fill or dredging in wetlands, long-term conversion of forested wetlands to shrubby or herbaceous cover type within the ROW, and in floodplains there could be changes in flood grade or elevations.
- Tensioning of lines—Potential impacts include sedimentation and turbidity from activities adjacent to wetlands.
- Construction equipment usage—Potential impacts include mechanical damage/crushing of wetland vegetation; compaction of wetland or floodplain soils, potentially reducing soil's water-holding capacity; and introduction of invasive species from construction equipment.
- Excavation and dewatering within wetlands or riparian areas for grounding wires, fiber optic regeneration cables, and transmission line structural foundations—Potential impacts include mechanical damage/crushing of wetland or riparian vegetation and alteration of hydrology.
- Blasting—Potential impacts include alteration of hydrology and sedimentation and turbidity from activities adjacent to wetlands.
- Hazardous materials handling—Potential impacts include contamination from accidental spills into wetlands or which could reach wetlands through overland runoff paths.
- Wastewater discharges from concrete batch plants—Potential impacts include contamination which could reach wetlands through overland runoff paths.

Because wetlands, floodplains, and riparian areas are attributes or features of the land, the present and reasonably foreseeable future actions described in Section 4.2 most likely to affect these features are those involving new land disturbances. Or, in the case of wetlands and riparian areas, they could be affected by contaminated runoff from projects, with or without new land disturbance. Impacts of the Project and the present and reasonably foreseeable future actions in Section 4.2 actions could be cumulative in the general sense (e.g., the combined acreage of impacted wetlands in a region is increased) or they could be cumulative in terms of a specific wetland, floodplain, or riparian area, depending on the physical proximity of the actions. In the case of floodplains, actions not in close proximity, but crossing floodplains of the same surface water feature, could have cumulative impacts by individually altering flood levels over a wide area and the affected areas overlap.

In Regions 1 and 2, transmission line actions would have impacts similar to the Project (although on a smaller scale because of the much shorter length) and could have cumulative impacts to wetlands, floodplains, and riparian zones. However, those impacts generally would be limited to locations where the wetland, floodplain, or wetland was crossed and in some cases construction in such locations could be avoided by spanning the area. Several road actions include bridges, which may have some impacts to wetland, floodplain, or riparian areas in a localized area if it is new construction. However, the potential impacts (disturbance of wetland, floodplain, or riparian vegetation or sedimentation from runoff), are expected to be small and would not overlap impacts of the Project.

Actions in Regions 3 and 4, where the number of potential wetland, floodplain, and riparian area crossings are the highest of any of the regions (Section 3.19.5) could have a higher likelihood of affecting such areas. Present and reasonably foreseeable future actions in Regions 3 and 4 include multiple road maintenance actions, a bridge replacement, and improvements at an existing airport (Section 4.2). All of which would be expected to primarily involve work on already disturbed land. No new structures would be expected as part of these actions, so no changes in flood elevations or floodplains would be expected. As with the Project, construction equipment would carry fuels and lubricants that could result in contaminated stormwater runoff if accidentally released and not quickly cleaned up. Otherwise, there would be minimal potential for adverse impacts to wetlands and riparian areas from these maintenance- and refurbishment-types of actions. In addition, the bridge and airport actions are well removed (each about 17 miles) from the nearest segment of the Applicant Proposed Route.

The present and reasonably foreseeable future actions in Regions 3 and 4 also include a transmission line, a hydroelectric plant, and oil pipelines. The transmission line would be expected to involve potential impacts very similar to those described in Section 3.19.6.1 for the Project, although at a smaller scale. Also, because the transmission line location is crossed by the Applicant Proposed Route as well as the HVDC alternative routes, there could be cumulative impacts to the same wetlands, floodplains, or riparian areas. The hydroelectric plant, being on the Arkansas River, could involve impacts to wetlands, floodplains, and riparian areas, but because the proposed plant site is about 12 miles from the nearest component of the Project, any cumulative impacts would likely not be to the same specific wetlands, floodplains, or riparian areas. The general path of the Diamond Pipeline is much the same as the Plains & Eastern Project in the central portion of Region 3 and the eastern end of Region 4, so there could be cumulative impacts to the same wetlands, floodplains, or riparian areas. Because the pipeline construction would involve a continuous stretch of disturbed ground (i.e., no air spans by which some ground areas might be avoided, as with a transmission line), impacts could potentially be greater than those of the Project.

Region 5 actions consist of road actions that would occur in existing disturbed ROWs. To the extent that these actions are not adjacent to wetlands, floodplains, and riparian areas and would not cause sedimentation or alter the hydrology, the Project would not contribute to cumulative impacts. The Central Arkansas Natural Gas Pipeline Enhancement Project is 16 miles from the nearest possible route alternative and any impacts would be not be cumulative with any impacts to wetlands, floodplains, or riparian areas along the Project. The general path of the Diamond Pipeline is much the same as the Plains & Eastern Project in the western half of Region 5, so there could be cumulative impacts to the same wetlands, floodplains, or riparian areas.

The present and reasonably foreseeable future actions in Region 6 include road and bridge actions and a rebuild of a transmission line. The transmission line could have cumulative impacts to the Project if wetlands, floodplains, and riparian areas occur at the location where the two actions cross. Most of the road and bridge actions involve work in existing road ROWs and on existing bridge structures and no impacts to wetlands, floodplains, and riparian areas are expected. Proposed road and bridge construction in Poinsett County, Arkansas for the Highway 63 access road (4.7 miles) would include six bridges and a new road that would cross the St. Francis River and adjacent waterbodies (see Section 4.2.6). Several Project alternative routes are in the general vicinity (0.8 to 4 miles) of the construction. Potential impacts could be cumulative with the road and bridge construction if any of these alternative routes are selected for the Project.

Region 7 actions include some of the largest construction activities along the Project ROI. The I-69 extension and the Southern Gateway Project in Region 7 represent significant construction efforts, but are potentially many years from construction. Both actions could reasonably involve loss of regional wetlands, floodplains, and riparian areas that would be cumulative with losses associated with the Project as well as any other action that expands the urban area. Also, based on where most of the corridors for the Southern Gateway Project are being considered, its ultimate location, if implemented, would likely be well south of the Project. Other Region 7 present and reasonably foreseeable future actions include two development areas, one as an industrial park (Great River Super Site) and another as a housing community (Green Meadows) where loss of wetlands, floodplains, and riparian areas could occur, although most of the land area being developed appears to be agricultural land. Potential impacts to wetlands, floodplains, and riparian areas from the Project would likely be cumulative only on a general, regional basis unless specific alternative routes near these projects were selected.

4.3.20 Wildlife, Fish, and Aquatic Invertebrates

Consistent with the presentation of the affected environment and impacts in Chapter 3, this section's discussion is presented in two separate groupings: (1) wildlife, and (2) fish and aquatic invertebrates.

4.3.20.1 Wildlife

As identified in Section 3.20.1.7.1, wildlife resources evaluated include important recreational species, migratory birds, reptiles and amphibians, and mammal species known to occur or have the potential to occur within the ROI. Wildlife impacts of concern for the Project are as follows:

- Potential impacts from short or long-term displacement of wildlife species
- Fragmentation of wildlife habitat, including significant grassland habitat in central Oklahoma
- Potential disturbance to known populations and/or suitable habitat for wildlife species
- Potential impacts to old growth forests
- Potential impacts to wildlife movement, migratory birds and flyways (including the Mississippi Flyway, Audubon-designated Important Bird Areas, or other federal or state designated bird areas)
- Potential for avian collisions and/or electrocution
- Potential impacts of invasive plant species on wildlife habitats

Potential impacts would vary by region because the spatial and temporal (i.e., seasonal presence) distribution of wildlife species varies by Project region (1 through 7). Wildlife species in the Project's ROI are discussed in Section 3.20.1.3 and distribution of these species by Region is discussed in Section 3.20.1.5.

To the extent that the present and reasonably foreseeable future actions described in Section 4.2 involve wildlife mortalities or injuries, displace wildlife by disturbance (short- or long-term), and disturb habitats used by wildlife species (e.g., for breeding, nesting, brood-rearing, wintering, or foraging), impacts could be additive with those of the Project. Impacts during construction could include loss of habitat from land clearing, temporary disturbance displacement, and possible mortality or injury by vehicles and construction equipment. Most of these impacts would be short term except for habitat loss on sites used for project structures, access (i.e., roads), or ROW maintenance. During operations and maintenance of projects, activities could impact wildlife species through periodic disturbance (i.e., human activity, noise) and habitat modification (e.g., mowing, cutting, or herbicide spraying of vegetation in ROWs) as well as continuous disturbance via the presence of transmission lines and structures. If present and reasonably foreseeable future actions involved the erection of aboveground structures such as transmission structures, power lines, and wind turbines, mortality and injury of wildlife species from collisions and electrocutions could occur. Construction and operation and maintenance impacts could be cumulative with the Project.

Many of the actions identified in Section 4.2, particularly those for upgrades and maintenance for existing roadways, bridges, or airports would either not involve significant disturbances of new land or would be limited to disturbances along existing disturbed ROWs (e.g., road widening). Most of these types of actions also would not involve construction of aboveground structures that could pose a hazard to wildlife species (e.g., migratory birds or bats). Therefore, those actions would not create cumulative impacts and are not addressed further in the following discussions of individual regions.

Because the climate and vegetation varies from west to east, the wildlife species present in each Region also varies from west to east. The wildlife species that could be impacted are described in Sections 3.20.1.4 and 3.20.1.5. Potential impacts to wildlife from the Project could be cumulative with similar impacts from reasonably foreseeable future electrical transmission lines and wind energy developments in Regions 1 and 2.

Considering that most of the reasonably foreseeable future actions in Region 4 consist of road actions, impacts could be cumulative in specific areas where road actions consist of new construction and could cause wildlife mortality, disturbance, and habitat loss. Similarly, impacts from construction of the Diamond Pipeline could be cumulative if it could cause wildlife mortality, disturbance, and habitat loss.

In Region 5, any impacts of the Project could be cumulative with impacts from any new road construction as well as with impacts from construction of the Diamond Pipeline. No cumulative impacts are anticipated to the impacts of the gas transmission pipeline as the nearest point of construction is 16 miles.

In Region 6, a potential new access road (4.7 miles) to be constructed along US-63 in Poinsett County, Arkansas would be expected to involve cumulative impacts to wildlife related to land clearing of vegetation.

Region 7 traverses eastern Arkansas to the termination of the project in Shelby County, Tennessee. The potential impacts to wildlife of the Project could be cumulative with the impacts of several other reasonably foreseeable future actions in Region 7 (see Section 4.2.7). An industrial development in Osceola, Arkansas on 4,800 acres and a 370 acre residential and commercial development in Munford, Tennessee could have impacts to wildlife species from mortality, habitat loss, and disturbance. The expansion of I-69 and the Southern Gateway Project in Tennessee could have impacts similar to the Project that would be cumulative.

4.3.20.2 Fish and Aquatic Invertebrates

As identified in Section 3.20.2.7.1, aquatic resources evaluated include river, stream, or creek crossings as well as any perennial waterbodies within the ROI. Fish and aquatic invertebrate impacts of concern for the Project are as follows:

- Potential impacts from construction activities, vehicles, equipment, and access roads on aquatic species and their habitats
- Potential impacts from permanent removal of vegetation or temporary mechanical damage to vegetation
- Possible spread and/or introduction of invasive plants or listed noxious weed species from the use of construction equipment at waterbody crossings
- Potential impacts associated with ROW vegetation maintenance, including the use of herbicides during operation of the Project
- Potential for sediment loading and introduction of chemicals from spills in aquatic habitat, causing alterations to the habitat or the introduction of hazardous materials.
- Potential changes to stream morphology due to adjacent riparian clearing

Impacts of concern to fish and aquatic invertebrate species from the Project include mortality of individuals and aquatic habitat disturbance or modification by Project construction or operation and maintenance activities. Because the spatial distribution of species varies by Project region, potential impacts also would vary by region. Fish and aquatic invertebrate species in the Project's ROI are discussed in Section 3.20.2.3 and distribution of these species by Project region is discussed in Section 3.20.2.5.

To the extent that the present and reasonably foreseeable future actions described in Section 4.2 involve mortalities of fish and aquatic invertebrate species or new disturbances of aquatic habitat used by fish and aquatic invertebrate species, impacts could be additive with those of the Project. Impacts during construction could include loss of habitat or mortality from in-stream disturbances and habitat degradation (e.g., sedimentation, vegetation clearing). Most of these impacts would be short term, although removal or modification of vegetation along stream banks or shorelines could cause longer term impacts. During operations and maintenance of projects, activities could impact fish and aquatic invertebrate species through in-stream disturbance and habitat modification (e.g., sedimentation). Accidental spraying of herbicides in aquatic habitat also could cause mortalities.

Many of the actions identified in Section 4.2, particularly those for upgrades and maintenance for existing roadways and airports would not likely involve disturbances of aquatic habitats. Most of these types of actions also would not involve construction near aquatic habitats (e.g., stream banks or shorelines) and would not be a hazard to fish and aquatic invertebrate species considering the standard requirements for management and control of runoff from construction sites. Therefore, many of these actions would not create cumulative impacts. Potential bridge actions may involve disturbances of aquatic habitats and could create cumulative impacts.

The Project could have cumulative impacts with other present and reasonably foreseeable future electrical transmission actions in the regions, but potential impacts would be limited to aquatic habitats crossed by the actions. Potential cumulative impacts are expected to be minor as disturbances to aquatic habitat would either not occur at river crossings or be short term and done under specific protocols to limit impacts.

Reasonably foreseeable future actions in Regions 3, 4, and 5 include construction of the Diamond Pipeline, which could have impacts to fish and aquatic invertebrates where the pipeline would cross or approach aquatic habitats. Such impacts could be cumulative with those of the Plains & Eastern Project. Potential cumulative impacts are expected to be minor because they would be short term and done under specific protocols to limit impacts.

Reasonably foreseeable future actions in Region 5 also include a gas transmission pipeline; however, no cumulative impacts are anticipated to the impacts of the gas transmission pipeline as the nearest point of construction is 16 miles.

The potential impacts of the Project would not be cumulative with the impacts of several reasonably foreseeable future actions in Region 7 (see Section 4.2.7). An industrial development in Osceola, Arkansas on 4,800 acres and a 370-acre residential, commercial development in Munford, Tennessee, and Interstate 69 expansion would not have impacts to aquatic habitats. Construction of the Project across the Mississippi River would not affect aquatic habitats as equipment would not be in the river. Therefore, any impacts of the Southern Gateway Project in Tennessee (potential new bridge across the Mississippi) would not have impacts cumulative with the Project.

This page intentionally left blank.

5. List of Preparers

Table 5-1:
EIS Preparation Team

U.S. Department of Energy			
Name		Organization	
Jane Summerson		National Nuclear Security Administration	
Aiden Smith		Southwestern Power Administration	
Mike Wech		Southwestern Power Administration	
Cooperating Agencies			
Name		Organization	
Anita Masters		Tennessee Valley Authority (TVA)	
Chuck Nicholson		Tennessee Valley Authority (TVA)	
Cynthia Blansett		U.S. Army Corps of Engineers (USACE)	
David Anderson		Bureau of Indian Affairs (BIA)	
Michael Jansky		U.S. Environmental Protection Agency (EPA)	
Steve Elsener		Natural Resources Conservation Service (NRCS)	
Vanessa Burge		U.S. Fish and Wildlife Service (USFWS)	
Name	Company	Location	Education
Project Management			
John MacDonald	Tetra Tech	Denver, CO	MEDes, Environmental Science, University of Calgary, 2001
Larry Keith	Tetra Tech	Denver, CO	BLArch (Bachelor of Landscape Architecture), Landscape Architecture, Kansas State University, 1975
Stephanie Phippen	Tetra Tech	Golden, CO	MS, Geology/Watershed Science, Colorado State University, 2000
Jacqueline Boltz	Tetra Tech	Arlington, VA	MBA, Business Administration, Boston University, 1991 BA, French Language and Literature, 1991
Joe Rivers	Rivers Consulting Inc.	Trinity, FL	BS, Mechanical Engineering, University of Florida, 1982
Administrative and Project Support			
Joanne Stover	Rivers Consulting Inc.	Yuma, AZ	BS, Business Management, University of Nevada–Las Vegas, 1997
Allie Chavez	Tetra Tech	Denver, CO	—
Teresa Kacprowicz	Tetra Tech	Denver, CO	BA, Antiquities (Liberal arts; emphasis on social and physical sciences), Missouri State University, 1982 BA, French, Missouri State University, 1982
Ellen Kessler	Tetra Tech	Denver, CO	—
Resource Section Authors			
Chris Hooper	Enertech Consultants	Campbell, CA	BA, Mathematics with Computer Emphasis, San Jose State University, 1987
Keith Davis	Rivers Consulting Inc.	Idaho Falls, ID	MS, Civil/Environmental Engineering, Utah State University
Greg Fasano	Rivers Consulting Inc.	Las Vegas, NV	MBA, Business Administration, National University, 1988
Ron Green	Rivers Consulting Inc.	Las Vegas, NV	PhD, Zoology, Colorado State University, 1987
Chris Borstel	Tetra Tech	Morris Plains, NJ	PhD, Anthropology, Indiana University, 1993
Delight Buenaflor	Tetra Tech	Arlington, VA	BA, Biology, Western Maryland College, 1996

Table 5-1:
EIS Preparation Team

John Crookston	Tetra Tech	Bothell, WA	MS, Ecology, San Diego State University, 2007
Matt Dadswell	Tetra Tech	Bothell, WA	PhD, Candidate, University of Washington MA, Economic Geography, University of Cincinnati, 1990
Lori Davidson	Tetra Tech	Denver, CO	MS, Landscape Architecture, University of Michigan, 2005
Brian Dresser	Tetra Tech	Manchester, NH	MS, Ecology, University of Georgia, Odum School of Ecology, 2003
Bob Evans	Tetra Tech	Boston, MA	MS, Landscape Architecture, Auburn University, 2006 MS, Community Planning, Auburn University, 2006
Connie Farmer	Tetra Tech	Golden, CO	MS, Natural Resources and Cultural Resources Analysis, Miami University, Oxford, 1994 BS, Geography–Cartography and Remote Sensing, Michigan State University, 1977
Marybeth Gay	Tetra Tech	Arlington, VA	MSc (by research), Marine Fish Ecology, Cranfield University, 2012 BS, Marine Biology, Texas A&M University, 2007
Anne-Marie Griger	Tetra Tech	Austin, TX	MURPL (Master of Urban and Regional Planning), Concentration: Environmental Planning, Virginia Polytechnic Institute & State University, 2002
Chris James	Tetra Tech	Bothell, WA	MS, Hydrology, University of Washington, 2007 BA, Environmental Studies (Minor: Chemistry), Lewis and Clark College, 1999
Erik Kalipinski	Tetra Tech	Boston, MA	BS, Civil and Environmental Engineering, University of Massachusetts, 1994
Rebecca Kipp	Tetra Tech	King of Prussia, PA	MS, Wildlife Ecology, University of Delaware, 2003 BA, Biological Sciences, University of Delaware, 1997
John Knutzen	Tetra Tech	Bothell, WA	MS, Fisheries, University of Washington, 1977 BA, Biology, Western Washington State College, 1972
Tara Low	Tetra Tech	Denver, CO	MS, Environmental Sciences, University of Colorado, 2005
Chuck Luna	Tetra Tech	Denver, CO	BS (Bachelor of Science), Civil Engineering, New Mexico State University, 1972
Sydne Marshall	Tetra Tech	Morris Plains, NJ	PhD, Anthropology, Columbia University, 1981
Rachel Miller	Tetra Tech	Golden, CO	MS, Water Resources Science, University of Kansas, 1987
Tricia Pellerin	Tetra Tech	Boston, MA	Environmental Science Graduate Program, The University of Western Ontario, 2005 MESc, Chemical and Biochemical Engineering, The University of Western Ontario, 2005
Dan Shea	Tetra Tech	Golden, CO	BS, Civil Engineering, Rutgers University, 1993
Todd Tamura	Tetra Tech	Boston, MA	MS, Technology and Policy, Massachusetts Institute of Technology, 1993 MS, Chemistry, University of California at Los Angeles, 1990
David Wertz	Tetra Tech	Arlington, VA	MS, Geophysics, Boston College, 2001
Stephanie Wiedmeyer	Tetra Tech	Denver, CO	BA, Environmental Studies/Environmental Policy, University of Colorado, 2006
Steve Yarbrough	Tetra Tech	Denver, CO	MA, Biology, University of Colorado at Denver, 2000
GIS Support			
Jake Engelman	Tetra Tech	Denver, CO	BS, Geography-Professional, Minnesota State University-Mankato, 2010
Matt Smith	Tetra Tech	Denver, CO	BA, Geography, University of Missouri–Columbia, 2002

Contents

This page intentionally left blank.

6. References

References for the Draft EIS are presented below by chapter and subsection. References for geographic information system (GIS) data used or referenced in the development of the EIS (noted as "GIS Data Source" in the EIS) are listed separately in Section 6.5.

6.1 EIS Summary References

10 CFR Part 1021. "National Environmental Policy Act Implementing Procedures." *Energy*. U.S. Department of Energy. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt10.4.1021&rgn=div5>.

25 CFR Part 169. "Rights-Of-Way over Indian Lands." *Indians*. Bureau of Indian Affairs, Department of the Interior. <http://www.ecfr.gov/cgi-bin/text-idx?SID=0de8c836d0733e4ece8435e84bc337dc&node=25:1.0.1.8.75&rgn=div5>.

36 CFR Part 800. "Protection of Historic Properties." *Parks, Forests, and Public Property*. Advisory Council on Historic Preservation. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt36.3.800&rgn=div5>.

40 CFR Part 1500. "Purpose, Policy, and Mandate." *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1500&rgn=div5>.

40 CFR Part 1501. "NEPA and Agency Planning." *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1501&rgn=div5>.

40 CFR Part 1502. "Environmental Impact Statement." *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1502&rgn=div5>.

40 CFR Part 1503. "Commenting." *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1503&rgn=div5>.

40 CFR Part 1504. "Predecision Referrals to the Council of Proposed Federal Actions Determined to be Environmentally Unsatisfactory." *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1504&rgn=div5>.

40 CFR Part 1505. "NEPA and Agency Decisionmaking." *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1505&rgn=div5>.

40 CFR Part 1506. “Other Requirements of NEPA.” *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1506&rgn=div5>.

40 CFR Part 1507. “Agency Compliance.” *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1507&rgn=div5>.

49 CFR Part 24, Subpart B. “Real Property Acquisition.” *Transportation*. Office of the Secretary of the Department of Transportation. <http://www.ecfr.gov/cgi-bin/text-idx?SID=92b999c02a6e9bb859c5da689aa9d395&mc=true&node=sp49.1.24.b&rgn=div6>.

80 FR 23520. “Application for Proposed Project for Clean Line Plains & Eastern Transmission Line.” April 28, 2015. <http://www.gpo.gov/fdsys/pkg/FR-2015-04-28/pdf/2015-09941.pdf#page=1>.

110 Stat. 888-1197. “Federal Agriculture Improvement and Reform Act of 1996” (Pub. L. 104-127) <http://www.gpo.gov/fdsys/pkg/STATUTE-110/pdf/STATUTE-110-Pg888.pdf>.

128 Stat. 649. “Agricultural Act of 2014” (Pub. L. 113-79) <http://www.gpo.gov/fdsys/pkg/PLAW-113publ79/html/PLAW-113publ79.htm>.

7 USC §§ 4201-4209. “Farmland Protection Policy Act” (Pub. L. 97-98) <http://www.law.cornell.edu/uscode/pdf/lii_usc_TI_07_CH_73.pdf>.

16 USC §§ 668-668d. “Bald and Golden Eagle Protection Act” (Pub. L. 86-70) <http://www.law.cornell.edu/uscode/text/16/chapter-5A/subchapter-II>.

16 USC §§ 668dd-68ee. “National Wildlife Refuge System” (Pub. L. 89-669) <http://www.law.cornell.edu/uscode/pdf/uscode16/lii_usc_TI_16_CH_5A_SC_III_SE_668dd.pdf>.

16 USC §§ 703-712. “Migratory Bird Treaty Act of 1918” (40 Stat. 755) <http://www.law.cornell.edu/uscode/text/16/chapter-7/subchapter-II>.

16 USC §§ 1001-1012. “Watershed and Flood Prevention Act” (Pub. L. 83-566) <http://www.law.cornell.edu/uscode/pdf/lii_usc_TI_16_CH_18.pdf>.

16 USC § 1531 *et seq*. “Endangered Species Act of 1973” (Pub. L. 93-205) <http://www.law.cornell.edu/uscode/pdf/lii_usc_TI_16_CH_35.pdf>.

16 USC § 6501 *et seq*.”Healthy Forests Restoration Act of 2003” (Pub. L. 108-148) <http://www.law.cornell.edu/uscode/pdf/lii_usc_TI_16_CH_84.pdf>.

33 USC § 408. “Taking possession of, use of, or injury to harbor or river improvements.” *Navigation and Navigable Waters*. <http://www.law.cornell.edu/uscode/pdf/uscode33/lii_usc_TI_33_CH_9_SC_I_SE_408.pdf>.

33 USC § 1251 *et seq*. "Clean Water Act of 1972" (Pub. L. 92-500) <http://www.law.cornell.edu/uscode/pdf/lii_usc_TI_33_CH_26.pdf>.

33 USC § 1344. "Permits for dredged or fill material." *Water Pollution Prevention and Control*. <https://www.law.cornell.edu/uscode/pdf/uscode33/lii_usc_TI_33_CH_26_SC_IV_SE_1344.pdf>.

42 USC § 15801 *et seq*. "Energy Policy Act of 2005" (Pub. L. 109-58). <http://www.law.cornell.edu/uscode/text/42/chapter-149>.

42 USC § 4321 *et seq*. "National Environmental Policy Act of 1969" (Pub. L. 91-190) <http://www.law.cornell.edu/uscode/pdf/uscode42/lii_usc_TI_42_CH_55_SE_4321.pdf>.

42 USC § 7401 *et seq*. "Clean Air Act of 1990" (Pub. L. 101-549) <http://www.law.cornell.edu/uscode/pdf/lii_usc_TI_42_CH_85.pdf>.

54 USC § 306108. "National Historic Preservation Act of 1966, Section 106" (Pub. L. 113-287) <https://www.law.cornell.edu/uscode/text/54/usc_sec_54_00306108----000->.

79 FR 75132. "Plains & Eastern Clean Line Transmission Project Draft Environmental Impact Statement Notice of Availability and Public Hearing." December 17, 2014. <http://www.gpo.gov/fdsys/pkg/FR-2014-12-17/pdf/2014-29524.pdf#page=1>.

79 FR 78079. "Plains & Eastern Clean Line Transmission Project Draft Environmental Impact Statement Notice of Availability and Public Hearings; Correction." December 29, 2014. <http://www.gpo.gov/fdsys/pkg/FR-2014-12-29/pdf/2014-30393.pdf#page=1>.

79 FR 78088. "Environmental Impact Statements; Notice of Availability." December 29, 2014. <http://www.gpo.gov/fdsys/pkg/FR-2014-12-29/pdf/2014-30383.pdf#page=1>.

80 FR 7850. "Extension of Public Comment Period, Draft Environmental Impact Statement for the Plains & Eastern Clean Line Transmission Project." February 12, 2015. <http://www.gpo.gov/fdsys/pkg/FR-2015-02-12/pdf/2015-02947.pdf#page=1>.

Executive Order 13186. "Responsibilities of Federal Agencies to Protect Migratory Birds." January 10, 2001. (66 FR 3853). <http://www.gpo.gov/fdsys/pkg/FR-2001-01-17/pdf/01-1387.pdf>.

6.2 EIS References

6.2.1 Chapter 1

7 CFR Part 658. "Farmland Protection Policy Act." *Agriculture*. Regulations of the Department of Agriculture. <http://www.ecfr.gov/cgi-bin/text-idx?SID=dce3b523e8ee144a1f8e82d55de5269d&node=pt7.6.658&rgn=div5>.

10 CFR Part 1021. "National Environmental Policy Act Implementing Procedures." *Energy*. U.S. Department of Energy. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt10.4.1021&rgn=div5>.

25 CFR Part 169. "Rights-Of-Way over Indian Lands." *Indians*. Bureau of Indian Affairs, Department of the Interior. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt25.1.169&rgn=div5>.

36 CFR Part 800. "Protection of Historic Properties." *Parks, Forests, and Public Property*. Advisory Council on Historic Preservation. <http://www.ecfr.gov/cgi-bin/text-idx?SID=dce3b523e8ee144a1f8e82d55de5269d&node=pt36.3.800&rgn=div5>.

40 CFR Part 1500. "Purpose, Policy, and Mandate." *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1500&rgn=div5>.

40 CFR Part 1501. "NEPA and Agency Planning." *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1501&rgn=div5>.

40 CFR Part 1502. "Environmental Impact Statement." *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1502&rgn=div5>.

40 CFR Part 1503. "Commenting." *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1503&rgn=div5>.

40 CFR Part 1504. "Predecision Referrals to the Council of Proposed Federal Actions Determined to be Environmentally Unsatisfactory." *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1504&rgn=div5>.

40 CFR Part 1505. "NEPA and Agency Decisionmaking." *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1505&rgn=div5>.

40 CFR Part 1506. "Other Requirements of NEPA." *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1506&rgn=div5>.

40 CFR Part 1507. "Agency Compliance." *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1507&rgn=div5>.

40 CFR Part 1508. “Terminology and Index.” *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1508&rgn=div5>.

75 FR 32940. “Request for Proposals for New or Upgraded Transmission Line Projects Under Section 1222 of the Energy Policy Act of 2005.” June 10, 2010. <http://www.gpo.gov/fdsys/pkg/FR-2010-06-10/pdf/2010-13943.pdf#page=1>.

79 FR 75132. “Plains & Eastern Clean Line Transmission Project Draft Environmental Impact Statement Notice of Availability and Public Hearing.” December 17, 2014. <http://www.gpo.gov/fdsys/pkg/FR-2014-12-17/pdf/2014-29524.pdf#page=1>.

79 FR 78079. “Plains & Eastern Clean Line Transmission Project Draft Environmental Impact Statement Notice of Availability and Public Hearings; Correction.” December 29, 2014. <http://www.gpo.gov/fdsys/pkg/FR-2014-12-29/pdf/2014-30393.pdf#page=1>.

79 FR 78088. “Environmental Impact Statements; Notice of Availability.” December 29, 2014. <http://www.gpo.gov/fdsys/pkg/FR-2014-12-29/pdf/2014-30383.pdf#page=1>.

80 FR 7850. “Extension of Public Comment Period, Draft Environmental Impact Statement for the Plains & Eastern Clean Line Transmission Project.” February 12, 2015. <http://www.gpo.gov/fdsys/pkg/FR-2015-02-12/pdf/2015-02947.pdf#page=1>.

80 FR 23520. “Application for Proposed Project for Clean Line Plains & Eastern Transmission Line.” April 28, 2015. <http://www.gpo.gov/fdsys/pkg/FR-2015-04-28/pdf/2015-09941.pdf#page=1>.

110 Stat. 888-1197. “Federal Agriculture Improvement and Reform Act of 1996” (Pub. L. 104-127) <http://www.gpo.gov/fdsys/pkg/STATUTE-110/pdf/STATUTE-110-Pg888.pdf>.

113 Stat. 224, “Route 66 Corridor, Historic Preservation” (Pub. L. 106-45). <http://www.gpo.gov/fdsys/pkg/PLAW-106publ45/pdf/PLAW-106publ45.pdf>.

128 Stat. 649. “Agricultural Act of 2014” (Pub. L. 113-79) <http://www.gpo.gov/fdsys/pkg/PLAW-113publ79/html/PLAW-113publ79.htm>.

7 USC §§ 4201-4209. “Farmland Protection Policy Act” (Pub. L. 97-98) <http://www.law.cornell.edu/uscode/pdf/lii_usc_TI_07_CH_73.pdf>.

16 USC §§ 668-668d. “Bald and Golden Eagle Protection Act” (Pub. L. 86-70) <http://www.law.cornell.edu/uscode/text/16/chapter-5A/subchapter-II>.

16 USC §§ 668dd-68ee. “National Wildlife Refuge System” (Pub. L. 89-669) <http://www.law.cornell.edu/uscode/pdf/uscode16/lii_usc_TI_16_CH_5A_SC_III_SE_668dd.pdf>.

16 USC §§ 703-712. “Migratory Bird Treaty Act of 1918” (40 Stat. 755) <http://www.law.cornell.edu/uscode/text/16/chapter-7/subchapter-II>.

16 USC §§ 791-828c. “Federal Regulation and Development of Power.” (Pub. L. 113-23) <http://www.law.cornell.edu/uscode/pdf/lii_usc_TI_16_CH_12.pdf>.

16 USC §§ 1001-1012. “Watershed and Flood Prevention Act” (Pub. L. 83-566) <http://www.law.cornell.edu/uscode/pdf/lii_usc_TI_16_CH_18.pdf>.

16 USC § 1241-1251. “The National Trails System Act” (Pub. L. 90-543). <http://www.law.cornell.edu/uscode/pdf/uscode16/lii_usc_TI_16_CH_27_SE_1241.pdf>.

16 USC § 1531 *et seq*. “Endangered Species Act of 1973” (Pub. L. 93-205) <http://www.law.cornell.edu/uscode/pdf/lii_usc_TI_16_CH_35.pdf>.

16 USC § 6501 *et seq*.”Healthy Forests Restoration Act of 2003” (Pub. L. 108-148) <http://www.law.cornell.edu/uscode/pdf/lii_usc_TI_16_CH_84.pdf>.

33 USC § 401. “Construction of Bridges, Causeways, Dams or Dikes Generally; Exemptions.” *Navigation and Navigable Waters*. <http://www.law.cornell.edu/uscode/text/33/401>.

33 USC § 403.” Rivers and Harbors Appropriation Act of 1899.” <https://www.law.cornell.edu/uscode/text/33/403>.

33 USC § 408. “Taking possession of, use of, or injury to harbor or river improvements.” *Navigation and Navigable Waters*. <http://www.law.cornell.edu/uscode/text/33/408>.

33 USC § 1344. “Permits for dredged or fill material.” *Water Pollution Prevention and Control*. <http://www.law.cornell.edu/uscode/text/33/1344>.

42 USC § 4321 *et seq*. “National Environmental Policy Act of 1969” (Pub. L. 91-190) <http://www.law.cornell.edu/uscode/pdf/uscode42/lii_usc_TI_42_CH_55_SE_4321.pdf>.

42 USC § 7401 *et seq*. “Clean Air Act of 1990” (Pub. L. 101-549) <http://www.law.cornell.edu/uscode/pdf/lii_usc_TI_42_CH_85.pdf>.

42 USC § 15801 *et seq*. “Energy Policy Act of 2005” (Pub. L. 109-58). <http://www.law.cornell.edu/uscode/text/42/chapter-149>.

42 USC § 16421. “Transmission Infrastructure Modernization; Third-party finance.” *National Energy Policy and Programs*. <http://www.law.cornell.edu/uscode/text/42/chapter-149/subchapter-XII/part-A>.

54 USC § 306108. “Effect of undertaking on historic property” (the Section 106 process). (Pub. L. 113–287). https://www.law.cornell.edu/uscode/text/54/306108-

ACHP (Advisory Council on Historic Preservation). 2013. "Section 106 Regulations Summary." <http://www.achp.gov/106summary.html>.

American Rivers. 2014. "What are the key parts of a river's anatomy?" <http://www.americanrivers.org/rivers/about/>. Accessed February 7, 2014.

Clean Line. 2015. Plains & Eastern Clean Line Transmission Line - Part 2 Application. <http://energy.gov/oe/downloads/plains-eastern-clean-line-transmission-line-part-2-application>. Accessed September 2, 2015.

———. 2011. *Update To Plains & Eastern Clean Line Proposal for New or Upgraded Transmission Line Projects Under Section 1222 of the Energy Policy Act of 2005*. Transmitted to the DOE Office of Electricity Delivery & Energy Reliability. <http://energy.gov/sites/prod/files/Plains_and_Eastern_Clean_Line_August_2011_1222_update.pdf>. Accessed April 30, 2014.

DOE (U.S. Department of Energy). 2015. "Request for formal consultation and conference under Section 7 of the Endangered Species Act for potential impacts related to the proposed Plains & Eastern Clean Line Transmission Project." Letter from J. Summerson, DOE NEPA Document Manager, to J. Polk, USFWS, dated March 27. (Available on EIS Reference CD.)

———. 2013. *DOE Alternatives Development Report*. Prepared by Tetra Tech for the U.S. Department of Energy, December. (Available on EIS Reference CD.)

———. 2012. "Letter from Deputy Secretary Poneman to Clean Line Energy Regarding the Plains & Eastern Clean Line Project under Section 1222 of EPAct 2005 (April 5, 2012)." <http://energy.gov/oe/downloads/letter-deputy-secretary-poneman-clean-line-energy-regarding-plains-eastern-clean-line>. Accessed April 30, 2014.

DOE and USFWS (U.S. Department of Energy and U.S. Fish and Wildlife Service). 2013. *Memorandum of Understanding Between the United States Department of Energy and the United States Fish and Wildlife Service Regarding Implementation of Executive Order 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds*". <http://www.energy.gov/sites/prod/files/2013/10/f3/Final%20DOE-FWS%20Migratory%20Bird%20MOU.pdf>. Accessed September 25, 2014.

Executive Order 13186. "Responsibilities of Federal Agencies to Protect Migratory Birds." January 10, 2001. (66 FR 3853). <http://www.gpo.gov/fdsys/pkg/FR-2001-01-17/pdf/01-1387.pdf>.

USFS (U.S. Forest Service). 2005. *Revised Land and Resource Management Plan, Ozark-St. Francis National Forests*. Management Bulletin R8-MB 125 A. September. <http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsm8_042809.pdf>. Accessed June 19, 2014.

6.2.2 Chapter 2

40 CFR Part 1502. “Environmental Impact Statement.” *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1502&rgn=div5>.

40 CFR 1506.5(a). “Agency Responsibility.” *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=b491b35cebd0b774d8f3a163c598e404&node=pt40.33.1506&rgn=div5#se40.33.1506_15>.

40 CFR 1508.25. “Terminology and Index: Scope.” *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1508&rgn=div5#se40.33.1508_125>.

49 CFR Part 24, Subpart B, “Real Property Acquisition.” *Uniform Relocation Assistance and Real Property Acquisition for Federal and Federally Assisted Programs*. U.S. Department of Transportation. <http://www.ecfr.gov/cgi-bin/text-idx?SID=7e1283ae1c07dbd15930164326ba0643&node=pt49.1.24&rgn=div5#sp49.1.24.b>.

42 USC § 4601 *et seq*. “Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970” (Pub. L. 91-646) <http://www.law.cornell.edu/uscode/pdf/uscode42/lii_usc_TI_42_CH_61_SC_I_SE_4601.pdf>.

42 USC § 15801 *et seq*. *Energy Policy Act of 2005* (Pub. L. 109-58). <http://www.law.cornell.edu/uscode/text/42/chapter-149>.

Tennessee Code 65-4-201 (Title 65, Chapter 4, Part 2, Section 201). “Certificate of Public Convenience and Necessity.” <http://www.lawserver.com/law/state/tennessee/tn-code/tennessee_code_65-4-201>.

Tennessee Code 65-4-208 (Title 65, Chapter 4, Part 2, Section 208). “Interstate Transmission of Electric Power.” <http://www.lawserver.com/law/state/tennessee/tn-code/tennessee_code_65-4-208>.

ABB. 2015a. “HVDC Underground Cables: Underground Cables up to 320kV DC.” <http://new.abb.com/systems/high-voltage-cables/cables/hvdc-extruded-cables/hvdc-underground-cables>. Accessed July 21, 2015.

———. 2015b. “Murraylink: The World’s Longest Underground Power Transmission System.” <http://new.abb.com/systems/hvdc/references/murraylink>. Accessed July 21, 2015.

CEQ (Council on Environmental Quality). 1981. Memorandum to Agencies: Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations. <http://energy.gov/sites/prod/files/G-CEQ-40Questions.pdf>. Accessed September 17, 2015.

Clean Line. 2014a. “Petition for Certificate of Public Convenience and Necessity from Plains and Eastern Clean Line LLC (“Plains and Eastern”) to the Tennessee Regulatory Authority.” April 4. Docket number 14-00036 (In the matter of the petition of Plains and Eastern Clean Line LLC for a Certificate of Public Convenience and

Necessity approving a plan to construct a transmission line and to operate as an electric transmission public utility). <http://share.tn.gov/tra/orders/2014/1400036.pdf>. Accessed September 24, 2014.

———. 2014b. *Wind Generation Technical Report for the Plains and Eastern Transmission Line Project*. March. Prepared for the Department of Energy pursuant to 10 CFR 1021.215(b)(2). (Available on EIS Reference CD.)

———. 2013. *Tier IV Routing Study*. Prepared by Ecology and Environment, Inc. for Clean Line Energy Partners. November 13. (Available on EIS Reference CD.)

DOE (U.S. Department of Energy). 2014a. *Champlain Hudson Power Express Transmission Project Environmental Impact Statement*. Final; Volume I. <http://www.chpexpresseis.org/docs/library/final-eis/full/2_CHPE%20FEIS%20Vol%20I_Impact%20Analyses_Aug14.pdf> Accessed July 21, 2015.

———. 2014b. *Draft Northern Pass Transmission Line Project Environmental Impact Statement*. July. <http://energy.gov/nepa/downloads/eis-0463-draft-environmental-impact-statement>. Accessed September 2, 2015.

———. 2013. *DOE Alternatives Development Report*. Prepared by Tetra Tech for the U.S. Department of Energy, December. (Available on EIS Reference CD.)

———. 2011. *2010 Wind Technologies Market Report*. DOE/GO-102011-3322. Prepared by the National Renewable Energy Laboratory for the U.S. Department of Energy. <http://www1.eere.energy.gov/wind/pdfs/51783.pdf>. Accessed July 21, 2014.

IEEE (Institute of Electrical and Electronics Engineers). 2011. *2012 National Electrical Safety Code*. August. <http://standards.ieee.org/about/nesc/index.html>. Accessed July 21, 2014.

KCC (Kansas Corporation Commission). 2013. "Excerpt of the direct testimony of Dr. Wayne Galli P.E., Clean Line Energy Executive Vice President–Technical and Transmission Service (Ph.D., Electrical Engineering), before the Kansas Corporation Commission regarding the viability of buried transmission lines." Docket No.13-GBEE-803-MIS (pp 7-8), June 28. <http://estar.kcc.ks.gov/estar/ViewFile.aspx/20130715113406.pdf?Id=467ae836-59a0-42ef-8136-835e99dc5ac7>.

Northeast Energy Link. 2015. "Technical Description." <http://www.northeastenergylink.com/technical_description/default.aspx>. Accessed July 21, 2015.

NREL (National Renewable Energy Laboratory). 2011. "National 80m wind resource potential for the United States." *Wind Maps*. <http://www.nrel.gov/gis/images/80m_wind/USwind300dpe4-11.jpg>.

Siemens. 2015. "HVDC link connects Scotland and England." <http://www.siemens.com/about/sustainability/en/core-topics/customers-portfolio/references/hvdc-link.htm>. Accessed July 21, 2015.

Tennessee Regulatory Authority (TRA). 2015. "Order Granting Certificate of Public Convenience and Necessity." *Petition of Plains and Eastern Clean Line, LLC, for a Certificate of Convenience and Necessity Approving a Plan to Construct a Transmission Line and to Operate as an Electric Transmission Public Utility*. Docket No. 14-00036. <http://www.plainsandeasterncleanline.com/sites/plains_eastern/media/docs/TRA-14-00036.CPCN_Order_050515.pdf>. Accessed September 9, 2015.

6.2.3 Chapter 3

6.2.3.1 Introduction

40 CFR 1502.16. "Environmental Consequences." *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=7026140700b975e12ed794fc6f542782&node=pt40.33.1502&rgn=div5#se40.33.1502_116>.

DOE (U.S. Department of Energy). 2013. *DOE Alternatives Development Report*. Prepared by Tetra Tech for the U.S. Department of Energy, December. (Available on EIS Reference CD.)

6.2.3.2 Agricultural Resources

7 USC §§ 4201-4209. "Farmland Protection Policy Act" (Pub. L. 97-98) <http://www.law.cornell.edu/uscode/pdf/lii_usc_TI_07_CH_73.pdf>.

Adams, J.A. 2014. Email from J.A. Adams, Cartographer, USDA Natural Resources Conservation Service. Stillwater, OK, to J. Chester, Tetra Tech, and others. May 28. (Available on EIS Reference CD.)

Bancroft, J.B.; Morrison, A.; and Lachapelle, G. 2012. *Validation of GNSS under 500,000 Volt Direct Current (DC) Transmission Lines*. University of Calgary, Schulich School of Engineering. April. <http://plan.geomatics.ucalgary.ca/papers/bancroftetal2012-500kvinterference%20planweb%2028feb12.pdf>.

Denholm, P.; Hand, M.; Jackson, M.; and Ong, S. 2009. *Land-Use Requirements of Modern Wind Power Plants in the United States*. Technical Report NREL/TP-6A2-45834. National Renewable Energy Laboratory. August. <http://www.nrel.gov/docs/fy09osti/45834.pdf>. Accessed September 30, 2014.

FSA (Farm Service Agency). 2015a. "Summary of Active Contracts by Program Year-Arkansas." CRP – Monthly Contracts 20 Report. U.S. Department of Agriculture. Data search in project area as of July 1, 2015. <https://apps.fsa.usda.gov/CRPReport/monthly_report.do?method=displayReport&report=June-2015-ActiveContractsSummaryByProgramYear-05>. Accessed July 30, 2015.

——— 2015b. "Summary of Active Contracts by Program Year-Tennessee." CRP – Monthly Contracts 20 Report. U.S. Department of Agriculture. Data search in project area as of July 1, 2015. <https://apps.fsa.usda.gov/CRPReport/monthly_report.do?method=displayReport&report=June-2015-ActiveContractsSummaryByProgramYear-47>. Accessed July 2015.

———. 2014a. "Summary of Active Contracts by Program Year-Oklahoma." CRP – Monthly Contracts 20 Report. U.S. Department of Agriculture. Data search in project area as of August 1, 2014.

<https://apps.fsa.usda.gov/CRPReport/monthly_report.do?method=displayReport&report=July-2014-ActiveContractsSummaryByProgramYear-40>. Accessed July 30, 2015.

———. 2014b. "Summary of Active Contracts by Program Year-Texas." CRP – Monthly Contracts 20 Report. U.S. Department of Agriculture. Data search in project area as of August 1, 2014. <https://apps.fsa.usda.gov/CRPReport/monthly_report.do?method=displayReport&report=July-2014-ActiveContractsSummaryByProgramYear-48>. Accessed July 30, 2015.

Sagona, F. 2014. "FPPA regulation and Assessment Criteria." Email from F. Sagona, Biologist/Environmental Liaison for the USDA Natural Resources Conservation Service. Chattanooga, TN, to M. Ardis, U.S. Department of Energy, and J. Chester, Tetra Tech. July 16. (Available on EIS Reference CD.)

USDA (U.S. Department of Agriculture). 2014a. *2012 Census of Agriculture. State and County Profiles*. U.S. Department of Agriculture. December. <http://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_1_US/>. Accessed July 2015.

———. 2014b. *2012 Census of Agriculture - County Data – Arkansas*. "Table 1. County Summary Highlights." <http://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_2_County_Level/Arkansas/st05_2_001_001.pdf>. Accessed July 2014.

———. 2014c. *2012. Census of Agriculture - County Data – Oklahoma*. "Table 1. County Summary Highlights." <http://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_2_County_Level/Oklahoma/st40_2_001_001.pdf>. Accessed July 2015.

———. 2014d. *2012. Census of Agriculture - County Data – Tennessee*. "Table 1. County Summary Highlights." <http://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_2_County_Level/Tennessee/st47_2_001_001.pdf>. Accessed July 2014.

———.2014e. *2012 Census of Agriculture - County Data – Texas.* "Table 1. County Summary Highlights." < <http://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_2_County_Level/Texas/st48_2_001_001.pdf>. Accessed July 2014.

———. 2008. *FSA Handbook. Agricultural Resource Conservation Program for State and County Offices*. 2-CRP (Revision 4). p 12-8. <http://www.fsa.usda.gov/Internet/FSA_File/2-crp.pdf>. Accessed April 30, 2014.

6.2.3.3 Air Quality and Climate Change

40 CFR Part 50. "National Primary and Secondary Ambient Air Quality Standards." *Protection of Environment*. Environmental Protection Agency. <http://www.ecfr.gov/cgi-bin/text-idx?c=ecfr;sid=7cd8f48d596a7f42ad1701f5a0ba1ded;rgn=div5;view=text;node=40%3A2.0.1.1.1;idno=40;cc=ecfr>.

40 CFR Part 80. "Regulation of Fuels and Fuel Additives." *Protection of Environment*. Environmental Protection Agency. <http://www.ecfr.gov/cgi-bin/text-idx?SID=dd2d7312164162d167f8b7b8aeb00d7a&node=pt40.17.80&rgn=div5>.

40 CFR Part 81. "Designation of Areas for Air Quality Planning Purposes." *Protection of Environment*. Environmental Protection Agency. <http://www.ecfr.gov/cgi-bin/text-idx?SID=9eef2d54dd6d5de38ef24369d1aae03c&node=40:18.0.1.1.1&rgn=div5>.

40 CFR Part 86. "Control of Emissions from New and In-Use Highway Vehicles and Engines." *Protection of Environment*. Environmental Protection Agency. <http://www.ecfr.gov/cgi-bin/text-idx?SID=70a71bb2639c600d4939cf561f1daed0&mc=true&node=pt40.19.86&rgn=div5>.

40 CFR Part 89. "Control of Emissions from New and In-Use Nonroad Compression-Ignition Engines." *Protection of Environment*. Environmental Protection Agency. <http://www.ecfr.gov/cgi-bin/text-idx?SID=5435fe3c21cd3b4461b0f1038dd66887&mc=true&node=pt40.20.89&rgn=div5>.

40 CFR Part 90. "Control of Emissions from Nonroad Spark-Engines at or below 19 kilowatts." *Protection of Environment*. Environmental Protection Agency. <http://www.ecfr.gov/cgi-bin/text-idx?SID=5435fe3c21cd3b4461b0f1038dd66887&mc=true&node=pt40.20.90&rgn=div5>.

40 CFR Part 93. "Determining Conformity of Federal Actions to State or Federal Implementation Plans." *Protection of Environment*. Environmental Protection Agency. <http://www.ecfr.gov/cgi-bin/text-idx?SID=5435fe3c21cd3b4461b0f1038dd66887&mc=true&node=pt40.20.93&rgn=div5>.

40 CFR Part 98. "Mandatory Greenhouse Gas Reporting." *Protection of Environment*. Environmental Protection Agency. <http://www.ecfr.gov/cgi-bin/text-idx?SID=dd2d7312164162d167f8b7b8aeb00d7a&node=pt40.21.98&rgn=div5>.

40 CFR Part 1039. "Control of Emissions from New and In-Use Nonroad Compression-Ignition Engines." *Protection of Environment*. Environmental Protection Agency. <http://www.ecfr.gov/cgi-bin/text-idx?SID=f49088face2b36da3f7e7f9a4ed61239&mc=true&node=pt40.33.1039&rgn=div5>.

40 CFR Part 1048. "Control of Emissions from New, Large Nonroad Spark-Ignition Engines." *Protection of Environment*. Environmental Protection Agency. <http://www.ecfr.gov/cgi-bin/text-idx?SID=f49088face2b36da3f7e7f9a4ed61239&mc=true&node=pt40.33.1048&rgn=div5>.

42 USC § 7401 *et seq*. "Clean Air Act of 1990" (Pub. L. 101-549). <http://www.law.cornell.edu/uscode/text/42/chapter-85>.

Buizer, J.L.; Fleming, P.; Hays, S.L.; Dow, K.; Field, C.B.; Gustafson, D.; Luers, A.; and Moss, R.H. 2013. *Report on Preparing the Nation for Change: Building a Sustained National Climate Assessment Process*. National Climate Assessment and Development Advisory Committee. September. <http://downloads.globalchange.gov/nca/NCADAC/NCADAC_Sustained_Assessment_Special_Report_Sept2013.pdf>. Accessed October 5, 2014.

CARB (California Air Resources Board). 2005. *Air Quality and Land Use Handbook: A Community Health Perspective*. April. <http://www.arb.ca.gov/ch/handbook.pdf>. Accessed June 16, 2014.

Clean Line. 2014. *Wind Generation Technical Report for the Plains & Eastern Clean Line*. March. Prepared by Clean Line Energy Partners for the Department of Energy pursuant to 10 CFR 1021.215(b)(2). (Available on EIS Reference CD.)

———. 2013. *Air Quality and Climate Change Technical Report*. December. Prepared by Clean Line Energy Partners for the Department of Energy pursuant to 10 CFR 1021.215(b)(2). (Available on EIS Reference CD.)

Countess Environmental. 2006. *WRAP Fugitive Dust Handbook*. Prepared for the Western Governors' Association (Denver, CO) under WGA Contract No. 30204-111. September 7. <http://www.wrapair.org/forums/dejf/fdh/content/FDHandbook_Rev_06.pdf>. Accessed June 3, 2014.

———. 2001. *Methodology for Estimating Fugitive Windblown and Mechanically Resuspended Road Dust Emissions Applicable for Regional Scale Air Quality Modeling*. Final Report for Western Governors' Association, Contract No. 30203-9. April. <http://pbadupws.nrc.gov/docs/ML1321/ML13213A294.pdf>. Accessed July 3, 2014.

EIA (U.S. Energy Information Administration). 2011. *Emissions of Greenhouse Gases in the United States 2009*. DOE/EIA-0573(2009). March. <http://www.eia.gov/environment/emissions/ghg_report/pdf/0573(2009).pdf>. Accessed June 16, 2014.

EPA (U.S. Environmental Protection Agency). 2012. "Motor Vehicle Emission Simulator (MOVES)." Version MOVES2010b. <http://www3.epa.gov/otaq/models/moves/moves-docum.htm>. Accessed June 17, 2014.

———. 2011. "Paved Roads". Section 13.2.1 of the *AP-42 Compilation of Emission Factors*. November. <http://www.epa.gov/ttn/chief/ap42/ch13/final/c13s0201.pdf>. Accessed July 3, 2014.

———. 2009. *NONROAD2008a Model*. Last updated 2009. <http://www.epa.gov/otaq/nonrdmdl.htm>. Accessed June 17, 2014.

———. 2008. "AP-42 Compilation of Emission Factors." <http://www.epa.gov/ttn/chief/ap42/>. Accessed July 22, 2014.

———. 2006a. "Concrete Batching". Section 11.12 of the *AP-42 Compilation of Emission Factors*. June. <http://www.epa.gov/ttn/chief/ap42/ch11/final/c11s12.pdf>. Accessed July 3, 2014.

———. 2006b. "Unpaved Roads". Section 13.2.2 of the *AP-42 Compilation of Emission Factors*. November. <http://www.epa.gov/ttn/chief/ap42/ch13/final/c13s0202.pdf>. Accessed July 3, 2014.

IPCC (Intergovernmental Panel on Climate Change). 2013. "Summary for Policymakers." In: *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J.

Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds). Cambridge University Press, Cambridge, United Kingdom, and New York, NY, USA.<http://www.ipcc.ch/report/ar5/wg1/>. Accessed June 17, 2014.

Kerr, R. 2013. “Forecasting Regional Climate Change Flunks Its First Test.” *Science* 339, p. 628. <http://www.sciencemag.org/content/339/6120/638.summary?sid=ced9b170-9fe2-496f-a168-3a5203621eca>. Accessed June 17, 2014.

NCDC (National Climate Data Center). 2014. Meteorological summaries for the states of Arkansas, Oklahoma, Tennessee, and Texas. <http://www.ncdc.noaa.gov/>. Accessed February 11, 2014.

Repholz, M. 2014. Email communication from M. Repholz, Construction Foreman, Tetra Tech, Inc., to T. Tamura, Program Manager, Tetra Tech, Inc. June 23. (Available on EIS Reference CD.)

USGCRP (U.S. Global Change Research Program). 2014. *2014 National Climate Assessment*. J.M. Melillo, Terese (T.C.) Richmond, and G.W. Yohe (eds). <http://nca2014.globalchange.gov/system/files_force/downloads/low/NCA3_Climate_Change_Impacts_in_the_United%20States_LowRes.pdf?download=1>. Accessed July 3, 2014.

Watson and Chow. 2000. *Reconciling Urban Fugitive Dust Emissions Inventory and Ambient Source Contribution Estimates: Summary of Current Knowledge and Needed Research*. DRI Document No. 6110.4F. May. <http://www.epa.gov/ttn/chief/efdocs/fugitivedust.pdf>. Accessed July 3, 2014.

6.2.3.4 Electrical Environment

47 CFR Part 15. “Radio Frequency Devices.” *Federal Communications Division*. <http://www.ecfr.gov/cgi-bin/text-idx?SID=79b6473554bccccab04847c01e7ae0f9&node=47:1.0.1.1.16&rgn=div5>.

ACGIH (American Conference of Governmental Industrial Hygienists). 2010. *TLVs and BEIs—Threshold Limit Values for Chemical Substances and Physical Agents*. Cincinnati, Ohio. ISBN: 978-1-607260-19-6. <http://www.acgih.org/forms/store/ProductFormPublic/2010-tlvs-and-beis>. Accessed July 22, 2014.

ACS (American Cancer Society) 2015a. “Power Lines, Electrical Devices and Extremely Low Frequency Radiation.” <http://www.cancer.org/cancer/cancercauses/radiationexposureandcancer/extremely-low-frequency-radiation>. Accessed July 22, 2015.

———. 2015b. “Brain and Spinal Cord Tumors in Adults.” <http://www.cancer.org/cancer/braincnstumorsinadults/detailedguide/brain-and-spinal-cord-tumors-in-adults-risk-factors>. Accessed July 22, 2015.

ADEQ (Arkansas Department of Environmental Quality). 2014. “Exceedances of the 8-hour Standard.” <http://www.adeq.state.ar.us/air/ozone/exceedances.htm>. Accessed February 17, 2014.

Aesculap 2012. “proGAV—The Adjustable MIETHKE Gravitational System.” January. <http:/www.aesculapusa.com/default.aspx?pageid=208>. Accessed February 17, 2014.

AHA (American Heart Association). 2013. “Devices that may Interfere with Implantable Cardioverter Defibrillators (ICDs).” January 23. <http://www.heart.org/HEARTORG/Conditions/Arrhythmia/PreventionTreatmentofArrhythmia/Devices-that-may-Interfere-with-Implantable-Cardioverter-Defibrillators-ICDs_UCM_448464_Article.jsp>. Accessed March 27, 2014.

———. 2012. “Devices that may Interfere with Pacemakers.” August 16. <http://www.heart.org/HEARTORG/Conditions/Arrhythmia/PreventionTreatmentofArrhythmia/Devices-that-may-Interfere-with-Pacemakers_UCM_302013_Article.jsp>. Accessed March 21, 2014.

Algers, B. and Hennichs, K. 1985. “The effect of exposure to 400-kV transmission lines on the fertility of cows: a retrospective cohort study.” *Preventive Veterinary Medicine* 3:351-361. <http://www.sciencedirect.com/science/article/pii/0167587785900121>. Accessed July 22, 2014.

Algers, B. and Hultgren, J. 1987. “Effects of long-term exposure to a 400-kV, 50-Hz transmission line on estrous and fertility in cows.” *Preventive Veterinary Medicine* 5:21-36. <http://www.sciencedirect.com/science/article/pii/0167587787900031>. Accessed July 22, 2014.

Amstutz, H.E. and Miller, D.B. 1980. “A study of farm animals near 765 kV transmission lines.” *Bovine Practitioner* 1 (15): 51–62. <http://www.cabdirect.org/abstracts/19802262168.html;jsessionid=9C77BBE73969FA609E5EF46F18DAD91C>. Accessed July 22, 2015.

Anderson, R.C.E. MD; Walker, M.L. MD; Viner, J.M. PhD; Kestle, J.R.W. MD, MSc. 2004. “Adjustment and Malfunction of a Programmable Valve after Exposure to Toy Magnets.” *J. Neurosurg (Pediatrics 2)* 101:222-225. <http://thejns.org/doi/abs/10.3171/ped.2004.101.2.0222?journalCode=ped>. Accessed July 22, 2014.

Angell, R.F.; Schott, M.R.; Raleigh, R.J.; and Bracken, T.D. 1990. “Effects of a high-voltage direct-current transmission line on beef cattle production.” *Bioelectromagnetics* 11(4):273-82. <http://www.ncbi.nlm.nih.gov/pubmed/2285413>. Accessed July 22, 2014.

Bancroft, J.B.; Morrison, A.; and Lachapelle, G. 2012. *Validation of GNSS under 500,000 Volt Direct Current (DC) Transmission Lines*. University of Calgary, Schulich School of Engineering. April. <http://plan.geomatics.ucalgary.ca/papers/bancroftetal2012-500kvinterference%20planweb%2028feb12.pdf>. Accessed July 22, 2015.

Barrow (Barrow Neurological Institute). 2015. “DBS Frequently Asked Questions:” <http://www.thebarrow.org/Neurological_Services/DBS_Program/211742>. Accessed July 22, 2015.

Beale, I.L; Pearce, N.E.; Conroy, D.M.; Henning, M.A.; and Murrell, K.A. 1997. "Psychological Effects of Chronic Exposure to 50 Hz Magnetic Fields in Humans Living Near Extra-High-Voltage Transmission Lines." *Bioelectromagnetics* 18:584-594. <http://www.ncbi.nlm.nih.gov/pubmed/9383247>. Accessed July 30, 2015.

Beason, R.C. 2005. “Mechanisms of Magnetic Orientation in Birds.” *Integrative and Comparative Biology* 45:565-573. <http://www.jstor.org/stable/4485829?seq=1#page_scan_tab_contents>. Accessed July 22, 2015.

Beaver, D.L.; Hill, R.W.; and Hill, S.D. 1994. *ELF Communications System Ecological Monitoring Program: Small Vertebrate Studies- Final Report*. Technical Report D06212-1, Illinois Institute of Technology Research Institute (IITRI). October. <http://www.dtic.mil/cgi-bin/GetTRDoc?Location=U2&doc=GetTRDoc.pdf&AD=ADA297213>. Accessed July 22, 2014.

Begall, S.; Cerveny, J.; Neef, J.; Vojtech, O.; and Burda, H. 2008. "Magnetic Alignment in Grazing and Resting Cattle and Deer." *Proc Natl Acad Sci U.S.A.* 105(36):13451-13455. <http://www.pnas.org/content/early/2008/08/22/0803650105.full.pdf+html>. Accessed July 22, 2014.

BioInitiative. 2007. *BioInitiative Report: A Rationale for a Biologically-based Public Exposure Standard for Electromagnetic Fields (ELF and RF)*. Participants: Carpenter, D.; Davanipour, Z.; Gee, D.; Hardell, L.; Johansson, O.; Lai, H.; Hansson Mild, K.; Sobel, E.; Xu, Z.; Chen, G.; and Sage, A. August 31. (Available on EIS Reference CD.)

BioEm. 2015. "Hypersensitivity: Scientists Review History, Science." In *BioEM2015 Meeting Program.* Annual Meeting of the Bioelectromagnetics Society (BEMS) and the European BioElectromagnetics Association (EBEA). Asilomar Conference Center, California, June 14-19, 2015. <http://bioem2015.org/Program.pdf>. Accessed July 30, 2015.

Boston Scientific 2015. Letter in response to question about compatibility of implantable devices with electromagnetic fields in the workplace. March 30. (Available on EIS Reference CD.)

BPA (Bonneville Power Administration) 2010. *Power lines and crops can be good neighbors*. DOE/BP-4183. August. <http://www.bpa.gov/news/pubs/GeneralPublications/lusi-Power-lines-and-crops-can-be-good-neighbors.pdf>. Accessed July 22, 2015.

———. 2007. *Living and Working Safely Around High Voltage Power Lines*. DOE/BP-3804. October. <http://www.bpa.gov/news/pubs/GeneralPublications/lusi-Living-and-working-safely-around-high-voltage-power-lines.pdf>. Accessed July 22, 2015.

———. 1977. *Description of Equations and Computer Program for Predicting Audible Noise, Radio Interference, Television Interference, and Ozone from A-C Transmission Lines*. Technical Report No. ERJ-77-167, September. (Available on EIS Reference CD.)

Burchard, J.F.; Nguyen, D.H.; and Block, E. 1998. "Effects of electric and magnetic fields on nocturnal melatonin concentrations in dairy cows." *Journal of Dairy Science* 81(3):722-7. <http://www.sciencedirect.com/science/article/pii/S0022030298756280>. Accessed August 18, 2014.

Burchard, J.F.; Nguyen, D.H.; Monardes, H.G.; and Petitclerc, D. 2004. "Lack of effect of 10kV/m 60Hz electric field exposure on pregnant dairy heifer hormones." *Bioelectromagnetics* 25(4):308-12. <http://onlinelibrary.wiley.com/doi/10.1002/bem.20020/abstract>. Accessed September 24, 2014.

Burchard, J.F.; Nguyen, D.H.; Richard, L.; and Block, E. 1996. "Biological Effects of Electric and Magnetic Fields on Productivity of Dairy Cows." *Journal of Dairy Science* 79:1549-1554. <http://www.sciencedirect.com/science/article/pii/S0022030296765165>. Accessed September 24, 2014.

Burda, H.; Begall, S.; Cerveny, J.; Neef; and Nemec, P. 2009. “Extremely Low-Frequency Electromagnetic Fields Disrupt Magnetic Alignment of Ruminants.” *Proc Natl Acad Sci U.S.A.* 106(14):5708-5713. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2667019/>. Accessed September 24, 2014.

Canseven, A.G.; Keskil, Z.A.; Keskil, S.; and Seyhan, N. 2007. “Pentylenetetrazol-Induced Seizures are not Altered by Pre- or Post-Drug Exposure to a 50 Hz Magnetic Field.” *International Journal of Radiation Biology* 2007:83(4):231-35. <http://informahealthcare.com/doi/abs/10.1080/09553000701206676>. Accessed July 21, 2015.

Carstensen, E.L. 1987. *Biological Effects of Transmission Line Fields*. New York: Elsevier Press. <http://www.amazon.ca/Biological-Effects-Transmission-Line-Fields/dp/0444010181>. Accessed September 24, 2014.

CENCELEC (European Committee for Electrotechnical Standardization) 2010. “Procedure for the assessment of the exposure to electromagnetic fields of workers bearing active implantable medical devices - Part 1: General.” EN 50527-1, April 2010. <http://www.electricalengineeringstandards.com/csn-en-50527-1-procedure-for-the-assessment-of-the-exposure-to-electromagnetic-fields-of-workers-bearing-active-implantable-medical-devices-part-1-general/>. Accessed September 24, 2014.

Chakravarti, K. and Pontrelli, G.J. 1976. "The Measurement of Carpet Static.” *Textile Research Journal* 46:129-134. <http://trj.sagepub.com/content/46/2/129.abstract>. Accessed September 24, 2014.

Charry, J.M. 1987. “Biological effects of air ions: a comprehensive review of laboratory and clinical data.” Chapter 6 in *Air ions: physical and biological aspects*. Charry, J.M. and Kavet, R.I. (eds) Boca Raton: CRC Press, Inc., 91-149. <https://books.google.com/books/about/Air_Ions.html?id=tP9FAAAAYAAJ>. Accessed July 24, 2015.

Cinar N.; Sahin S.; and Erdinc, O.O. 2013. “What is the Impact of Electromagnetic Waves on Epileptic Seizures?” *Medical Science Monitor Basic Research* 19: 141–145. May 10. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3659130/>. Accessed July 21, 2015.

Clean Line. 2014a. *Responses to Department of Energy Data Request (dated January 31, 2014) Electrical Environment Technical Report*. March 5. (Available on EIS Reference CD.)

———. 2014b. *Electrical Environment Assessment of the Plains and Eastern Transmission Line Project*. January 14. Prepared by Clean Line Energy Partners for the Department of Energy pursuant to 10 CFR 1021.215(b)(2). (Available on EIS Reference CD.)

———. 2014c. *Wind Generation Technical Report for the Plains and Eastern Transmission Line Project*. March. Prepared for the Department of Energy pursuant to 10 CFR 1021.215(b)(2). (Available on EIS Reference CD.)

———. 2013. *Land Use and Recreation Technical Report for the Plains and Eastern Transmission Line Project*. December. Prepared for the Department of Energy pursuant to 10 CFR 1021.215(b)(2). (Available on EIS Reference CD.)

Codman. 2006. *Codman Hakim Programmable Valve System for Hydrocephalus—Procedure Guide*. <http://codman-sb.siliconmtn.com/binary/org/CODMAN/PDF/VAL-10-001-CHPV-proc-guide.pdf>. Accessed July 23, 2014.

CRC. 1981. *CRC Handbook of Chemistry and Physics–Atmospheric Electricity.* CRC Press. <http://www.amazon.com/Handbook-Chemistry-Physics-62nd-1981-1982/dp/B000NKPN1I/>.

———. 2007. *Electric Power Substations Engineering*. Second Edition, pp. 9-8 and 9-9, CRC Press. McDonald, J.D. (ed). <http://www.crcpress.com/product/isbn/9780849373831>. Accessed September 24, 2014.

Deno, D.W. and Silva, J.M. 1987. "Transmission Line Electric Field Shielding by Objects." *IEEE Transactions on Power Delivery*, Vol. PWRD-2, No. 1, pp. 269-280. <http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=5527327&url=http%3A%2F%2Fieeexplore.ieee.org%2Fiel5%2F39%2F5527271%2F05527327.pdf%3Farnumber%3D5527327>. Accessed October 21, 2014.

Enertech Consultants. 1985. *AC Field Exposure Study: Human Exposure to 60 Hz Electric Fields*. EPRI Report EA-3993. Electric Power Research Institute, Palo Alto, CA. <http://www.epri.com/search/Pages/results.aspx?k=AC%20Field%20Exposure%20Study:%20Human%20Exposure%20to%2060-Hz%20Electric%20Fields>. Accessed June 18, 2014.

EPA (U.S. Environmental Protection Agency). 2015. “Electric and Magnetic Fields: Rules and Guidance.” <http://www3.epa.gov/radtown/electric-magnetic-fields.html#rules-guidance>. Accessed July 22, 2015.

———. 2014. “Regulatory Actions.” <http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=6368902>. Accessed October 6, 2014.

———. 2008. “National Ambient Air Quality Standards (NAAQS).” March. <http://www3.epa.gov/ttn/naaqs/criteria.html>. Accessed February 12, 2014.

———. 1974. *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*. No. 550/9-74-004. March. <http://www.nonoise.org/library/levels74/levels74.htm>. Accessed September 24, 2014.

EPRI (Electric Power Research Institute). 2013a. *Electromagnetic Interference and Implantable Medical Devices—An Update and Future Perspective*. Technical Report 3002001140, November. <http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000003002001140>. Accessed September 24, 2014.

———. 2013b. EMFWorkstation 2013 software program, Palo Alto, California. <http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000003002001126>. Accessed September 24, 2014.

———. 2012. *Environmental and Potential Health Effects of HVDC Transmission Lines*. Product ID #1025385. July 31. <http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000000001025385>. Accessed June 18, 2014.

———. 2010. *Electrical Effects of HVDC Transmission Lines*. Product ID #1020118. December 23. <http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000003002000860>. Accessed June 18, 2014.

———. 2006a. *Transmission Line Reference Book-200 kV and Above* (Third Edition). Product ID #1011974. January 23. <http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=0000000000010119>. Accessed June 18, 2014.

———. 2006b. *Integration of Transmission Design Tools and Software—2006 Progress Report*. Technical Report 1012318. Palo Alto, California. <http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000000001012318>. Accessed September 24, 2014.

———. 2006c. *EPRI AC Transmission Line Reference Book—200 kV and Above*. Third Edition. EPRI Product 1011974. <http://mydocs.epri.com/Docs/CorporateDocuments/SectorPages/PDM/ColorBookDocs/1016297_RedBook.pdf>. Accessed July 21, 2015.

———. 1999. *Electric and Magnetic Field Management Reference Book.* First Edition. TR-114200. December. <http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=TR-114200>. Accessed June 18, 2014.

———. 1997. EMFWorkstation Version 2.51 software program, Palo Alto, California. <http://www.enertech.net/html/emfw.html>. Accessed September 24, 2014.

———. 1996. Transmission Line Workstation (TLWorkstation or TLW) Version 3.0 software program, Palo Alto, California. <http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000000001012318>. Accessed September 24, 2014.

———. 1982. *Bipolar HVDC Transmission System Study Between $\underline{+}$600 kV and $\underline{+}$I200 kV – Corona Study, Phase II*. EPRI Report EL-2794. December. <http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=EL-2794>. Accessed July 21, 2015.

———. 1978. *Transmission Line Reference Book HVDC to $\underline{+}$600kV*. <http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=EL-100-V2>. Accessed July 30, 2015.

FCC (Federal Communications Commission). 2014. “Digital Radio.” <http://www.fcc.gov/guides/digital-radio-sound-future>. Accessed March 14, 2014.

———. 1999. *DTV Report on COFDM and 8-VSB Performance*. Office of Engineering and Technology. September 30. <http://www.fcc.gov/Bureaus/Engineering_Technology/Documents/reports/dtvreprt.pdf>. Accessed June 18, 2014.

FDA (U.S. Food and Drug Administration). 2015a. “Types of Hearing Aids.“ <http://www.fda.gov/MedicalDevices/ProductsandMedicalProcedures/HomeHealthandConsumer/ConsumerProducts/HearingAids/ucm181470.htm>. Accessed July 22, 2015.

———. 2015b. “Heaing Aids and Cell Phones.“ <http://www.fda.gov/MedicalDevices/ProductsandMedicalProcedures/HomeHealthandConsumer/ConsumerProducts/HearingAids/ucm181478.htm>. Accessed July 22, 2015.

———. 1998. *Guidance for the Submission of Premarket Notifications for Magnetic Resonance Diagnostic Devices*. U.S. Department of Health and Human Services, Center for Devices and Radiological Health Guidance for Industry. November 14. <http://www.fda.gov/downloads/MedicalDevices/DeviceRegulationandGuidance/GuidanceDocuments/ucm073818.pdf>. Accessed July 2, 2014.

Fernie, K.J.; Bird, D.M.; Dawson, R.D.; and Lague, P.C. 2000. “Effects of electromagnetic fields on the reproductive success of American kestrels.” *Physiological Biochemistry and Zoology* 73(1):60-5. <http://www.avaate.org/IMG/pdf/Fernie2000_pbz73_60-65.pdf>. Accessed September 24, 2014.

Fernie, K.J. and Reynolds, S.J. 2005. “The effects of electromagnetic fields from power lines on avian reproductive biology and physiology: a review.” *Journal of Toxicology and Environmental Health Part B Critical Reviews* 8(2):127-40. <http://www.fws.gov/southwest/es/documents/R2ES/LitCited/LPC_2012/Fernie_and_Reynolds_2005.pdf>. Accessed September 24, 2014.

Fortin, P.; Rideout, K.; Copes, R.; and Bos, C. 2013. *Wind Turbines and Health*. National Collaborating Centre for Environmental Health (NCCEH), February. <http://www.ncceh.ca/sites/default/files/Wind_Turbines_Feb_2013.pdf>. Accessed March 17, 2014.

Foster, K.R. and Rubin, G.J. 2014. "Allergic to Technology: Ethics and the ‘Electrically Hypersensitive’ Individual.” *Ethics in Biology, Engineering & Medicine - An International Journal* 5(1): 39-50.<http://dl.begellhouse.com/journals/6ed509641f7324e6,59bf2d6a63e1cf43,2ef483027d2fcba3.html>. Accessed July 22, 2015.

Gauger, J.R. 1985. “Household Appliance Magnetic Field Survey.” *IEEE Transactions on Power Apparatus and Systems*, Vol. PAS-104, No. 9:2436-44. <http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=4113405&url=http%3A%2F%2Fiee>. Accessed July 2, 2014.

———. 1984. *Household Appliance Magnetic Field Survey*. Prepared by the Illinois Institute of Technology Research Institute for the U.S. Naval Electronic Systems under Contract N00039-84-C-0070. March. <http://www.dtic.mil/cgi-bin/GetTRDoc?Location=U2&doc=GetTRDoc.pdf&AD=ADA143282>. Accessed August 18, 2014.

Goodwin, J.G. Jr. 1975. *Big game movement near a 500-kV transmission line in northern Idaho*. Bonneville Power Administration, Engineering and Construction Division, Portland, Oregon. June 27. (Copyright-protected; cover page available on EIS Reference CD)

Greenberg, B.; Bindokas, V.P.; Frazier, M.J.; and Gauger, J.R. 1981. "Response of honey bees, *apis mellifera* L., to high-voltage transmission lines." *Environmental Entomology* 10:600-610. <http://ee.oxfordjournals.org/content/10/5/600>. Accessed September 24, 2014.

Hauth, R.L.; Tatro, P.J.; Railing, B.D.; Johnson, B.K.; Stewart, J.R.; and Fink, J.L. 1997. *HVDC Power Transmission Environmental Issues Review*. ORNL/SUB/95-SR893/2. Prepared for the Oak Ridge National Laboratory under U.S. Department of Energy Contract DE-AC05-96OR22464. <http://web.ornl.gov/~webworks/cppr/y2001/rpt/92023.pdf>. Accessed August 18, 2014.

HCN (Health Council of the Netherlands). 2008. "BioInitiative Report." Memo from Prof M. de Visser, Vice-President of HCN, to the Minister of Housing, Spatial Planning and the Environment dated September 8. http://www.gezondheidsraad.nl/sites/default/files/200817E_0.pdf>. Accessed July 22, 2015.

Hefeneider, S.H.; McCoy, S.L.; Hausman, F.A.; Christensen, H.L.; Takahashi, D.; Perrin, N.; Bracken, T.D.; Shin, K.Y.; and Hall, A.S. 2001. "Long-term effects of 60-Hz electric vs. magnetic fields on IL-1 and IL-2 activity in sheep." *Bioelectromagnetics* 22(3):170-177. <http://www.ncbi.nlm.nih.gov/pubmed/11255212>. Accessed September 24, 2014.

Hert, J.; Jelinek, L.; Pekarek, L.; and Pavlicek, A. 2011. "No Alignment of Cattle Along Geomagnetic Field Lines Found." *J Comp Physiol A Neuroethol Sens Neural Behav Physiol* 197(6):677-682. <http://link.springer.com/article/10.1007/s00359-011-0628-7>. Accessed September 24, 2014.

Holmberg, B. 1995. "Magnetic fields and cancer: animal and cellular evidence: an overview." *Environmental Health Perspectives* 103 Suppl. 2:63-7. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1518854/>. Accessed September 24, 2014.

Huuskonen, H.; Saastamoinen, V.; Komulainen, H.; Laitinen, J.; and Juutilainen, J. 2001. "Effects of low-frequency magnetic fields on implantation in rats." *Reproductive Toxicology* 15(1):49-59. <http://www.ncbi.nlm.nih.gov/pubmed/11137378>. Accessed September 24, 2014.

IARC (International Agency for Research on Cancer) 2002. "IARC Monographs on the evaluation of carcinogenic risks to humans." Volume 80: *Static and Extremely Low-Frequency (ELF) Electric and Magnetic Fields*. IARC Press. Lyon, France. <http://monographs.iarc.fr/ENG/Monographs/vol80/mono80.pdf>. Accessed September 24, 2014.

ICES (International Committee on Electromagnetic Safety). 2002. *IEEE Standard for Safety Levels with Respect to Human Exposure to Electromagnetic Fields, 0 – 3 kHz*. IEEE Standard C95.6-2002. Institute of Electrical and Electronics Engineers (IEEE). <http://standards.ieee.org/getieee/C95/download/C95.6-2002.pdf>. Accessed July 2, 2014.

ICNIRP (International Commission on Non-Ionizing Radiation Protection). 2010. “Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (1 Hz To 100 kHz).” *Health Physics* 99(6):818-836. <http://www.danskenergi.dk/~/media/Netteknik/Teknisk_Haandbog_Magnetfelter/ICNIRP_2010.ashx>. Accessed July 2, 2014.

———. 2009. “Guidelines on Limits of Exposure to Static Magnetic Fields,” *Health Physics* 96:504-514. <http://www.icnirp.de/documents/statgdl.pdf>. Accessed July 2, 2014.

IEEE (Institute of Electrical and Electronics Engineers). 2012. *National Electrical Safety Code*. 2012 Edition. <http://standards.ieee.org/about/nesc/2012.html>. Accessed July 30, 2015.

———. 1998. *IEEE Guide for the Design, Construction, and Operation of Electric Power Substations for Community Acceptance and Environmental Compatibility*. IEEE Standard 1127-1998. <http://standards.ieee.org/findstds/standard/1127-1998.html>. Accessed July 22, 2015.

———. 1994. *IEEE Standard Procedures for Measurement of Power Frequency Electric and Magnetic Fields from AC Power Lines*. IEEE Std 644-1994. <http://standards.ieee.org/findstds/standard/644-1994.html>. Accessed August 18, 2014.

———. 1986. *IEEE Standard Procedures for the Measurement of Radio Noise from Overhead Power Lines and Substations*. ANSI/IEEE Standard 430-1986. <http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=29119&url=http%3A%2F%2Fieeexplore.ieee.org%2Fstamp%2Fstamp.jsp%3Ftp%3D%26arnumber%3D29119>. Accessed July 2, 2014.

———. 1985. *Corona and Field Effects of AC Overhead Transmission Lines - Information for Decision Makers*. IEEE Power Engineering Society, July. (Copyright-protected; cover page available on EIS Reference CD.)

———.1974. “Psychoacoustics–Proceedings of a Workshop.” IEEE Power Engineering Society, Publication Number 74 CHO 967-0PWR. July 17. (Available on EIS Reference CD.).

———.1971. “Radio Noise Design Guide for High Voltage Transmission Lines.” IEEE Committee Report, *IEEE Transactions on Power Apparatus and Systems*, PAS-90, No. 2, pp. 833- 842, March/April. <http://www.researchgate.net/publication/3460271_Radio_Noise_Design_Guide_for_High-Voltage_Transmission_Lines>. Accessed July 2, 2014.

———. 1965. “Transmission System Radio Influence.” IEEE Committee Report IEEE PAS-84. pp. 714-724. August. <http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=4766247>. Accessed August 18, 2014.

Inoue, T.; Kuzu, Y.; Ogasawara, K.; and Ogawa, A. 2005. “The Effect of 3-Tesla Magnetic Resonance Imaging on Various Pressure-Programmable Shunt Valves.” *J. Neurosurg (Pediatrics 2)* 103:163-165. <http://www.ncbi.nlm.nih.gov/pubmed/16370283>. Accessed August 18, 2014.

ISO (International Standards Organization). 2012. *Active implantable medical devices— Electromagnetic compatibility— EMC test protocols for implantable cardiac pacemakers, implantable cardioverter* *defibrillators and cardiac resynchronization devices*. ISO-14117:2012. <https://www.iso.org/obp/ui/#iso:std:iso:14117:ed-1:v1:en>. Accessed July 22, 2015.

Keast, D.N. 1980. "Assessing the Impact of Audible Noise from AC Transmission Lines: A Proposed Method." *IEEE Transactions on Power Apparatus and Systems* Vol. PAS-99, No. 3, May/June. <http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=4113898&sortType%3Dasc_p_Sequence%26filter%3DAND%28p_IS_Number%3A4113873%29>. Accessed July 2, 2014.

Korpinen L.; Kuisti, H.; Elovaara, J.; and Virtanen, V. 2012. "Cardiac Pacemakers in Electric and Magnetic Fields of 400-kV Power Lines." *Pacing and Clinic Electrophysiology (PACE)* 35(4);422-430. <http://www.researchgate.net/publication/221809918_Cardiac_pacemakers_in_electric_and_magnetic_fields_of_400-kV_power_lines>. Accessed September 25, 2014.

Kroeker, G.; Parkinson, D.; Vriend, J.; and Peeling, J. 1996. "Neurochemical effects of static magnetic field exposure." *Surgical Neurology* 45(1):62-6. <http://www.sciencedirect.com/science/article/pii/0090301995003770>. Accessed September 24, 2014.

Lee, J.M.; Pierce, K.S.; Spiering, C.A.; Stearns, R.D.; and Van Ginhoven, G. 1996. *Electrical and biological effects of transmission lines: a review*. DOE/BPA-2938. Bonneville Power Administration, Portland, Oregon. December. (Available on EIS Reference CD.).

Lee, J.M.; Stormshak, F.; Thompson, J.; Hess, D.L.; and Foster, D.L. 1995. "Melatonin and puberty in female lambs exposed to EMF: a replicate study." *Bioelectromagnetics* 16(2):119-23. <http://onlinelibrary.wiley.com/doi/10.1002/bem.2250160208/abstract>. Accessed September 25, 2014.

Lee, J.M.; Stormshak, F.; Thompson, J.; Thinesen, P.; Painter, L.; Olenchek, B.; Hess, D.; and Forbes, R. 1993. "Melatonin secretion and puberty in female lambs exposed to environmental electric and magnetic fields." *Biology of Reproduction* 49(4):857-64. <http://www.biolreprod.org/content/49/4/857.abstract>. Accessed September 25, 2014.

Liu S.; Greene R.; Thomas G.A.; and Madsen J.R. 2005. "Household magnets can change the programmable shunt valve in hydrocephalus patients." In *Proceedings of the IEEE 31st Annual Northeast Bioengineering Conference, April*. <http://ieeexplore.ieee.org/xpl/freeabs_all.jsp?arnumber=1431907>. Accessed September 25, 2014.

Martin, F.B.; Steuernagel, G.; Bender, A.; Robinson, R.A.; Revsbech, R.; Sorenson, D.K.; and Williamson, N. 1983. *A Statistical/Epidemiological Study of Bovine Performance Associated with the CPA/UPA DC Power Line in Minnesota*. Minnesota Environmental Quality Board (MEQB), September. <http://archive.leg.state.mn.us/docs/pre2003/other/840039.pdf>. Accessed September 25, 2014.

Maruvada, P.S. 2000. *Corona Performance of High-Voltage Transmission Lines*. Research Studies Press Ltd., Philadelphia, PA. 2000. ISBN 0863802540. <http://www.worldcat.org/title/corona-performance-of-high-voltage-transmission-lines/oclc/43706715>. Accessed July 30, 2015.

McCallum L.C.; Aslund, M.L.W.; Knopper, L.D.; Ferguson, G.M.; and Ollson, C.A. 2014. "Measuring electromagnetic fields (EMF) around wind turbines in Canada: is there a human health concern?" *Environmental Health* 13:9. <http://www.ncbi.nlm.nih.gov/pubmed/24529028>. Accessed March 17, 2014.

McKinnon, B. 1994. *Electromagnetic Interference in Hearing Aid T-Coil Applications*. MC^2 Systems Design Group, Inc. North Vancouver, B.C. <http://www.mcsquared.com/caa94.htm>. Accessed July 24, 2015.

Medtronic. 2013a. "Magnetic Use with Medtronic Pacemakers." *CRDM Technical Services Standard Letter*. April 30. <http://www.medtronic.com/for-healthcare-professionals/products-therapies/crdm-technical-services/index.htm>. Accessed February 17, 2014.

———. 2013b. Electromagnetic Interference (EMI). April 30. <http://www.medtronic.com/wcm/groups/mdtcom_sg/@mdt/@corp/documents/documents/crdm_sl_emi.pdf>. Accessed July 24, 2015.

———. 2013c. Important Safety Information." February 18, <http://www.medtronic.com/patients/chronic-pain/important-safety-information/neurostimulators/>. Accessed July 22, 2015.

———. 2012. *Strata Valves and Magnetic Fields*. <http://www.medtronic.com/wcm/groups/mdtcom_sg/@mdt/@nt/documents/documents/ns-stratamagnetic_rev-e.pdf>. Accessed February 17, 2014.

———. 2008. *Neurostimulation Therapy for Chronic Pain*. <http://www.medtronic.com.hk/wcm/groups/mdtcom_sg/@mdt/@neuro/documents/documents/scs-stg3-pt-bro-impl.pdf>. Accessed July 22, 2015.

Merrill, R.T. and McElhinney, M.W. 1983. "The Earth's Magnetic Field." *International Geophysics* 32:20. <http://www.sciencedirect.com/science/article/pii/S0074614208603940>. Accessed July 2, 2014.

Mild, K.H. and Sandstrom, M. 2015. "Electrohypersensitivity–a moving target from VDT to WiFi." Presented at BioEm 2015, Annual Meeting of the Bioelectromagnetics Society (BEMS) and the European BioElectromagnetics Association (EBEA). Asilomar Conference Center, California, June 14-19, 2015. (Available on EIS Reference CD.)

Miller, L.N. 1978. "Sound Levels of Rain and Wind in the Trees," *Noise Control Engineering* 11(3):101-109, November/December. <http://ince.publisher.ingentaconnect.com/content/ince/nce/1978/00000011/00000003/art00001>. Accessed July 2, 2014.

Miwa, K.; Kondo, H.; and Sakai, N. 2001. "Pressure Changes Observed in Codman-Medos Programmable Valves Following Magnetic Exposures and Filliping." *Child's Nervous Syst*. 17:150-153. <http://www.ncbi.nlm.nih.gov/pubmed/11305768>. Accessed August 18, 2014.

Morrison, J. 2014. "Electronics' Noise Disorients Migratory Birds," Nature News. May 7. <http://www.nature.com/news/electronics-noise-disorients-migratory-birds-1.15176> Accessed July 22, 2015.

Naikun (Naikun Wind Energy Group, Inc.). 2014. *Wind Energy and Electromagnetic Fields*. <http://www.naikun.ca/information/NaikunEMF.pdf>. Accessed March 17, 2014.

National Grid. 2014a. "Effects of EMFs on farm animals." <http://www.emfs.info/effects/agriculture/gibbs-report/>. Accessed February 21, 2014.

———. 2014b. "Effects of EMFs on plants." <http://www.emfs.info/effects/agriculture/gibbs-report/>. Accessed February 21, 2014.

NCI (National Cancer Institute). 2015. "Magnetic Field Exposure and Cancer." <http://www.cancer.gov/about-cancer/causes-prevention/risk/radiation/magnetic-fields-fact-sheet>. Accessed July 22, 2015.

Neutra, R.R.; Del Pizzo, V.; and Lee, G.M. 2002. *An evaluation of the possible risks from electric and magnetic fields (EMFs) from power lines, internal wiring, electrical occupations and appliances*. Final Report. Prepared for the California Department of Health Services (CDHS). California EMF Program, Oakland, CA. <http://www.ehib.org/emf/RiskEvaluation/riskeval.html>. Accessed July 22, 2015.

Neutra, R.R. and Del Pizzo, V. 2001. "A richer conceptualization of 'exposure' for epidemiological studies of the 'EMF mixture'." *Bioelectromagnetics Supplements* 5:S48-S57. January 26. <http://onlinelibrary.wiley.com/doi/10.1002/1521-186X(2001)22:5%2B%3C::AID-BEM1023%3E3.0.CO;2-C/abstract>. Accessed July 22, 2015.

NIEHS and DOE (National Institute of Environmental Health Sciences and U.S. Department of Energy) 1995. *Questions and Answers about EMF—Electric and Magnetic Fields Associated with the Use of Electric Power*. Prepared by Oak Ridge National Laboratory, under the direction of the National Institute of Environmental Health Sciences and the U.S. Dept. of Energy, for the EMF Research and Public Information Dissemination (RAPID) Program. January. <http://www.niehs.nih.gov/health/materials/electric_and_magnetic_fields_associated_with_the_use_of_electric_power_questions_and_answers_english_508.pdf>. Accessed July 2, 2014.

NIEHS and NIH (National Institute of Environmental Health Sciences and National Institutes of Health). 2002. *Electric and Magnetic Fields Associated with the Use of Electric Power: Questions and Answers*. Prepared for the NIEHS/DOE EMF RAPID Program, June. <http://www.niehs.nih.gov/health/materials/electric_and_magnetic_fields_associated_with_the_use_of_electric_power_questions_and_answers_english_508.pdf>. Accessed July 2, 2014.

NRPB (National Radiological Protection Board). 2004a. *Advice on Limiting Exposure to Electromagnetic Fields (0-300 GHz)*. Documents of the NRPB, Volume 15, No 2. <http://grouper.ieee.org/groups/scc28/sc4/NRPB.limits_15_2.03.04.pdf>. Accessed July 22, 2015.

———. 2004b. *Review of the Scientific Evidence for Limiting Exposure to Electromagnetic Fields (0-300 GHz)*. Documents of the NRPB, Volume 15, No 3. <http://webarchive.nationalarchives.gov.uk/20140722091854/http://www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1194947383619>. Accessed July 22, 2015.

———. 2004c. *Particle Deposition in the Vicinity of Power Lines and Possible Effects on Health*. Documents of the NRPB, Volume 15, No. 1. <http://www.boerderijanders.nl/hoogspanningmaarssen/Eneco/doc_15_1.pdf>. Accessed July 22, 2015.

ODEQ (Oklahoma Department of Environmental Quality). 2013. *Air Quality Rules*. July. <http://www.deq.state.ok.us/rules/100.pdf>. Accessed February 17, 2014.

Olsen, R.A. 2014. *High Voltage Overhead Transmission Line Electromagnetics*. p. 9-34. In press. (Available on EIS Reference CD.).

Olsen, R.A. and Sheppard, A.R. 2012. "HVDC: Essentials for Utility System and Environmental Planners about the High Voltage Direct Current Transmission Environment and Potential Effects on People and the Natural Environment." Resource Paper Prepared for the EPRI Environment Division, Electric Power Research Institute (EPRI), Palo Alto, California. March 8. (Available on EIS Reference CD.)

Picton, H.D.; Canfield, J.E.; and Nelson, G.P. 1985. *The impact of a 500-kV transmission line upon the North Boulder Winter Elk Range*. Prepared under U.S. Forest Service Contract 53-0398-30E-3. <http://books.google.com/books/about/Final_Report_North_Boulder_River_Elk_Stu.html?id=X-DnGwAACAAJ>. Accessed October 6, 2014.

Pollock and Wright (Pollock and Wright Land Surveying Goematics). 2011. *Bipole III Transmission Project: Effects on Global Positioning Systems*. November. <https://www.hydro.mb.ca/projects/bipoleIII/eis/BPIII_GPS_Reports_November%202011.pdf>. Accessed July 22, 2015.

PSCW (Public Service Commission of Wisconsin). 1996. Investigation on the Commission's Own Motion Into the Practices, Policies and Procedures Concerning Stray Voltage for Electric Distribution Utilities in Wisconsin. 05-EI-115. July 16. <http://psc.wi.gov/utilityInfo/electric/documents/strayVoltage/strayvol.pdf>. Accessed July 22, 2015.

Radio Locator 2014. "Frequently Asked Questions about Radio-Locator Coverage Maps." Theodric Technologies LLC, Somerville, Massachusetts. <http://www.radio-locator.com/cgi-bin/page?p=maps>. Accessed March 14, 2014.

Raleigh, R. 1988. *Joint HVDC Agricultural Study: Final Report*. Oregon State University, Report from Bonneville Power Administration, Portland, Oregon. <http://www.researchgate.net/publication/236532888_Joint_HVDC_Agricultural_Study__Final_Project_Report>. Accessed September 25, 2014.

Rideout, K.; Copes, R.; and Bos, C. 2010. *Wind Turbines and Health*. National Collaborating Centre for Environmental Health (NCCEH). January. <http://www.ncceh.ca/sites/default/files/Wind_Turbines_January_2010.pdf>. Accessed March 17, 2014.

Rogers, L.E.; Beedlow, P.A.; Carlile, D.W.; Ganok, K.A.,;and Lee, J.M. 1984. *Environmental studies of a 1100-kV prototype transmission line: an annual report for the 1983 study period*. Prepared by Battelle Pacific Northwest Laboratory for Bonneville Power Administration, Portland, Oregon. <http://www.researchgate.net/publication/236475575_Environmental_studies_of_a_1100-kV_prototype_transmission_line_an_annual_report_for_the_1983_study_period>. Accessed September 25, 2014.

Rogers, L.E. ; Warren, J.L.; Hinds, N.R.; Gano, K.A.; Fitzner, R.E.; and Piepel, G.F. 1982. *Environmental Studies of a 1100-kV Prototype Transmission Line: an Annual Report for the 1981 Study Period*. DOE/BP-142. Prepared for the U.S. Department of Energy by Bonneville Power Administration under Contract 2311102793, Battelle Pacific Northwest Laboratories, September. (Available on EIS Reference CD.)

Rubin G,J,; Das Munshi, J.; and Wessely, S. 2005. "Electromagnetic Hypersensitivity: A Systematic Review of Provocation Studies." *Psychosomatic Medicine* Mar-Apr; 67(2):224-32. <http://www.ncbi.nlm.nih.gov/pubmed/15784787>. Accessed July 31, 2015.

SCC (Sierra Club Canada). 2011. *The Real Truth About Wind Energy—A Literature Review on Wind Turbines in Ontario*. Ottawa, Ontario, June 10. <http://www.worldcat.org/title/real-truth-about-wind-energy-a-literature-based-introduction-to-wind-turbines-in-ontario/oclc/785802825>. Accessed March 17, 2014.

SCENIHR (Scientific Committee on Emerging and Newly Identified Health Risks). 2015. *Opinion on Potential Health Effects of Exposure to Electromagnetic Fields (EMF)*. January 27. <http://ec.europa.eu/health/scientific_committees/emerging/docs/scenihr_o_041.pdf> . Accessed July 22, 2015.

———. 2009. *Health Effects of Exposure to EMF*. January 19. <http://ec.europa.eu/health/ph_risk/committees/04_scenihr/docs/scenihr_o_022.pdf>. Accessed July 30, 2015.

Shellock F.G.; Wilson S.F.; and Mauge, C.P. 2007. “Magnetically programmable shunt valve: MRI at 3-Tesla.” *Magnetic Resonance Imaging* 25:1116-1121. <http://www.ncbi.nlm.nih.gov/pubmed/17707175>. Accessed September 25, 2014,

Silva, J.M.; Hummon, N.P.; Rutter, D.A.; and Hooper, H.C 1989. “Power Frequency Magnetic Fields in the Home.” *IEEE Transactions on Power Delivery* Vol. PWRD-4, No. 1, pp. 465-478, January. <http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=19237&isnumber=730&url=http%3A%2F%2Fieeexplore.ieee.org%2Fxpls%2Fabs_all.jsp%3Farnumber%3D19237%26isnumber%3D730>. Accessed July 2, 2014.

Silva, J.M. and Olsen, R.G. 2002. "Use of Global Positioning System (GPS) Receivers under Power Line Conductors.” *IEEE Transactions on Power Delivery*, Vol. 17, No. 4, pp 938-944, October.

<http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=1046866&isnumber=22435&url=http%3A%2F%2Fieeexplore.ieee.org%2Fxpls%2Fabs_all.jsp%3Farnumber%3D1046866%26isnumber%3D22435>. Accessed July 2, 2014.

Smith, D.R. 2004. *Digital Transmission Systems*. Hardcover, Third Edition, Kluwer Academic Publishers, p.15. <http://www.springer.com/engineering/electronics/book/978-1-4020-7587-2>. Accessed July 2, 2014.

Sophyusa. 2014. “Polaris Adjustable Valve.” Crown Point, Indiana.<http://www.sophysa.com/en/page/polaris-r>. Accessed February 14, 2014.

———. 2009. “Polaris—The First MRI-Stable Adjustable Valve.” Crown Point, Indiana. May. <http://www.sophysa.com/sophysa-neurosurgical-shunts-adjustable-valves_121.html>. Accessed August 18, 2014.

Southern, W.E. 1988. “The Earth’s Magnetic Field as a Navigational Cue.” Chapter 3 in *Modern Bioelectricity*, Marino. A. ISBN 0-8247-7788-3. (Available on EIS Reference CD.)

SSHLA (Southern Surgical Hospital Louisiana). 2015. “Spinal Cord Stimulator Trial & Implant.” <http://www.sshla.com/services/Pain-Management/Spinal-Cord-Stimulator-Trial--Implant>. Accessed July 22, 2015.

St. Jude Medical. 2015. “Important Safety Information: Precaution, Electromagnetic Interference.” <http://www.poweroveryourpain.com/safety/SCSSafety>. Accessed July 24, 2015.

———. 2014. *EMI in the Workplace Environment*. May. <http://professional.sjm.com/~/media/pro/products/crm/documents/emi-field-testing-may-2014.ashx>. Accessed July 24, 2015.

Stormshak, F.; Bracken, T.D.; Carey, M.; Chartier, V.; Dickson, L.; Forbes, R.; Hall, A.; Havens, P.; Hess, D.; Krippaehne, S.; Lee, J.; Ogden, B.; Olenchek, B.; Painter, L.; Rowe, K.; Stearns, R.; Thinesen, P.; and Thompson, J. 1992. *Joint HVAC transmission EMF environmental study: final report on experiment 1*. Bonneville Power Administration, Contract # DE-B179-90BPO4293, Portland, Oregon, May. <http://www.osti.gov/scitech/servlets/purl/10164303>. Accessed September 25, 2014.

Thompson, J.M.; Stormshak, F.; Lee, J.M.; Hess, D.; and Painter, L. 1995. “Cortisol secretion and growth in ewe lambs chronically exposed to electric and magnetic fields of a 60-Hertz 500-kilovolt AC transmission line.” *Journal of Animal Science* 73(11):3274-80. <http://www.animal-science.org/content/73/11/3274.abstract>. Accessed September 25, 2014.

TDEC (Tennessee Department of Environment and Conservation). 2014. “Ozone Early Action Compact.” <http://www.tn.gov/environment/air/air_early-action.shtml>. Accessed February 17, 2014.

USDA (U.S. Department of Agriculture) 1991. “Effects of Electrical Voltage/Current on Farm Animals.” Agriculture Handbook Number 696: December. <http://naldc.nal.usda.gov/download/CAT92970513/PDF>. Accessed July 22, 2015.

Utsuki, S.; Shimizu, S.; Oka, H.; Suzuki, S.; and Fujii, K. 2006. “Alteration of the Pressure Setting of a Codman-Hakim Programmable Valve by a Television.” *Neurol. Med. Chir* Tokyo, Japan. 46:405-407. <http://www.ncbi.nlm.nih.gov/pubmed/16936463>. Accessed September 25, 2014.

Veimeister, P.E. 1972. *The Lightning Book*. MIT Press, Cambridge, MA, April. <http://www.amazon.com/Lightning-Book-Peter-E-Viemeister/dp/1258821680/ref=la_B0034PE9XW_1_1?s=books&ie=UTF8&qid=1404333549&sr=1-1>. Accessed July 2, 2014.

Vollrath, L.; Spessert, R.; Kratzsch, T.; Keiner, M.; and Hollmann, H. 1997. “No short-term effects of high-frequency electromagnetic fields on the mammalian pineal gland.” *Bioelectromagnetics* 18(5):376-87. <http://www.pemf.com/en/science-database/article/1454-no-short-term-effects-of-high-frequency-electromagnetic-fields-on-the-mammalian-pineal-gland.html>. Accessed September 25, 2014.

WHO (World Health Organization). 2015. “Electromagnetic fields and public health: radars and human health.” <http://www.who.int/peh-emf/publications/facts/fs226/en/>. Accessed July 22, 2015.

———. 2007. *Extremely Low Frequency Fields*. Environmental Health Criteria 238 (EHC 238). WHO Press, Geneva, Switzerland. <http://www.who.int/entity/peh-emf/publications/Complet_DEC_2007.pdf?ua=1>. Accessed September 25, 2014.

———. 2006. *Static Fields*. Environmental Health Criteria 232 (EHC 232), WHO Press, Geneva, Switzerland. <http://www.who.int/entity/peh-emf/publications/EHC_232_Static_Fields_full_document.pdf?ua=1> Accessed September 25, 2014.

———. 2005. E*lectromagnetic Fields and Public Health - Electromagnetic Hypersensitivity*. December. <http://www.who.int/peh-emf/publications/facts/fs296/en/>. Accessed July 30, 2015.

Wilson, B.W.; Anderson, L.E.; Hilton, D.I.; and Phillips, R.D. 1981. “Chronic exposure to 60-Hz electric fields: effects on pineal function in the rat.” *Bioelectromagnetics* 2(4):371-80. <http://onlinelibrary.wiley.com/doi/10.1002/bem.2250020408/abstract>. Accessed September 25, 2014.

Zuzak, T.; Balmer, B.; Schmidig, D.; Boltshauser, E.; and Grotzer, M.A. 2009. “Magnetic Toys: Forbidden for Pediatric Patients with Certain Programmable Shunt Valves?” *Child's Nervous Syst*. 25:161-164. <http://www.ncbi.nlm.nih.gov/pubmed/19057906>. Accessed September 25, 2014.

6.2.3.5 Environmental Justice

59 FR 7629. “To address environmental justice in minority populations and low-income population.” Office of the President. February 16, 1994. <http://www.archives.gov/federal-register/executive-orders/pdf/12898.pdf>.

CEQ (Council on Environmental Quality). 1997. *Environmental Justice Guidance under the National Environmental Policy Act*. <http://www.epa.gov/environmentaljustice/resources/policy/ej_guidance_nepa_ceq1297.pdf>.

DOL (U.S. Department of Labor). 2005. “Findings from the National Agricultural Workers Survey (NAWS) 2001–2002. A Demographic and Employment Profile of United States Farm Workers.” Office of the Assistant

Secretary for Policy, Office of Programmatic Policy, Research Report No. 9. March. <http://www.doleta.gov/agworker/report9/toc.cfm>. Accessed March 15, 2014.

EPA (U.S. Environmental Protection Agency). 1998. *Final Guidance for Incorporating Environmental Justice Concerns in EPA's NEPA Compliance Analyses.* <http://www.epa.gov/compliance/ej/resources/policy/ej_guidance_nepa_ceq1297.pdf>. Accessed July 22, 2015.

Executive Order 12948. "Amendment to Executive Order No. 12898." January 30, 1995 (60 FR 6381). <http://www.gpo.gov/fdsys/pkg/FR-1995-02-01/pdf/95-2687.pdf>.

Executive Order 12898. "Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations." February 11, 1994 (59 FR 7629). <http://www.archives.gov/federal-register/executive-orders/pdf/12898.pdf>.

USCB (U.S. Census Bureau). 2011. "Hispanic or Latino Origin by Race." <http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml>.

6.2.3.6 Geology, Paleontology, Minerals, and Soils

6.2.3.6.1 Geology, Paleontology, and Minerals References

42 USC § 7701 *et seq*. "National Earthquake Hazards Reduction Program Reauthorization Act of 2004" (Pub. L. 108-360). <http://www.law.cornell.edu/uscode/pdf/uscode42/lii_usc_TI_42_CH_86_SE_7701.pdf>.

BLM (Bureau of Land Management) and Office of the Solicitor (eds). 2001. *The Federal Land Policy and Management Act*, as amended. U.S. Department of the Interior, Bureau of Land Management Office of Public Affairs, Washington, D.C. 69 pp. <http://www.blm.gov/flpma/FLPMA.pdf>. Accessed July 16, 2014.

Clean Line 2014. *Responses to Department of Energy Data Request (dated February 5, 2014) Comments on Geology, Soil, and Mineral Resources Technical Report*. March 11. Prepared for the Department of Energy pursuant to 10 CFR 1021.215(b)(2). (Available on EIS Reference CD.)

EIA (Energy Information Administration). 2011. *Annual Energy Review 2011*. <http://www.eia.gov/totalenergy/data/annual/pdf/aer.pdf>. Accessed June 19, 2014.

Epstein, J.B.; Weary, D.J.; Orndorff, R.C.; Bailey, Z.C.; and Kerbo, R.C. 2005. "National Karst Map Project, an Update." U.S. Geological Survey and National Park Service. <http://water.usgs.gov/ogw/karst/kig2002/jbe_map.html>. Accessed July 15, 2014.

FEMA (Federal Emergency Management Agency). 2009. *NERHP [National Earthquake Hazards Reduction Program] Recommended Provisions for New Buildings and Other Structures*. FEMA P-750. <http://www.fema.gov/media-library-data/20130726-1730-25045-1580/femap_750.pdf>. Accessed June 23, 2014.

Fenneman, N.H. 1928. “Physiographic Divisions of the United States.” *Annals of the Association of American Geographers* 18(4):261-353. December. <http://www.aag.org/cs/publications/annals>. Accessed September 25, 2014.

Foti, T. and Bukenhofer, G.A. 1998. “A description of Sections and Subsections of the Interior Highlands of Arkansas and Oklahoma.” *Journal of the Arkansas Academy of Science* Vol. 52. <http://libinfo.uark.edu/aas/issues/1998v52/v52a8.pdf>. Accessed September 25, 2014.

Johnson, K.S. 2008. *Geologic History of Oklahoma*. Oklahoma Geological Survey Educational Publication 9, University of Oklahoma Press. <http://www.ogs.ou.edu/pubsscanned/EP9_2-8geol.pdf>. Accessed July 17, 2014.

McFarland, J.D. 1998. *Stratigraphic Summary of Arkansas*. Information Circular 36. Arkansas Geological Commission. Little Rock, Arkansas. <http://www.geology.ar.gov/pdf/IC-36_v.pdf>. Accessed July 16, 2014.

NRCS (Natural Resource Conservation Service). 2014. *National Soil Survey Handbook*, title 430-VI [Online]. U.S. Department of Agriculture. <http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/geo/?cid=nrcs142p2_054241>. Accessed February 2014.

OGS (Oklahoma Geological Survey). 2002. *Oklahoma Oil and Gas Fields*. OGS GM36 2002. <http://www.ogs.ou.edu/level3-oilgas.php>. Accessed June 19, 2014.

Sagona, F. 2014. “FPPA regulation and Assessment Criteria.” Email from F. Sagona, Biologist/Environmental Liaison for the USDA Natural Resources Conservation Service. Chattanooga, TN, to M. Ardis, U.S. Department of Energy, and J. Chester, Tetra Tech. July 16. (Available on EIS Reference CD.)

USGS (U.S. Geological Survey). 2013. “Earthquake Archive Search & URL Builder.” U.S. Geological Survey Earthquake Hazards Program. Data search range from 1973 to present. Output as GIS shapefiles. <http://earthquake.usgs.gov/earthquakes/search/>. Accessed November 2013.

———. 2010a. “Quaternary Fault and Fold Database for the United States.” Downloaded GIS shapefiles dated November 3. <http://earthquake.usgs.gov/hazards/qfaults/download.php>. Accessed February 2014.

———. 2010b. “Significant United States Earthquakes, 1568-2009.” Data search range from February 1973 to present. Output as CSV file. <http://earthquake.usgs.gov/earthquakes/search/>. Accessed February 2014.

USGS and TBEG (U.S. Geological Survey and Texas Bureau of Economic Geology). 2010. “Quaternary Fault and Fold Database for the United States.” <http//earthquakes.usgs.gov/regional/qfaults/>. Accessed August 2013.

6.2.3.6.2 Soils References

7 CFR Part 657. “Prime and Unique Farmlands.” Agriculture. Natural Resources Conservation Service. <http://www.ecfr.gov/cgi-bin/text-idx?SID=c353fffae1f4b6179d91234969ab7ebc&node=pt7.6.657&rgn=div5>.

59 FR 16835. U.S. Department of Agriculture. 1994. "Changes in hydric soils of the United States." July 13. <http://www.gpo.gov/fdsys/pkg/FR-1994-07-13/html/94-16835.htm>.

16 USC §§ 668dd-68ee. "National Wildlife Refuge System" (Pub. L. 89-669) <http://www.law.cornell.edu/uscode/pdf/uscode16/lii_usc_TI_16_CH_5A_SC_III_SE_668dd.pdf>. Accessed August 19, 2014.

Environmental Laboratory. 1987. U.S. *Army Corps of Engineers Wetland Delineation Manual*. Wetlands Research Program Technical Report Y-87-1 (on-line edition). <http://el.erdc.usace.army.mil/elpubs/pdf/wlman87.pdf> Accessed August 14, 2014.

EPA (U.S. Environmental Protection Agency). 2014. *City of Perryton Well #2 (Ochiltree County) Perryton*. Texas Fact Sheet. EPA ID# TX0001399435, Site ID: 0605015. EPA Region 6. June. <http://www.epa.gov/region6/6sf/pdffiles/perryton-tx.pdf>. Accessed July 16, 2014.

NRCS (Natural Resource Conservation Service). 2014a. "Farmland Protection Policy Act." U.S. Department of Agriculture. <http://www.nrcs.usda.gov/wps/portal/nrcs/detail/?ss=16&navtype=SUBNAVIGATION&cid=nrcs143_008275&navid=100170180000000&position=Welcome.Html&ttype=detail>. Accessed February 4, 2014.

———. 2014b. *National Soil Survey Handbook*, title 430-VI [Online]. U.S. Department of Agriculture. <http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/geo/?cid=nrcs142p2_054241>. Accessed February 2014.

Plant and Soil Sciences eLibrary 2014. "Soil Genesis and Development, Lesson 6 - Global Soil Resources and Distribution." <http://passel.unl.edu/pages/informationmodule.php?idinformationmodule=1130447033&topicorder=12&maxto=12&minto=1>. Accessed February 4, 2014.

USFS (U.S. Forest Service). 2005. *Revised Land and Resource Management Plan, Ozark-St. Francis National Forests*. Management Bulletin R8-MB 125 A. September. <http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsm8_042809.pdf>. Accessed June 19, 2014.

6.2.3.7 Groundwater

40 CFR Part 143. "National Secondary Drinking Water Regulations." Protection of Environment. Environmental Protection Agency. <http://www.ecfr.gov/cgi-bin/text-idx?SID=2e9de6f21549ea9e1dc0b8ef0ca31a42&node=pt40.23.143&rgn=div5>.

42 USC § 300f "Safe Drinking Water Act" (Pub. L. 104-182) <http://www.law.cornell.edu/uscode/text/42/chapter-6A/subchapter-XII>.

Arkansas Act 154 of 1991. "Critical Groundwater Designations." <http://www.arkleg.state.ar.us/assembly/1991/R/Acts/154.pdf>.

Arkansas Act 472 of 1949. "Arkansas Water Pollution Control Act." <https://www.adeq.state.ar.us/commission/>.

Arkansas Act 1051 of 1985. “Arkansas State Water Planning.” <http://www.arkleg.state.ar.us>.

Oklahoma Administrative Code Title 785. “Water Resources Board.” <http://www.oar.state.ok.us/oar/codedoc02.nsf/frmMain?OpenFrameSet&Frame=Main&Src=_75tnm2shfcdnm8pb4dthj0chedppmcbq8dtmmak31ctijujrgcln50ob7ckj42tbkdt374obdcli00_>.

Oklahoma Administrative Code 785:30 (Title 785, Chapter 30). “Taking and Use of Groundwater.” <http://www.oar.state.ok.us/oar/codedoc02.nsf/All/3F02C54FD8EB674486257B8E00553694?OpenDocument>.

Oklahoma Administrative Code 785:45 (Title 785, Chapter 45). “Oklahoma’s Water Quality Standards.” <http://www.oar.state.ok.us/oar/codedoc02.nsf/All/5BB37140A14FE73886257B9C00612F50?OpenDocument>.

Oklahoma Administrative Code 785:46 (Title 785, Chapter 46). “Implementation of Oklahoma’s Water Quality Standards.” <http://www.oar.state.ok.us/oar/codedoc02.nsf/All/3FBF48BC092154B086257B9C00612FC4?OpenDocument>.

Texas Administrative Code 30-293.19 (Title 30, Part 1, Chapter 293, Subchapter C, Section 19). “Commission-Initiated Creation of a Groundwater Conservation District in a Priority Groundwater Management Area.” <http://info.sos.state.tx.us/pls/pub/readtac$ext.TacPage?sl=R&app=9&p_dir=&p_rloc=&p_tloc=&p_ploc=&pg=1&p_tac=&ti=30&pt=1&ch=293&rl=19>.

Texas Administrative Code 30-294.41 to 294.44 (Title 30, Part 1, Chapter 294, Subchapter E). “Designation of Priority Groundwater Management Areas.” <http://info.sos.state.tx.us/pls/pub/readtac$ext.ViewTAC?tac_view=5&ti=30&pt=1&ch=294&sch=E&rl=Y>.

AGS (Arkansas Geological Survey) 2014. “Aquifers.” <http://www.geology.ar.gov/water/aquifer.htm>. Accessed February 11, 2014.

ANRC (Arkansas Natural Resources Commission). 2014. “The Facts About Critical Groundwater Designation.” <http://www.arkansas.gov/awwcc/gw_designation_graphic.pdf>. Accessed March 14, 2014.

———. 2013. *Arkansas Groundwater Protection and Management Report for 2012, A Supplement to the Arkansas Water Plan*. January. <https://static.ark.org/eeuploads/anrc/2012-2013-Annual-Report.pdf>. Accessed March 14, 2014.

———. 2012. *Arkansas Ground-Water Protection and Management Report for 2011.* January. <https://static.ark.org/eeuploads/anrc/2011_gw_report.pdf>. Accessed March 14, 2014.

———. 2009. *Order Designating the Cache Critical Ground Water Area.* CGWA 2009-1. Adopted December 8. <https://static.ark.org/eeuploads/anrc/NEA_Critical_Ground_Water_Designation_2009.pdf>. Accessed March 14, 2014.

———. 2005. “Rules for Protection and Management of Ground Water, Title 4.” <http://anrc.ark.org/rules/current-rules/>. Accessed March 14, 2014.

BLM (U.S. Department of the Interior Bureau of Land Management) 2010, *West Butte Wind Power Right of Way Final Environmental Impact Statement*. DOI-BLM-OR-P060-2009-0064-EIS. October. Prineville District Office, Oregon. <http://www.blm.gov/or/districts/prineville/plans/wbw_power_row/files/wbw_power_row_final_EIS.pdf>. Accessed April 22, 2014.

———. 2005. *Final Programmatic Environmental Impact Statement on Wind Energy Development on BLM-Administered Lands in the Western United States*. FES 05-11. June. <http://windeis.anl.gov/documents/fpeis/index.cfm>. Accessed April 18, 2014.

Bohac, C.E. and A.K. Bowen. 2012. *Water Use in the Tennessee Valley for 2010 and Projected Use in 2035. Tennessee Valley Authority, Chattanooga, TN*. July. <http://www.tva.com/river/watersupply/water_use.pdf>. Accessed August 21, 2015.

Clean Line. 2014. *Wind Generation Technical Report for the Plains and Eastern Transmission Line Project*. March. Prepared by Clean Line Energy Partners for the Department of Energy pursuant to 10 CFR 1021.215(b)(2). (Available on EIS Reference CD.)

———. 2013. *Groundwater Technical Report for the Plains and Eastern Transmission Line Project*. December. Prepared by Clean Line Energy Partners for the Department of Energy pursuant to 10 CFR 1021.215(b)(2). (Available on EIS Reference CD.)

Denholm, P.; Hand, M.; Jackson, M.; and Ong, S. 2009. *Land-Use Requirements of Modern Wind Power Plants in the United States*. Technical Report NREL/TP-6A2-45834. National Renewable Energy Laboratory. August. <http://www.nrel.gov/docs/fy09osti/45834.pdf>. Accessed September 30, 2014.

D'Lugosz, J.J.; McClafin, R.G.; and Marcher, M.V. 1986. "Geohydrology of the Vamoosa-Ada Aquifer East-Central Oklahoma." Oklahoma Geological Survey Circular 87. <http://www.ogs.ou.edu/pubsDLCirculars.php>. Accessed March 13, 2014.

DOE (U.S. Department of Energy) 2013. *Upper Great Plains Wind Energy Programmatic Environmental Impact Statement - Draft*. DOE/EIS-0408. March. <http://energy.gov/nepa/downloads/eis-0408-draft-programmatic-environmental-impact-statement>. Accessed April 21, 2014.

EPA (U.S. Environmental Protection Agency). 2014. "InertFinder—Pesticides, Search Criteria CAS Number: 64742-47-8." February 21. <http://iaspub.epa.gov/apex/pesticides/f?p=INERTFINDER:1:10206141102532::NO:1>. Accessed February 21, 2014.

———. 2013. "National Pollutant Discharge Elimination System (NPDES)—Authorization Status for EPA's Stormwater Construction and Industrial Programs." September 10. <http://cfpub.epa.gov/npdes/stormwater/authoizationstatus.cfm>. Accessed February 21, 2014.

———. 2009. "State of the Ground Water Report." Ground Water Center, U.S. Environmental Protection Agency, Region 6. January. <http://www.epa.gov/region6/water/swp/groundwater/2008-report.pdf>. Accessed March 14, 2014.

George, P.B.; Mace, R.E.; and Petrossian, R. 2011. "Aquifers of Texas." Report 380. July. Texas Water Development Board. <http://www.twdb.state.tx.us/publications/reports/numbered_reports/index.asp>. Accessed March 13, 2014.

North Plains Groundwater Conservation District. 2013. "Rules of North Plains Groundwater Conservation District." January 15. <http://www.northplainsgcd.org/phocadownload/information/adoped%20%20rules%2001-15-2013.pdf>. Accessed April 11, 2014.

OWRB (Oklahoma Water Resources Board). 2014. "Oklahoma Water Resources Board Fact Sheet, Determination of Maximum Annual Yield." <http://www.owrb.ok.gov/studies/reports/reports_pdf/DetermineMAY.pdf>. Accessed February 10, 2014.

———. 2013a. "Central Watershed Planning Region Report, Version 1.1." <http://owrb.ok.gov/supply/ocwp/ocwp.php>. Accessed February 11, 2014.

———. 2013b. "Lower Arkansas Watershed Planning Region Report, Version 1.1." <http://owrb.ok.gov/supply/ocwp/ocwp.php>. Accessed February 12, 2014.

———. 2012. "Oklahoma Comprehensive Water Plan Executive Report." <http://www.owrb.ok.gov/supply/ocwp/ocwp.php>. Accessed March 12, 2014.

Renken, R.A. 1998. "Ground Water Atlas of the United States. Arkansas, Louisiana, Mississippi, HA 730-F." U.S. Geological Survey. <http://pubs.usgs.gov/ha/ha730/ch_e/index.html>. Accessed March 14, 2014.

TCEQ (Texas Commission on Environmental Quality). 2013. "Priority Groundwater Management Areas." <http://www.tceq.state.tx.us/groundwater/pgma.html>. Accessed March 20, 2014.

TDEC (Tennessee Department of Environment and Conservation). 2013. "General Water Quality Criteria." *Rules of the Tennessee Department of Environment and Conservation*. Tennessee Rule Chapter 0400-40-03. <http://www.tennessee.gov/sos/rules/0400/0400-40/0400-40-03.20131216.pdf>.

———. 2012, "Water Registration Requirements." *Rules of the Tennessee Department of Environment and Conservation*. Tennessee Rule Chapter 0400-45-08. <https://www.tn.gov/sos/rules/0400/0400-45/0400-45-08.20120916.pdf>.

———. 2003. "Tennessee Source Water Assessment Report August 2003." TDEC Division of Water Supply. <http://www.tennessee.gov/environment/water/water-supply_source-assessment.shtml>. Accessed March 15, 2014.

Thomas, J. 2014. "Questions for Clean Line." Email communication from J. Thomas, Clean Line, to J. MacDonald, Tetra Tech, June 17. (Available on EIS Reference CD.)

USGS (U.S. Geological Survey). 2014a. "National Water Information System: Web Interface." Database of field measurements queried by state and county for data collected 2012-01-01 to present. If no data were produced, the query was extended back to 2005-01-01. <http://nwis.waterdata.usgs.gov/nwis/gw>. Accessed April 11, 2014.

———. 2014b. “Water Use in the United States—Estimated Use of Water in the United States County-Level Data for 2010, Data Files for Arkansas, Oklahoma, Tennessee, and Texas.” (MS Excel files). (These are data files that support USGS Circular 1405, published in 2014.) <http://water.usgs.gov/watuse/data/2010/>. Accessed November 18, 2014.

Webbers, A. 2003. *Public Water-Supply Systems and Associated Water Use in Tennessee, 2000*. U.S. Geological Survey Water-Resources Investigations Report 03-4264. <http://pubs.usgs.gov/wri/wri034264/PDF/PublicSupply.pdf>. Accessed August 21, 2015.

6.2.3.8 Health, Safety, and Intentional Destructive Acts

29 CFR Part 1910. “Occupational Safety and Health Standards.” *Labor*. U.S. Department of Labor. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt29.6.1910&rgn=div5>.

29 CFR Part 1926. “Safety and Health Regulations for Construction.” *Labor*. U.S. Department of Labor. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt29.8.1926&rgn=div5>.

29 USC § 651-678. “Occupational Safety and Health Act of 1970.” (Pub. L. 91-596) <http://www.law.cornell.edu/uscode/pdf/lii_usc_TI_29_CH_15.pdf>.

42 USC § 6901 *et seq*. “Resource Conservation and Recovery Act of 1976.” (Pub. L. 94-580) <http://www.law.cornell.edu/uscode/pdf/lii_usc_TI_42_CH_82.pdf>.

42 USC § 9601 *et seq*. “Comprehensive Environmental Response, Compensation, and Liability Act of 1980.” (Pub. L. 96-510) <http://www.law.cornell.edu/uscode/pdf/uscode42/lii_usc_TI_42_CH_103_SC_I_SE_9601.pdf>.

Arkansas Code Annotated 8-7-201-227 (Title 8, Chapter 7, Subchapter 2) “Hazardous Waste Management Act.” <http://www.lexisnexis.com/hottopics/arcode/Default.asp>.

Oklahoma Administrative Code 252:20 (Title 252, Chapter 20) “Emergency Planning and Community Right-to-Know.” <http://www.deq.state.ok.us/rules/020.pdf>.

Oklahoma Statutes 27A-2-7-101 (Title 27A, Section 2-7-101) “Oklahoma Hazardous Waste Management Act.” <http://webserver1.lsb.state.ok.us/OK_Statutes/CompleteTitles/os27A.rtf>.

Oklahoma Statutes 27A-4-2-102 (Title 27A, Section 4-2-102) “Oklahoma Hazardous Materials Emergency Response Commission.” <http://webserver1.lsb.state.ok.us/OK_Statutes/CompleteTitles/os27A.rtf>.

Texas Statutes, Health and Safety Code, Chapter 502, Title 6, Subtitle D. “Hazard Communication Act.” <http://www.statutes.legis.state.tx.us/>.

ADEQ (Arkansas Department of Environmental Quality). 2013. "The ADEQ Hazardous Waste Division." <http://www.adeq.state.ar.us/hazwaste/>. Accessed October 16, 2013.

ADEM (Arkansas Department of Emergency Management). 2013. *State of Arkansas All-Hazards Mitigation Plan*. <http://www.adem.arkansas.gov/ADEM/Divisions/Admin/Mitigation/Documents/State%20All%20Hazard%20Mitigation%20Plan%202013.pdf>. Accessed August 18, 2014.

Airspace & Safety Initiative. 2013. *Managing the Impact of Wind Turbines on Aviation*. <http://airspacesafety.com/wp-content/uploads/2013/09/20130701ManagingTheImpactOfWindTurbinesOnAviation_Script_FINAL_V1.pdf>. Accessed September 2, 2014.

Albert, A. and Hallowell, M. 2012. "Safety risk management for electrical transmission and distribution line construction." *Safety Science* 51 (2013) pp. 118-126. <http://www.electri.org/research/safety-risk-management-electrical-transmission-and-distribution-line-construction>. Accessed September 25, 2014.

AWEA (American Wind Energy Association). 2009. *Wind Turbines and Health Fact Sheet*. <http://aweablog.org/uploads/files/Wind-Turbines-and-Health-Factsheet_WP12.pdf>. Accessed April 24, 2014.

Blinder A. 2013. "Power Grid Is Attacked in Arkansas." *The New York Times*. October 8. <http://www.nytimes.com/2013/10/09/us/power-grid-is-attacked-in-arkansas.html?_r=0>. Accessed July 14, 2014.

BLS (Bureau of Labor Statistics). 2012a. "Table 1. Incidence rates of nonfatal occupational injuries and illnesses by case type and ownership, selected industries, 2012". <http://www.bls.gov/news.release/osh.t01.htm>. Accessed October 30, 2014.

———. 2012b. "Fatal occupational injuries, total hours worked, and rates of fatal occupational injuries by selected worker characteristics, occupations, and industries, civilian workers, 2012." <http://www.bls.gov/iif/oshwc/cfoi/cfoi_rates_2012hb.pdf>. Accessed August 26, 2014.

Bos, C.; Copes, R.; Fortin, P.; and Rideout, K. 2013. *Wind Turbines and Health*. National Collaborating Centre for Environmental Health (NCCEH). <http://www.ncceh.ca/sites/default/files/Wind_Turbines_Feb_2013.pdf>. Accessed April 24, 2014.

Clean Line. 2014a. *Wind Generation Technical Report for the Plains and Eastern Transmission Line Project*. March. Prepared by Clean Line Energy Partners for the Department of Energy pursuant to 10 CFR 1021.215(b)(2). (Available on EIS Reference CD.)

———. 2014b. *Responses to Department of Energy Data Request Comments*. September 12. Prepared for the Department of Energy pursuant to 10 CFR 1021.215(b)(2). (Available on EIS Reference CD.)

———. 2014c. *Plains and Eastern Clean Line Transmission Project Provision of Updated Information to the Department of Energy Section 12, "Air Quality and Climate Change" of Clean Line's Wind Generation Technical Report*. March. Submittal Date: May 20, 2014. (Available on EIS Reference CD.)

———. 2013a. *Safety, Security, and Hazards Technical Report for the Plains and Eastern Transmission Line Project*. December. Prepared by Clean Line Energy Partners for the Department of Energy pursuant to 10 CFR 1021.215(b)(2). (Available on EIS Reference CD.)

———. 2013b. *Socioeconomics and Environmental Justice Technical Report for the Plains and Eastern Transmission Line Project*. December. Prepared for the Department of Energy pursuant to 10 CFR 1021.215(b)(2). (Available on EIS Reference CD.)

Collins, N. 2013. "Sabotage suspected at toppled wind turbine as second is brought down." *The Telegraph*. <http://www.telegraph.co.uk/earth/environment/9841848/Sabotage-suspected-at-toppled-wind-turbine-as-second-is-brought-down.html>. Accessed April 18, 2014.

DHS (U.S. Department of Homeland Security). 2010. *Energy Sector-Specific Plan: An Annex to the National Infrastructure Protection Plan*. <http://www.dhs.gov/xlibrary/assets/nipp-ssp-energy-2010.pdf>. Accessed July 14, 2014.

Epilepsy Foundation (American Epilepsy Foundation) 2013. "Photosensitivity and Epilepsy, Photosensitivity and Seizures." <http://www.epilepsy.com/learn/triggers-seizures/photosensitivity-and-seizures>. Accessed June 23, 2014.

ESCSWG (Energy Sector Control Systems Working Group). 2011. *Roadmap to Achieve Energy Delivery Systems Cybersecurity*. <http://energy.gov/sites/prod/files/Energy%20Delivery%20Systems%20Cybersecurity%20Roadmap_finalweb.pdf>. Accessed Jul 14, 2014.

Executive Order 13045. "Protection of Children from Environmental Health Risks and Safety Risks." April 21, 1997 (62 FR 19885). <http://www.gpo.gov/fdsys/pkg/FR-1997-04-23/pdf/97-10695.pdf>.

FERC (Federal Energy Regulatory Commission). 2013. "Version 5 Critical Infrastructure Protection Reliability Standards Mandatory Protection, 18 CFR Part 40, Docket No. RM13-5-000RM06-22, Order Number 791." November 22. <http://www.ferc.gov/whats-new/comm-meet/2013/112113/E-2.pdf>. Accessed October 23, 2014.

Harding, G.; Harding, P.; and Wilkins, A. 2008. "Wind turbines, flicker, and photosensitive epilepsy: Characterizing the flashing that may precipitate seizures and optimizing guidelines to prevent them." *Epilepsia* 49(6):1095-1098. <http://onlinelibrary.wiley.com/doi/10.1111/j.1528-1167.2008.01563.x/abstract>. Accessed July 14, 2014.

Hau, E. 2000. *Windturbines: Fundamentals, Technologies, Applications and Economics*. Springer, Berlin, Germany. <http://www.springer.com/engineering/energy+technology/book/978-3-642-27150-2>. Accessed July 14, 2014.

IEEE (Institute of Electrical and Electronics Engineers). 2011. *2012 National Electrical Safety Code*. August. <http://standards.ieee.org/about/nesc/index.html>. Accessed February 12, 2014.

LoJack (LoJack Corporation). 2012. *Heavy Construction Equipment Theft*. The 2011 LoJack Corporation Study On Heavy Construction Equipment Theft. (Available on EIS Reference CD.)

NERC (North American Electric Reliability Corporation). 2014. “About NERC.” <http://www.nerc.com/AboutNERC/Pages/default.aspx>. Accessed February 13, 2014.

NICB (National Insurance Crime Bureau). 2012. *2011 Equipment Theft Report*. <http://www.ner.net/annual-theft-report.html>. Accessed September 25, 2014.

NIEHS and NIH (National Institute of Environmental Health Sciences and National Institutes of Health). 2002. *Electric and Magnetic Fields Associated with the Use of Electric Power: Questions and Answers*. Prepared for the NIEHS/DOE EMF RAPID Program, June. <http://www.niehs.nih.gov/health/materials/electric_and_magnetic_fields_associated_with_the_use_of_electric_power_questions_and_answers_english_508.pdf>. Accessed July 2, 2014.

ODEM (Oklahoma Department of Emergency Management). 2011. *Standard Hazard Mitigation Plan Update for the Great State of Oklahoma*. February 17. <http://www.ok.gov/OEM/documents/Oklahoma%20State%20HMP%20%20Public.pdf>. Accessed July 16, 2014.

OSHA (Occupational Safety and Health Administration). 2013a. “Commonly Used Statistics.” U.S. Department of Labor. <https://www.osha.gov/oshstats/commonstats.html>. Accessed August 26, 2014.

———. 2013b. Table A-1. Fatal Occupational injuries by industry and event or exposure, all United States, 2012 <http://www.bls.gov/iif/oshwc/cfoi/cftb0268.pdf>. Accessed August 26, 2014.

Presidential Policy Directive, “Critical Infrastructure Security and Resilience.” PPD-21. February 12, 2013. <http://www.whitehouse.gov/the-press-office/2013/02/12/presidential-policy-directive-critical-infrastructure-security-and-resil>. Accessed October 23, 2014.

TDEC (Tennessee Department of Environment and Conservation). 2012. “Hazardous Waste Program.” *Rules of the Tennessee Department of Environment and Conservation*. Tennessee Rule Chapter 0400-12-01. September. <http://tn.gov/sos/rules/0400/0400-12/0400-12-01/0400-12-01.htm>.

Thomas, J. 2014. “FTE Information for Health and Safety Analyses.” Email from J. Thomas, to J. MacDonald, Tetra Tech, and others dated July 2. (Available on EIS Reference CD.)

THP (Tornado History Project). 2014. “TornadoHistoryProject.com.” Data search in project area. Accessed April 2014. <http://www.tornadohistoryproject.com/>. Accessed July 14, 2014.

WAPA and USFWS (Western Area Power Administration and U.S. Fish and Wildlife Service). 2013. *Upper Great Plains Wind Energy Programmatic Environmental Impact Statement, Draft*. DOE/EIS-0408. U.S. Department of Energy and U.S. Department of the Interior. March.

<http://plainswindeis.anl.gov/documents/dpeis/Draft_UGP_Wind_Energy_PEIS.pdf>. Accessed July 14, 2014.

WHO (World Health Organization). 2007. *Extremely Low Frequency Fields*. Environmental Health Criteria 238 (EHC 238). WHO Press, Geneva, Switzerland. <http://www.who.int/entity/peh-emf/publications/Complet_DEC_2007.pdf?ua=1>. Accessed September 25, 2014.

6.2.3.9 Historic and Cultural Resources

10 CFR Part 1021. "National Environmental Policy Act Implementing Procedures." *Energy*. U.S. Department of Energy. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt10.4.1021&rgn=div5>.

25 CFR Part 169. "Rights-Of-Way over Indian Lands." *Indians*. Bureau of Indian Affairs, Department of the Interior. <http://www.ecfr.gov/cgi-bin/text-idx?SID=0de8c836d0733e4ece8435e84bc337dc&node=25:1.0.1.8.75&rgn=div5>.

36 CFR Part 60. "National Register of Historic Places." *Parks, Forests, and Public Property*. National Park Service, Department of the Interior. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt36.1.60&rgn=div5>.

36 CFR Part 296. "Protection of Archaeological Resources: Uniform Regulations." Parks, Forests, and Public Property. U.S. Department of Agriculture. <http://www.ecfr.gov/cgi-bin/text-idx?SID=280656fda1f728c843d410d693851c0a&node=pt36.2.296&rgn=div5>.

36 CFR Part 800. "Protection of Historic Properties." *Parks, Forests, and Public Property*. Advisory Council on Historic Preservation. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt36.3.800&rgn=div5>.

40 CFR Part 1500. "Purpose, Policy, and Mandate." *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1500&rgn=div5>.

40 CFR Part 1501. "NEPA and Agency Planning." *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1501&rgn=div5>.

40 CFR Part 1502. "Environmental Impact Statement." *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1502&rgn=div5>.

40 CFR Part 1503. "Commenting." *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1503&rgn=div5>.

40 CFR Part 1504. "Predecision Referrals to the Council of Proposed Federal Actions Determined to be Environmentally Unsatisfactory." *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1504&rgn=div5>.

40 CFR Part 1505. "NEPA and Agency Decisionmaking." *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1505&rgn=div5>.

40 CFR Part 1506. "Other Requirements of NEPA." *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1506&rgn=div5>.

40 CFR Part 1507. "Agency Compliance." *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1507&rgn=div5>.

40 CFR Part 1508. "Terminology and Index." *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1508&rgn=div5>.

43 CFR Part 10. "Native American Graves Protection and Repatriation Regulations." *Public Lands: Interior*. Office of The Secretary of the Interior. <http://www.ecfr.gov/cgi-bin/text-idx?SID=280656fda1f728c843d410d693851c0a&node=pt43.1.10&rgn=div5>.

16 USC §§ 470aa-470mm. "Archaeological Resources Protection Act of 1979" (Pub. L. 96-95). <http://www.law.cornell.edu/uscode/text/16/chapter-1B>.

25 USC §§ 3001-3013. "Native American Graves Protection and Repatriation Act" (Pub. L. 101-601) <http://www.law.cornell.edu/uscode/pdf/lii_usc_TI_25_CH_32.pdf>.

25 USC §§ 3051-3057. "Cultural and Heritage Cooperation Authority" <http://www.law.cornell.edu/uscode/text/25/chapter-32A>.

42 USC § 1996 *et seq*. "American Indian Religious Freedom Act." (Pub. L. 95-341) <http://www.law.cornell.edu/uscode/pdf/uscode42/lii_usc_TI_42_CH_21_SC_I_SE_1996.pdf>.

42 USC § 4321 *et seq*. "National Environmental Policy Act of 1969" (Pub. L. 91-190) <http://www.law.cornell.edu/uscode/pdf/lii_usc_TI_42_CH_55.pdf>.

54 USC § 300101 *et seq*. "National Historic Preservation Act of 1966" (Pub. L. 113–287). <https://www.law.cornell.edu/uscode/text/54/300101>.

54 USC § 306108. "Effect of undertaking on historic property" (the Section 106 process). (Pub. L. 113–287). <https://www.law.cornell.edu/uscode/text/54/306108->.

Arkansas Code Annotated 13-6-301–308 (Title 13, Chapter 6, Subchapter 3). “Arkansas Antiquities Act of 1967, as amended.” <http://www.lexisnexis.com/hottopics/arcode/Default.asp>.

Arkansas Code Annotated 13-6-401–409 (Title 13, Chapter 6, Subchapter 4). “Arkansas Grave Protection Act of 1991, as amended.” <http://www.lexisnexis.com/hottopics/arcode/Default.asp>.

Arkansas Code Annotated 13-6-406–408 (Title 13, Chapter 6, Subchapter 4, Sections 406 to 408). “Arkansas Burial Law.” <http://www.lexisnexis.com/hottopics/arcode/Default.asp>.

Arkansas Code Annotated 13-7-101–111 (Title 13, Chapter 7, Subchapter 1). “Arkansas Historic Preservation Program Act of 1977, as amended.” <http://www.lexisnexis.com/hottopics/arcode/Default.asp>.

Oklahoma Statues 21-1168.0-1168.6 (Title 21, Sections 1168.0 to 1168.6). “Oklahoma Burial Desecration Law of 1987, as amended.” <http://webserver1.lsb.state.ok.us/OK_Statutes/CompleteTitles/os21.rtf>.

Oklahoma Statutes 53-351-355 (Title 53, Sections 351 to 355). “Oklahoma State Register of Historic Places Act of 1983.” <http://webserver1.lsb.state.ok.us/OK_Statutes/CompleteTitles/os53.rtf>.

Oklahoma Statutes 53-361 (Title 53, Section 361). “Oklahoma Antiquities Law of 1985.” <http://webserver1.lsb.state.ok.us/OK_Statutes/CompleteTitles/os53.rtf>.

Tennessee Code 11-6-101–119 (Title 11, Chapter 6). “Tennessee Archaeology Code.” <http://www.lawserver.com/law/state/tennessee/tn-code/tennessee_code_title_11_chapter_6>.

Tennessee Code 39-17-311–312 (Title 39, Chapter 17, Part 3, Sections 311 to 312). “Tennessee Criminal Code.” <http://www.lawserver.com/law/state/tennessee/tn-code/tennessee_code_title_39_chapter_17>.

Tennessee Code 4-11 (Title 4, Chapter 11). “State Historian and Historical Commission.” <http://www.lawserver.com/law/state/tennessee/tn-code/tennessee_code_title_4_chapter_11>.

Texas Administrative Code 13-22 (Title 13, Part 2). “Texas Historical Commission Act.” <http://info.sos.state.tx.us/pls/pub/readtac$ext.ViewTAC?tac_view=3&ti=13&pt=2>.

Texas Administrative Code 13-22 (Title 13, Part 2, Chapter 22). “Cemeteries.” <http://info.sos.state.tx.us/pls/pub/readtac$ext.ViewTAC?tac_view=4&ti=13&pt=2&ch=22&rl=Y>.

Texas Administrative Code 13-24–26 (Title 13, Part 2, Chapters 24 to 26). “Texas Antiquities Code.” <http://info.sos.state.tx.us/pls/pub/readtac$ext.ViewTAC?tac_view=4&ti=13&pt=2&ch=24&rl=Y>; <http://info.sos.state.tx.us/pls/pub/readtac$ext.ViewTAC?tac_view=4&ti=13&pt=2&ch=25&rl=Y>; and <http://info.sos.state.tx.us/pls/pub/readtac$ext.ViewTAC?tac_view=4&ti=13&pt=2&ch=26>.

Texas Government Code Title 4, Chapter 442. “Texas Historical Commission.” <http://www.statutes.legis.state.tx.us/Docs/GV/htm/GV.442.htm>.

Texas Health and Safety Code Title 8, Chapter 711. “General Provisions Relating to Cemeteries.” <http://www.statutes.legis.state.tx.us/Docs/HS/htm/HS.711.htm>.

Texas Natural Resources Code Title 9, Chapter 191. “Antiquities Code.” <http://www.statutes.legis.state.tx.us/Docs/NR/htm/NR.191.htm#191.001>.

AHPP (Arkansas Historic Preservation Program). 2014. “National Register of Historic Places.” Data search on locations in Arkansas. <http://www.arkansaspreservation.com/historic-properties/national-register/>. Accessed February 2014.

———. 2013. *Foundation for the Future: The Arkansas Historic Preservation Plan 2013-2018*. <http://www.arkansaspreservation.com/!userfiles/editor/docs/AHPP-5YearPlan2013.pdf>. Accessed February 23, 2014.

Anderson, K.; Ross, J.; and Howell, G.R. 2002. *Oklahoma Route 66 Roadbed Documentation Project (1926-1970): A Survey of Roadbed and Integral Structures*. Prepared by the Oklahoma Route 66 Association, Chandler, Oklahoma, for Oklahoma State Historic Preservation Office, Oklahoma City. <http://www.okhistory.org/shpo/thematic/rt66roadbed.pdf>. Accessed March 22, 2012.

Arkansas Agriculture Department. 2015. “Arkansas Century Farm Program.” <http://aad.arkansas.gov/Pages/CenturyFarmList.aspx>. Accessed July 24, 2015.

Bailey, G.A. 2001. “Osage.” In *Handbook of North American Indians, Volume 13: Plains*, Raymond J. DeMallie (ed), pp. 476-496. Smithsonian Institution, Washington, D.C. <http://www.anthropology.si.edu/handbook.htm>. Accessed September 25, 2014.

Baird, W.D. and Gebhard, D. 1991. *Historic Context for the Native American Theme: Management Region #3, 1830-1941.* Oklahoma State Historic Preservation Office, Oklahoma City, Oklahoma. <http://www.okhistory.org/shpo/contexts/Region3NativeAmericanPt1.pdf>; <http://www.okhistory.org/shpo/contexts/Region3NativeAmericanPt2.pdf>; and <http://www.okhistory.org/shpo/contexts/Region3NativeAmericanPt3.pdf>. Accessed February 19, 2014.

Brain, J.P.; Roth, G.; and Jackson, J.B. 2004. “Tunica, Biloxi, and Ofo.” In *Handbook of North American Indians: Southeast*. Raymond D. Fogelson (ed), pp. 598-615. Smithsonian Institution, Washington, D.C. <http://www.anthropology.si.edu/handbook.htm>. Accessed September 25, 2014.

Callender, C. 1978. “Illinois.” In *Handbook of North American Indians, Volume 15: Northeast*, Bruce G. Trigger (ed), pp. 675-680. Smithsonian Institution, Washington, D.C. <http://www.anthropology.si.edu/handbook.htm>. Accessed September 25, 2014.

Cassity, M. 2002. *Final Survey Report for the Oklahoma Route 66 Historic Resources Survey, 1926-1970*. Oklahoma State Historic Preservation Office, Oklahoma City. <http://www.okhistory.org/shpo/thematics.htm>. Accessed March 22, 2012.

Clean Line. 2014. *Wind Generation Technical Report for the Plains and Eastern Transmission Line Project*. March. Prepared for the Department of Energy pursuant to 10 CFR 1021.215(b)(2). (Available on EIS Reference CD.)

———. 2013. *Historic and Cultural Resources Technical Report for the Plains and Eastern Transmission Line Project*. December. Prepared for the Department of Energy pursuant to 10 CFR 1021.215(b)(2). (Available on EIS Reference CD.)

DeMallie, R.J. 2001. "Introduction." In *Handbook of North American Indians, Volume 13: Plains*, Raymond J. DeMallie (ed), pp. vii-ix, 1-13. Smithsonian Institution, Washington, D.C. <http://www.anthropology.si.edu/handbook.htm>. Accessed September 25, 2014.

DOE (U.S. Department of Energy). 2015. "Council of the Cherokee Nation Resolution 03-15 Opposing the Establishment of an Energy Line Route by the Plains and Eastern Clean Line in Sequoyah County, Oklahoma Located Within the Cherokee Nation Jurisdictional Area." Letter from J. Summerson, DOE NEPA Document Manager, to Council of the Cherokee Nation dated March 17. (Available on EIS Reference CD.)

Dye, D.H. 2007. "The Protohistoric Period." In *Phase II Report: Cultural Affiliation Overview Study (Contract No.W912EQ-05-P-0153/ Project No.40704*). Gloria A. Young (ed), Principal Investigator. Prepared for U.S. Army Corps of Engineers, Memphis District, by Burns & McDonald Engineering Co., Kansas City, Missouri. <http://www.mvm.usace.army.mil/Portals/51/docs/Cultural%20Resources/Final_Report_1_15_08.pdf>. Accessed February 23, 2014.

Fischer, L. and Ruth, L. 1970. "National Register of Historic Places Inventory Nomination Form: Honey Springs Battlefield." <http://nrhp.focus.nps.gov/natreghome.do?searchtype=natreghome>. Accessed February 23, 2014.

Gremillion, K.J. 2004. "Environment." In *Handbook of North American Indians, Volume 14: Southeast*, Raymond D. Fogelson (ed), pp. 53-67. Smithsonian Institution, Washington, D.C. <http://www.anthropology.si.edu/handbook.htm>. Accessed September 25, 2014.

Griffith, G.E.; Bryce, S.A.; Omernik, J.M.; Comstock, J.A.; Rogers, A.C.; Harrison, B.; Hatch, S.L.; and Bezanson, D. 2004. *Ecoregions of Texas*. (2-sided color poster with map, descriptive text, and photographs). U.S. Geological Survey, Reston, VA. Scale 1:2,500,000. <http://www.epa.gov/wed/pages/ecoregions/tx_eco.htm>. Accessed February 23, 2014.

Griffith, G.E.; Omernik, J.M.; and Azevedo, S.H. 1998. *Ecoregions of Tennessee*. (2-sided color poster with map, descriptive text, summary Tables, and photographs). U.S. Geological Survey, Reston, VA. Scale 1:940,000. <http://www.epa.gov/wed/pages/ecoregions/tn_eco.htm>. Accessed February 23, 2014.

Horne, A.M. 2006. *Footprints Across Arkansas: Trail of Tears Removal Corridors for the Cherokees, Chickasaws, Choctaws, Creeks and Seminoles*. Prepared for the Arkansas Historic Preservation Program, Little Rock. <http://www.arkansaspreservation.com/preservation-services/trail-of-tears/removal-routes.aspx>. Accessed February 23, 2014.

Mainfort, R.C., Jr.; Compton, J.M.; and Cande, K.H. 2007. "1973 Excavations at the Upper Nodena Site." *Southeastern Archaeology* 26:108-123. <http://www.questia.com/library/journal/1P3-1337289761/1973-excavations-at-the-upper-nodena-site>. Accessed September 25, 2014.

Middle Tennessee State University Center for Historic Preservation. 2015. "About Tennessee Century Farms." <http://www.tncenturyfarms.org/about/>. Accessed July 25, 2015.

Nance, B.C. 2001. *The Trail of Tears in Tennessee: A Study of the Routes Used During the Cherokee Removal of 1838*. Prepared by the Tennessee Division of Archaeology, Nashville. <http://www.tn.gov/environment/docs/arch_roi15_trail_of_tears_2001.pdf>. Accessed February 26 2014.

NPS (National Park Service). 2014a. "National Park Service Route 66 Corridor Preservation Program." <http://www.cr.nps.gov/rt66/index.htm>. Accessed February 23, 2014.

———. 2014b. National Register of Historic Places Focus Database. <http://nrhp.focus.nps.gov/natreghome.do?searchtype=natreghome>. Accessed February 23, 2014.

———. 2014c. "A Journey of Injustice - Trail of Tears National Historic Trail." <http://www.nps.gov/trte/index.htm>. Accessed February 23, 2014.

———. 2014d. *Draft Chisholm and Great Western National Historic Trail Feasibility Study / Environmental Assessment*. NPS National Trails Intermountain Office, Santa Fe, New Mexico. <http://parkplanning.nps.gov/showFile.cfm?projectID=30803&MIMEType=application%252Fpdf&filename=CHGWPublicDraft%5F11%2D24%2D14%2Epdf&sfid=199624>. Accessed May 14, 2015.

———. 2013. "National Historic Landmarks Program: Lists of National Historic Landmarks. June. <http://www.nps.gov/nhl/designations/listsofNHLs.htm>. Accessed February 23, 2014.

———. 2007. *Trail of Tears National Historic Trail Additional Routes: National Historic Trail Feasibility Study Amendment and Environmental Assessment* (Final). Prepared by the National Trails System-Intermountain Region, National Park Service, Santa Fe, New Mexico. <http://parkplanning.nps.gov/document.cfm?parkID=448&projectID=17939&documentID=21329>. Accessed February 24, 2014.

OAS (Oklahoma Archaeological Survey). 2011. "Research in Oklahoma Archaeology." University of Oklahoma, Norman, Oklahoma. <http://www.ou.edu/cas/archsur/research.htm>. Accessed July 30, 2011.

OKDOT (Oklahoma Department of Transportation). 2012. "Oklahoma's Memorial Highways & Bridges: Route 66 County Maps: Creek County." <http://www.odot.org/memorial/route66/creek/index.htm>. Accessed March 4, 2014.

OKSHPO (Oklahoma State Historic Preservation Office). 2015. "Oklahoma Centennial Farm and Ranch Program." <http://www.okhistory.org/shpo/historyfr.htm>. Accessed July 24, 2015.

———. 2014a. "Historic Contexts." <http://www.okhistory.org/shpo/histcons.htm>. Accessed February 20, 2014.

———. 2014b. "Properties on the National Register of Historic Places in Oklahoma by County." <http://www.ocgi.okstate.edu/shpo/allsites.htm>. Accessed February 20, 2014.

Perttula, T.K. 2004 (ed). "An Introduction to Texas Prehistoric Archaeology." In *The Prehistory of Texas*, pp. 5-14. Anthropology Series 9. Texas A&M University Press, College Station, Texas. <http://www.tamupress.com/product/Prehistory-of-Texas,121.aspx>. Accessed September 25, 2014.

Rathjenm, F.W. 2010. "Panhandle." *Handbook of Texas Online*. Texas State Historical Association, Denton, Texas. <http://www.tshaonline.org/handbook/online/articles/ryp01>. Accessed March 4, 2014.

Smith, M.W. 1986a. *Resource Protection Planning Project: Patterns of White Settlement in Oklahoma, 1889-1907—Region One.* Oklahoma State Historic Preservation Office, Oklahoma City, Oklahoma. <http://www.okhistory.org/shpo/contexts/Region1Settlement.pdf>. Accessed February 19, 2014.

———. 1986b. *Resource Protection Planning Project: Patterns of White Settlement in Oklahoma, 1889-1907—Region Two.* Oklahoma State Historic Preservation Office, Oklahoma City, Oklahoma. <http://www.okhistory.org/shpo/contexts/Region2WSettlement.pdf>. Accessed February 19, 2014.

———. 1986c. *Resource Protection Planning Project: Patterns of White Settlement in Oklahoma, 1889-1907—Region Three.* Oklahoma State Historic Preservation Office, Oklahoma City, Oklahoma. <http://www.okhistory.org/shpo/contexts/Region3Settlement.pdf>. Accessed February 19, 2014.

———. 1984. *Resource Protection Planning Project: Settlement Patterns in the Unassigned Lands, Region Six.* Oklahoma State Historic Preservation Office, Oklahoma City, Oklahoma. <http://www.okhistory.org/shpo/contexts/Region6Settlement.pdf>. Accessed February 19, 2014.

Tennessee Historical Commission. 2013. *A Future for the Past: A Comprehensive Plan for Historic Preservation in Tennessee, 2013-2018*. <https://www.tn.gov/environment/history/docs/historic_preservation_plan.pdf>. Accessed February 26, 2014.

Texas Department of Agriculture. 2015. "Family Land Heritage Program." <https://texasagriculture.gov/Home/ProductionAgriculture/FamilyLandHeritage.aspx>. Accessed July 24, 2015.

Texas Historical Commission. 2014a. "Texas Heritage Trails." <http://www.thc.state.tx.us/preserve/projects-and-programs/texas-heritage-trails>. Accessed March 14, 2014.

———. 2014b. "Regional Archaeology." <http://www.thc.state.tx.us/preserve/projects-and-programs/regional-archaeology>. Accessed March 4, 2014.

Thomason, P. and Parker, S. 2003. *Historic and Historical Archaeological Resources of the Cherokee Trail of Tears*. National Register of Historic Places Multiple Property Documentation Form. <http://www.nps.gov/trte/parkmgmt/upload/Trailword.pdf>. Accessed February 24, 2014.

Trigger, B.G. 1978 (ed). "Introduction." In *Handbook of North American Indians, Volume 15: Northeast*. pp. vii-ix, 1-3. Smithsonian Institution, Washington, D.C. <http://www.anthropology.si.edu/handbook.htm>. Accessed September 25, 2014.

Warde, M.J.; Schwan, L.B.; and Gabbert, J. 2012. "National Historic Landmark Nomination: Honey Springs Battlefield." <http://www.nps.gov/nhl/news/LC/fall2012/HoneySprings.pdf>. Accessed February 23, 2014.

Wedel, W.R. and Frison, G.C. 2001. "Environment and Subsistence." In *Handbook of North American Indians, Volume 13: Plains*. Raymond J. DeMallie (ed), pp. 44-60. Smithsonian Institution, Washington, D.C. <http://www.anthropology.si.edu/handbook.htm>. Accessed September 25, 2014.

Woods, A.J.; Foti, T.L.; Chapman, S.S.; Omernik, J.M.; Wise, J.A.; Murray, E.O.; Prior, W.L.; Pagan, Jr., J.B.; Comstock, J.A.; and Radford, M. 2004. *Ecoregions of Arkansas*. (2-sided color poster with map, descriptive text, summary Tables, and photographs). U.S. Geological Survey, Reston, VA. Scale 1:1,000,000. <http://www.epa.gov/wed/pages/ecoregions/ar_eco.htm>. Accessed September 25, 2014.

Woods, A.J.; Omernik, J.M.; Butler, D.R.; Ford, J.G.; Henley, J.E.; Hoagland, B.W.; Arndt, D.S.; and Moran, B.C. 2005. *Ecoregions of Oklahoma*. (2-sided color poster with map, descriptive text, summary Tables, and photographs). U.S. Geological Survey, Reston, VA. Scale 1:1,250,000. <http://www.epa.gov/wed/pages/ecoregions/ok_eco.htm>. Accessed September 25, 2014.

Young, G.A. and Hoffman, M.P. 2001. "Quapaw." In *Handbook of North American Indians, Volume 13: Plains*. Raymond J. DeMallie (ed), pp. 497-514. Smithsonian Institution, Washington, D.C. <http://www.anthropology.si.edu/handbook.htm>. Accessed September 25, 2014.

6.2.3.10 Land Use

25 CFR Part 169. "Rights-Of-Way over Indian Lands." *Indians*. Bureau of Indian Affairs, Department of the Interior. <http://www.ecfr.gov/cgi-bin/text-idx?SID=0de8c836d0733e4ece8435e84bc337dc&node=25:1.0.1.8.75&rgn=div5>.

33 CFR 208.10. "Flood Control Regulations." *Navigation and Navigable Waters*. U.S. Army Corps of Engineers, Department of the Army, Department of Defense. <http://www.ecfr.gov/cgi-bin/text-idx?SID=0de8c836d0733e4ece8435e84bc337dc&tpl=/ecfrbrowse/Title33/33cfr208_main_02.tpl>.

36 CFR Part 251 Subpart B. "Special Uses." *Land Uses*. U.S. Forest Service, U.S. Department of Agriculture. <http://www.ecfr.gov/cgi-bin/text-idx?SID=39e024582d845c5d11b8c3f2dc5c953d&node=pt36.2.251&rgn=div5#sp36.2.251.b>.

16 USC § 460d. "Construction and operation of public parks and recreational facilities in water resource development projects; lease of lands; preference for use; penalty; application of section 3401 of title 18; citations and arrests with and without process; limitations; disposition of receipts." *National Parks, Military Parks, Monuments, and Seashores*. <http://www.law.cornell.edu/uscode/pdf/uscode16/lii_usc_TI_16_CH_1_SC_LXVI_SE_460d.pdf>.

16 USC § 528. "Development and administration of renewable surface resources for multiple use and sustained yield of products and services; Congressional declaration of policy and purpose." *National Forests*. <http://www.law.cornell.edu/uscode/pdf/uscode16/lii_usc_TI_16_CH_2_SC_I_SE_528.pdf>.

16 USC §§ 668dd-668ee. "National Wildlife Refuge System." (Pub. L. 89-669). <http://www.law.cornell.edu/uscode/pdf/uscode16/lii_usc_TI_16_CH_5A_SC_III_SE_668dd.pdf>.

33 USC § 408. "Taking possession of, use of, or injury to harbor or river improvements." *Navigation and Navigable Waters*. <http://www.law.cornell.edu/uscode/pdf/uscode33/lii_usc_TI_33_CH_9_SC_I_SE_408.pdf>.

Farm Bill of 2014. H.R. 2642; Pub. Law 113-79. <http://www.gpo.gov/fdsys/pkg/BILLS-113hr2642enr/pdf/BILLS-113hr2642enr.pdf>.

Arkansas Code Annotated Title 14. "Local Government." < http://www.lexisnexis.com/hottopics/arcode/Default.asp >.

Arkansas Constitution, Amendment 35. "Wild Life - Conservation - Arkansas State Game and Fish Commission." < http://www.arkleg.state.ar.us/assembly/Summary/ArkansasConstitution1874.pdf >.

Oklahoma Administrative Code 385:25 (Title 385, Chapter 25). "Oklahoma Title 29-3-304." <http://www.oar.state.ok.us/oar/codedoc02.nsf/frmMain?OpenFrameSet&Frame=Main&Src=_75tnm2shfcdnm8pb4dthj0chedppmcbq8dtmmak31ctijujrgcln50ob7ckj42tbkdt374obdcli00_>.

Oklahoma Statutes Title 19. "Counties and County Officers." <http://webserver1.lsb.state.ok.us/OK_Statutes/CompleteTitles/os19.rtf>.

Tennessee Code Title 6. "Cities and Towns." <http://www.lawserver.com/law/state/tennessee/tn-code/tennessee_code_title_6>.

Tennessee Code Title 6, Chapter 54. "Municipal Powers Generally." <http://www.lawserver.com/law/state/tennessee/tn-code/tennessee_code_title_6_chapter_54>.

Tennessee Code Title 6, Chapter 58. "Comprehensive Growth Plan." <http://www.lawserver.com/law/state/tennessee/tn-code/tennessee_code_title_6_chapter_58>.

AGFC (Arkansas Game and Fish Commission). 2014. *Code Book*. <http://www.agfc.com/enforcement/documents/agfc_code_of_regulations.pdf>. Accessed February 6, 2014.

ANHC (Arkansas Natural Heritage Commission). 2010a. "Introduction to Natural Areas: Protecting Diverse Ecosystems." <http://www.naturalheritage.com/natural-area/introduction.aspx>. Accessed February 6, 2014.

———. 2010b. "Find a Natural Area." <http://www.naturalheritage.com/natural-area/map.aspx>. Accessed February 6, 2014.

CLO (Commissioners of the Land Office). 2014. "Real Estate Management Division." <http://www.clo.ok.gov/REM/REMHome.htm>. Accessed February 6, 2014.

Denholm, P.; Hand, M.; Jackson, M.; and Ong, S. 2009. *Land-Use Requirements of Modern Wind Power Plants in the United States*. Technical Report NREL/TP-6A2-45834. National Renewable Energy Laboratory. August. <http://www.nrel.gov/docs/fy09osti/45834.pdf>. Accessed September 30, 2014.

NRCS (Natural Resources Conservation Service). 2014. "Wetland Reserve Program." U.S. Department of Agriculture. <http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/wetlands/>. Accessed February 6, 2014.

———. 2011. *Wetland Reserve Program Compatible Use Authorization Approval Process*. November. <http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_002201.pdf>. Accessed February 6, 2014.

USFS (U.S. Forest Service). 2005. *Revised Land and Resource Management Plan. Ozark-St. Francis National Forests*. Management Bulletin R8-MB 125 A. September. <http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsm8_042809.pdf>. Accessed April 30, 2014.

6.2.3.11 Noise

Bodwell, R.S. PE 2013. *Sound Level Assessment, Hancock Wind, LLC, Hancock Wind Project, Hancock County, Maine*. Prepared for First Wind Energy, LLC. April 2013. <http://www.maine.gov/dep/ftp/WindPowerProjectFiles/BinghamWind/application/5_Noise.pdf>.

BPA (Bonneville Power Administration). 1991. *Corona and Field Effects Program*. Version 3.0 Computer Program. Written by P Kingery for the Bonneville Power Administration, U.S. Department of Energy. (Available on EIS Reference CD.)

Britten, T.; Chartier, V.L.; and Zaffenalla, L.E. 2005. "Chapter 10, Audible Noise." *AC Transmission Line Reference Book – 200 Kv and Above*. Third Edition. Electric Power Research Institute Product 1011974. <http://mydocs.epri.com/Docs/CorporateDocuments/SectorPages/PDM/ColorBookDocs/1016297_RedBook.pdf>. Accessed August 19, 2014.

EPA (U.S. Environmental Protection Agency). 1974. *Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*. <http://www.fican.org/pdf/EPA_Noise_Levels_Safety_1974.pdf>. Accessed May 1, 2014.

FHWA (Federal Highway Administration). 2006. *Construction Noise Handbook*. U.S. Department of Transportation <http://www.fhwa.dot.gov/environment/noise/construction_noise/handbook/>. Accessed May 1, 2014.

FTA (Federal Transit Administration). 2012. *High-Speed Ground Transportation Noise and Vibration Impact Assessment*. U.S. Department of Transportation <http://www.fra.dot.gov/eLib/Details/L04090>. Accessed May 1, 2014.

GE (General Electric) Energy. 2005. *Technical Documentation Wind Turbine Generator System GE 1.5sl/sle 50 & 60 Hz Noise Emission Characteristics*. <http://www.co.kittitas.wa.us/uploads/cds/land-use/Wind%20Farm/WSA-07-

01%20Vantage%20Wind%20%20Power%20Project%20Application/07%202_Noise%20Emission%20Characteristics_NO.pdf>.

Hau, E. 2006. *Wind Turbines: Fundamentals, Technologies, Application, Economics – 2nd Edition*. Germany. <http://www.springer.com/engineering/energy+technology/book/978-3-642-27150-2>.

ISO (Organization for International Standardization). 1996. *Acoustics – Attenuation of Sound during Propagation Outdoors. Part 2: General Method of Calculation*. ISO Standard 9613-2. <https://www.iso.org/obp/ui/#iso:std:iso:9613:-2:ed-1:v1:en>.

Siemens. 2008. *Technical Description SWT-2.3-101*. Document ID: PG-R3-10-0000-01 14-02. Restricted Release. <http://www.energy.siemens.com/us/en/renewable-energy/wind-power/platforms/g2-platform/wind-turbine-swt-2-3-101.htm>. Accessed September 25, 2014.

6.2.3.12 Recreation

23 CFR 645.209(h)(1). "Utilities: General Requirements." *Highways*. Federal Highway Administration, Department of Transportation. <http://www.ecfr.gov/cgi-bin/text-idx?SID=6d13abb85ce68d9655fd0cd0686f8007&mc=true&node=se23.1.645_1209&rgn=div8>.

113 Stat. 224, "Route 66 Corridor, Historic Preservation" (Pub. L. 106-45). <http://www.gpo.gov/fdsys/pkg/PLAW-106publ45/pdf/PLAW-106publ45.pdf>.

123 Stat. 991, "The Omnibus Public Land Management Act of 2009" (Pub.L. 111-11). <http://www.gpo.gov/fdsys/pkg/STATUTE-123/html/STATUTE-123-Pg991.htm>.

16 USC § 1241-1251. "The National Trails System Act" (Pub. L. 90-543). <http://www.law.cornell.edu/uscode/pdf/uscode16/lii_usc_TI_16_CH_27_SE_1241.pdf>.

23 USC § 162 *et seq*. "National Scenic Byways Program" (Pub. L. 105-178). <http://www.law.cornell.edu/uscode/pdf/uscode23/lii_usc_TI_23_CH_1_SE_162.pdf>.

49 USC § 5301 *et seq*. "Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA)" (Pub. L. 102-240). <http://www.law.cornell.edu/uscode/text/49/subtitle-III/chapter-53>.

Arkansas Code Annotated Title 14. "Local Government." <http://www.lexisnexis.com/hottopics/arcode/Default.asp >.

Arkansas Code Annotated 15-23-301–315 (Title 15, Subtitle 2, Chapter 23, Subchapter 3, Sections 301 to 315). "Arkansas Natural and Scenic Rivers System Act." <http://www.lexisnexis.com/hottopics/arcode/Default.asp>.

Oklahoma Statutes Title 19. "Counties and County Officers." <http://webserver1.lsb.state.ok.us/OK_Statutes/CompleteTitles/os19.rtf>.

Oklahoma Statutes 82-1451–1471 (Title 82, Sections 1451 to 1471). "Oklahoma Scenic Rivers Act." <http://webserver1.lsb.state.ok.us/OK_Statutes/CompleteTitles/os82.rtf>.

Tennessee Code Title 7. "Consolidated Governments." <http://www.lawserver.com/law/state/tennessee/tn-code/tennessee_code_title_7>.

ADEQ (Arkansas Department of Environmental Quality). 2014. *Arkansas Natural and Scenic Rivers System Act*. <http://www.adeq.state.ar.us/water/branch_planning/pdfs/ar_code.pdf>. Accessed February 24, 2014.

AGFC (Arkansas Game and Fish Commission). 2014. *Code Book*. <http://www.agfc.com/enforcement/documents/agfc_code_of_regulations.pdf>. Accessed March 3, 2014

———. 2011a. "Wildlife Management Area – Cherokee." <http://www.agfc.com/hunting/Pages/wmaDetails.aspx?show=128>. Accessed February 14, 2014.

———. 2011b. "Wildlife Management Area – Frog Bayou." <http://www.agfc.com/hunting/pages/wmadetails.aspx?show=235>. Accessed February 14, 2014.

———. 2011c. "Wildlife Management Area – Ozark Lake." <http://www.agfc.com/hunting/Pages/wmaDetails.aspx?show=500>. Accessed February 14, 2014.

———. 2011d. "Wildlife Management Area – Ozark National Forest." <http://www.agfc.com/hunting/Pages/wmaDetails.aspx?show=505>. Accessed February 14, 2014.

———. 2011e. "Arkansas Water Trails." <http://www.agfc.com/education/Pages/EducationProgramsAWT.aspx#3>. Accessed July 28, 2015.

AHTD (Arkansas State Highway and Transportation Department). 2007a. "Boston Mountains Scenic Loop." <http://www.arkansashighways.com/scenic_byways_program/boston_mountais_scenic_loop.aspx>. Accessed February 24, 2014.

———. 2007b. "Highway 21/Ozark Highlands Scenic Byway." <http://www.arkansashighways.com/scenic_byways_program/Highway_21.aspx>. Accessed February 24, 2014.

———. 2007c. "Arkansas Scenic 7 Byway." <http://www.arkansashighways.com/scenic_byways_program/highway7.aspx>. Accessed February 24, 2014.

———. 2007d. "Scenic Byways Program." <http://www.arkansashighways.com/scenic_byways_program/scenic_byways_program.aspx>. Accessed February 24, 2014.

Arkansas.com. 2014. "Pig Trail Scenic Byway." <http://www.arkansas.com/places-to-go/scenic-byways/pig-trail/>. Accessed July 17, 2014.

DOI (U.S. Department of the Interior). 2013. "American Great Outdoors Initiative." <http://www.doi.gov/americasgreatoutdoors/whatwedo/rivers/Rivers-Demonstration-Projects.cfm>. Accessed July 28, 2015.

FHWA (Federal Highway Administration). 2014a. "Cherokee Hills Scenic Byway." <http://www.fhwa.dot.gov/byways/byways/2346>. Accessed February 24, 2014.

———. 2014b. "Crowley's Ridge Parkway." <http://www.fhwa.dot.gov/byways/byways/2588>. Accessed February 24, 2014.

———. 2014c. "Great River Road." <http://www.fhwa.dot.gov/byways/byways/2279>. Accessed February 24, 2014.

———. 2014d. "Historic Route 66." <http://www.fhwa.dot.gov/byways/byways/2489>. Accessed February 24, 2014.

NPS (National Park Service). "Chisholm and Great Western NHT Feasibility Study/Environmental Assessment." <http://parkplanning.nps.gov/projectHome.cfm?projectID=30803>. Accessed September 9, 2015.

———. 2014a. "Historic Route 66 Corridor Preservation Program." <http://www.nps.gov/history/rt66/prgrm/index.htm>. Accessed February 24, 2014.

———. 2014b. "Maps (Trail of Tears)." <http://www.nps.gov/trte/planyourvisit/maps.htm>. Accessed February 18, 2014.

———. 2014c. "Tell-Tale Signs (Trail of Tears)." <http://www.nps.gov/trte/planyourvisit/sign-standards.htm>. Accessed February 14, 2014.

———. 2011a. "Nationwide Rivers Inventory: Authorizations." <http://www.nps.gov/ncrc/programs/rtca/nri/auth.html>. Accessed September 15, 2014.

———. 2011b. "Nationwide Rivers Inventory: Outstanding Remarkable Values (ORVs)." <http://www.nps.gov/ncrc/programs/rtca/nri/eligb.html#orv>. Accessed February 14, 2014.

———. 2011c. "Nationwide Rivers Inventory: Rivers." <http://www.nps.gov/ncrc/programs/rtca/nri/index.html>. Accessed February 18, 2014.

———. 2011d. "Nationwide Rivers Inventory History: Presidential Directive and Council on Environmental Quality Regulations." <http://www.nps.gov/ncrc/programs/rtca/nri/hist.html>. Accessed October 2, 2014.

———. 2010. "Oklahoma Segments." <http://www.nps.gov/ncrc/programs/rtca/nri/states/ok.html>. Accessed February 14, 2014

———. 2004. "Arkansas Segments." <http://www.nps.gov/ncrc/programs/rtca/nri/states/ar.html>. Accessed February 18, 2014.

ODWC (Oklahoma Department of Wildlife Conservation). 2014a. “Optima Wildlife Management Area.” <http://www.wildlifedepartment.com/facts_maps/wma/optima.htm>. Accessed February 14, 2014.

———. 2014b. “Schultz Wildlife Management Area.” <http://www.wildlifedepartment.com/facts_maps/wma/schultz.htm>. Accessed February 14, 2014.

———. 2011. “Major County Wildlife Management Area.” <https://www.wildlifedepartment.com/facts_maps/wma/major.htm>. Accessed February 14, 2014.

OSU (Oklahoma State University). 2014. “Lake Carl Blackwell.” <http://lcb.okstate.edu/lake-information>. Accessed February 14, 2014.

Presidential Directive, “Memorandum for the Heads of Departments and Agencies regarding Nationwide Rivers Inventory.” 1979. <http://www.nps.gov/ncrc/programs/rtca/nri/hist.html#pd>. Accessed September 18, 2014.

TPWD (Texas Parks and Wildlife Department). 2014a. “Water Planning Data for Region A (Panhandle).” <http://www.tpwd.state.tx.us/landwater/water/environconcerns/water_quality/sigsegs/regiona.phtml>. Accessed April 11, 2014.

———. 2014b. “Palo Duro Reservoir.” <https://www.tpwd.state.tx.us/fishboat/fish/recreational/lakes/palo_duro/> Accessed March 21, 2014.

———. 2012. *Hansford County Complex*. <http://www.tpwd.state.tx.us/huntwild/hunt/public/lands/table_contents/media/2264_2265.pdf>. Accessed March 21, 2014.

USACE (U.S. Army Corps of Engineers). 2014a. “R.S. Kerr Recreation.” <http://www.swt.usace.army.mil/Locations/TulsaDistrictLakes/Oklahoma/RobertSKerrLockandDam/RobertSKerrRecreation.aspx>. Accessed February 14, 2014.

———. 2014b. “Webber Falls Recreation.” “http://www.swt.usace.army.mil/Locations/TulsaDistrictLakes/Oklahoma/WebbersFallsLockandDam/WebbersFallsRecreation.aspx>. Accessed February 14, 2014.

USFS (U.S. Forest Service). 2014. “Ozark and St. Francis National Forests Recreation.” <http://www.fs.usda.gov/recmain/osfnf/recreation>. Accessed February 14, 2014.

USFWS (U.S. Fish and Wildlife Service). 2014. “Optima National Wildlife Refuge.” <http://www.fws.gov/refuge/Optima/visit/visitor_activities.html>. Accessed February 14, 2014.

6.2.3.13 Socioeconomics

128 Stat. 649. “Agricultural Act of 2014” (Pub. L. 113-79) <http://www.gpo.gov/fdsys/pkg/PLAW-113publ79/html/PLAW-113publ79.htm>.

Oklahoma Administrative Code 710:65 (Title 710, Chapter 65). "Sales and Use Tax." <http://www.tax.ok.gov/rules/Rules2013/Chapter%2065%20Sales%20and%20Use%20Tax.pdf>.

APSC (Arkansas Public Service Commission). 2010. "Tax Division, Rules of Practice and Procedure." <http://www.apscservices.info/taxdivision.asp>. Accessed May 6, 2014.

Arkansas Assessment Coordination Department. 2013. *State of Arkansas 2012 Millage Report*. State of Arkansas. <http://www.arkansas.gov/acd/pdfs/2012-Millage-Report-2013-Collections-Final.pdf>. Accessed May 6, 2014.

———. 2012. *Frequently Asked Questions*. Second Revision. State of Arkansas. June 14. <http://www.arkansas.gov/acd/pdfs/2012_FAQ_-_final.pdf>. Accessed May 6, 2014.

Arkansas Department of Finance and Administration. 2013a. *Local Net Tax Distribution Report*. State of Arkansas. <http://www.dfa.arkansas.gov/offices/exciseTax/salesanduse/Documents/localTaxDistribution2013.pdf>. Accessed May 6, 2014.

———. 2013b. *What's New for Sales Tax in 2013*. <http://www.dfa.arkansas.gov/offices/exciseTax/salesanduse/Documents/whatsnew2013.pdf>. Accessed May 6, 2014.

BEA (U.S. Bureau of Economic Analysis). 2013a. "CA04 Personal income summary, 2012." <http://www.bea.gov>.

———. 2013b. "Table 2.3 Final Demand Employment Multipliers—industry aggregations." Regions: Arkansas (Type II), Oklahoma (Type II), Tennessee (Type II), Texas (Type II). Series: 2010 U.S. Annual I-O data and 2010 Regional Data. <http://www.bea.gov>.

———. 2012. "Total full-time and part-time employment by industry, 2001 and 2011." Table CA25N. <http://www.bea.gov>.

BLM (Bureau of Land Management). 2013. *Final Environmental Impact Statement for the Gateway West Transmission Line Project. Wyoming and Idaho*. U.S. Department of the Interior, Wyoming State Office. April. <http://www.blm.gov/wy/st/en/info/NEPA/documents/cfo/gateway-west/FEIS.html>. Accessed July 8, 2014.

BLS (U.S. Bureau of Labor Statistics). 2014a. "Labor Force Data by County, 2013 Annual Averages." <http://www.bls.gov/>. Accessed July 7, 2014.

———. 2014b. "Labor Force Data by State, 2013 Annual Averages." <http://www.bls.gov/>. Accessed July 7, 2014.

———. 2012. "May 2012 National Industry-Specific Occupational Employment and Wage Estimates.". Data collected from "Annual Mean Wage" column. <http://www.bls.gov/oes/current/naics4_237100.htm>. Accessed July 9, 2014.

Bottemiller, S.C.; Cahill, J.M.; and Cowger, J.R. 2000. “Impacts on Residential Property Values along Transmission Lines. An Update of Three Pacific Northwest Metropolitan Areas.” *Right of Way*. July/August. <https://www.irwaonline.org/EWEB/upload/0700c.pdf>. Accessed July 8, 2014.

CBER (Center for Business and Economic Research). 2013. “Tennessee County Population Projections 2011–2064.” University of Tennessee. Data from 2020 and 2040 projections for Shelby and Tipton counties and also the State of Tennessee. <http://tndata.utk.edu/sdcdemographics.htm>. Accessed April 18, 2014.

———. 2012. *Revisiting the Economic Impact of the Natural Gas Activity in the Fayetteville Shale: 2008-2012*. Sam M. Walton College of Business. May. <http://cber.uark.edu/files/Revisiting_the_Economic_Impact_of_the_Fayetteville_Shale.pdf>. Accessed July 22, 2015.

Chalmers, J.A. 2012. “High-Voltage Transmission Lines and Rural, Western Real Estate Values.” *The Appraisal Journal*. Winter. 30-45. <http://www.concernedcitizensmontana.net/Publish/AU_TAJ_WI12_Feature_HighVoltage_Lines.pdf>. Accessed July 22, 2015.

Chalmers, J.A. and Voorvaart, F.A. 2009. “High-Voltage Transmission Lines: Proximity, Visibility, and Encumbrance Effects.” *The Appraisal Journal*. Summer. 227-245 <http://www.thefreelibrary.com/High-voltage+transmission+lines%3a+proximity%2c+visibility%2c+and...-a0205745757>. Accessed October 3, 2014.

Chapman, D. 2005. “Transmission Lines and Industrial Property Value.” *Right of Way*. November/December, pp. 20-27. <https://www.irwaonline.org/eweb/upload/ROW%20Archives%207-05%20thru%207-06/1105/Transmission%20Lines%20&%20Industrial%20Property%20Value.pdf>. Accessed July 8, 2014.

Clean Line. 2014a. *Responses to Department of Energy Data Request (dated January 20, 2014) Comments on Socioeconomics and Environmental Justice Technical Report*. February 28. Prepared for the Department of Energy pursuant to 10 CFR 1021.215(b)(2). (Available on EIS Reference CD.)

———. 2014b. *Wind Generation Technical Report for the Plains and Eastern Transmission Line Project*. March. Prepared for the Department of Energy pursuant to 10 CFR 1021.215(b)(2). (Available on EIS Reference CD.)

———. 2013. *Socioeconomics and Environmental Justice Technical Report for the Plains and Eastern Transmission Line Project*. December. Prepared for the Department of Energy pursuant to 10 CFR 1021.215(b)(2). (Available on EIS Reference CD.)

Colwell, P.F. 1990. “Power Lines and Land Value.” *Journal of Real Estate Research*. 5(1):11--127. <http://aux.zicklin.baruch.cuny.edu/jrer/papers/pdf/past/vol05n01/v05p117.pdf>. Accessed July 8, 2014.

Cowger, J.R.; Bottemiller, S.C.; and Cahill, J.M. 1996. “Transmission Line Impact on Residential Property Values. A Study of Three Pacific Northwest Metropolitan Areas.” *Right of Way*. September/October. <http://www.irwaonline.org/eweb/upload/0996c.pdf>. Accessed July 8, 2014.

Delaney, C.J. and Timmons, D. 1992. “High Voltage Power Lines: Do They Affect Residential Property Value?” *Journal of Real Estate Research*. 7(3):315-329. <http://aux.zicklin.baruch.cuny.edu/jrer/papers/pdf/past/vol07n03/v07p315.pdf>. Accessed July 8, 2014.

Des Rosiers, F. 2002. “Power Lines, Visual Encumbrance and House Values: A Microspatial Approach to Impact Measurement.” *Journal of Real Estate Research* 23(3):275-301. <http://aux.zicklin.baruch.cuny.edu/jrer/papers/pdf/past/vol23n03/05.275_302.pdf>. Accessed July 8, 2014.

Fleming, M.M. 2013. “Growing pains in rural Oklahoma: Interim study addresses lack of housing.” *The Journal Record*. October 8. <http://www.predci.com/index.php/component/content/article/99-growing-pains-in-rural-oklahoma-interim-study-addresses-lack-of-housing>. Accessed July 8, 2014.

Hamilton, S.W. and Schwann, G.M. 1995. “Do High Voltage Electric Transmission Lines Affect Property Value?” *Land Economics* 71(4):436-44. <http://www.jstor.org/discover/10.2307/3146709?uid=3739520&uid=2&uid=4&uid=3739256&sid=21104273070647>. Accessed July 8, 2014.

Institute for Economic Advancement. 2012. “Vintage 2010 (based on Census 2010) Arkansas’ Single Age-Cohorts by Race and Hispanic Origin Population Projections by County and Planning and Development District 2011-2020.” University of Arkansas. <http://iea.ualr.edu/population-estimates-a-Projections.html>. Accessed July 7, 2014.

———. 2010. “Vintage 2000 (based on Census 2000) Time Series Extrapolations, 2005-2030.” University of Arkansa.s <http://iea.ualr.edu/population-estimates-a-Projections.html>. Accessed July 7, 2014.

Jackson, T. 2010. “Electric Transmission Lines: Is there an Impact on Rural Land Values?” *Right of Way*. November/December, pp 32-35. <http://www.real-analytics.com/Transmission%20Lines%20and%20Rural%20Land.pdf>. Accessed October 3, 2014.

Kresin, M. 2013. *Other Vacant Housing Units: 2000, 2005, and 2010*. Current Housing Reports. U.S. Department of Commerce, Economics and Statistics Administration. U.S. Census Bureau. <http://www.census.gov/prod/2013pubs/h121-13-01.pdf>. Accessed July 8, 2014.

Kroll, C. and Priestley, T. 1992. *The Effects of Overhead Transmission Lines on Property Values*. Prepared for the Edison Electric Institute Siting and Environmental Planning Task Force. Washington DC. July. 101 pp.<http://staff.haas.berkeley.edu/kroll/pubs/tranline.pdf>. Accessed July 8, 2014.

NEA (National Education Association). 2012. *Rankings & Estimates. Rankings of the States 2012 and Estimates of School Statistics 2013*. Table C-6. December. <http://www.nea.org/assets/docs/NEA-Rankings-and-Estimates-2013-2014.pdf>. Accessed May 6, 2014.

NREL (National Renewable Energy Laboratory). 2014. *Jobs and Economic Development Impacts (JEDI) Wind Model*. <http://www.nrel.gov/analysis/jedi/download.html>. Accessed July 8, 2014.

OMB (Office of Management and Budget). 2013. *Revised Delineations of Metropolitan Statistical Areas, Micropolitan Statistical Areas, and Combined Statistical Areas, and Guidance on Uses of the Delineations of these Areas*. OMB Bulletin No. 13-01. February 28. <http://www.whitehouse.gov/sites/default/files/omb/bulletins/2013/b13-01.pdf>. Accessed May 6, 2014.

OK Assessor. 2012. “Beaver County Levy Rates.” <http://beaver.oklahoma.usassessor.com/Shared/base/Levys/Levys.php>. Accessed May 6, 2014.

Oklahoma DOC (State of Oklahoma Department of Commerce). 2012. *2012 Demographic State of the State Report. Oklahoma State and County Population Projections through 2075*. Prepared by Steve Barker, MBA, Policy, Research and Economic Analysis Division. <http://www.okcommerce.gov/Libraries/Documents/Population-Projections-Report-_3648.pdf>. Accessed May 6, 2014.

Oklahoma SBE (State of Oklahoma State Board of Equalization). 2006. *Guidelines for Valuation of Railroad, Air Carrier and Public Service Property for Oklahoma State Board of Equalization*. April 4. <http://www.tax.ok.gov/advform/2011_Public_Service/Guide_Water.pdf>. Accessed July 8, 2014.

Oklahoma Tax Commission. 2013a. *July 2013 Sales Tax News Release*. <http://www.tax.ok.gov/NewsReleases/City-County20Sales20July202013.pdf>. Accessed October 21, 2013.

———. 2013b. *July 2013 Use Tax News Release*. <http://www.tax.ok.gov/NewsReleases/City-County20Use20July202013.pdf>. Accessed October 21, 2013.

Priestley, T. 2015. *Transmission Lines and Property Values: Briefing Paper*. Prepared for Clean Line Energy Partners LLC. Houston, Texas. CH2MHill. Los Angeles, California. April. <http://www.plainsandeasterncleanline.com/sites/plains_eastern/media/docs/Transmission_Lines_and_Property_Values_Briefing_Paper_041715__Final.pdf>. Accessed July 22, 2015.

Source Strategies (Source Strategies, Inc.). 2013a. “Texas Hotel Performance Report: 2013.” 3rd Quarter 2013 YTD: By County, by Metro by County. November 15. <http://www.sourcestrategies.org/texas/>.

———. 2013b. “Texas Hotel Report: 2013.” 2nd Quarter 2013 YTD: By Metro by County, by County, by County by City. August 19. <http://www.sourcestrategies.org/texas/>.

Tennessee Comptroller of the Treasury. 2013. “2012 Tennessee Property Tax Rates.” <http://www.comptroller.tn.gov/pa/LR.asp?W=12>. Accessed May 6, 2014.

Tennessee Department of Revenue. 2014a. Local Option Tax Rates. March 1. <http://www.tn.gov/revenue/tntaxes/salesanduse.shtml>.

———. 2014b. “Revenue Collections.” January. <http://www.tn.gov/revenue/pubs/2014/coll201401.pdf>. Accessed July 7, 2014.

Tennessee SBE (State of Tennessee State Board of Equalization). 2014. “Property Tax Overview.” <http://www.comptroller.tn.gov/sboe/sbptxov.asp>. Accessed May 6, 2014.

———. 2013. "Appraisal Ratios." May 9. <http://www.comptroller.tn.gov/sboe/ratio13.asp>. Accessed May 6, 2014.

Texas Comptroller of Public Accounts. 2014. "Texas Property Tax System." <http://www.window.state.tx.us/taxinfo/proptax/ptax5.html>. Accessed February 12, 2014.

———. 2013a. "County Sales and Use Tax." <http://www.window.state.tx.us/taxinfo/local/county.html>. Accessed February 12, 2014.

———. 2013b. "2012 County Rates and Levies." <http://www.window.state.tx.us/taxinfo/proptax/taxrates/>. Accessed February 12, 2014.

Texas State Data Center. 2012. *Texas Population Projections Program, Population Projections for the State of Texas and Counties*. <http://txsdc.utsa.edu/Data/TPEPP/Projections/Index.aspx>. Accessed May 6, 2014.

USCB (U.S. Census Bureau). 2014a. "Annual Estimates of the Resident Population for Counties: April 1, 2010 to July 1, 2012." Data collected for cited counties. <http://www.census.gov/popest/data/counties/totals/2012/CO-EST2012-01.html>. Accessed February 12, 2014.

———. 2014b. "ACS Demographic and Housing Estimates. 2008–2012 American Community Survey 5 Year Estimates." Table DP05. <http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_12_5YR_DP05&prodType=table>. Accessed February 7, 2014.

———. 2010. "Land Area." USA Counties Data File Downloads. <http://www.census.gov/support/USACdataDownloads.html#LND>. Accessed February 3, 2014.

———. 2002. Table CO-EST2001-12-05 – Time Series of Arkansas Intercensal Population Estimates by County: April 1, 1990 to April 1, 2000. <http://www.census.gov/popest/data/intercensal/st-co/files/CO-EST2001-12-05.pdf>. Accessed July 22, 2014.

USDA (U.S. Department of Agriculture). 2014. *2012 Census of Agriculture. State and County Profiles*. National Agricultural Statistics Service. <http://www.agcensus.usda.gov/Publications/2012/Online_Resources/County_Profiles/>. Accessed July 23, 2015.

———. 2013a. "Cash Rents by County 2013." <http://www.nass.usda.gov/Surveys/Guide_to_NASS_Surveys/Cash_Rents_by_County/index.asp>. Accessed July 22, 2014.

———. 2013b. *Land Values 2013 Summary*. August. <http://nass.usda.gov/Publications/Todays_Reports/reports/land0813.pdf>. Accessed July 8, 2014.

USDA ERS (U.S. Department of Agriculture Economic Research Service). 2008. "2004 County Typology Codes." July 1. <http://www.ers.usda.gov/data-products/county-typology-codes.aspx>. Accessed July 8, 2014.

6.2.3.14 Special Status Wildlife, Fish, Aquatic Invertebrate, and Amphibian Species

6.2.3.14.1 Special Status Terrestrial Wildlife Species References

50 CFR Part 22. "Eagle Permits." *Wildlife and Fisheries*. U.S. Fish and Wildlife Service. <http://www.ecfr.gov/cgi-bin/text-idx?SID=09d66537a14e73fe80204273d86de222&node=pt50.9.22&rgn=div5>.

50 CFR Part 402. "Interagency Cooperation—Endangered Species Act of 1973, As Amended." *Wildlife and Fisheries*. Joint Regulations (United States Fish and Wildlife Service, Department of the Interior and National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Department of Commerce); Endangered Species Committee Regulations. <http://www.ecfr.gov/cgi-bin/text-idx?SID=09d66537a14e73fe80204273d86de222&node=pt50.11.402&rgn=div5>.

78 FR 60023. "Endangered and Threatened Wildlife and Plants; Proposed Threatened Status for the Rufa Red Knot (*Calidris canutus rufa*); Proposed Rule." U.S. Fish and Wildlife Service. September 30, 2013. <http://www.gpo.gov/fdsys/pkg/FR-2013-09-30/pdf/2013-22700.pdf#page=1>.

78 FR 61045. "Endangered and Threatened Wildlife and Plants; 12-Month Finding on a Petition To List the Eastern Small-Footed Bat and the Northern Long-Eared Bat as Endangered or Threatened Species; Listing the Northern Long-Eared Bat as an Endangered Species; Proposed Rule." U.S. Fish and Wildlife Service. October 2, 2013. <http://www.gpo.gov/fdsys/pkg/FR-2013-10-02/pdf/2013-23753.pdf#page=1>.

78 FR 70103. "Endangered and Threatened Wildlife and Plants; Review of Native Species That are Candidates for Listing as Endangered or Threatened; Annual Notice of Findings on Resubmitted Petitions; Annual Description of Progress on Listing Actions; Proposed Rule." U.S. Fish and Wildlife Service. November 22, 2013. <http://www.gpo.gov/fdsys/pkg/FR-2013-11-22/pdf/2013-27391.pdf#page=1>.

79 FR 19974. "Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for the Lesser Prairie-Chicken." U.S. Fish and Wildlife Service, Department of the Interior. April 10, 2014. <http://www.gpo.gov/fdsys/pkg/FR-2014-04-10/pdf/2014-07302.pdf#page=2>.

79 FR 20074. "Endangered and Threatened Wildlife and Plants; Special Rule for the Lesser Prairie-Chicken; Final Rule." U.S. Fish and Wildlife Service. April 10, 2014. <http://www.gpo.gov/fdsys/pkg/FR-2014-04-10/pdf/2014-07298.pdf#page=2>.

79 FR 72449. "Endangered and Threatened Wildlife and Plants; Review of Native Species That Are Candidates for Listing as Endangered or Threatened; Annual Notice of Findings on Resubmitted Petitions; Annual Description of Progress on Listing Actions." U.S. Fish and Wildlife Service. December 5, 2014. <http://www.gpo.gov/fdsys/pkg/FR-2014-12-05/pdf/2014-28536.pdf>.

80 FR 17974. "Endangered and Threatened Wildlife and Plants; Threatened Species Status for the Northern Long-Eared Bat With 4(d) Rule." U.S. Fish and Wildlife Service. April 2, 2015. <http://www.gpo.gov/fdsys/pkg/FR-2015-04-02/pdf/2015-07069.pdf#page=2>.

16 USC §§ 668-668d. “Bald and Golden Eagle Protection Act” (Pub. L. 86-70) <http://www.law.cornell.edu/uscode/text/16/chapter-5A/subchapter-II>.

16 USC §§ 703-712. “Migratory Bird Treaty Act of 1918” (40 Stat. 755) <http://www.law.cornell.edu/uscode/text/16/chapter-7/subchapter-II>.

16 USC § 1531 *et seq*. “Endangered Species Act of 1973” (Pub. L. 93-205) <http://www.law.cornell.edu/uscode/pdf/lii_usc_TI_16_CH_35.pdf>.

Arkansas Code Annotated 15-45-301–306 (Title 15, Subtitle 4, Chapter 45, Subchapter 3). “Wildlife Resources.” <http://www.lexisnexis.com/hottopics/arcode/Default.asp>.

Oklahoma Statutes 29-5-412.1 (Title 29, Section 5-412.1). “Game and Fish.” <http://webserver1.lsb.state.ok.us/OK_Statutes/CompleteTitles/os29.rtf>.

Tennessee Code 70-1-101 (Title 70, Chapter 1, Section 101). “Construction of dates and provisions.” <http://www.lawserver.com/law/state/tennessee/tn-code/tennessee_code_70-1-101>.

Texas Administrative Code 31-65.171–65.177 (Title 31, Part 2, Chapter 65, Subchapter G). “Threatened and Endangered Nongame Species.” <http://info.sos.state.tx.us/pls/pub/readtac$ext.ViewTAC?tac_view=5&ti=31&pt=2&ch=65&sch=G&rl=Y>.

ANHC (Arkansas Natural Heritage Commission). 2013. Rare Species Search. Data search in project area. <http://www.naturalheritage.com/research-data/rarespecies-search.aspx>.

APLIC (Avian Power Line Interaction Committee). 2012. Reducing Avian Collisions with Power Lines – The State of the Art in 2012. Edison Electric Institute and APLIC. Washington, D.C. <http://www2010test.eei.org/resourcesandmedia/products/Pages/reducingaviancollisions.aspx>.

APLIC and USFWS (Avian Power Line Interaction Committee and U.S. Fish and Wildlife Service). 2005. *Avian Protection Plan Guidelines*. A joint document prepared by The Edison Electric Institute’s Avian Power Line Interaction Committee and U.S. Fish and Wildlife Service. <http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/APP/AVIAN%20PROTECTION%20PLAN%20FINAL%204%2019%2005.pdf>.

Arkansas State Parks. 2014. “Watchable Wildlife – Arkansas Birds.” <http://www.arkansasstateparks.com/things-to-do/wildlife/birding.aspx#.Uxc9kvldWtp>. Accessed March 5, 2014.

Bidwell, T.G.; Fuhlendorf, S.; Gillen, B.; Harmon, S.; Horton, R.; Manes, R.; Rodgers, R.; Sherrod, S.; and Wolfe, D. 2003. *Ecology and management of the lesser prairie-chicken in Oklahoma*. Oklahoma State University Extension Circular E-970. <http://www.fws.gov/southwest/es/oklahoma/documents/te_species/wind%20power/ecology%20and%20management%20of%20the%20lesser%20prairie%20chicken%20osu%20e_970web.pdf>. Accessed August 19, 2014.

Buehler, D.A. 2000. “Bald Eagle (*Haliaeetus leucocephalus*).” *The Birds of North America Online* (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology. <http://bna.birds.cornell.edu/bna/species/506>. Accessed August 4, 2014.

Caceres, C. M. and Barclay, R.M. 2000. “Myotis septentrionalis.” *Mammalian Species* 634:I-4. <http://www.science.smith.edu/departments/Biology/VHAYSSEN/msi/pdf/634_Myotis_septentrionalis.pdf>. Accessed September 25, 2014.

CEC (Commission for Environmental Cooperation). 2005. *Assessment of Avian Mortality from Collisions and Electrocutions*. CEC-700-2005-015. <http://www.altamontsrc.org/alt_doc/cec_june_2005_assessment_of_avian_mortality_from_collisions_and_electrocutions.pdf>. Accessed August 4, 2014.

Dinan, L.R.; Jorgensen, J.G.; Brown. M.B. 2012. “Interior least tern powerline collision on the Lower Platte River.” *The Prairie Naturalist* 44:109-110. <http://www.sdstate.edu/nrm/organizations/gpnss/tpn/upload/44_2_Dinan-et-al.pdf>. Accessed September 25, 2014.

Elmore, D.; Bidwell, T.; Ranft, R.; and Wolfe, D. 2009. *Habitat Evaluation Guide for the Lesser Prairie-Chicken*. Oklahoma Cooperative Extension Service, Division of Agricultural Sciences and Natural Resources, Oklahoma State University, Stillwater. 25 pp. <http://www.fws.gov/southwest/es/documents/R2ES/LitCited/LPC_2012/Elmore_et_al_2009.pdf>. Accessed July 24, 2015.

EPA (U.S. Environmental Protection Agency). 2012. “Level I Ecoregions Map.” <http://www.epa.gov/wed/pages/ecoregions/na_eco.htm>. Accessed August 4, 2014.

Executive Order 13186. “Responsibilities of Federal Agencies to Protect Migratory Birds.” January 10, 2001. (66 FR 3853). <http://www.gpo.gov/fdsys/pkg/FR-2001-01-17/pdf/01-1387.pdf>.

Fremling, C.R. and Johnson, D.K. 1989. *Recurrence of Hexagenia Mayflies Demonstrates Improved Water Quality in Pool 2 and Lake Pepin, Upper Mississippi River*. <http://link.springer.com/chapter/10.1007/978-94-009-2397-3_28>. Accessed August 4, 2014.

Graening, G.O.; Harvey, M.J.; Puckette, W.L.; Stark, R.C.; Sasse, D.B.; Hensley, S.L.; and Redman, R.K. 2011. *Conservation Status of the Endangered Ozark Big-eared Bat* (Corynorhinus townsendii ingens) – *A 34-year Assessment*. Publications of the Oklahoma Biological Survey. <http://digital.library.okstate.edu/obs/obsv11p001.pdf>. Accessed August 4, 2014.

Hagen, C. A.; Grisham, B.A.; Boal, C.W.; and Haukos, D.A. 2013. “A meta-analysis of lesser prairie-chicken nesting and brood-rearing habitats: Implications for habitat management.” *Wildlife Society Bulletin* 37(4):750-758. <http://onlinelibrary.wiley.com/doi/10.1002/wsb.313/abstract>. Accessed October 28, 2014.

Hagen, C.A.; Jamison, B. E.; Giesen, K.M.; and Riley, T.Z. 2004. “Guidelines for managing lesser prairie-chicken populations and their habitats.” *Wildlife Society Bulletin* 32:69-82.

<http://onlinelibrary.wiley.com/doi/10.2193/0091-7648(2004)32%5B69:GFMLPP%5D2.0.CO;2/abstract>. Accessed October 28, 2014.

Harrington, B.A. 2001. "Red Knot (*Calidris canutus*)." *The Birds of North America Online* (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology. <http://bna.birds.cornell.edu/bna/species/563>. Accessed August 4, 2014.

Henderson, I.G.; Langston, R.H.W.: and Clark, N.A. 1996. "The response of common terns (*Sterna hirundo*) to power lines: An assessment of risk in relation to breeding commitment, age and wind speed." *Biological Conservation* 77:185-192. <http://www.sciencedirect.com/science/article/pii/0006320795001441>. Accessed September 25, 2014.

Holloway, A.K. and Schnell, G.D. 1997. "Relationship between numbers of endangered American Burying Beetle, Nicrophorus americanus, Olivier (*Coleoptera: Silphidae*) and available food resources." *Biological Conservation* 81:145-152. <http://www.sciencedirect.com/science/article/pii/S0006320796001589>. Accessed August 4, 2014.

Jones, K.H. 2012. *Population survey of the interior least tern on the Mississippi River from Cape Girardeau, Missouri to Baton Rouge, Louisiana*. For the United States Army Corps of Engineers – Memphis District. <http://www.mvm.usace.army.mil/Portals/51/docs/Environmental/Least%20Tern%20Surveys/FinalPopulationSurveyfinal2012.pdf>. Accessed July 27, 2015.

Kochert, M.N.; Steenhof, K.; Mcintyre, L.; and Craig, E.H. 2002. "Golden Eagle (*Aquila chrysaetos*)." *The Birds of North America Online* (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology. <http://bna.birds.cornell.edu/bna/species/684>. Accessed September 13, 2013.

Lish, J.W. and Sherrord, S.K. 1986. "A history of bald eagle nesting activity in Oklahoma." In *Proceedings of Oklahoma Academy of Sciences* 66:15-20. <http://digital.library.okstate.edu/OAS/oas_pdf/v66/p15_20.pdf>. Accessed September 25, 2014.

Lomolino, M.V. and Creighton, J.C. 1996. "Habitat selection, breeding success and conservation of the endangered American Burying beetle *Nicrophorus americanus*." *Biological Conservation* 77:235-241. <http://www.sciencedirect.com/science/article/pii/0006320796000031>. Accessed August 4, 2014.

Lomolino, M.V.; Creighton, J.C.; Schnell, G.D.; and Certain, D.L. 1995. "Ecology and conservation of the endangered American burying beetles (Nicrophorus americanus)." *Conservation Biology* 9:605-614. <http://www.jstor.org/discover/10.2307/2386614?uid=3739520&uid=2&uid=4&uid=3739256&sid=21104449377367>. Accessed August 4, 2014.

Lott, C.A. 2006. *Distribution and abundance of the interior population of least tern (Sternula antillarum) 2005:* ERDC/EL TR-06-13. November. <http://el.erdc.usace.army.mil/elpubs/pdf/trel06-13.pdf>. Accessed August 7, 2014.

Lott, C.A.; Wiley, R.L.; Fischer, R.A.; Hartfield, P.D.; and Scott, J.M. 2013. "Interior Least Tern (Sternula antillarum) breeding distribution and ecology: implications for population-level studies and the evaluation of alternative management strategies on large, regulated rivers." *Ecology and Evolution* 3(10):3613-3627. <http://onlinelibrary.wiley.com/doi/10.1002/ece3.726/full>. Accessed October 3, 2014.

Martin, C.O. 2007. *Assessment of the Population Status of the Gray Bat* (Myotis grisescens). ERDC/EL TR-07-22. U.S. Army Corps of Engineers, Engineer Research and Development Center. <http://www.dtic.mil/cgi-bin/GetTRDoc?Location=U2&doc=GetTRDoc.pdf&AD=ADA473199>. Accessed August 4, 2014.

Martin, G.R. 2011. "Understanding bird collisions with man-made objects: a sensory ecology approach." *Ibis* 153:239-254. <http://onlinelibrary.wiley.com/doi/10.1111/j.1474-919X.2011.01117.x/full>. Accessed October 28, 2014.

McNeil, R.; Rodriguez, J.R.; and Quellet, H. 1985. "Bird mortality at a power transmission line in northeastern Venezuela." *Biological Conservation* 31:153-165. <http://www.sciencedirect.com/science/article/pii/0006320785900461>. Accessed August 5, 2014.

Nagorsen, D.W. and Brigham, R.M. 1993. *Bats of British Columbia*. UBC Press, Vancouver, British Columbia, Canada. <http://books.google.com.my/books?id=J9MpeByPvjwC&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false>. Accessed September 25, 2014.

ODWC (Oklahoma Department of Wildlife Conservation). 2014a. "Optima Wildlife Management Area." <http://www.wildlifedepartment.com/facts_maps/wma/optima.htm>. Accessed August 5, 2014.

———. 2014b. "Canton Lake Wildlife Management Area." <http://www.wildlifedepartment.com/facts_maps/wma/canton.htm>. Accessed August 5, 2014.

———. 2013. "Oklahoma's Threatened, Endangered and Rare Species." Data search in project area. <http://www.wildlifedepartment.com/wildlifemgmt/endangeredspecies.htm>. Accessed August 4, 2014.

———. 2012. *Oklahoma Lesser Prairie Chicken Conservation Plan*. <http://www.wildlifedepartment.com/wildlifemgmt/lepc/Final_OK_LEPC_Mgmt_Plan_23Oct2012.pdf>. Accessed August 4, 2014.

———. 2011a. "Eagles in Oklahoma." <https://www.wildlifedepartment.com/wildlifemgmt/eaglesinok.htm>. Accessed March 5, 2014.

———. 2011b. "Eagles Viewing Sites." <https://www.wildlifedepartment.com/wildlifemgmt/eaglestours.htm>. Accessed March 5, 2014.

———. 2011c. "Golden Eagle Species Profile." <http://www.wildlifedepartment.com/wildlifemgmt/goldenprofile.htm>. Accessed September 13, 2013.

Permian Basin Petroleum Assn v. Department of Interior, No. MO–14–CV–50, 2015 WL 5192526 (W.D. Tex. Sept. 15, 2015). "Order Granting Plaintiffs' Motion for Summary Judgment & Order Granting in Part and Denying in Part Defendants' Motion for Summary Judgment." U.S. District Court, Western District of Texas, Midland-Odessa Division.

Pitman, J.C.; Hagen, C.A.; Robel, R.J.; Loughin, T.M.; and Applegate, R.D. 2005. "Location and success of lesser prairie-chicken nests in relation to vegetation and human disturbance." *Journal of Wildlife Management* 69:1259-1269. <http://www.fws.gov/southwest/es/documents/R2ES/LitCited/LPC_2012/Pitman_et_al_2005.pdf>. Accessed September 25, 2014.

Pruett, C.L.; Patten, M.A.; and Wolfe, D.H. 2009. "Avoidance Behavior by Prairie Grouse: Implications for Development of Wind Energy." *Conservation Biology* 23(5):1253-1259. <http://www.ncbi.nlm.nih.gov/pubmed/19500121>. Accessed October 28, 2014.

Robbins, M.B. and Dale B.C. 1999. "Sprague's pipit (*Anthus spragueii*)." *The Birds of North America Online* (A. Poole, Ed.), Ithaca: Cornell lab of Ornithology. <http://bna.birds.cornell.edu/bna/species/439>. Accessed September 13, 2013.

Robel, R.J.; Harrington, Jr., J.A.; Hagen, C.A.; Pitman, J.C.; and Reker, R.R. 2004. "Effect of energy development and human activity on the use of sand sagebrush habitat by Lesser Prairie-Chickens in southwestern Kansas." *Transactions of the North American Wildlife and Natural Resources Conference* 69:251-266. <http://kec.kansas.gov/wptf/robertrobel.pdf>. Accessed September 25, 2014.

Savereno, A.J.; Savereno, L.A.; Boettcher, R.; and Haig, S.M. 1996. "Avian behavior and mortality at power lines in coastal South Carolina." *Wildlife Society Bulletin* 24(4): 636-648. <http://pubs.er.usgs.gov/publication/70017691>. Accessed September 25, 2014.

Sikes, D.S. and Raithel, C.J. 2002. "A review of hypotheses of decline of the endangered American burying beetle (Silphidae: *Nicrophorus americanus* Olivier)." *Journal of insect Conservation* 6(2),103-113. <http://www.researchgate.net/publication/263564786_A_Review_of_Hypotheses_of_Decline_of_the_Endangered_American_Burying_Beetle_%28Silphidae_Nicrophorus_americanus_Olivier%29>. Accessed September 25. 2014.

Stehn, T.V. and Wassenich, T. 2006. "Whooping crane collisions with power lines: an issue paper." In *Proceedings of the North American Crane Workshop* 10:25-36. <http://www.savingcranes.org/images/stories/pdf/conservation/nacwg_10_proceedings.pdf>. Accessed September 25, 2014.

Tacha, M.; Bishop, A.; and Brei, J. 2010. "Development of the Whooping Crane Tracking Project Geographic Information System." In *Proceedings of the North American Crane Workshop* 11: 98-104. <https://www.savingcranes.org/images/stories/pdf/conservation/eleventh_proceedings.pdf>. Accessed September 25, 2014.

TDEC (Tennessee Department of Environment and Conservation). 2014. "Natural Heritage Inventory Program." Data search in project area. <http://tn.gov/environment/natural-areas/natural-heritage-inventory-program.shtml>. Accessed August 4, 2014.

Thompson, B.C.; Jackson, J.A.; Burger, J.; Hill, L.A.; Kirsch, E.M.; and Atwood, J.L. 1997. “Least Tern (*Stemula antillarum*).” *The Birds of North America Online* (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology. <http://bna.birds.cornell.edu/bna/species/290/articles/introduction>. Accessed August 4, 2014.

TPWD (Texas Parks and Wildlife Department). 2013. “Rare, Threatened, and Endangered Species of Texas by County.” Data search in project area. <http://www.tpwd.state.tx.us/landwater/land/maps/gis/ris/endangered_species/>. Accessed August 2014.

Tulsa Audubon Society. 2009. “Greenleaf State Park – Muskogee County, Oklahoma.” <http://www.tulsaaudubon.org/guides/greenleaf-state-park.htm>. Accessed August 4, 2014.

Tuttle, G. MD. 1976. “Population Ecology of the Gray Bat (*Myotis grisescens*): Factors Influencing Growth and Survival of Newly Volant Young.” *Ecology* 57(3):587. <http://www.jstor.org/discover/10.2307/2424705?uid=3739520&uid=2&uid=4&uid=3739256&sid=21104449057717>. Accessed August 4, 2014.

———. 1975. “Population Ecology of the Gray Bat (*Myotis grisescens*): Factors Influencing Early Growthand Development.” *Occasional Papers of the Museum of Natural History, University of Kansas*. 36:2. <http://www.biodiversitylibrary.org/page/4467773#page/7/mode/1up>.

Tyler, N.; Stokkan, K.-A.; Hogg, C.; Nellemann, C.; Vistnes, A.-I.; and Jeffery, G. 2014. “Ultraviolet Vision and Avoidance of Power Lines in Birds and Mammals.” *Conservation Biology* 28:630-631. <http://onlinelibrary.wiley.com/doi/10.1111/cobi.12262/full>. Accessed October 28, 2014.

USFWS (U.S. Fish and Wildlife Service). 2015. “American Burying Beetle: Additional Information, ABB Location Data, 2013.” <http://www.fws.gov/southwest/es/oklahoma/ABB_Add_Info.htm>. Accessed June 26, 2015.

———. 2014a. “Information, Planning, and Conservation System (IPaC).” Environmental Conservation Online System. <http://ecos.fws.gov/ipac/wizard/chooseLocation!prepare.action;jsessionid=C7829CCD4B2142FF6B226E86D96A72AE>. Accessed August 4, 2014.

———. 2014b. *2014 Range-wide Indiana Bat Summer Survey Guidelines*. January 13. <http://www.fws.gov/midwest/Endangered/mammals/inba/surveys/pdf/2014IBatSummerSurveyGuidelines13Jan2014.pdf>. Accessed August 4, 2014.

———. 2014c. *Northern Long-Eared Bat Interim Conference and Planning Guidance – USFWS Regions 2, 3, 4, 5, & 6*. January 6. <http://www.fws.gov/midwest/endangered/mammals/nlba/pdf/NLEBinterimGuidance6Jan2014.pdf>. Accessed August 4, 2014.

———. 2014d. *Master Species Information for Special Status Species for the Plains & Eastern Clean Line Project*. Prepared for the U.S. Department of Energy. (Available on EIS Reference CD.)

———. 2014e. *American Burying Beetle Impact Assessment for Project Reviews*. Southwest Region, Oklahoma Ecological Services Field Office, March 6. <http://www.fws.gov/southwest/es/oklahoma/documents/abb/abb%20impact%20assessment%20for%20project%20reviews_6mar2014.pdf>. Accessed September 17, 2014.

———. 2013a. *Interior Least Tern* (Sternula antillarum) *5-Year Review: Summary and Evaluation*. Southeast Region, Mississippi Field Office. <http://www.fws.gov/southeast/5yearReviews/5yearreviews/interiorLeastTern5yrReivew102413.pdf>. Accessed September 17, 2014.

———. 2013b. *Ozark Plateau National Wildlife Refuge*. <http://www.fws.gov/refuge/ozark_plateau/>. Accessed August 4, 2014.

———. 2012a. "American Burying Beetle (*Nicrophorus americanus*)." South Dakota Field Office. <http://www.fws.gov/southdakotafieldoffice/beetle.htm>. Accessed August 4, 2014.

———. 2012b*. White-nose syndrome: The devastating disease of hibernating bats in North America*. <http://www.whitenosesyndrome.org/sites/defaultffiles/resource/white-nose_fact_sheet_9-2012.pdf>. Accessed August 4, 2014.

———. 2012c. *Land-Based Wind Energy Guidelines*. March 23. <http://www.fws.gov/windenergy/docs/weg_final.pdf>. Accessed August 4, 2014.

———. 2012d. *Whooping Crane* (Grus americana) *Five-year Review: Summary and Evaluation*. <http://ecos.fws.gov/docs/five_year_review/doc3977.pdf>. Accessed July 24, 2015.

———. 2011a. *Species assessment and Listing Priority Assignment form: Sprague's pipit* (Anthus spragueii). May 31. <http://pbadupws.nrc.gov/docs/ML1227/ML12276A159.pdf>. Accessed August 5, 2014.

———. 2011b. *Gray Bat. Oklahoma Ecological Services Field Office*. <http://www.fws.gov/southwest/es/oklahoma/Documents/TE_Species/Species%20Profiles/Gray%20Bat.pdf>. Accessed July 24, 2015.

———. 2009a. *Gray Bat* (Myotis grisescens) *5-Year Review: Summary and Evaluation*. <http://www.fws.gov/ecos/ajax/docs/five_year_review/doc2625.pdf>. Accessed August 4, 2014.

———. 2009b. *Indiana Bat* (Myotis sodalis) *5-Year Review: Summary and Evaluation*. <http://www.fws.gov/midwest/endangered/recovery/5yr_rev/pdf/INBA5Yr30Sept2009.pdf>. Accessed August 4, 2014.

———. 2009c. *Piping Plover* (*Charadrius melodus*) *Spotlight Species Action Plan for the threatened Atlantic Coast and Northern Great Plains populations*. <http://www.fws.gov/ecos/ajax/docs/action_plans/doc3033.pdf>. Accessed August 4, 2014.

———. 2009d. *Whooping Cranes and Wind Development — an Issue Paper by Regions 2 and 6*. <http://www.fws.gov/southwest/es/oklahoma/documents/te_species/wind%2Opower/whooping%2Ocrane%20and%20wind%20development%2Ofws%20issue%20paper%20-%20final%20%20april%202009.pdf>. Accessed August 4, 2014.

———. 2009e. *Piping Plover* (Charadrius melodus) *5-Year Review: Summary and Evaluation*. <http://ecos.fws.gov/docs/five_year_review/doc3009.pdf>. Accessed July 24, 2015.

———. 2008a. *American Burying Beetle* (Nicrophorus americanus) *5-Year Review: Summary and Evaluation*. <http://www.fws.gov/northeast/EcologicalServices/pdf/endangered/American%20Burying%20Beetle%205%20Year%20Review.pdf>. Accessed August 4, 2014.

———. 2008b. *Ozark Big-eared Bat* (Corynorhinus townsendii ingins) *5-Year Review: Summary and Evaluation*. <http://ecos.fws.gov/docs/five_year_review/doc1912.pdf>. Accessed August 4, 2014.

———. 2008c. *Florida Panther Recovery Plan*. November. <http://www.fws.gov/verobeach/MammalsPDFs/FinalizedFloridaPantherRecoveryPlan081218.pdf>. Accessed August 4, 2014.

———. 2007a. *Indiana Bat* (Myotis sodalis) *Draft Recovery Plan: First Revision*. <http://ecos.fws.gov/docs/recovery_plan/070416.pdf>. Accessed August 4, 2014.

———. 2007b. *National Bald Eagle Management Guidelines*. <http://www.fws.gov/midwest/eagle/pdf/NationalBaldEagleManagementGuidelines.pdf>. Accessed August 4, 2014.

———. 1997. *Gray Bat* (Myotis grisescens) *Fact Sheet*. <http://www.fws.gov/midwest/endangered/mammals/pdf/gray-bat.pdf>. Accessed August 4, 2014.

———. 1990. *Recovery plan for the interior population of the least tern* (Sterna antillarum). September. <http://ecos.fws.gov/docs/recovery_plan/900919a.pdf>. Accessed August 4, 2014.

USGS (U.S. Geological Survey) 2014. "Biodiversity Information Serving Our Nation (BISON) Database. Data search in project areas." <http://bison.usgs.ornl.gov/#home>. Accessed September 25, 2014.

Van Pelt, W.E.; Kyle, S.; Pitman, J.; Klute, D.; Beauprez, G.; Schoeling, D.; Janus, A.; and Haufler, J. 2013. *The Lesser Prairie-Chicken Range-wide Conservation Plan*. Western Association of Fish and Wildlife Agencies. Cheyenne, Wyoming. <http://www.wafwa.org/documents/2013LPCRWPfinalfor4drule12092013.pdf>. Accessed August 7, 2014.

Winder, V.L.; McNew, L.B.; Gregory, A.J.; Hunt, L.M.; Wisely, S.M.; and Sandercock, B.K. 2014. "Space use of female Greater Prairie-Chickens in response to wind energy development." *Ecosphere* 5(1):Article 3. <http://www.k-state.edu/bsanderc/2014ecosphere.pdf>.

Wolfe, D.H.; Patten, M. A.; Shochat, E.; Pruett, C.L.; and Sherrod, S.K. 2007. “Causes and Patterns of Mortality in Lesser Prairie-Chickens *Tympanuchus pallidicinctus* and Implications for Management.” *Wildlife Biology* 13(sp1):95-104. <http://www.bioone.org/doi/abs/10.2981/0909-6396%282007%2913%5B95%3ACAPOMI%5D2.0.CO%3B2>. Accessed September 17, 2014.

6.2.3.14.2 Special Status Fish, Aquatic Invertebrate, and Amphibian Species References

50 CFR Part 402. “Interagency Cooperation—Endangered Species Act of 1973, As Amended.” *Wildlife and Fisheries*. Joint Regulations (United States Fish and Wildlife Service, Department of the Interior and National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Department of Commerce); Endangered Species Committee Regulations. <http://www.ecfr.gov/cgi-bin/text-idx?SID=09d66537a14e73fe80204273d86de222&node=pt50.11.402&rgn=div5>.

41 FR 24062. “Endangered and Threatened Wildlife and Plants: Endangered Status for 159 Taxa of Animals.” U.S. Fish and Wildlife Service. June 14, 1976. <http://ecos.fws.gov/docs/federal_register/fr103.pdf>. Accessed October 31, 2014.

75 FR 17758. “Approved Recovery Plan for the Scaleshell Mussel”. U.S. Fish and Wildlife Service. April 7, 2010. <http://www.gpo.gov/fdsys/pkg/FR-2010-04-07/pdf/2010-7849.pdf#page=1>.

77 FR 8631. “Endangered and Threatened Wildlife and Plants; Determination of Endangered Status for the Rayed Bean and Snuffbox Mussels Throughout Their Ranges; Final Rule.” U.S. Fish and Wildlife Service. February 14, 2012. <http://www.gpo.gov/fdsys/pkg/FR-2012-02-14/pdf/2012-2940.pdf>.

77 FR 14914. “Endangered and Threatened Wildlife and Plants; Determination of Endangered Status for the Sheepnose and Spectaclecase Mussels Throughout Their Range; Final Rule.” U.S. Fish and Wildlife Service. March 13, 2012. <http://www.gpo.gov/fdsys/pkg/FR-2012-03-13/pdf/2012-5603.pdf>.

77 FR 63469. “Endangered and Threatened Wildlife and Plants; Proposed Endangered Status for the Neosho Mucket, Threatened Status for the Rabbitsfoot, and Designation of Critical Habitat for Both Species; Proposed Rule.” U.S. Fish and Wildlife Service. October 16, 2012. <http://www.gpo.gov/fdsys/pkg/FR-2012-10-16/pdf/2012-24151.pdf#page=1>.

77 FR 63604. “Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Cumberland Darter, Rush Darter, Yellowcheek Darter, Chucky Madtom, and Laurel Dace; Final Rule.” U.S. Fish and Wildlife Service. October 16, 2012. <http://www.gpo.gov/fdsys/pkg/FR-2012-10-16/pdf/2012-24468.pdf#page=2>.

80 FR 24692. “Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for Neosho Mucket and Rabbitsfoot.” U.S. Fish and Wildlife Service. April 30, 2015. <http://www.gpo.gov/fdsys/pkg/FR-2015-04-30/pdf/2015-09200.pdf#page=2>.

16 USC § 1531 *et seq*. "Endangered Species Act of 1973" (Pub. L. 93-205) <http://www.law.cornell.edu/uscode/pdf/lii_usc_TI_16_CH_35.pdf>.

Arkansas Code Annotated 15-45-301–306 (Title 15, Subtitle 4, Chapter 45, Subchapter 3). "Wildlife Resources." <http://www.lexisnexis.com/hottopics/arcode/Default.asp>.

Oklahoma Administrative Code Title 800. "Department of Wildlife Conservation." <http://www.oar.state.ok.us/oar/codedoc02.nsf/frmMain?OpenFrameSet&Frame=Main&Src=_75tnm2shfcdnm8pb4dthj0chedppmcbq8dtmmak31ctijujrgcln50ob7ckj42tbkdt374obdcli00_>.

Oklahoma Statutes 29-5-412.1 (Title 29, Section 5-412.1). "Game and Fish." <http://webserver1.lsb.state.ok.us/OK_Statutes/CompleteTitles/os29.rtf>.

Tennessee Code 70-1-101 (Title 70, Chapter 1, Section 101). "Construction of dates and provisions." <http://www.lawserver.com/law/state/tennessee/tn-code/tennessee_code_70-1-101>.

Texas Administrative Code 31-65.171–65.177 (Title 31, Part 2, Chapter 65, Subchapter G). "Threatened and Endangered Nongame Species." <http://info.sos.state.tx.us/pls/pub/readtac$ext.ViewTAC?tac_view=5&ti=31&pt=2&ch=65&sch=G&rl=Y>.

AGFC (Arkansas Game and Fish Commission). 2011a. "Species and Habitats – Ozark Cavefish." <http://www.agfc.com/species/Pages/SpeciesEndangeredDetails.aspx?Title=Ozark%20Cavefish>.

———. 2011b. "Species and Habitats – Fat Pocketbook." <http://www.agfc.com/species/Pages/SpeciesEndangeredDetails.aspx?Title=Fat%20Pocketbook>.

ANHC (Arkansas Natural Heritage Commission). 2014. "Rare Species Search Engine." Data search in project area. <http://www.naturalheritage.com/research-data/rarespecies-search.aspx>.

Bruenderman, S.; Sternburg, J.; and Barnhart, C. 2002. *Missouri Freshwater Mussels*. Missouri Department of Conservation. <http://molluskconservation.org/Library/Maps/pdfs/Missouri-freshwater.pdf>. Accessed October 29, 2014.

Clean Line. 2013. *Fish, Wildlife, and Vegetation Technical Report for the Plains and Eastern Transmission Line Project*. December. Prepared for the Department of Energy pursuant to 10 CFR 1021.215(b)(2). (Available on EIS Reference CD.)

CRMWA (Canadian River Municipal Water Authority). 2005. *Arkansas River Shiner* (Notropis girardi) *Management Plan for the Canadian River from U.S. Highway 54 at Logan, New Mexico to Lake Meredith, Texas*. <http://www.ose.state.nm.us/PDF/ISC/BasinsPrograms/Canadian/UteShorelineAppendices/J-c-ArkansasRiverShinerMgmtPlan.pdf>.

Cummings, K. and Cordeiro, J. 2012. *Lampsilis rafinesqueana*. "The IUCN Red List of Threatened Species." Version 2015.2. <http://www.iucnredlist.org/details/11242/0>. Accessed July 1, 2015.

Eberle, M.E. and Stark, W.J. 2000. „Status of the Arkansas darter in south-central Kansas and adjacent Oklahoma." *Prairie Naturalist*, 32(2):103-113. (Version 07JAN2002). <http://www.npwrc.usgs.gov/resource/fish/darter/index.htm>. Accessed August 5, 2014.

EPA (U.S. Environmental Protection Agency). 2007. *Appendix C: Status and Life History of the Pallid Sturgeon (*Scaphirhynchus albus*).* <http://www.epa.gov/espp/litstatus/effects/appendix_c_life_history_sturgeon.pdf>. Accessed August 5, 2014.

Gordon, M.E. and Layzer, J.B. 1989. *Mussels (*Bivalvia: Unionoidea*) of the Cumberland River: review of life histories and ecological relationships*. U.S. Fish and Wildlife Service Biological Report, 89(15). 99 pp. <http://searchworks.stanford.edu/view/2712802>. Accessed September 29, 2014.

Harris, J.L.; Farris, J.L.; and Christian, A.D. 2007. *Status of Epioblasma florentina curtisii (Frierson and Utterback 1916), Curtis Pearlymussel, in Arkansas*. Final Report. December 31. (Available on EIS Reference CD.)

Jennings, S. 1998. *Needs in the management of native freshwater mussels in the national park system.* Technical Report NPS/NRWRD/NRTR-97-147. National Park Service. December. <https://ia601507.us.archive.org/13/items/needsinmanagemen00jenn/needsinmanagemen00jenn.pdf>. Accessed August 5, 2014.

Johnson, T.R. 2000. "Family Cryptobranchidae." *The Amphibians and Reptiles Of Missouri*. 2nd Ed. Missouri Department of Conservation. Jefferson City, Missouri. (Available on EIS Reference CD.).

KDWPT (Kansas Department of Wildlife, Parks, and Tourism). 2011. "Arkansas Darter (*Etheostoma cragini*)." <http://kdwpt.state.ks.us/news/layout/set/print/Services/Threatened-and-Endangered-Wildlife/Threatened-and-Endangered-Species/Species-Information/ARKANSAS-DARTER>. Accessed August 5, 2014.

MDC (Missouri Department of Conservation). 2014a. "Ozark Cavefish." <http://mdc.mo.gov/discover-nature/field-guide/ozark-cavefish>. Accessed August 5, 2014.

———. 2014b. "Hellbender." <http://mdc.mo.gov/discover-nature/field-guide/hellbender>. Accessed October 29, 2014.

———. 2014c. *Best Management Practices: Pink Mucket (*Lampsilis abrupta*).* <http://mdc.mo.gov/sites/default/files/resources/2010/08/9560_6500.pdf>. Accessed August 5, 2014.

———. 2014d. *Best Management Practices: Scaleshell Mussel (*Leptodea leptodon). <http://mdc.mo.gov/sites/default/files/resources/2010/08/9572_6509.pdf>. Accessed August 5, 2014.

———. 2000. *Curtis pearlymussel: Best Management Practices*. <http://mdc.mo.gov/sites/default/files/resources/2010/08/9565_6505.pdf>. Accessed October 31, 2014.

Miller, A.C. and Payne, B.S. 2005. "The curious case of the fat pocketbook mussel, *Potamilus capax*." *Endangered Species Update*, 22(2):61-70.

<http://www.thefreelibrary.com/The+curious+case+of+the+fat+pocketbook+mussel%2c+Potamilus+capax.-a0137756040>. Accessed September 29, 2014.

Natureserve. 2014a. “Arkansas Darter.” <http://explorer.natureserve.org/servlet/NatureServe?searchSciOrCommonName=Arkansas+darter+&x=8&y=11>. Accessed February 8, 2014.

———. 2014b. Arkansas River Shiner. <http://www.natureserve.org/explorer/servlet/NatureServe?searchSciOrCommonName=Arkansas+River+shiner>. Accessed February 8, 2014.

———. 2014c. “Fat Pocketbook.” <http://www.natureserve.org/explorer/servlet/NatureServe?searchSciOrCommonName=fat+pocketbook>. Accessed February 8, 2014.

———. 2014d. “Neosho mucket.” <http://www.natureserve.org/explorer/servlet/NatureServe?searchSciOrCommonName=Neosho+mucket>. Accessed February 8, 2014.

———. 2014e. “’Ozark Cavefish.” <http://www.natureserve.org/explorer/servlet/NatureServe?searchSciOrCommonName=Ozark+cavefish>. Accessed February 8, 2014.

———. 2014f. “Pallid Sturgeon.” <http://www.natureserve.org/explorer/servlet/NatureServe?searchSciOrCommonName=pallid+sturgeon>. Accessed February 8, 2014.

———. 2014g. “Pink Mucket.” <http://www.natureserve.org/explorer/servlet/NatureServe?searchSciOrCommonName=pink+mucket>. Accessed February 8, 2014.

———. 2014h. “Rabbitsfoot.” <http://www.natureserve.org/explorer/servlet/NatureServe?searchSciOrCommonName=rabbitsfoot>. Accessed February 8, 2014.

———. 2014i. “Scaleshell Mussel.” <http://www.natureserve.org/explorer/servlet/NatureServe?searchSciOrCommonName=scaleshell>. Accessed February 8, 2014.

———. 2014j. “Speckled Pocketbook.” <http://www.natureserve.org/explorer/servlet/NatureServe?searchSciOrCommonName=speckled+pocketbook>. Accessed February 8, 2014.

———. 2014k. “Spectaclecase.” <http://www.natureserve.org/explorer/servlet/NatureServe?searchSciOrCommonName=spectaclecase>. Accessed February 8, 2014.

———. 2014l. “Yellowcheek Darter.” <http://www.natureserve.org/explorer/servlet/NatureServe?searchSciOrCommonName=yellowcheek+darter> Accessed February 8, 2014.

———. 2014m. “Blackside Darter.” <http://explorer.natureserve.org/servlet/NatureServe?searchSciOrCommonName=Percina%20maculata>. Accessed April 8, 2014.

———. 2014n. “Longnose Darter.” <http://explorer.natureserve.org/servlet/NatureServe?searchSciOrCommonName=Percina%20nasuta>. Accessed April 8, 2014.

———. 2014o. “Blue Sucker.” <http://explorer.natureserve.org/servlet/NatureServe?searchSciOrCommonName=Cycleptus%20elongatus>. Accessed April 8, 2014.

———. 2014p. “Curtis’ Pearlymussel.” <http://explorer.natureserve.org/servlet/NatureServe?searchSciOrCommonName=curtis+pearlymussel&x=0&y=0>. Accessed October 31, 2014.

ODWC (Oklahoma Department of Wildlife Conservation). 2014. “Oklahoma’s Threatened, Endangered and Rare Species.” <http://www.wildlifedepartment.com/wildlifemgmt/endangeredspecies.htm>.

———. 2011a. “Neosho Mucket (*Lampsilis rafinesqueana*).” <http://wildlifedepartment.com/wildlifemgmt/endangered/mucket.htm>. Accessed August 5, 2014.

———. 2011b. “Black-sided Darter (*Percina maculata*).” <http://www.wildlifedepartment.com/wildlifemgmt/endangered/black_sided_darter.htm>. Accessed August 5, 2014.

Peterson, C.L. and Wilkinson, R.F. 1996. “Home range size of the hellbender (*Cryptobranchus alleganiensis*) in Missouri.” *Herpetological Review* 27(3):126-127. (Available on EIS Reference CD.)

Posey, B. and Irwin, K. 2012. “The Spectaclecase Mussel (*Cumberlandia monodonta*) in Arkansas.” *Life in the Rocks:* The Newsletter of the Arkansas Game and Fish Commission Nongame Aquatic Program, Volume. 15.03. July–September 2012. <http://www.agfc.com/resources/Publications/FishQtrly/LR2012Jul-Sep.pdf>. Accessed August 5, 2014.

TDEC (Tennessee Department of Environment and Conservation). 2014. “Natural Heritage Inventory Program.” Data search in project area. <http://tn.gov/environment/natural-areas/natural-heritage-inventory-program.shtml>. Accessed August 5, 2014.

TPWD (Texas Parks and Wildlife Department). 2014. “Rare, Threatened, and Endangered Species of Texas by County.” <http://www.tpwd.state.tx.us/landwater/land/maps/gis/ris/endangered_species/>. Accessed August 5, 2014.

University of Michigan Museum of Zoology. 2015. Collection: Mollusks – Complete Catalog: <http://www.lsa.umich.edu/ummz/mollusks/collections/fullMolluskDB.asp?offset=12050>; database: <http://fms.lsa.umich.edu/fmi/iwp/cgi?-db=ummz_mollusks&-loadframes>. Accessed July 1, 2015.

USFWS (U.S. Fish and Wildlife Service). 2015a. *Revised Endangered Species Inventory*. June 12. <http://www.fws.gov/arkansas-es/docs/COAR%20TEC%20List_6_12_15.pdf>. Accessed July 24, 2015.

———. 2015b. *US Counties in which the Arkansas River shiner, Arkansas R. Basin is known to or is believed to occur*. <http://ecos.fws.gov/speciesProfile/profile/countiesBySpecies?entityId=299>. Accessed July 24, 2015.

———. 2014a. “Species Profile – Pallid Sturgeon (*Scaphirhynchus albus*).” <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=E06X#lifeHistory>. Accessed August 5, 2014.

———. 2014b. “Life Histories – Speckled Pocketbook (*Lampsilis streckeri*).” <http://ecos.fws.gov/docs/life_histories/F020.html>. Accessed August 5, 2014.

———. 2014c. *Master Species Information for Special Status Species for the Plains & Eastern Clean Line Project*. Prepared for the U.S. Department of Energy. (Available on EIS Reference CD.)

———. 2014d. “Response to DOE Request for an updated list and clarification on surveys and survey protocols on federally listed and proposed endangered or threatened species and critical habitat for the proposed Plains and Eastern Clean Line Transmission Project.” Letter from M. Shaughnessy, USFWS, to J. Thomas, Clean Line Energy Partners, April 2, 2014. (Available on EIS Reference CD.)

———. 2013. *Recovery Plan for the Pallid Sturgeon (*Scaphirhynchus albus). <http://www.fws.gov/mountain-prairie/species/fish/pallidsturgeon/DrafRevisedRecoveryPlanMarch2013.pdf>. Accessed August 5, 2014.

———. 2012a. *Spectaclecase (a freshwater mussel)* Cumberlandia monodonta. March. <http://www.fws.gov/midwest/endangered/clams/spectaclecase/pdf/SpectaclecaseFactSheetMarch2012.pdf>. Accessed August 5, 2014.

———. 2012b. *Fat Pocketbook (*Potamilus capax*). 5-Year Review: Summary and Evaluation*. <http://www.fws.gov/southeast/5yearReviews/5yearreviews/fatpocketbookmussel.pdf>. Accessed August 5, 2014.

———. 2012c. *Land-Based Wind Energy Guidelines*. March 23. <http://www.fws.gov/windenergy/docs/weg_final.pdf>. Accessed August 5, 2014.

———. 2012d. *Recovery Outline for the Ozark Hellbender*. <http://www.fws.gov/midwest/Endangered/amphibians/ozhe/pdf/ozheRecoveryOutline.pdf>. Accessed October 29, 2014.

———. 2011a. *Ozark cavefish* (Amblyopis rosae Eigenmann 1898) *5-Year Review: Summary and Evaluation*. <http://ecos.fws.gov/docs/five_year_review/doc3850.pdf>. Accessed August 5, 2014.

———. 2011b. *Ozark Hellbender*. September. <http://www.fws.gov/midwest/endangered/amphibians/ozhe/pdf/OzarkHellbenderFactSheet_Sept2011.pdf>. Accessed October 29, 2014.

———. 2010a. *Species Assessment and Listing Priority Assignment Form: Arkansas darter* (*Etheostoma cragini*). Region 6. May 6. <http://www.fws.gov/ecos/ajax/docs/candforms_pdf/r6/E06H_V01.pdf>. Accessed August 5, 2014.

———. 2010b. *Species Assessment and Listing Priority Assignment Form*: *Neosho Mucket* (*Lampsilis rafinesqueana*). March 12.<http://www.fws.gov/ecos/ajax/docs/candforms_pdf/r4/F00F_I01.pdf>. Accessed August 5, 2014.

———. 2010c. The Curtis' Pearlymussel (*Epioblasma florentina curtisii*) *5-Year Review: Summary and Evaluation*. <http://ecos.fws.gov/docs/five_year_review/doc3119.pdf>. Accessed October 31, 2014.

———. 2009a. *Spotlight Species Action Plan – Pallid Sturgeon (Scaphirhynchus albus*). 2009. <http://ecos.fws.gov/docs/action_plans/doc3026.pdf>. Accessed August 5, 2014.

———. 2009b. *Spotlight Species Action Plan – Fat Pocketbook (Potamilus capax*). October 1. <http://ecos.fws.gov/docs/action_plans/doc3065.pdf>. Accessed August 5, 2014.

———. 2008. *Species Assessment and Listing Priority Assignment Form: Yellowcheek Darter* (*Etheostoma moorei*). March 14. <http://www.fws.gov/ecos/ajax/docs/candforms_pdf/r4/E01E_V01.pdf>. Accessed August 5, 2014.

———. 2007a. *Programmatic Safe Harbor Agreement and Candidate Conservation Agreement with Assurances for the Endangered Speckled Pocketbook* (Lampsilis streckeri) *and Candidate Yellowcheek Darter* (*Etheostoma moorei*) *in the Upper Little Red River watershed, Arkansas*. <http://www.fws.gov/southeast/candidateconservation/pdf/CCAA_YellowcheekDarterSpeckedPocketbook.pdf>. Accessed August 5, 2014.

———. 2007b. *Speckled Pocketbook* (Lampsilis streckeri Frierson 1927) *5-Year Review: Summary and Evaluation*. <http://ecos.fws.gov/docs/five_year_review/doc1035.pdf>. Accessed August 5, 2014.

———. 2002. "Life Histories – Ozark cavefish (*Amblyopsis rosae*)." April 18. <http://ecos.fws.gov/docs/life_histories/E02J.html>. Accessed August 5, 2014.

———. 1997a. *Curtis' Pearlymussel* (Epioblasma florentina curtisi) *Fact Sheet*. <http://www.fws.gov/midwest/endangered/clams/pdf/curtis-pm.pdf>. Accessed October 31, 2014.

———. 1997b. *Pink Mucket* (Lampsilis orbiculata). November. <http://www.fws.gov/midwest/endangered/clams/pdf/pink-mucket.pdf>. Accessed August 5, 2014.

———. 1989. *A Recovery Plan for the Fat Pocketbook Pearly Mussel: Potamilus capax* (Green 1832). <http://ecos.fws.gov/docs/recovery_plan/891114c.pdf>. Accessed August 5, 2014.

———. 1986. *A Recovery Plan for the Curtis' Pearlmussel*: *Epioblasma florentina curtisi*. <http://ecos.fws.gov/docs/recovery_plan/860204.pdf>. Accessed October 31, 2014.

———. 1985. *Recovery Plan for the Pink Mucket Pearly Mussel: Lampsilis orbiculata* (Hildreth, 1828). <http://ecos.fws.gov/docs/recovery_plan/pink%20mucket%20rp.pdf>. Accessed August 5, 2014.

Vaughn, C.C. 1997. "Determination of the Status and Habitat Preference of the Neosho Mucket in Oklahoma." Final Report – Section 6 – Endangered Species Act. Oklahoma Department of Wildlife Conservation, Oklahoma City, OK. (Available on EIS Reference CD.)

6.2.3.15 Surface Water

16 USC § 1271. "Wild and Scenic Rivers Act" (Pub. L. 90-542) <http://www.law.cornell.edu/uscode/text/16/chapter-28>.

33 USC § 403. "Construction of bridges, causeways, dams or dikes generally; exemptions." *Rivers and Harbors Appropriation Act of 1899*, Section 10. <http://www.law.cornell.edu/uscode/pdf/uscode33/lii_usc_TI_33_CH_9_SC_I_SE_403.pdf>.

33 USC § 1251 *et seq*. "Clean Water Act of 1972" (Pub. L. 92-500) <http://www.law.cornell.edu/uscode/pdf/lii_usc_TI_33_CH_26.pdf>.

Arkansas Act 81 of 1957.

Arkansas Code Annotated 23-3-5 (Title 23, Chapter 3, Subchapter 5). "Navigable Water Crossings." <http://www.lexisnexis.com/hottopics/arcode/Default.asp>.

Oklahoma Administrative Code Title 785. "Water Resources Board." <http://www.oar.state.ok.us/oar/codedoc02.nsf/frmMain?OpenFrameSet&Frame=Main&Src=_75tnm2shfcdnm8pb4dthj0chedppmcbq8dtmmak31ctijujrgcln50ob7ckj42tbkdt374obdcli00_>.

Oklahoma Administrative Code 785:20 (Title 785, Chapter 20). "Appropriation and Use of Stream Water," <http://www.oar.state.ok.us/oar/codedoc02.nsf/frmMain?OpenFrameSet&Frame=Main&Src=_75tnm2shfcdnm8pb4dthj0chedppmcbq8dtmmak31ctijujrgcln50ob7ckj42tbkdt374obdcli00_>.

Oklahoma Administrative Code 785:45 (Title 785, Chapter 45). "Oklahoma's Water Quality Standards." <http://www.oar.state.ok.us/oar/codedoc02.nsf/All/5BB37140A14FE73886257B9C00612F50?OpenDocument>.

Tennessee Code 11-13 (Title 11, Chapter 13). “The Tennessee Scenic Rivers Act of 1968.” <http://law.justia.com/codes/tennessee/2010/title-11/chapter-13/>.

Tennessee Code 69-3-108 (Title 69, Chapter 3, Part 1, Section 108). “Water Quality Control Act, Permits.” <http://www.lawserver.com/law/state/tennessee/tn-code/tennessee_code_69-3-108>.

Texas Administrative Code 30-1-307 (Title 30, Part 1, Chapter 307). “Texas Surface Water Standards.” <http://info.sos.state.tx.us/pls/pub/readtac$ext.ViewTAC?tac_view=4&ti=30&pt=1&ch=307&rl=Y>.

Texas Administrative Code 31-357.43 (Title 31, Part 10, Section 357, Subchapter D, Rule 357.43). “Regulatory, Administrative, or Legislative Recommendations.” <http://info.sos.state.tx.us/pls/pub/readtac$ext.TacPage?sl=R&app=9&p_dir=&p_rloc=&p_tloc=&p_ploc=&pg=1&p_tac=&ti=31&pt=10&ch=357&rl=43>.

Texas Water Code 2-11 (Title 2, Chapter 11). “Water Rights.” <http://statutes.laws.com/texas/water-code/title-2-water-administration/chapter-11-water-rights>.

ADEQ (Arkansas Department of Environmental Quality) 2014a. *Assessment Methodology for the Preparation of the 2014 Integrated Water Quality Monitoring and Assessment Report Pursuant to Clean Water Act Sections 303(d) and 305(b)*. <http://www.adeq.state.ar.us/water/branch_planning/303d/pdfs/final_2014_assessment_methodology.pdf>. Accessed March 17, 2014

———. 2014b. *Category 5 Waters: Arkansas’s Water Quality Limited Waterbodies (Streams) – 2014 303(d) list*. <http://www.adeq.state.ar.us/water/branch_planning/303d/pdfs/category_5_map_20140401.pdf>. Accessed March 17, 2014.

———. 2014c. *Category 4a Waters: Impaired Waterbodies (Streams) with Completed TMDLs*. January. <http://www.adeq.state.ar.us/water/branch_planning/303d/pdfs/category_4a_map_20140401.pdf>. Accessed March 17, 2014.

———. 2011. “Permit No. ARR150000, Authorization to Discharge Stormwater Under the National Pollutant Discharge Elimination System and the Arkansas Water and Air Pollution Control Act.” Effective Date: November 1, 2011. <http://www.adeq.state.ar.us/water/branch_permits/general_permits/stormwater/construction/pdfs/ARR150000_permit.pdf>. Accessed February 20, 2014.

ANRC (Arkansas Natural Resources Commission). 2009. “Rules for the Utilization of Surface Water, Title 3.” <https://static.ark.org/eeuploads/anrc/Title_3_EZ_read.pdf>. Accessed September 18, 2014.

APCEC (Arkansas Pollution Control and Ecology Commission) 2011. “Regulation Establishing Water Quality Standards for Surface Waters of the State of Arkansas.” Regulation No. 2 of the Arkansas Pollution Control and Ecology Commission. Effective September 26, 2011. <http://www.adeq.state.ar.us/regs/files/reg02_final_140324.pdf>. Accessed March 19, 2014.

BLM (Bureau of Land Management) 2005. *Final Programmatic Environmental Impact Statement on Wind Energy Development on BLM-Administered Lands in the Western United States*. FES 05-11. U.S. Department of the Interior. June. <http://windeis.anl.gov/documents/fpeis/index.cfm>. Accessed April 18, 2014.

Clean Line 2013. *Surface Water Technical Report for the Plains and Eastern Transmission Line Project*. December. Prepared by Clean Line Energy Partners for the Department of Energy pursuant to 10 CFR 1021.215(b)(2). (Available on EIS Reference CD.)

DOE (U.S. Department of Energy) 2013. *Upper Great Plains Wind Energy Programmatic Environmental Impact Statement - Draft*. DOE/EIS-0408. March. <http://energy.gov/sites/prod/files/EIS-0408-DEIS-2013.pdf>. Accessed April 21, 2014.

EPA (U.S. Environmental Protection Agency). 2014. *2012 Construction General Permit (CGP)—Fact Sheet*. Source webpage last updated on February 5, 2014. <http://www.epa.gov/npdes/pubs/cgp2012_finalfactsheet.pdf>. Accessed February 24, 2014.

———. 2013a. "National Pollutant Discharge Elimination System (NPDES)—Authorization Status for EPA's Stormwater Construction and Industrial Programs." September 10. <http://cfpub.epa.gov/npdes/stormwater/authorizationstatus.cfm>. Accessed February 21, 2014.

———. 2013b. "Water Quality Assessment and Total Maximum Daily Loads Information." December 13. <http://www.epa.gov/waters/ir/index.html>. Accessed on March 16, 2014.

NPS (National Park Service) 2010. "Nationwide River Inventory, Oklahoma Segments." September 7. <http://www.nps.gov/ncrc/programs/rtca/nri/states/ok.html>. Accessed March 19, 2014.

———. 2004. "Nationwide River Inventory, Arkansas Segments." November 23. <http://www.nps.gov/ncrc/programs/rtca/nri/states/ar.html>. Accessed March 19, 2014.

NWSRS (National Wild and Scenic River System). 2014. "About the WSR Act." <http://www.rivers.gov/wsr-act.php>. Accessed March 19, 2014.

———. 2012. "River Mileage Classifications for Components of the National Wild and Scenic River System." September. <http://www.rivers.gov/documents/rivers-table.pdf>. Accessed March 19, 2014.

ODEQ (Oklahoma Department of Environmental Quality) 2014. "Gallery of GIS Maps, New Flex Viewer." With 303(d) waterbodies. <http://www.deq.state.ok.us/mainlinks/gis/index.html>. Access March 14, 2014

———. 2013. "Water Quality in Oklahoma, 2012 Integrated Report – Prepared Pursuant to Section 303(d) and 305(b) of the Clean Water Act." With Appenidx C – 303(d) List of Impaired Waters. Approved December 19, 2013. <http://www.deq.state.ok.us/WQDNew/305b_303d/index.html>. Accessed March 15, 2014.

———. 2012. *General Permit OKR10 for Storm Water Discharges from Construction Activities within the State of Oklahoma*. September 13.

<http://www.deq.state.ok.us/wqdnew/stormwater/OKR10Permit_2012_final%20Review_August.pdf>. Accessed February 20, 2014.

OWRB (Oklahoma Water Resources Board). 2011a. *Oklahoma Water Quality Standards, High Quality Waters (HQW)*. Map dated July 1. <http://www.owrb.ok.gov/maps/pdf_map/WQS%20Special%20Provisions%20HQW.pdf>. Accessed March 19, 2014.

———. 2011b. *Oklahoma Water Quality Standards, Outstanding Resource Waters (ORW)*. Map dated July 1. <http://www.owrb.ok.gov/maps/pdf_map/WQS%20Special%20Provisions%20ORW.pdf>. Accessed March 19, 2014.

———. 2011c. *Oklahoma Water Quality Standards, Scenic Rivers (SR)*. Map dated July 1. <http://www.owrb.ok.gov/maps/pdf_map/WQS%20Special%20Provisions%20Scenic%20Rivers.pdf>. Accessed March 19, 2014.

———. 2011d. *Oklahoma Water Quality Standards, Sensitive Public and Private Water Supplies (SWS)*. Map dated July 1. <http://www.owrb.ok.gov/maps/pdf_map/WQS%20Special%20Provisions%20SWS.pdf>. Accessed March 19, 2014.

Seaber, P.R.; Kapinos, F.P.; and Knapp, G.L. 1987. *Hydrologic Unit Maps*, United States Geological Survey Water-Supply Paper 2294. <http://pubs.usgs.gov/wsp/wsp2294/pdf/wsp_2294.pdf>. Accessed July 3, 2014.

TCEQ (Texas Commission on Environmental Quality) 2013a. "2012 Index of All Impaired Waters (Categories 4 and 5)." *2012 Texas Integrated Report of Surface Water Quality for Clean Water Act Sections 305(b) and 303(d).* Approved by TCEQ February 13, 2013; approved by EPA May 9, 2013. <http://www.tceq.texas.gov/waterquality/assessment/waterquality/assessment/12twqi/twqi12>. Accessed April 15, 2014.

———. 2013b. "Hydrography Maps and Data: Surface Water Segments." November 18. <http://tceq.texas.gov/waterquality/tmdl/hydromaps.html/>. Accessed April 16, 2014.

TDEC (Tennessee Department of Environment and Conservation) 2014. *Final Version Year 2012 303(d) List*. January. <http://www.tn.gov/environment/water/docs/wpc/2012-final-303d-list.pdf>. Accessed March 18, 2014.

———. 2013a. "General Water Quality Criteria." *Rules of the Tennessee Department of Environment and Conservation*. Tennessee Rule Chapter 0400-40-03. <http://www.tennessee.gov/sos/rules/0400/0400-40/0400-40-03.20131216.pdf>.

———. 2013b. "TDEC Interactive Maps Portal." <http://tn.gov/environment/geographic-information-systems_mapping.shtml>. Accessed March 18, 2014.

———. 2013c. "The Known Exceptional Tennessee Waters and Outstanding National Resource Waters." Most recent list entry: August 27, 2013. Searchable database, searched for Tipton and Shelby counties.

Accessed March 19, 2014. <http://environment-online.state.tn.us:8080/pls/enf_reports/f?p=9034:34304:26523853229638>. Accessed February 20, 2014.

———. 2012. “Water Registration Requirements.” *Rules of the Tennessee Department of Environment and Conservation*. Tennessee Rule Chapter 0400-45-08. <https://www.tn.gov/sos/rules/0400/0400-45/0400-45-08.20120916.pdf>.

TDWPC (Tennessee Division of Water Pollution Control). 2011. “State of Tennessee NPDES Permit – General NPDES Permit for Stormwater Associated with Construction Activities, Permit No. TNR100000.” Effective May 24, 2011. <http://www.tn.gov/environment/water/docs/wpc/tnr100000.pdf>. Accessed February 20, 2014.

Thomas, J. 2014. “Questions for Clean Line.” Email communication from J. Thomas, Clean Line, to J. MacDonald, Tetra Tech, June 17. (Available on EIS Reference CD.)

TPWD (Texas Parks and Wildlife Department) 2014. “Ecologically Significant Stream Segments, Planning Data by Region.” <http://www.tpwd.state.tx.us/landwater/water/environconcerns/water_quality/sigsegs/>. Accessed April 15, 2014.

USACE (U.S. Army Corps of Engineers). 2014a “Navigable Waters within the Memphis District.” <http://www.mvm.usace.army.mil/Missions/Navigation/HeadsofNavigation.aspx>. Accessed on March 19, 2014.

———. 2014b. “Navigable Waters Subject to Section 10 Jurisdiction in the Tulsa District.” <http://www.swt.usace.army.mil/Missions/Regulatory/Section10Waters.aspx>. Accessed on March 19, 2014.

———. 2004. *Streams Considered Navigable in Little Rock District (“Navigable Waters of the U.S.”)*. May 19. <http://www.swl.usace.army.mil/Portals/50/docs/regulatory/navigablestreams.pdf>. Accessed March 19, 2014.

USFWS (U.S. Fish and Wildlife Service) 2014. “Critical Habitat Portal – Online Mapper.” <http://ecos.fws.gov/crithab/>. Accessed March 18, 2014.

6.2.3.16 Transportation

14 CFR Part 77. “Safe, Efficient Use, and Preservation of the Navigable Airspace.” *Aeronautics and Space.* Department of Transportation. <http://www.ecfr.gov/cgi-bin/text-idx?SID=534623173a9c8a2d128a6caa401b245e&node=pt14.2.77&rgn=div5>.

14 CFR Part 157. “Notice of Construction, Alteration, Activation, and Deactivation of Airports.” *Aeronautics and Space.* Department of Transportation. <http://www.ecfr.gov/cgi-bin/text-idx?SID=534623173a9c8a2d128a6caa401b245e&node=pt14.3.157&rgn=div5>.

23 CFR 645.209(a). "Safety, General requirements." *Highways*. Federal Highway Administration, Department of Transportation. <http://www.ecfr.gov/cgi-bin/text-idx?SID=58369bc5f537185345bfcca635fb1593&node=pt23.1.645&rgn=div5#se23.1.645_1209>.

72 Stat. 731. "Federal Aviation Act of 1958" (Pub. L. 85-726).

23 USC § 162 *et seq*. "National Scenic Byways Program" (Pub. L. 105-178). <http://www.law.cornell.edu/uscode/pdf/uscode23/lii_usc_TI_23_CH_1_SE_162.pdf>.

49 USC § 5301 *et seq*. "Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA)" (Pub. L. 102-240). <http://www.law.cornell.edu/uscode/text/49/subtitle-III/chapter-53>.

AASHTO (American Association of State Highway Transportation Officials). 2011. *A Policy on Geometric Design of Highways and Streets, 6th Edition*. <https://bookstore.transportation.org/collection_detail.aspx?ID=110>. Accessed August 19, 2014.

AHTD (Arkansas State Highway and Transportation Department). 2012. "2012 Annual Average Daily Traffic Estimates." <http://www.arkansashighways.com/planning_research/technical_services/2012_traffic.aspx>. Accessed July 2013.

———. 2011. *Arkansas Motor Vehicle and Traffic Laws and State Highway Commission Regulations*. Sections 27-35-203(a), (b), (d)(1); 27-35-206-208. <http://www.arkansashighways.com/act300/AR%20Motor%20Veh%2011E.pdf>. Accessed March 2014.

Clean Line. *Traffic Technical Report for the Plains & Eastern Clean Line – Supplemental Information*. February. Prepared by Clean Line Energy Partners for the Department of Energy pursuant to 10 CFR 1021.215(b)(2). (Available on EIS Reference CD.)

———. 2013. *Traffic Technical Report for the Plains and Eastern Transmission Line Project*. December. Prepared by Clean Line Energy Partners for the Department of Energy pursuant to 10 CFR 1021.215(b)(2). (Available on EIS Reference CD.)

FAA (Federal Aviation Administration). 2014a. "FAA Regulations." <http://www.faa.gov/airports/central/engineering/part77/>. Accessed February 2014.

———. 2014b. "National Flight Database." <http://avn.faa.gov/index.asp?xml=aeronav/applications/digital/nfd>. Accessed April 2014.

FHWA (Federal Highway Administration). 2009. "Manual of Uniform Traffic Control Devices." 2009 Edition with Revisions 1 and 2 (May 2012). <http://mutcd.fhwa.dot.gov/kno_2009r1r2.htm>. Accessed February 2014.

FRA (Federal Railroad Association). 2014. "About FRA." <https://www.fra.dot.gov/Page/P0002>. Accessed April 2014.

IEEESA (Institute of Electrical and Electronic Engineers Standards Association). 2012. "2012 National Electric Safety Code (NESC)." <http://standards.ieee.org/findstds/standard/C2-2012.html>. Accessed February 2014.

KSDOT (Kansas Department of Transportation). 2014. "State and District Traffic County Maps." March. <http://www.ksdot.org/burtransplan/maps/MapsTrafficDist.asp>. Accessed April 2014.

NTSB (National Transportation Safety Board). 2014. "Office of Railroad, Pipeline and Hazardous Materials Investigations." <http://www.ntsb.gov/about/office_rph.html>. Accessed April 2014.

OCGI (Oklahoma Center for GeoSpatial Information). 2012. "Oklahoma County Collector Line Layer." <http://www.ocgi.okstate.edu/zipped/>. Accessed March 2014.

OKDOT (Oklahoma Department of Transportation). 2014. "Oklahoma Highways with Annual Average Daily Traffic." <http://www.okladot.state.ok.us/maps/shp/index.htm>. Accessed August 2014.

———. 2012. "Oklahoma Highways with Annual Average Daily Traffic." <http://www.okladot.state.ok.us/maps/shp/index.htm>. Accessed July 2013.

OKDPS (Oklahoma Department of Public Safety). 2014. Sections 730:30-9-1 through 30-9-7. <http://www.oar.state.ok.us/oar/codedoc02.nsf/All/F9BB5F8D71E335FF86257B8000618F1C?OpenDocument>. Accessed March 2014.

TNDOT (Tennessee Department of Transportation). 2012. *Annual Average Daily Traffic Estimates*. <http://www.tdot.state.tn.us/projectplanning/adt/2012adt/county%20index.pdf>. Accessed July 2013.

———. 2003. *Rules of Tennessee Department of Transportation Central Services Division*. Chapter 1680-7-1. <http://www.state.tn.us/sos/rules/1680/1680-07/1680-07-01.pdf>. Accessed March 2014.

TRB (Transportation Research Board). 2010. *Highway Capacity Manual*. <http://hcm.trb.org/?qr=1>. Accessed August 19, 2014.

TXDMV (Texas Department of Motor Vehicles) 2014. "Oversize/Overweight Permit Criteria Summary." <http://txdmv.gov/component/k2/item/95?Itemid=223>. Accessed March 2014.

TXDOT (Texas Department of Transportation). 2014. "Annual Average Daily Traffic Estimates." <http://www.txdot.gov>. Accessed August 2014.

———. 2013. "Annual Average Daily Traffic Estimates." <http://www.txdot.gov>. Accessed December 2013.

6.2.3.17 Vegetation Communities and Special Status Plant Species

7 USC § 7701 *et seq*. "Plant Protection Act" (Pub. L. 106-224). <http://www.law.cornell.edu/uscode/pdf/lii_usc_TI_07_CH_104.pdf>.

7 USC § 136. "Definitions: Environmental Pesticide Control." <http://www.law.cornell.edu/uscode/text/7/chapter-6/subchapter-II>.

7 USC § 2801 *et seq*. “Federal Noxious Weed Act of 1974” (Pub. L. 93-629) <http://www.law.cornell.edu/uscode/pdf/lii_usc_TI_07_CH_61.pdf>.

16 USC § 1531 *et seq*. “Endangered Species Act of 1973” (Pub. L. 93-205) <http://www.law.cornell.edu/uscode/pdf/lii_usc_TI_16_CH_35.pdf>.

Arkansas Code Annotated 2-16-207 (Title 2, Subchapter 2, Chapter 16, Subchapter 2, Section 207). “Powers and duties of board.” < http://www.lexisnexis.com/hottopics/arcode/Default.asp >.

Arkansas Code Annotated 2-16-209 (Title 2, Subchapter 2, Chapter 16, Subchapter 2, Section 209). “Transportation, etc., of insect pests, etc., generally.” < http://www.lexisnexis.com/hottopics/arcode/Default.asp >.

Arkansas Code Annotated 2-16-201 (Title 2, Subchapter 2, Chapter 16, Subchapter 2). “Arkansas Plant Act of 1917.” < http://www.lexisnexis.com/hottopics/arcode/Default.asp >.

Texas Administrative Code 4-19 (Title 4, Chapter 19). “Quarantines and Noxious and Invasive Plants.” <http://info.sos.state.tx.us/pls/pub/readtac$ext.ViewTAC?tac_view=4&ti=4&pt=1&ch=19>.

Texas Administrative Code 5-88 (Title 5, Subtitle G, Chapter 88). “Endangered Plant.” <http://statutes.laws.com/texas/parks-and-wildlife-code/title-5-wildlife-and-plant-conservation/chapter-88-endangered-plants>.

Texas Administrative Code 31-69.1–9 (Title 31, Part 2, Chapter 69, Subchapter A, Sections 69.1 to 69.9). “Endangered, Threatened, and Protected Native Plants; Rules.” <http://info.sos.state.tx.us/pls/pub/readtac$ext.ViewTAC?tac_view=5&ti=31&pt=2&ch=69&sch=A&rl=Y>.

ANHC (Arkansas Natural Heritage Commission). 2014a. “Rare Species Search Engine: Find Arkansas Endangered.” Data search in project areas. <http://www.naturalheritage.com/research-data/rarespecies-search.aspx>. Accessed August 13, 2014.

———. 2014b. “Rare Species Search Engine: Find Arkansas Endangered.” Data search on Alabama snow-wreath in project areas. <http://www.naturalheritage.com/research-data/rarespecies-search.aspx>. Accessed August 13, 2014.

———. 2011. “*Geocarpon Minimum*: The Big Picture for a Tiny Plant.” <http://www.naturalheritage.com/news-events/event-detail.aspx?id=75>. Accessed August 13, 2014.

———. 2009. “ANHC Acquires New Natural Area in Poinsett County.” *Natural News*. <http://www.naturalheritage.com/!UserFiles/enews-archive/2009/anhc-oct-09-enews.pdf>. Accessed August 13, 2014.

Arkansas Plant Board. 2014a. *Circular 10: Regulations on the Sale of Planting Seed in Arkansas*. June. <http://plantboard.arkansas.gov/Seed/Documents/CIR%2010%20-%20JUNE%202014.pdf>. Accessed September 10, 2014.

———. 2014b. “Noxious Weeds.” <http://plantboard.arkansas.gov/Seed/Certification/Pages/NoxiousWeeds.aspx>. Accessed September 10, 2014.

———. 1993. *Circular 8: Arkansas Laws on Plants and Seeds.* <http://plantboard.arkansas.gov/PlantIndustry/Documents/circular8PlantSeedLaws.pdf>. Accessed September 10, 2014.

CISEH (Center for Invasive Species and Ecosystem Health). 2014. “Early Detection & Distribution Mapping System (EDDMapS).” The University of Georgial. <http://www.eddmaps.org/>. Accessed May 28, 2014.

DeLay, L.; O’Conner, R.; Ryan, J.; and Currie, R.R. 1993. *Recovery Plan for Pondberry* (Lindera melissifolia). Prepared for the U.S. Fish and Wildlife Service. <http://ecos.fws.gov/docs/recovery_plan/930923a.pdf>. Accessed August 12, 2014.

Denholm, P.; Hand, M.; Jackson, M.; and Ong, S. 2009. *Land-Use Requirements of Modern Wind Power Plants in the United States*. Technical Report NREL/TP-6A2-45834. National Renewable Energy Laboratory. August. <http://www.nrel.gov/docs/fy09osti/45834.pdf>. Accessed September 30, 2014.

Devall, M.; Schiff, N.; and Boyette, D. 2001. “Ecology and reproductive biology of the endangered Pondberry, Lindera melissifolia (Walt) Blume.” *Natural Areas Journal* 21 (3):250-258. <http://www.treesearch.fs.fed.us/pubs/2750>. Accessed September 25, 2014.

eFlora. 2013. “Flora of North America.” *Lindera melissifolia*. FNA Volume. 3. <http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=233500748>. Accessed August 13, 2014.

EPA (U.S. Environmental Protection Agency). 2012. “Level I Ecoregions Map.” <http://www.epa.gov/wed/pages/ecoregions/na_eco.htm#Level I>. Accessed July 24, 2014.

Executive Order 13112. “Invasive Species.” July 14, 1999 (64 FR 6183) <http://www.gpo.gov/fdsys/pkg/FR-1999-02-08/pdf/99-3184.pdf>.

Griffith, G.E.; Bryce, S.A.; Omernik, J.M.; Comstock, J.A.; Rogers, A.C.; Harrison, B.; Hatch, S.L.; and Bezanson, D. 2004. *Ecoregions of Texas*. (2-sided color poster with map, descriptive text, and photographs). U.S. Geological Survey, Reston, VA. Scale 1:2,500,000. <http://www.epa.gov/wed/pages/ecoregions/tx_eco.htm>. Accessed July 24, 2014.

Griffith, G.E.; Omernik, J.M.; and Azevedo, S.H. 1998. *Ecoregions of Tennessee*. (2-sided color poster with map, descriptive text, summary Tables, and photographs). U.S. Geological Survey, Reston, VA. Scale 1:940,000. <http://www.epa.gov/wed/pages/ecoregions/tn_eco.htm>. Accessed July 24, 2014.

Kartesz, J.T. 1999. “A synonymized checklist and atlas with biological attributes for the vascular flora of the United States, Canada, and Greenland.” First edition. In: Kartesz, J.T. and C.A. Meacham. *Synthesis of the North American Flora*. Version 1.0. North Carolina Botanical Garden, Chapel Hill, N.C. <http://www.bonap.org/synth.html>. Accessed August 13, 2014.

———. 1994. *A synonymized checklist of the vascular flora of the United States, Canada, and Greenland*. Second Edition. 2 vols. Timber Press, Portland, Oregon. <http://www.worldcat.org/title/synonymized-checklist-of-the-vascular-flora-of-the-united-states-canada-and-greenland/oclc/28798415>. Accessed August 25, 2015.

LDWF (Louisiana Department of Wildlife and Fisheries). 2013. *Rare Plants of Louisiana Lindera melissifolia—Pondberry*. <http://www.wlf.louisiana.gov/sites/default/files/pdf/fact_sheet_plant/31917-Lindera%20melissifolia/lindera_melissifolia.pdf>. Accessed August 13, 2014.

Meades, S.J.; Hay, S.G; and Brouillet, L. 2000. *Annotated Checklist of Vascular Plants of Newfoundland and Labrador*. Memorial University Botanical Gardens, St John's, Newfoundland. March 25. <http://www.digitalnaturalhistory.com/meades.htm>. Accessed August 13, 2014.

NatureServe. 2014a. "Interrupted Fern (*Osmunda claytoniana*)." <http://explorer.natureserve.org/servlet/NatureServe?searchSciOrCommonName=interrupted+fern+&x=10&y=11>. Accessed October 9, 2014.

———. 2014b. "Whorled Dropseed (*Sporobolus pyramidatus*)." <http://explorer.natureserve.org/servlet/NatureServe?loadTemplate=tabular_report.wmt&paging=home&save=all&sourceTemplate=reviewMiddle.wmt>. Accessed October 9, 2014.

———. 2013. "*Geocarpon minimum* – Mackenzie." <http://www.natureserve.org/explorer/servlet/NatureServe?searchName=Geocarpon+minimum>. Accessed August 12, 2014.

NRCS (National Resources Conservation Service). 2014. *Plant Fact Sheet. Whorled Dropseed*. U.S. Department of Agriculture. <http://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/txpmcfs7291.pdf> Accessed on July 21, 2014.

ODA (Oklahoma Department of Agriculture). 2000. "Noxious Weeds." Noxious Weed Laws and Rules, Section 3-220, Title 35, Chapter 30, Subchapter 34." <http://www.ok.gov/~okag/forms/law/noxweedlaw.htm>. Accessed August 13, 2014.

ODWC (Oklahoma Department of Wildlife Conservation). 2013. "Oklahoma's Threatened, Endangered and Rare Species." <http://www.wildlifedepartment.com/wildlifemgmt/endangeredspecies.htm>. Accessed on July 21, 2014.

ONHP (Oklahoma Natural Heritage Program). 2014. "List of rare plants." <http://oknaturalheritage.ou.edu/plants_rare_vulnerable.htm>. Accessed March 3, 2014.

Pittman, A.B., PhD. 1993. *Geocarpon minimum McKenzie Recovery Plan*. Prepared for the U.S. Fish and Wildlife Service. <http://ecos.fws.gov/docs/recovery_plan/930726.pdf>. Accessed August 12, 2014.

Taylor, D. 2014. "Appalachian Bristle Fern (*Trichomanes boschianum* Strum)." U.S. Forest Service Plant of the Week. <http://www.fs.fed.us/wildflowers/plant-of-the-week/trichomanes_boschianum.shtml>. Accessed September 15, 2014.

TDA (Tennessee Department of Agriculture). 2007. "Chapter 0080-6-24, Pest Plant Regulations." *Rules of the Tennessee Department of Agriculture Division of Plant Industries*. June 28. <http://www.state.tn.us/sos/rules/0080/0080-06/0080-06-24.pdf>. Accessed August 13, 2014.

TDEC (Tennessee Department of Environment and Conservation). 2014. *Rare Plant List*. <http://www.tn.gov/environment/natural-areas/docs/plant_list.pdf>. Accessed August 13, 2014.

———. 2008. "Chapter 0400-06-02, Rare Plant Protection and Conservation Regulations." *Rules of the Tennessee Department of Environment and Conservation*. August 13. <http://www.tn.gov/sos/rules/0400/0400-06/0400-06-02.pdf>.

Tyrl, R.J.; Bidwell, T.G.; and Masters, R.E. 2002. *Field guide to Oklahoma plants: commonly encountered prairie, shrubland, and forest species*. Department of Plant and Soil Sciences, Oklahoma State University. <https://openlibrary.org/books/OL3438400M/Field_guide_to_Oklahoma_plants>. Accessed August 12, 2014.

USDA (U.S. Department of Agriculture). 2013. "Plants database." <http://plants.usda.gov/java/>. Accessed on June 10, 2014.

USFWS (U.S. Fish and Wildlife Service). 2015. "CITES" [Convention on International Trade in Endangered Species of Wild Fauna and Flora]. <http://www.fws.gov/international/cites/index.html>. Accessed September 4, 2015.

———. 2014. *Master Species Information for Special Status Species for the Plains & Eastern Clean Line Project*. Prepared for the U.S. Department of Energy. (Available on EIS Reference CD.)

———. 2013a. "Environmental Conservation Online System." <http://ecos.fws.gov>. Accessed on June 10, 2014.

_____. 2013b. "Species by County Report. Shelby County, Tennessee." Environmental Conservation Online System. <http://ecos.fws.gov/tess_public/countySearch!speciesByCountyReport.action?fips=47157>. Accessed August 13, 2014.

_____. 2013c. "Species by County Report. Tipton County, Tennessee." Environmental Conservation Online System. <http://ecos.fws.gov/tess_public/countySearch!speciesByCountyReport.action?fips=47167>. Accessed August 13, 2014.

_____. 2009. *Geocarpon minimum 5-Year Review: Summary and Evaluation*. <http://ecos.fws.gov/docs/five_year_review/doc2487.pdf>. Accessed July 24, 2014.

Woods, A.J.; Foti, T.L.; Chapman, S.S.; Omernik, J.M.; Wise, J.A.; Murray, E.O.; Prior, W.L.; Pagan, Jr., J.B.; Comstock, J.A.; and Radford, M. 2004. Ecoregions of Arkansas. (2-sided color poster with map, descriptive text, summary Tables, and photographs). U.S. Geological Survey, Reston, VA. Scale 1:1,000,000. <http://www.epa.gov/wed/pages/ecoregions/ar_eco.htm>.

Woods, A.J.; Omernik, J.M.; Butler, D.R.; Ford, J.G.; Henley, J.E.; Hoagland, B.W.; Arndt, D.S.; and Moran, B.C. 2005. Ecoregions of Oklahoma. (2-sided color poster with map, descriptive text, summary Tables, and photographs). U.S. Geological Survey, Reston, VA. Scale 1:1,250,000. <http://www.epa.gov/wed/pages/ecoregions/ok_eco.htm>.

6.2.3.18 Visual Resources

36 CFR 800.5. "Assessment of adverse effects." *Protection of Historic Properties*. Advisory Council on Historic Preservation. <http://www.ecfr.gov/cgi-bin/text-idx?SID=534623173a9c8a2d128a6caa401b245e&node=pt36.3.800&rgn=div5#se36.3.800_15>.

40 CFR Part 1500. "Purpose, Policy, and Mandate." *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1500&rgn=div5>.

40 CFR Part 1501. "NEPA and Agency Planning." *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1501&rgn=div5>.

40 CFR Part 1502. "Environmental Impact Statement." *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1502&rgn=div5>.

40 CFR Part 1503. "Commenting." *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1503&rgn=div5>.

40 CFR Part 1504. "Predecision Referrals to the Council of Proposed Federal Actions Determined to be Environmentally Unsatisfactory." *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1504&rgn=div5>.

40 CFR Part 1505. "NEPA and Agency Decisionmaking." *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1505&rgn=div5>.

40 CFR Part 1506. "Other Requirements of NEPA." *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1506&rgn=div5>.

40 CFR Part 1507. "Agency Compliance." *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1507&rgn=div5>.

40 CFR Part 1508. "Terminology and Index." *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=a8b986ac7dd2766009e1453a422532c7&node=pt40.33.1508&rgn=div5>.

60 FR 26759. "Notice of FHWA Interim Policy, National Scenic Byways Program." Federal Highway Administration, U.S. Department of Transportation. May 18, 1995. <http://www.gpo.gov/fdsys/pkg/FR-1995-05-18/pdf/95-12211.pdf#page=1>.

16 USC §§ 1241-1251. "The National Trails System Act" (Pub. L. 90-543). <http://www.law.cornell.edu/uscode/pdf/uscode16/lii_usc_TI_16_CH_27_SE_1241.pdf>.

16 USC § 1244. "National scenic and national historic trails." 2009 Amendment. (Pub. L. 111-11). <http://www.law.cornell.edu/uscode/text/16/1244?qt-us_code_temp_noupdates=0#qt-us_code_temp_noupdates>.

16 USC §§ 1271-1287. "Wild and Scenic River Act" (Pub. L. 90-542). <http://www.law.cornell.edu/uscode/pdf/uscode16/lii_usc_TI_16_CH_28_SE_1271.pdf>.

23 USC § 162 *et seq*. "National Scenic Byways Program" (Pub. L. 105-178). <http://www.law.cornell.edu/uscode/pdf/uscode23/lii_usc_TI_23_CH_1_SE_162.pdf>.

42 USC § 4321 *et seq*. "National Environmental Policy Act of 1969" (Pub. L. 91-190) <http://www.law.cornell.edu/uscode/pdf/uscode42/lii_usc_TI_42_CH_55_SE_4321.pdf>.

43 USC § 1701 *et seq*. "Federal Land Policy and Management Act of 1976" (Pub. L. 94-579) <http://www.law.cornell.edu/uscode/text/43/1701>.

49 USC § 5301 *et seq*. "Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA)" (Pub. L. 102-240). <http://www.law.cornell.edu/uscode/text/49/subtitle-III/chapter-53>.

54 USC § 306108. "Effect of undertaking on historic property" (the Section 106 process). (Pub. L. 113–287). https://www.law.cornell.edu/uscode/text/54/306108-

Arkansas Code Annotated 15-23-301 (Title 15, Subtitle 2, Chapter 23, Subchapter 3, Section 301). "Arkansas Natural and Scenic Rivers System Act." <http://www.lexisnexis.com/hottopics/arcode/Default.asp>.

Arkansas Code Annotated 27-67-203 (Title 27, Subtitle 5, Chapter 67, Subchapter 2, Section 203). "Scenic Highway Designations." <http://www.lexisnexis.com/hottopics/arcode/Default.asp>.

Oklahoma Statutes 82-1451-1471 (Title 82, Sections 1451-1471). "Oklahoma Scenic Rivers Act." <http://www.oklegislature.gov/osStatuesTitle.html>.

Tennessee Code 54-17 (Title 54, Chapter 17). "Scenic Byway System Act of 1995." <http://law.justia.com/codes/tennessee/2010/title-54/chapter-17/part-1/>.

Tennessee Code 11-13 (Title 11, Chapter 13). "The Tennessee Scenic Rivers Act of 1968." <http://law.justia.com/codes/tennessee/2010/title-11/chapter-13/>.

ADEQ (Arkansas Department of Environmental Quality). 2012. “Outstanding Resource Waters (Extraordinary Resource Waters, Natural and Scenic Waterways).” <http://www.swl.usace.army.mil/Missions/Regulatory/ArkansasSpecialResourceWaters.aspx>. Accessed August 14, 2014.

AGFC (Arkansas Game and Fish Commission). 2013. “WMA Boundary Representation—Leased Lands Only.” <http://www.agfc.com/resources/Pages/wmaMaps.aspx>. Accessed April 30, 2014.

AHTD (Arkansas State Highway and Transportation Department). 2007. “Scenic Byways Program.” <http://www.arkansashighways.com/scenic_byways_program/scenic_byways_program.aspx>. Accessed February 24, 2014.

BLM (U.S. Bureau of Land Management). 2010. “Visual Resource Inventory.” *BLM Manual Handbook H-8410-1*. <http://www.blm.gov/pgdata/etc/medialib/blm/wo/Information_Resources_Management/policy/blm_handbook.Par.31679.File.dat/H-8410.pdf>. Accessed April 30, 2014.

———. 1986. “Visual Resource Contrast Rating.” *BLM Manual Handbook 8431-1*. <http://www.blm.gov/pgdata/etc/medialib/blm/wo/Information_Resources_Management/policy/blm_handbook.Par.79462.File.dat/8431.pdf>. Accessed February 2014.

———. 1984. “Visual Resource Management.” *BLM Manual Handbook 8400*. <http://www.blm.gov/pgdata/etc/medialib/blm/wo/Information_Resources_Management/policy/blm_manual.Par.34032.File.dat/8400.pdf>. Accessed September 5, 2014.

Clean Line. 2014. *Visual Resources Technical Report for the Plains and Eastern Transmission Line Project*. May. Prepared for the Department of Energy pursuant to 10 CFR 1021.215(b)(2). (Available on EIS Reference CD.)

ESRI (Environmental Systems Research Institute, Inc.). 2010. “Data and Maps for ArcGIS.” <http://www.esri.com/data/data-maps/data-and-maps-dvd.html>. Accessed April 30, 2014.

Koordinates. 2006. “Texas State Parks/Wildlife Management Areas.” <https://koordinates.com/layer/778-texas-state-parks-wildlife-management-areas-1970-1995/>. Accessed June 2013.

National Wild and Scenic Rivers System. 2014. “Managing Agencies.” <http://www.rivers.gov/agencies.php>. Accessed April 7, 2014.

Sullivan, R.G.; Kirchler, L.B.; Lahti, T.; Roché, S.; Beckman, K.; Cantwell, B.; Richmond, P. 2011. *Wind Turbine Visibility and Visual Impact Threshold Distances in Western Landscapes*. Argonne National Laboratory for the U.S. Department of Energy under Contract No. DE-AC02-06CH11357. <http://visualimpact.anl.gov/windvitd/docs/WindVITD.pdf>. Accessed June 25, 2013.

TDEC (Tennessee Department of Environmental Conservation). 2013. “The Known Exceptional Tennessee Waters and Outstanding National Resource Waters.” <http://environment-online.state.tn.us:8080/pls/enf_reports/f?p=9034:34304:26523853229638>. Accessed March 2014.

———. 2011. “Tennessee Natural Areas and State Park Boundaries.” Tennessee State Parks. January 20. <http://www.tn.gov/environment/parks/gis/data/>.

TPWD (Texas Parks and Wildlife Department). 2011. “State Parks Trails.” <https://www.tpwd.state.tx.us/landwater/land/maps/gis/data_downloads/>. Accessed July 2013.

USFS (U.S. Forest Service). 2014. “National Datasets.” <http://data.fs.usda.gov/geodata/edw/datasets.php>. Accessed February 4, 2014.

———. 2005a. *Revised Land and Resource Management Plan Ozark-St. Francis National Forests*. <http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsm8_042809.pdf>. Accessed February 4, 2014.

———. 2005b. *Final Environmental Impact Statement for the Revised Land and Resource Management Plan: Ozark-St. Francis National Forests*. September. <http://www.fs.usda.gov/detail/osfnf/landmanagement/planning/?cid=stelprdb5212187>. Accessed August 19, 2014.

USFWS (U.S. Fish and Wildlife Service). 2012. USFWS Cadastral Geodatabase. <http://www.fws.gov/GIS/data/CadastralDB/index.htm>. Accessed August 19, 2014.

6.2.3.19 Wetlands, Floodplains, and Riparian Areas

10 CFR Part 1022. “Compliance With Floodplain and Wetland Environmental Review Requirements.” *Energy*. U.S. Department of Energy. <http://www.ecfr.gov/cgi-bin/text-idx?SID=534623173a9c8a2d128a6caa401b245e&node=pt10.4.1022&rgn=div5>.

33 CFR Part 322. “Permits for Structures or Work in or Affecting Navigable Waters of the United States.” *Navigation and Navigable Waters*. U.S. Army Corps of Engineers, Department of the Army, Department of Defense. <http://www.ecfr.gov/cgi-bin/text-idx?SID=1b481fbf8207380342553f6457a478e4&node=pt33.3.322&rgn=div5>.

33 CFR 328. *Definitions of Waters of the United States*. U.S. Army Corps of Engineers, Department of the Army, Department of Defense. <http://www.ecfr.gov/cgi-bin/text-idx?SID=d11cb17968a1bcd337a12a82a1cc432b&mc=true&node=pt33.3.328&rgn=div5>.

44 CFR 9.4. “Floodplain Management and Protection of Wetlands, Definitions.” *Emergency Management and Assistance*. Federal Emergency Management Agency, Department of Homeland Security. <http://www.ecfr.gov/cgi-bin/text-idx?SID=534623173a9c8a2d128a6caa401b245e&node=se44.1.9_14&rgn=div8>.

80 FR 37054. “Clean Water Rule: Definition of ‘‘Waters of the United States: Final Rule.” U.S. Army Corps of Engineers, Department of the Army, Department of Defense; and Environmental Protection Agency. June 19, 2015. <http://www.gpo.gov/fdsys/pkg/FR-2015-06-29/pdf/2015-13435.pdf#page=2>.

33 USC § 403. "Construction of bridges, causeways, dams or dikes generally; exemptions." *Rivers and Harbors Appropriation Act of 1899*, Section 10. <http://www.law.cornell.edu/uscode/pdf/uscode33/lii_usc_TI_33_CH_9_SC_I_SE_403.pdf>.

33 USC § 1251 *et seq*. "Clean Water Act of 1972" (Pub. L. 92-500) <http://www.law.cornell.edu/uscode/pdf/lii_usc_TI_33_CH_26.pdf>.

Tennessee Code 69-3-1 (Title 69, Chapter 3, Part 1). "Tennessee Water Quality Control Act of 1977." <http://law.justia.com/codes/tennessee/2010/title-69/chapter-3/part-1/>.

Clean Line. 2013. *Fish, Wildlife, and Vegetation Technical Report for the Plains and Eastern Transmission Line Project*. December. Prepared for the Department of Energy pursuant to 10 CFR 1021.215(b)(2). (Available on EIS Reference CD.)

Cowardin, L.M.; Carter, V.; Golet, F.C.; and LaRoe, E.T. 1979. *Classification of Wetlands and Deepwater Habitats of the United States*. FWS/OBS-79/31. U.S.Fish and Wildlife Service. <http://www.fws.gov/wetlands/Documents/Classification-of-Wetlands-and-Deepwater-Habitats-of-the-United-States.pdf>. Accessed August 19, 2014.

Environmental Laboratory. 1987. U.S. *Army Corps of Engineers Wetland Delineation Manual*. Wetlands Research Program Technical Report Y-87-1. <http://el.erdc.usace.army.mil/elpubs/pdf/wlman87.pdf>. Accessed August 14, 2014.

Executive Order 11988. "Floodplain Management." May 24, 1977 (42 FR 26971). <http://www.archives.gov/federal-register/codification/executive-order/11988.html>.

Executive Order 11990. "Protection of Wetlands." May 24, 1977 (42 FR 26961). <http://www.archives.gov/federal-register/codification/executive-order/11990.html>.

FEMA (Federal Emergency Management Agency). 2013a. "Flood Maps." <https://msc.fema.gov/webapp/wcs/stores/servlet/FemaWelcomeView?storeId=10001&catalogId=10001&langId=-1>. Accessed July 2013.

———. 2013b. Digital Q3 Data, Product Information. <https://msc.fema.gov/webapp/wcs/stores/servlet/info?storeId=10001&catalogId=10001&langId=-1&content=productQ3&title=Digital Q3 Data&parent=productInfo&parentTitle=Product Information>. Accessed October 28, 2013.

USACE (U.S. Army Corps of Engineers). 2015. "Jurisdictional Information." <http://www.usace.army.mil/Missions/CivilWorks/RegulatoryProgramandPermits/juris_info.aspx>. Accessed September 21, 2015.

USDA (U.S. Department of Agriculture). 2013. "Plants database." <http://plants.usda.gov/java/>.

Williams, M.D. 2005. *The All Season Pocket Guide to Identifying Common Tennessee Trees*. Tennessee Division of Forestry. <http://www.tn.gov/twra/pdfs/treeguide.pdf>.

6.2.3.20 Wildlife, Fish, and Aquatic Invertebrates

6.2.3.20.1 Wildlife

40 CFR 1502.22. "Environmental Impact Statement: Incomplete or unavailable information." *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=280656fda1f728c843d410d693851c0a&node=pt40.33.1502&rgn=div5#se40.33.1502_122>.

50 CFR Part 22. "Eagle Permits." *Wildlife and Fisheries*. U.S. Fish and Wildlife Service. <http://www.ecfr.gov/cgi-bin/text-idx?SID=09d66537a14e73fe80204273d86de222&node=pt50.9.22&rgn=div5>.

50 CFR Part 402. "Interagency Cooperation—Endangered Species Act of 1973, As Amended." *Wildlife and Fisheries*. Joint Regulations (United States Fish and Wildlife Service, Department of the Interior and National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Department of Commerce); Endangered Species Committee Regulations. <http://www.ecfr.gov/cgi-bin/text-idx?SID=09d66537a14e73fe80204273d86de222&node=pt50.11.402&rgn=div5>.

16 USC §§ 668-668d. "Bald and Golden Eagle Protection Act" (Pub. L. 86-70) <http://www.law.cornell.edu/uscode/text/16/chapter-5A/subchapter-II>.

16 USC §§ 703-712. "Migratory Bird Treaty Act of 1918" (40 Stat. 755) <http://www.law.cornell.edu/uscode/text/16/chapter-7/subchapter-II>.

16 USC § 1531 *et seq*. "Endangered Species Act of 1973" (Pub. L. 93-205) <http://www.law.cornell.edu/uscode/pdf/lii_usc_TI_16_CH_35.pdf>.

33 USC § 1251 *et seq*. "Clean Water Act of 1972" (Pub. L. 92-500) <http://www.law.cornell.edu/uscode/pdf/lii_usc_TI_33_CH_26.pdf>.

78 FR 65843. "General Provisions; Revised List of Migratory Birds; Final Rule." U.S. Fish and Wildlife Service. November 1, 2013. <http://www.gpo.gov/fdsys/pkg/FR-2013-11-01/pdf/2013-26061.pdf#page=1>.

Arkansas Code Annotated 15-4, (Title 15, Subtitle 4). "Wildlife Resources." <http://www.lexisnexis.com/hottopics/arcode/Default.asp>.

Oklahoma Administrative Code Title 800. "Department of Wildlife Conservation." <http://www.oar.state.ok.us/oar/codedoc02.nsf/frmMain?OpenFrameSet&Frame=Main&Src=_75tnm2shfcdnm8pb4dthj0chedppmcbq8dtmmak31ctijujrgcln50ob7ckj42tbkdt374obdcli00_>.

Oklahoma Statutes 29-5-412.1 (Title 29, Section 5-412.1). "Game and Fish." <http://webserver1.lsb.state.ok.us/OK_Statutes/CompleteTitles/os29.rtf>.

Tennessee Code 70-1-101 (Title 70, Chapter 1, Part 1, Section 101). "Wildlife Resources." <http://www.lawserver.com/law/state/tennessee/tn-code/tennessee_code_70-1-101>.

Texas Administrative Code 31-65.171–65.176 (Title 31, Part 2, Chapter 65, Subchapter G). "Threatened and Endangered Nongame Species." <http://info.sos.state.tx.us/pls/pub/readtac$ext.ViewTAC?tac_view=5&ti=31&pt=2&ch=65&sch=G&rl=Y>.

AGFC (Arkansas Game and Fish Commission). 2013a. *2013–14 Waterfowl and Migratory Bird Seasons*. <http://www.agfc.com/hunting/Documents/LateMigratoryBirdSeasons.pdf>. Accessed August 19, 2014.

———. 2013b. "Early Migratory Bird Species Information." <http://www.agfc.com/species/Pages/SpeciesWildlifeClass2.aspx?SpeciesGroup=Early%20Migratory%20Birds>. Accessed August 19, 2014.

———. 2013c. "Hunting Other Species." <http://www.agfc.com/hunting/Pages/HuntingOtherSpecies.aspx>. Accessed August 19, 2014.

———. 2011. "Species and Habitats." <http://www.agfc.com/species/Pages/SpeciesWildlife.aspx>. Accessed August 19, 2014.

APLIC (Avian Power Line Interaction Committee). 2012. *Reducing Avian Collisions with Power Lines – The State of the Art in 2012*. Edison Electric Institute and APLIC. <http://www.eei.org/resourcesandmedia/products/Pages/ProductDetails.aspx?prod=F20558BF-A097-4289-A8BA-1674B6096523&type=P>. Accessed August 19, 2014.

APLIC and USFWS (Avian Power Line Interaction Committee and U.S. Fish and Wildlife Service). 2005. *Avian Protection Plan Guidelines*. A joint document prepared by The Edison Electric Institute's Avian Power Line Interaction Committee and U.S. Fish and Wildlife Service. <http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/APP/AVIAN%20PROTECTION%20PLAN%20FINAL%204%2019%2005.pdf>.

Caire, W.; Taylor, J.D.; Glass, B.P.; and Mares, M.A. 1989. *Mammals of Oklahoma*. University of Oklahoma Press, Norman. <http://www.abebooks.com/servlet/BookDetailsPL?bi=853497107&searchurl=an%3DCaire%252C%2BW.%252C%2BJ.D.%2BTyler%2Bet.%2Bal.%26amp%3Btn%3DMAMMALS%2BOF%2BOKLAHOMA>. Accessed September 24, 2014.

CEC (Commission for Environmental Cooperation). 2005. *Assessment of Avian Mortality from Collisions and Electrocutions*. CEC-700-2005-015. <http://www.altamontsrc.org/alt_doc/cec_june_2005_assessment_of_avian_mortality_from_collisions_and_electrocutions.pdf>. Accessed August 19, 2014.

Clean Line. 2013. *Fish, Wildlife, and Vegetation Technical Report for the Plains and Eastern Transmission Line Project*. December. Prepared for the Department of Energy pursuant to 10 CFR 1021.215(b)(2). (Available on EIS Reference CD.)

Coates, P.S. and Delehanty, D.J. 2010. “Nest Predation of Greater Sage-grouse in Relation to Microhabitat Factors and Predators.” *Journal of Wildlife Management* 74:240-248. <http://www.jstor.org/discover/10.2307/27760445?uid=3739520&uid=2134&uid=2&uid=70&uid=4&uid=3739256&sid=21104679803757>. Accessed September 24, 2014.

Engel, K.A.; Young, L.S.; Steenhof, K.; Roppe, J.A.; and Kochert, M.N. 1992. “Communal roosting of common ravens in southwestern Idaho.” *Wilson Bulletin* 104:105-121. <http://www.jstor.org/discover/10.2307/4163120?uid=3739520&uid=2&uid=4&uid=3739256&sid=21104679803757>. Accessed September 24, 2014.

EPA (U.S. Environmental Protection Agency). 2012. “Level I Ecoregions Map.” <http://www.epa.gov/wed/pages/ecoregions/na_eco.htm>. Accessed August 19, 2014.

Executive Order 13186. “Responsibilities of Federal Agencies to Protect Migratory Birds.” January 10, 2001. (66 FR 3853). <http://www.gpo.gov/fdsys/pkg/FR-2001-01-17/pdf/01-1387.pdf>.

Kays, R.W.; Gompper, M.E.; and Ray, J.C. 2008. “Landscape ecology of eastern coyotes based on large-scale estimates of abundance.” *Ecological Applications* 18(4):1014-1027. <http://www.jstor.org/discover/10.2307/40062206?uid=3739520&uid=2134&uid=2&uid=70&uid=4&uid=3739256&sid=21104679803757>. Accessed September 24, 2014.

Lowther, P.E. 1993. “Brown-headed Cowbird (*Molothrus ater*).” The Birds of North America Online (A. Poole Ed.). Ithaca: Cornell Lab of Ornithology. <http://bna.birds.cornell.edu/bna/species/047>. Accessed October 18, 2013.

MacArthur, R.H. and Wilson, E.O. 1967. *The theory of island biogeography*. Princeton University Press, Princeton. <http://press.princeton.edu/titles/7051.html>. Accessed September 24, 2014.

Manzer, D.L. and Hannon, S.J. 2005. “Relating Grouse Nest Success and Corvid Density to Habitat: A Multi-Scale Approach.” *Journal of Wildlife Management* 69:110-123. <http://www.jstor.org/discover/10.2307/3803590?uid=3739520&uid=2134&uid=2&uid=70&uid=4&uid=3739256&sid=21104679803757>. Accessed September 24, 2014.

Masters, R.; Ditchkoff, S.; and Farley, S.C. 2002. *Wildlife Management Notes: No. 10 Edge and Other Wildlife Concepts*. Oklahoma Extension Service, Oklahoma State University, Stillwater Oklahoma. <http://pods.dasnr.okstate.edu/docushare/dsweb/Get/Document-5198/Edge%20L-276.pdf>. Accessed September 24, 2014.

Murcia, C. 1995. “Edge effects in fragmented forests: implications for conservation.” *Trends in Ecology and Evolution* 10(2):58-62. <http://www.ncbi.nlm.nih.gov/pubmed/21236953>. Accessed September 29, 2014.

Nagorsen, D.W. and Brigham, R.M. 1993. *Bats of British Columbia*. UBC Press, Vancouver, British Columbia, Canada. <http://www.amazon.com/British-Columbia-Royal-Museum-Handbook/dp/0774804823>. Accessed July 31, 2015.

NAS (National Audubon Society). 2013. "National Map of Important Bird Areas." <http://www.mapsportal.org/audubon_national_iba/>. Accessed September 15, 2013.

NERC (North American Electric Reliability Corporation). 2011. *NERC Reliability Standard FAC-003-2*. <http://www.ferc.gov/industries/electric/indus-act/reliability/vegetation-mgt/fac-003-2.pdf>. Accessed September 4, 2015.

ODWC (Oklahoma Department of Wildlife Conservation). 2014. "Optima Wildlife Management Area." <http://www.wildlifedepartment.com/facts_maps/wma/optima.htm>. Accessed August 19, 2014.

———. 2013. "Oklahoma Hunting Guide, Laws and Regulations." <http://www.wildlifedepartment.com/laws_regs/huntingguide.htm>. Accessed August 19, 2014.

Piorkowski, M.D. 2006. *Breeding Bird Habitat Use and Turbine Collisions of Birds and Bats Located at a Wind Farm in Oklahoma Mixed-Grass Prairie*. Thesis,.Oklahoma State University, Norman. <http://www.batsandwind.org/pdf/Piorkowski_2006.pdf>. Accessed August 5, 2014.

Piorkowski, M.D. and O'Connell, T.J. 2010. "Spatial Pattern of Summer Bat Mortality from Collisions with Wind Turbines in Mixed-grass Prairie." *The American Midland Naturalist* 164(2):260-269. <http://www.bioone.org/doi/abs/10.1674/0003-0031-164.2.260>. Accessed July 31, 2015.

Recher, H. 1969. "Bird Species Diversity and Habitat Diversity in Australia and North America." *The American Naturalist* 103(929). <http://www.jstor.org/discover/10.2307/2459469?uid=3739520&uid=2&uid=4&uid=3739256&sid=21104711038267>. Accessed September 29, 2014.

Saunders, D.A. and Hobbs, R.J. (eds). 1991. *Nature Conservation 2: The Role of Corridors*. Surrey Beatty and Sons, Chipping Norton. <http://www.nhbs.com/title/view/24371>. Accessed September 29, 2014.

Sealander, J.A. and Heidt, G.A. 1990. *Arkansas Mammals: Their Natural History, Classification, and Distribution*. The University of Arkansas Press, Fayetteville. <http://isbn.nu/work/arkansas_mammals_their>. Accessed September 29, 2014.

Smith, J.K. (ed) 2000. *Wildland fire in ecosystems: effects of fire on fauna*. Gen. Tech. Rep. RMRS-GTR-42-vol. 1. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 83 p. <http://www.fs.fed.us/rm/pubs/rmrs_gtr042_1.pdf>. Accessed September 29, 2014.

Stahlecker, D.W. 1978. "Effects of a new transmission line on wintering prairie raptors." *Condor* 80:444-446.

Steenhof, K.; Kochert, M.N.; and Roppe, J.A. 1993. "Nesting by raptors and common ravens on electrical transmission line towers." *Journal of Wildlife Management* 57:271-281. <http://www.fws.gov/southwest/es/documents/R2ES/LitCited/LPC_2012/Steenhof_et_al_1993.pdf>. Accessed September 29, 2014.

TPWD (Texas Parks and Wildlife Department). 2013. “Hunting and Fishing Regulations.” <http://www.tpwd.state.tx.us/regulations/outdoor-annual/>. Accessed August 5, 2014.

TWRA (Tennessee Wildlife Resources Agency). 2013a. *Tennessee Hunting and Trapping 2013 Guide*. <http://www.eregulations.com/wp-content/uploads/2013/07/13TNHD_LR.pdf>. Accessed August 5, 2014.

———. 2013b. “Tennessee's Watchable Wildlife — Mammals.” <http://www.tnwatchablewildlife.org/Mammals.cfm>. Accessed August 5, 2014.

USFWS (U.S. Fish and Wildlife Service). 2014. “Cache River National Wildlife Refuge.” <http://www.fws.gov/cacheriver/>. Accessed August 5, 2014.

———. 2012. *Land-Based Wind Energy Guidelines*. <http://www.fws.gov/windenergy/docs/weg_final.pdf>. March 23, 2012.

———. 2011. “Migratory Birds and Habitat Programs.” <http://www.fws.gov/pacific/migratorybirds/definition.html>. Accessed August 5, 2014.

———. 2009. “North American Flyways.” <http://www.flyways.us/>. Accessed September 2013.

Way, J.G. and Eatough, D.L. 2006. “Use of micro-corridors by eastern coyotes, *Canis latrans*, in a heavily urbanized area: implications for ecosystem management.” *The Canadian Field-Naturalist* 120(4) 474-476. <http://canadianfieldnaturalist.ca/index.php/cfn/article/download/358/358>. Accessed September 29, 2014.

6.2.3.20.2 Fish and Aquatic Invertebrates

Anderson, J.E. (ed) 2006. *Arkansas Wildlife Action Plan, Species Reports: Mussels*. Arkansas Game and Fish Commission. <http://www.wildlifearkansas.com/strategy.html>. Accessed August 14, 2014.

ADF&G (Alaska Department of Fish and Game). 1991. Blasting Standards for the Protection of Fish. Rationale for Blasting Standards (11 AAC 95). Developed to Prevent Explosive Injury to Fish. February 15. <http://www.adfg.alaska.gov/static/license/uselicense/pdfs/adfg_blasting_standards.pdf>. Accessed August 14, 2014.

AGFC (Arkansas Game and Fish Commission). 2011. “Fishing by Species: Fish Species in Arkansas.” <http://www.agfc.com/fishing/Pages/FishingbySpecies.aspx>. Accessed August 14, 2014.

ANHC (Arkansas Natural Heritage Commission). 2014. “Rare Species Search Engine.” Data search in project area. <http://www.naturalheritage.com/research-data/rarespecies-search.aspx>. Accessed October 1, 2014.

Clean Line. 2014. *Wind Generation Technical Report for the Plains and Eastern Transmission Line Project*. March. Prepared for the Department of Energy pursuant to 10 CFR 1021.215(b)(2). (Available on EIS Reference CD.)

———. 2013a. *Fish, Wildlife, and Vegetation Technical Report for the Plains and Eastern Transmission Line Project*. December. Prepared for the Department of Energy pursuant to 10 CFR 1021.215(b)(2). (Available on EIS Reference CD.)

———. 2013b. *Surface Water Technical Report for the Plains and Eastern Transmission Line Project*. December. Prepared for the Department of Energy pursuant to 10 CFR 1021.215(b)(2). (Available on EIS Reference CD.)

EPA (US Environmental Protection Agency). 2003. *EPA Region 10 Guidance for Pacific Northwest State and Tribal Temperature Water Quality Standards*. EPA 910-B-03-002. Region 10 Office of Water, Seattle, Washington. April. <http://www.epa.gov/region10/pdf/water/final_temperature_guidance_2003.pdf>. Accessed September 29, 2014.

———. 2014. "Physical Habitat." *The Causal Analysis/Diagnosis Decision Information System*. <http://www.epa.gov/caddis/ssr_phab_int.html>. Accessed September 29, 2014.

Harris, J.L.; Posey II, W.R.; Davidson, C.L.; Farris, J.L.; Oetker, S.R.; Stoeckel, J.N.; Crump, B.G.; Barnett, M.S.; Martin, H.C.; Matthews, M.W.; Seagraves, J.H.; Wentz, N.J.; Winterringer, R.; Osborne, C.; and Christian, A.D. 2009. "Unionoida (Mollusca: Margaritiferidae, Unionidae) in Arkansas, third status review." *Journal of the Arkansas Academy of Science* 63:50-86. <http://libinfo.uark.edu/aas/issues/2009v63/v63a8.pdf>. Accessed September 29, 2014.

HookandBullet. 2014a. "Fishing Spots in Texas County, OK." Fishing, Guides, Charters, Bait Information. <http://www.hookandbullet.com/cn/fishing-texas-ok/>. Accessed August 14, 2014.

———. 2014b. "Fishing Spots in Tennessee." Fishing, Guides, Charters, Bait Information. <http://www.hookandbullet.com/s/fishing-tennessee/>. Accessed August 14, 2014.

———. 2014c. "Fishing Spots in Texas." Fishing, Guides, Charters, Bait Information. <http://www.hookandbullet.com/s/fishing-texas/>. Accessed August 14, 2014.

———. 2014d. "Fishing Spots in Oklahoma." Fishing, Guides, Charters, Bait Information. <http://www.hookandbullet.com/s/fishing-oklahoma/>. Accessed August 14, 2014.

Linam, G.W.; Kleinsasser, L.J.; and Mayes, K. 2002. *Regionalization of the Index of Biotic Integrity for Texas Streams*. Texas Parks and Wildlife Department. <http://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_rp_t3200_1086.pdf>. Accessed July 24, 2014.

Mather, C.M. 2005. "The Freshwater Mussels of Oklahoma. Final Report to the Oklahoma Department of Wildlife Conservation. Federal Aid Grant No. T-14-P-1." Oklahoma City, Oklahoma. <http://www.digitalprairie.ok.gov/cdm/compoundobject/collection/stgovpub/id/7476/rec/3131>. Accessed July 24, 2014.

NERC (North American Electric Reliability Corporation). 2011. *NERC Reliability Standard FAC-003-2*. <http://www.ferc.gov/industries/electric/indus-act/reliability/vegetation-mgt/fac-003-2.pdf>. Accessed September 4, 2015.

ODWC (Oklahoma Department of Wildlife Conservation). 2015. *Federal and State Endangered, Threatened and Candidate Species in Oklahoma by County*. <http://www.biosurvey.ou.edu/download/heritage/countypr0503.pdf>. Accessed July 22, 2015.

———. 2014. *Oklahoma Fishing: Official Guide to the 2014 Fishing Regulations*. <http://www.wildlifedepartment.com/laws_regs/2014fishguide.pdf>. Accessed July 24, 2014.

TPWD. (Texas Parks and Wildlife Department). 2014a. "Freshwater Fishes Found in Texas." <http://www.tpwd.state.tx.us/landwater/water/aquaticspecies/inland.phtml>. Accessed July 24, 2014.

———. 2014b. "Rare, Threatened, and Endangered Species of Texas by County." <http://www.tpwd.state.tx.us/landwater/land/maps/gis/ris/endangered_species/>. Accessed August 14, 2014.

TDEC (Tennessee Department of Environment and Conservation). 2014. "Natural Heritage Inventory Program." Data search in project area. <http://tn.gov/environment/natural-areas/natural-heritage-inventory-program.shtml>. Accessed October 1, 2014.

TranBC (British Columbia Ministry of Transportation). 2000. "Use of Explosives in or near Fish and Fish Habitat." Technical Circular T3/00. <http://www.th.gov.bc.ca/publications/Circulars/All/T_Circ/2000/t03-00.pdf>. Accessed September 29, 2014.

TWRA (Tennessee Wildlife Resources Agency). 2011. *Tennessee Commercial Musseling Regulation Summary*. <http://www.tn.gov/twra/fish/mussels/musreg11.pdf>. Accessed July 24, 2014.

USGS (U.S. Geological Survey). 2014. "Nonindigenous Aquatic Species Database." Gainesville, Florida. <http://nas.er.usgs.gov/queries/FactSheetList.aspx>. Accessed July 24, 2014.

6.2.4 Chapter 4

40 CFR Part 93, Subpart A. "Conformity to State or Federal Implementation Plans of Transportation Plans, Programs, and Projects Developed, Funded or Approved Under Title 23 U.S.C. or the Federal Transit Laws." *Protection of Environment*. Environmental Protection Agency. <http://www.ecfr.gov/cgi-bin/text-idx?SID=534623173a9c8a2d128a6caa401b245e&node=pt40.20.93&rgn=div5#sp40.20.93.a>.

40 CFR Part 93, Subpart B. "Determining Conformity of General Federal Actions to State or Federal Implementation Plans." *Protection of Environment*. Environmental Protection Agency. <http://www.ecfr.gov/cgi-bin/text-idx?SID=534623173a9c8a2d128a6caa401b245e&node=pt40.20.93&rgn=div5#sp40.20.93.b>.

40 CFR 1508.7. "Terminology and Index, Cumulative impact." *Protection of Environment*. Council on Environmental Quality. <http://www.ecfr.gov/cgi-bin/text-idx?SID=534623173a9c8a2d128a6caa401b245e&node=pt40.33.1508&rgn=div5#se40.33.1508_17>

104 Stat. 3096. “Global Climate Change Act of 1990” (Pub. L. 101-606) <http://www.gpo.gov/fdsys/pkg/STATUTE-104/pdf/STATUTE-104-Pg3096.pdf>.

AHTD (Arkansas State Highway and Transportation Department). 2014a. “District 1 Projects.” Individual county maps dated March 10. <http://www.arkansashighways.com/district1.aspx>. Accessed May 7, 2014.

———. 2014b. “District 4 Construction Projects by County.” Individual county maps dated March 10. <http://www.arkansashighways.com/district4.aspx>. Accessed May 7, 2014.

———. 2014c. “District 5 Construction Projects by County.” Individual county maps dated March 10. <http://www.arkansashighways.com/district5.aspx>. Accessed May 7, 2014.

———. 2014d. “District 8 Construction Projects by County.” Individual county maps dated March 10. <http://www.arkansashighways.com/district8.aspx>. Accessed May 7, 2014.

———. 2014e. “District 10 Construction Projects by County.” Individual county maps dated March 10. <http://www.arkansashighways.com/district10.aspx>. Accessed May 7, 2014.

———. 2013. *(Presentation to the)* “Jonesboro Regional Chamber of Commerce.” July 15. <http://www.arkansashighways.com/PowerPoints/2013/071513_SEB_JonesboroChamber.pdf>. Accessed May 9, 2014.

———. 2012. *(Application for)* “Transportation Investment Generating Economic Recovery Discretionary Grant Program Fiscal Year 2012.” Project Name: Highway 71 New Location (Future Interstate 49). <http://www.arkansashighways.com/TIGER/T4/71.aspx>. Accessed June 3, 2014.

Arnold, K. 2014. “Jones Riverside Airport cleared for $12.1 million in improvements.” *Tulsa World.* February 20. <http://www.tulsaworld.com/business/aerospace/jones-riverside-airport-cleared-for-million-in-improvements/article_cb56a0b8-1a84-5e92-9c41-08ed2cc61db6.html>. Accessed May 7, 2014.

Carter, L. M.; Jones, J.W.; Berry, L.; Burkett, V.; Murley, J.F.; Obeysekera, J.; Schramm, P.J.; and Wear, D. 2014. Southeast and the Caribbean. Chapter 17 in *Climate Change Impacts in the United States: The Third National Climate Assessment*, J.M. Melillo, Terese (T.C.) Richmond, and G.W. Yohe (eds). U.S. Global Change Research Program, 396-417. doi:10.7930/J0N-P22CB. <http://nca2014.globalchange.gov/report/regions/southeast>. Accessed July 24, 2015.

CenterPoint Energy. 2014. “Central Arkansas Pipeline Enhancement—Project Overview and Project Schedule.” <http://www.centerpointenergy.com/services/pipelines/centralarkansaspipelineenhancement/>. Accessed May 8, 2014.

———. 2013. “Central Arkansas Pipeline Enhancement—Construction Process” (factsheet). February. <http://www.centerpointenergy.com/staticfiles/CNP/Common/SiteAssets/doc/130565%20CAPE%20construction%20factsheet.pdf>. Accessed May 8, 2014.

CEQ (Council on Environmental Quality). 1997. “Considering Cumulative Effects Under the National Environmental Policy Act.” <http://ceq.hss.doe.gov/nepa/ccenepa/ccenepa.htm>. Accessed May 12, 2014.

Crabtree, S. 2013. “Highway department makes progress on bypass project.” *Courier News*. June 5, 2013. <http://www.couriernews.com/view/full_story/22801910/article-Highway-department-makes-progress-on-bypass-project>. Accessed May 7, 2013.

Dandridge, D.F. 2012. “Cherokees approve hydroelectric plant.” *Sequoyah County Times*. January 25. <http://www.sequoyahcountytimes.com/news/local_news/article_d223bcda-0d83-531a-b028-974fe418ad05.html>. Accessed May 7, 2014.

Diamond Pipeline, LLC. 2015. “Diamond Pipeline LLC, Project Overview.” <http://www.diamondpipelinellc.com/project-overview.html>. Accessed June 4, 2015.

Dyersburg State Gazette. 2013. “TDOT commissioner visits Dyersburg, speaks on I-69.” February 23. <http://www.stategazette.com/story/1944253.html>. Accessed May 9, 2014.

Entergy. 2013. *Entergy Proposed 2014–2018 Final Construction Plan*. September Summit, September 11. <http://www.oatioasis.com/EES/EESdocs/2013-09-11_ICT_Summit_Item_3_Entergy_Proposed_2014-2018_Final_Construction_Plan.pdf>. Accessed May 8, 2014.

Epley, C. 2012. “$200 million mixed-used development in Munford to begin first phase.” *Memphis Business Journal*. May 4. <http://www.bizjournals.com/memphis/print-edition/2012/05/04/200-million-mixed-used-development-in.html>. Accessed July 7, 2014.

FERC (Federal Energy Regulatory Commission). 2014. “Major Pipeline Projects Pending (Onshore) – Docket No. CP14-23 – Enable Gas Transmission, LLC (CP14-23-000) Central Arkansas Pipeline Enhancement Project.” Data as of June 15, 2014. < http://www.ferc.gov/CalendarFiles/20140717151109-CP14-23-000.pdf>. Accessed September 18, 2015.

FHWA and AHTD (Federal Highway Administration and Arkansas State Highway and Transportation Department). 2012. *Environmental Assessment Job 100682—Future Interstate 555 Access Road Study (U.S. Highway 63), Poinsett County*. January 15. <https://www.arkansashighways.com/public_meetings/2012/100682/US%2063%20EA%20-%20Final%20signed%20with%20Appendices%20(022112)_reduced.pdf>. Accessed May 9, 2014.

Green Meadows (Green Meadows Development Corporation). 2014 “Green Meadows at Munford.” <http://www.greenmeadowsliving.com/>. Accessed May 9, 2014.

IPCC (Intergovernmental Panel on Climate Change). 2013. “Summary for Policymakers.” In: *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds). Cambridge University Press, Cambridge, United Kingdom, and New York, NY, USA.<http://www.ipcc.ch/report/ar5/wg1/>. Accessed June 17, 2015.

KEIN (Kansas Energy Information Network). 2014. "Oklahoma Wind Farms." April 12. <http://kansasenergy.org/wind_projects_OK.htm>. Accessed May 5, 2014.

Maxwell, S. 2014. "Cherokees Studying Hydroelectric Plans." *KXMX Local News*. May 19. <http://arklahoma.blogspot.com/2014/05/cherokees-studying-hydroelectric-plans.html>. Accessed June 4, 2014.

Mississippi County (Arkansas) Economic Development Area. 2014 "Great River Super Site: Osceola, Arkansas." <http://www.greatriversupersite.com/>. Accessed May 9, 2014.

Oklahoma Bid Network. 2013. "Bid Opportunities-2013-September-03, Bridge and Approaches." <http://www.oklahomabids.com/bid-opportunities/2013/09/03/5128863-Bridge-and-Approaches.html>. Accessed April 30, 2014.

OKDOT (Oklahoma Department of Transportation). 2013a. "2014 to 2021 Construction Work Plan Division 1" (Division 1 Map). October 7. <http://www.okladot.state.ok.us/cwp-8-year-plan/index.htm>. Accessed April 30, 2014.

———. 2013b. "2014 to 2021 Construction Work Plan Division 3" (Division 3 Map). October 7. <http://www.okladot.state.ok.us/cwp-8-year-plan/index.htm>. Accessed April 30, 2014.

———. 2013c. "2014 to 2021 Construction Work Plan Division 4" (Division 4 Map). October 7. <http://www.okladot.state.ok.us/cwp-8-year-plan/index.htm>. Accessed April 30, 2014.

———. 2013d. "2014 to 2021 Construction Work Plan Division 6" (Division 6 Map). October 7. <http://www.okladot.state.ok.us/cwp-8-year-plan/index.htm>. Accessed April 30, 2014.

———. 2013e. "2014 to 2021 Construction Work Plan Division 8" (Division 8 Map). October 7. <http://www.okladot.state.ok.us/cwp-8-year-plan/index.htm>. Accessed April 30, 2014.

———. 2013f. *FFY-2014 through FFY-2021 Construction Work Plan, Volume XI*. October 7. <http://www.okladot.state.ok.us/cwp-8-year-plan/index.htm>. Accessed April 30, 2014.

OG&E (Oklahoma Gas and Electric Company). 2014a. ""Transmission Projects, Seminole/Muskogee Project." <http://www.oge.com/ABOUT/TRANSMISSIONLINES/TRANSMISSIONPROJECTS/Pages/SeminoleMuskogee.aspx>. Accessed May 6, 2014.

———. 2014b. "Transmission Projects, Woodward/Hitchland." <http://www.oge.com/about/TransmissionLines/TransmissionProjects/Pages/WoodwardHitchland.aspx>. Accessed April 30, 2014.

———. 2011. "OG&E Woodward District EHV to Thistle Transmission Line Project" (Fact Sheet & Route Options Map). July. <http://www.oge.com/about/TransmissionLines/TransmissionProjects/Pages/WoodwardThistle.aspx>. Accessed May 5, 2014.

Plains All American (Plains All American Pipeline, L.P.). 2014. “Plains All American Announces Plans to Construct Pipeline from Cushing to Memphis.” News Release dated August 21. <http://ir.paalp.com/profiles/investor/NewsPrint.asp?b=789&ID=72064&m=rl&v=2&g=549>. Accessed June 4, 2015.

SemGroup (SemGroup Corporation). 2014a. *Fourth Quarter & Full-Year 2013 Results, Earnings Conference Call February 28, 2014—SemGroup and Rose Rock Midstream*. <http://ir.semgroupcorp.com/Cache/1001184055.PDF?Y=&O=PDF&D=&fid=1001184055&T=&iid=4135511>. Accessed May 5, 2014.

———. 2014b “Glass Mountain Pipeline.” <http://www.semgroupcorp.com/OperationsAndCommodities/CrudeOil/GlassMountainPipeline.aspx>. Accessed May 5, 2014.

Shafer, M.; Ojima, D.; Antle, J.M.; Kluck, D.; McPherson, R.A.; Petersen, S.; Scanlon, B.; and Sherman, K. 2014. “Great Plains.” Chapter 19 in *Climate Change Impacts in the United States: The Third National Climate Assessment*, J.M. Melillo, Terese (T.C.) Richmond, and G.W. Yohe (eds). U.S. Global Change Research Program, 441-461. doi:10.7930/J0D798BC. <http://nca2014.globalchange.gov/report/regions/great-plains>. Accessed July 24, 2015.

SPP (Southwest Power Pool). 2013. “Facility Study for Generator Interconnection Request GEN-2008-047.” SPP Generator Interconnection Studies. November. <http://sppoasis.spp.org/documents/swpp/transmission/studies/files/2008_Generation_Studies/GEN-2008-047%20Fac%20Study%2011-08-2013.pdf>. Accessed April 29, 2014.

TNDOT (Tennessee Department of Transportation). 2014. “Interstate 69 Project—I-69 Corridor from Millington to Dyersburg.” <http://www.tdot.state,tn.us/i69/segment9/map.htm>. Accessed May 9, 2014.

———. 2011. *Tennessee Environmental Streamling Agreement Concurrence Point #1—Purpose and Need and Study Area Package for the Southern Gateway Project, Shelby County*, Tennessee. June 15 (minor modification to format July 8, 2011). <http://www.southerngatewayproject.com/index.asp>. Accessed May 9, 2014.

Tipton County. 2014. “Tipton County Property Search Application.” <http://tiptontn.geopowered.com/PropertySearch?>. Accessed July 8, 2014.

USACE (U.S. Army Corps of Engineers). 2013. “Corps replacing aging Highway 151 Bridge over Keystone Dam.” Tulsa District article of October 28. <http://www.swt.usace.army.mil/Media/NewsReleases/tabid/4954/Article/18108/corps-to-replace-aging-highway-151-bridge-over-keystone-dam.aspx>. Accessed May 7, 2014.

USGCRP (U.S. Global Change Research Program). 2014. *2014 National Climate Assessment*. J.M. Melillo, Terese (T.C.) Richmond, and G.W. Yohe (eds). <http://nca2014.globalchange.gov/system/files_force/downloads/low/NCA3_Climate_Change_Impacts_in_the_United%20States_LowRes.pdf?download=1>. Accessed July 24, 2015.

U.S. House of Representatives. 2014. *The Water Resources Reform and Development Act of 2014 Conference Report*." H.R. 3080. Transportation and Infrastructure Committee. May 15. <http://transportation.house.gov/wrrda/conference.htm>. Accessed June 4, 2014.

Wilbur Smith Associates. 2006. *Mississippi River Crossing Feasibility and Location Study—Executive Summary*. Prepared for Tennessee Department of Transportation, June. <http://www.tdot.state.tn.us/documents/MRCexecsum.pdf>. Accessed May 12, 2014.

Xcel Energy. 2014. "Power for the Plains, Hitchland-Woodward 345 kV Transmission Line." <http://www.powerfortheplains.com/projects/hitchland-woodward/index.asp>. Accessed July 1, 2014.

———. 2013. "Wind Energy Purchase Agreement between Southwestern Public Service Company and Mammoth Plains Wind Project Holdings, LLC." <http://www.xcelenergy.com/staticfiles/xe/Regulatory/Regulatory%20PDFs/NM-2013-Wind-Purchased-Power-Agreemtents/NM-2013-Wind-PPA-Mammoth-Plains.pdf>. Accessed May 5, 2014.

6.3 GIS Data Sources

This section provides source information for GIS data used or referenced in the development of the EIS, including those used to produce the maps in Appendix A. The data files are not provided on the Reference CD accompanying the EIS because the file sizes can be very large and the files also require specialized software to view. The data sources that were analyzed are available at the links provided below.

79 FR 19974. "Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for the Lesser Prairie-Chicken." U.S. Fish and Wildlife Service, Department of the Interior. April 10, 2014. <http://www.gpo.gov/fdsys/pkg/FR-2014-04-10/pdf/2014-07302.pdf#page=2>.

AGFC (Arkansas Game and Fish Commission). 2014. "Wildlife Management Areas (AGFC-owned and leased land)." Received from Wesley Cleland at Arkansas Game and Fish Commission on August 27.

———. 2005. Wildlife Management Area Boundary. <http://www.geostor.arkansas.gov/G6/Home.html?id=34339f1b592d09c009dda083ef643329>. Accessed August 2014.

AHTD (Arkansas State Highway and Transportation Department). 2006a. Arkansas Census 2000 Roads. U.S. Department of Commerce, U.S. Census Bureau, Geography Division 2000. TIGER/Line Files. <http://www.geostor.arkansas.gov/G6/Home.html>. <http://www.census.gov/geo/maps-data/data/tiger-line.html>.

———. 2006b. Arkansas Municipal Boundaries. City Limit (polygon). <http://www.geostor.arkansas.gov/G6/Home.html>.

———. 2006c. Arkansas Public Land Boundaries. <http://www.geostor.arkansas.gov/G6/Home.html>.

ANRC (Arkansas Natural Resources Commission). 2014. Groundwater Study Areas Designated as Critical in Arkansas. Email communication with attached electronic shape files dated March 19, 2014, from Chris Kelley, Arkansas Natural Resources Commission. Received files from Chris Kelly at Arkansas Natural Resources Commission.

AOGC (Arkansas Oil and Gas Commission) 2015. Arkansas Oil and Natural Gas Well Map. <http://www.aogc.state.ar.us/Maps.htm>. Accessed July 1, 2014.

AWWCC (Arkansas Water Well Construction Commission) 2014. Well Records. <http://www.arkansas.gov/awwcc/FramesConstructionReports.htm>. Accessed July 2014.

BTS (Bureau of Transportation Statistics) 2013. Layers include places; airports; counties; interstate, U.S., and State highways; railroads; States. Federal Aviation Administration (FAA), Research and Innovation Technology Administration's Bureau of Transportation Statistics (RITA/BTS), National Transportation Atlas Database (NTAD) 2013. Airports and railroads. <http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_atlas_database/index.html>.

Clean Line. 2015a. Digitized Structures including Agricultural, Commercial, and Industrial Structures, Residences, Churches, Hospitals Private Airstrips, and Helipads. Data Layer in the Vicinity of the Plains & Eastern Clean Line Project, Created by Clean Line via Stakeholder Comments Received by Clean Line (2010-2012) and Scoping Comments Received by DOE During the Scoping Period (December-March 2013), Supplemented With Aerial Photograph Interpretation and Field Verification Surveys Conducted From Public Roads in 2012 and 2013.

———. 2015b. Digitized Private Airfields. Data Layer in the Vicinity of the Plains & Eastern Clean Line Project, Created by Clean Line via Aerial Photograph Interpretation.

———. 2015c. Digitized Transmission Structures and Derived Electrical Transmission Lines (69kV and higher). Data Layer in the Vicinity of the Plains & Eastern Clean Line Project, Created by Clean Line via Aerial Photograph Interpretation.

———. 2015d. U.S. Geographic Names Information System Cemeteries, ESRI Data & Maps 2013. Dataset included with ArcMap 10.2.

———. 2014. Key Observation Points.

———. 2013a. Tipton County Water Wells.

———. 2013b. Shelby County Water Wells.

———. 2013c. Arkansas Scenic Byways and Highways.

———. 2013d. Level of Service.

CSA (Center for Spatial Analysis) 2014. University of Oklahoma, State-wide Municipal Boundaries 2014. <http://geo.ou.edu/DataFrame.htm>.

———. 2007. University of Oklahoma, State-wide Roads 2007. http://geo.ou.edu/DataFrame.htm

CUSEC (Central U.S. Earthquake Consortium). 2008. State Geologists, Liquefaction Susceptibility Map 2008. Accessed March 11, 2014. <http://crystal.isgs.uiuc.edu/research/earthquake-hazards/cusec/digital-maps.shtml>.

EIA (U.S. Energy Information Administration) 2011a. Shale Plays. <http://www.eia.gov/pub/oil_gas/natural_gas/analysis_publications/maps/maps.htm>.

———. 2011b. Shale Basins. <http://www.eia.gov/pub/oil_gas/natural_gas/analysis_publications/maps/maps.htm>.

EPA (Environmental Protection Agency). 2014a. Air Quality Monitoring Station. EPA Interactive webpage. <http://www.epa.gov/airquality/airdata/ad_maps.html>.

———. 2014b. EPA Geospatial Data Access Project, Facility Registry Services 2013. <http://www.epa.gov/enviro/geo_data.html>. Accessed January 31, 2014.

———. 2011. National Sole Source Aquifer GIS Layer. EPA webpage. <https://edg.epa.gov/data>. Accessed March 2014.

———. 2010. US Level III Ecoregions. EPA webpage. <http://www.epa.gov/wed/pages/ecoregions/level_iii_iv.htm#Level III>. Accessed March 2014.

FCC (Federal Communications Commission). 2012. Licensing Database Extracts 2012. <http://wireless.fcc.gov/geographic/index.htm?job=licensing_database_extracts>.

FEMA (Federal Emergency Management Agency). 2014. National Flood Hazard Layer. <https://msc.fema.gov/portal/advanceSearch>. Accessed August 11, 2014.

FHWA (Federal Highway Administration). 2013. National Scenic Byways. Received via FTP from Gary Jensen at FHWA (August 2014).

Garrity and Soller. 2009. USGS, Database of the Geologic Map of North America - Adapted from the Map by J.C. Reed, Jr. and others (2005) 2009. <http://ngmdb.usgs.gov/gmna/>. Accessed February 20, 2014.

IWSRCC (Interagency Wild and Scenic River Coordinating Council). 1999. USGS National Atlas. Wild and Scenic Rivers. Rivers.gov webpage. <http://www.rivers.gov/mapping-gis.php>.

Jin, S.; Yang, L.; Danielson, P.; Homer, C.; Fry, J.; and Xian, G. 2013. “A comprehensive change detection method for updating the National Land Cover Database to circa 2011.” *Remote Sensing of Environment* 132:159-175. <http://www.mrlc.gov/downloadfile2.php?file=Preferred_NLCD11_citation.pdf>.

KBS (Kansas Biological Survey). 2014. Lesser Prairie-chicken Leks. University of Kansas. <http://kars.ku.edu/geonetwork/srv/en/main.home>. Accessed April 2, 2014.

———. 2013a. Lesser Prairie-chicken Estimated Occupied Range. University of Kansas. <http://kars.ku.edu/geonetwork/srv/en/main.home>. Accessed April 2, 2014.

———. 2013b. Lesser Prairie-chicken Crucial Habitat. University of Kansas. <http://kars.ku.edu/geonetwork/srv/en/main.home>. Accessed April 2, 2014.

NAIP (National Agriculture Imagery Program) 2013a. Arkansas Aerial Photography (1-meter resolution). U.S. Department of Agriculture (USDA), Farm Service Agency (FSA), Aerial Photography Field Office (APFO). <http://gis.apfo.usda.gov/arcgis/services>.

———. 2013b. Oklahoma Aerial Photography (1-meter resolution). U.S. Department of Agriculture (USDA), Farm Service Agency (FSA), Aerial Photography Field Office (APFO). <http://gis.apfo.usda.gov/arcgis/services>.

———. 2014a. Tennessee Aerial Photography (1-meter resolution). U.S. Department of Agriculture (USDA), Farm Service Agency (FSA), Aerial Photography Field Office (APFO). <http://gis.apfo.usda.gov/arcgis/services>.

———. 2014b. Texas Aerial Photography (1-meter resolution). U.S. Department of Agriculture (USDA), Farm Service Agency (FSA), Aerial Photography Field Office (APFO). <http://gis.apfo.usda.gov/arcgis/services>.

NASS (National Agricultural Statistics Service). 2013. United States Department of Agriculture (USDA), National Agricultural Statistics Service (NASS), Research and Development Division (RDD), Geospatial Information Branch (GIB), Spatial Analysis Research Section (SARS) 2014. CropScape "Cropland Data Layer." <http://nassgeodata.gmu.edu/CropScape/>. Accessed May 9, 2014

NCED (National Conservation Easement Database). 2014. <http://conservationeasement.us/>.

NPS (National Park Service). 2013. National Trails of the Intermountain Region, Designated Routes of the Santa Fe National Historic Trail, Old Spanish National Historic Trail, El Camino Real de Tierra Adentro National Historic Trail, El Camino Real de los Tejas National Historic Trail, Mormon Pioneer National Historic Trail, Pony Express National Historic Trail, California National Historic Trail, Oregon National Trail, and Trail of Tears National Historic Trail. Received via email April 9.

NRCS (Natural Resources Conservation Service). 2013. U.S. Department of Agriculture, Natural Resources Conservation Service, Web Soil Survey, SSURGO 2013. <http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm>. Accessed February 2014.

———. 2006. U.S. Department of Agriculture, Natural Resources Conservation Service, Land Resource Regions and Major Land Resource Areas for the Conterminous U.S. 2006. <http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/?cid=nrcs142p2_053624>. Accessed July 23, 2014.

———. 2005. U.S. Department of Agriculture, Oklahoma Natural Resources Conservation Service, NRCS Oklahoma Watershed Dam Locations 2005 <http://geo.ou.edu/DataFrame.htm>.

OCC (Oklahoma Corporation Commission). 2015. Oil and Gas Division. All Oklahoma UIC Wells. <http://www.occeweb.com/og/oghome.htm>. Accessed February 20, 2014.

ODEQ (Oklahoma Department of Environmental Quality) 2012. Wellhead Protection Areas. OKDEQ webpage. Accessed March 2014. Sent by e-mail.

ODWC (Oklahoma Department of Wildlife Conservation). 2014. “Shorb and Schultz Wildlife Management Areas.” Digitized areas of these two WMAs using the ODWC Hunting online map viewer. <http://maps.wildlifedepartment.okstate.edu/flexviewers/Hunting%20Viewer/>. Accessed September 4, 2015.

OWRB (Oklahoma Water Resources Board). 2014. Groundwater Wells. <http://www.owrb.ok.gov/maps/pmg/owrbdata_GW.html>.

———. 2011a. OWRB Groundwater Aquifers 2014. <http://www.owrb.ok.gov/maps/PMG/owrbdata_GW.html>. Accessed February 24, 2014.

———. 2011b. Oklahoma Water Quality Standards, Appendix D - Classifications for Groundwater in Oklahoma (State Groundwater Vulnerability) 2011. <http://www.owrb.ok.gov/maps/pmg/owrbdata_GW.html>. Accessed March, 2014.

———. 2011c. Oklahoma Water Quality Standards, Class I - Special Source Groundwater 2011. <http://www.owrb.ok.gov/maps/pmg/owrbdata_GW.html>. Accessed March, 2014.

PLJV (Playa Lakes Joint Venture). 2011. Probable Playas Version 4. PLJV webpage. <http://www.pljv.org/partners/maps-data/playa-maps>. Accessed March 2014.

Stutts. 2014. National Park Service (NPS), National Register of Historic Places (NRHP) Public Dataset 2014. Geospatial Dataset-2210280. Current as of May 20, 2014. <https://irma.nps.gov/App/Reference/Profile/2210280/>. Accessed June 17, 2014.

Tetra Tech 2014. Scenic Quality Analysis. Compiled from multiple sources.

TNC (The Nature Conservancy). 2013. The Nature Conservancy Lands. <http://maps.tnc.org/gis_data.html#TNClands>.

TNGIS (Tennessee GIS Clearinghouse). 2014a. City Limits Derived from 1996 U.S. Census Tiger Files <http://www.tngis.org/administrative-boundaries.htm>.

TNGIS (Tennessee GIS Clearinghouse). 2014b. County Boundaries provided by Tennessee Department of Transportation 2010. <http://www.tngis.org/administrative-boundaries.htm>.

Tobin and Weary 2004. Digital Engineering Aspects of Karst Map: A GIS Version of Davies, W.E., Simpson, J.H., Ohlmacher, G.C., Kirk, W.S., and Newton, E.G., 1984, Engineering Aspects of Karst: U.S. Geological Survey, National Atlas of the United States of America 2004 <http://pubs.usgs.gov/of/2004/1352/>.

TPWD (Texas Parks & Wildlife Department) 2012. Land and Water Resources Conservation and Recreation Plan Statewide Inventory 2012 Data for Conservation and Recreation Lands in Texas 2012. <http://www.tpwd.state.tx.us/gis/apps/lwrcrp/>.

TWDB (Texas Water Development Board). 2013. Well Data from TWDB Groundwater Database. <http://www.twdb.state.tx.us/mapping/gisdata.asp>.

TWRA (Tennessee Wildlife Resources Agency). 2007. TWRA Owned/Managed Lands. <http://www.tn.gov/twra/gis/gishome.html>.

TXDOT (Texas Department of Transportation). 2014. Texas Municipal Boundaries. Texas Natural Resources Information System (TNRIS), Texas Water Developent Board, Texas Strategic Mapping Program (StratMap) 2012. <http://www.tnris.org/get-data?quicktabs_2=1>.

———. 2013. Texas Roads. Texas Natural Resources Information System (TNRIS), Texas Water Development Board. <http://www.tnris.org/get-data?quicktabs_2=1>.

USACE (United States Army Corps of Engineers). 2010. Interior Least Tern survey data. Memphis District. Obtained September 30, 2011.

USCB (U.S. Census Bureau). 2013. U.S. Department of Commerce, Geography Division 2013. TIGER/Line shapefile. <http://www.census.gov/geo/maps-data/data/tiger-line.html>.

———. 2011. U.S. Department of Commerce, Geography Division 2013. TIGER/Line shapefile. (block group boundaries). American Community Survey 2011 (low-income statistics) <http://www.census.gov/geo/maps-data/data/tiger.html>.

———. 2000. U.S. Department of Commerce, Geography Division 2000. TIGER/Line Files. <http://www.census.gov/geo/maps-data/data/tiger-line.html>.

USFS (U.S. Forest Service). 2014a. Administrative Forest Boundaries. <http://data.fs.usda.gov/geodata/edw/datasets.php>.

———. 2014b. Wilderness Areas. <http://data.fs.usda.gov/geodata/edw/datasets.php>.

———. 2014c. Basic Ownership 2014. <http://data.fs.usda.gov/geodata/edw/datasets.php>.

USFWS (U.S. Fish and Wildlife Service). 2014a. Arkansas River Shiner: USFWS, Final Critical Habitat for the Arkansas River Shiner 2005.

———. 2014b. Whooping Crane: USFWS, Final Critical Habitat for the Whooping Crane 2003 <http://ecos.fws.gov/crithab/>.

———. 2014c. FWS Approved Boundaries 2014. <http://www.fws.gov/gis/data/CadastralDB/index.htm>.

———. 2014d. FWS Acquired Land 2014. <http://www.fws.gov/gis/data/CadastralDB/index.htm>.

———. 2014e. USFWS Whooping Crane Central Flyway

———. 2014f. USFWS Whooping Crane Sightings

———. 2014g. National Wetland Inventory. NWI Webpage. <http://www.fws.gov/wetlands/Data/Mapper.html>.

———. 2010. Karst Region v2010. Provided to Clean Line Energy Partners. via e-mail by USFWS Arkansas Field Office on October 30, 2013.

USGS (U.S. Geological Survey). 2014a. National Hydrography Dataset (NHD). USGS webpage. <http://nhd.usgs.gov/data.html>. Accessed April 2014.

———. 2014b. National US Topo Map. ArcGIS webpage. <http://www.arcgis.com/home/item.html?id=99cd5fbd98934028802b4f797c4b1732>. Accessed April 2014

———. 2012. Oklahoma Land Stewardship. Gap Analysis Program. <http://gapanalysis.usgs.gov/padus/data/download/>. Accessed August 25, 2015.

———. 2008a. Earthquake Location/History. Earthquake Hazards Program, National Earthquake Information Center, Earthquake Archive Search. The 2008 U.S. Geological Survey National Seismic Hazard Map. <http://earthquake.usgs.gov/hazards/products/conterminous/index.php#2008>. Accessed February 20, 2014.

———. 2008b. Peak Horizontal Acceleration with 10 Percent Probability of Exceedance in 50 Years. Scientific Investigations Map 3195, Seismic-Hazard Maps for the Conterminous United States 2008. <http://pubs.usgs.gov/sim/3195/>. Accessed February 26, 2014.

———. 2005a. Active Mines and Mineral Processing Plants in the US in 2003, 2005. <http://mrdata.usgs.gov/mineplant/>.

———. 2005b. Mineral Resource Locations. Mineral Resources Data System 2005. <http://mrdata.usgs.gov/mrds/>. Accessed April 21, 2014.

———. 2004a. National American Atlas 2004. Lakes/Reservoirs. Hydrography Layer. <http://www.nationalatlas.gov/atlasftp.html?openChapters=chpwater#chpwater>.

———. 2004b. National Atlas 2014. One Million-Scale Streams of the United States. <http://www.nationalatlas.gov/atlasftp.html?openChapters=chpwater#chpwater>. Accessed March 2014.

———. 2003. National Atlas, Principal Aquifers of the 48 Conterminous United States. <http://www.nationalatlas.gov/mld/aquifrp.html>.

———. 2001. Landslide Incidence and Susceptibility in the Conterminous United States. <http://landslides.usgs.gov/hazards/nationalmap/>. Accessed February 21, 2014.

———. 1999. National Digital Elevation Dataset. <http://ned.usgs.gov/>.

———. 1996. Lower 48 National River Inventory GIS Data. <http://www.nps.gov/ncrc/programs/rtca/nri/index.html>. Accessed June 2014.

This page intentionally left blank.

7. Glossary

100-Year Floodplain	The area that would be inundated by a flood with a recurrence interval of once in 100 years, on average. This can also be stated as areas that have a 1 percent chance of being flooded in a given year. (See Floodplain.)
600kV DC Transmission Line	A transmission line with a capacity of approximately 600 kilovolts of direct-current electricity.
AADT (Annual Average Daily Traffic)	The total volume of traffic passing a point or segment of a roadway facility in both directions for 1 year divided by the number of days in the year.
AC Collection System	AC collection system is made up of thirteen 2-mile-wide routes in Oklahoma (Beaver, Cimarron, and Texas counties) and Texas (Hansford, Ochiltree, and Sherman counties) within which four to six AC transmission lines would be sited; depending on the location of future wind energy development. The AC collection system would collect energy from generation resources. Components of the AC collection system include: • ROW easements for the transmission line, with a typical width of approximately 150 to 200 feet • Tubular or lattice steel structures used to support the transmission line • Electrical conductor • Communications/control and protection facilities (optical ground wire (OPGW), static wire, and fiber optic regeneration sites)
AC/DC (Alternating Current/Direct Current)	An alternating current (AC) power line alternates as a rate of 50 to 60 times a second (Hz), while a direct current (DC) power line produces a static electric field that does not alternate.
Access road	Roads constructed to each structure site first to build the tower and line, and later to maintain and repair it. Access roads are built where no roads exist. Where county roads or other access is already established, access roads are built as track roads to the structure site except where they pass through cultivated land. There, the road is restored for crop production after construction is completed.
Advisory Council on Historic Preservation	Established by the National Historic Preservation Act in 1966, the Advisory Council on Historic Preservation is an independent Federal agency that promotes the preservation, enhancement, and productive use of the advisory agency for the president and congress on historic preservation policy.
Aerial Photography	Used to identify and verify land uses within the Project corridors and ROWs.
Affected Environment	The affected environment section of the EIS describes the baseline conditions with regard to a specific resource to provide the context for understanding the environmental impacts associated with the Project.
Agriculture	Agriculture: The science, art, or practice of cultivating the soil, producing crops, and raising livestock. A land use characterized by land cultivated for crop production and raising livestock.
Alluvium	Deposits left by flowing water, usually clay, silt, sand, or gravel.
Alternative	Options that a federal agency considers to address the significant issues and meet the purpose of and need for a proposed project in an environmental analysis. Also used to describe other routes under consideration.
Alternative Route Adjustment	As a result of the “route variations” developed for the Applicant Proposed Route in response to public comments on the Draft EIS, DOE and Clean Line developed route adjustments for the Regions 3, 5, and 6 HVDC alternative routes to re-establish the continuity with the Applicant Proposed Route in these regions.

Alternative Routes	Multiple individual transmission line routes that each traverse from point A to point B in a separate and distinct way. In addition to the Applicant Proposed Route, DOE has identified and compared two to six alternative routes within each of the seven geographic regions: • Region 1: Oklahoma Panhandle in Texas, Beaver, Harper, and Woodward counties, Oklahoma • Region 2: Oklahoma Central Great Plains in Woodward, Major, and Garfield counties, Oklahoma • Region 3: Oklahoma Cross Timbers in Garfield, Kingfisher, Logan, Payne, Lincoln, Creek, Okmulgee, and Muskogee counties in Oklahoma • Region 4: Arkansas River Valley in Sequoyah County, Oklahoma and Crawford, Franklin, Johnson, and Pope counties, Arkansas • Region 5: Central Arkansas in Pope, Conway, Van Buren, Faulkner, Cleburne, White, and Jackson counties, Arkansas • Region 6: Cache River, Crowley's Ridge Area, and St. Francis Channel in Jackson, Cross, and Poinsett counties • Region 7: Arkansas Mississippi River Delta and Tennessee in Poinsett and Mississippi counties, Arkansas and in Tipton and Shelby counties, Tennessee
Anthropogenic	Made by people or resulting from human activities.
APE (Area of Potential Effect)	The geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historic properties, if any such properties exist. Additionally, the APE is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking (36 CFR 800.16(d)).
APP (Avian Protection Plan)	A plan, consistent with Avian Power Line Interaction Committee (APLIC) guidelines that describes a program of specific and comprehensive actions that, when implemented, would reduce the risk of avian mortality.
Applicant	Clean Line Energy Partners LLC of Houston, Texas, the parent company of Plains and Eastern Clean Line LLC and Plains & Eastern Clean Line Oklahoma LLC (collectively referred to as Clean Line or the Applicant in the Plains and Eastern Environmental Impact Statement).
Applicant Proposed Project	Based on Clean Line's proposal to DOE, the basic elements include converter stations in Oklahoma and Tennessee, AC interconnections at each converter station, an AC collection system, and an HVDC transmission line from the Oklahoma Panhandle to western Tennessee. The Applicant Proposed Project is described in Sections 2.1.2 through 2.1.7.
Applicant Proposed Route	The single route alternative defined by Clean Line to connect the converter station in the Oklahoma Panhandle Region to the converter station in western Tennessee. The Applicant Proposed Route is defined in Section 2.4.2. Alternatives to the Applicant Proposed Route are described as part of the DOE Alternatives in Section 2.4.3.
Aquatic	Occurring in, or closely associated with, water.
Arkansas Converter Station Alternative AC Interconnection Siting Area	A 2-mile-wide corridor within which one or more potential AC transmission line route(s) would be sited from the Arkansas converter station alternative to an interconnection point(s) (5 acres) to an existing 500kV transmission line. The interconnection would also include a new substation at the point where the new AC interconnection line would tap the existing 500kV line. The footprint of this substation is estimated to be between 25 and 35 acres
Arkansas Converter Station Alternative Siting Area	An approximate 360-acre siting area in Pope County, Arkansas, within which the converter station and associated AC switchyard (20 to 35 acres total) and access road(s) would be sited.
ARPA (Archaeological Resources Protection Act)	Prohibits unauthorized collecting and excavation at archaeological sites on federal and tribal lands.
Attainment Area	An area considered to have air quality as good as or better than the National Ambient Air Quality standards as defined in the Clean Air Act.

Audible Noise	The natural phenomenon of corona from a transmission line can create audible noise. Audible noise is measured in decibels (dB) of sound pressure with respect to the threshold of human hearing. The decibel is a dimensionless unit used to compare the level of some quantity to a reference level and it always needs a reference quantity to have meaning.
Bedrock	Solid rock beneath the soil and superficial rock (rock fragments or unconsolidated rock materials).
BGEPA (Bald and Golden Eagle Protection Act)	A law that prohibits the take, possession, selling, purchasing, bartering, or transporting of live or dead bald or golden eagles, or any parts, nests, or eggs of these birds.
BIA (Bureau of Indian Affairs)	Established in 1824, the Bureau of Indian Affairs is responsible for the administration and management of 55 million surface acres and 57 million acres of subsurface minerals estates held in trust by the United States of American Indian, Indian tribes, and Alaska Natives.
Big Game	Large animals that may be taken by hunters, pursuant to local government restrictions and regulations.
Biological Assessment	A Biological Assessment documents a federal agency's conclusions and the rationale to support those conclusions regarding the effects of the proposed action on protected resources. Although there are no statutory or regulated contents for a Biological Assessment recommended elements are identified in 50 CFR §402.12(f).
Biological Opinion	A document that states the opinion of the U.S. Fish and Wildlife Service as to whether a federal action is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat. The USFWS opinion is based on the review of a Biological Assessment.
Blading	Use of a bulldozer, grader, or other construction equipment to level or shape a travel surface.
BMPs (Best Management Practices)	Some resource sections have included BMPs. In these resources, implementation of the EPMs would not be able to completely avoid or minimize potential adverse effects resulting from construction, operations and maintenance, and decommissioning of the Project. BMPs have been identified to further avoid or minimize these potential adverse effects. The ROD or other appropriate Federal decision document would include conditions of approval (e.g., BMPs) imposed by DOE or other agency that has a decision to make or a consultation responsibility (e.g., TVA, USACE, USFWS) regarding the Project. The DOE-Applicant participation agreement would require a monitoring plan to ensure implementation of all such conditions of approval.
Border Zone	A zone on each side of the wire zone to the edge of the ROW, maintained to exclude tall vegetation. Vegetation within the border zone is limited to low-growing grasses, legumes, herbs, crops and shrubs where the conductor is 50 feet or less from the ground.
CAA (Clean Air Act)	The federal law that defines the Environmental Protection Agency's responsibilities for protecting and improving the nation's air quality and the stratospheric ozone layer. The last major change in the law, the Clean Air Act Amendments of 1990, was enacted by Congress in 1990. Legislation passed since then has made several minor changes. The Clean Air Act was incorporated into the United States Code as Title 42, Chapter 85.
Candidate Species	Taxa for which the U.S. Fish and Wildlife Service has on file sufficient information on biological vulnerability and threat(s) to support issuance of a proposal to list, but issuance of a proposed rule is currently precluded by higher priority listing actions (61 FR 7596-7613;February 28, 1996).
Capacity	Refers to the amount of power a transmission facility (line, transformer, etc.) can reliably deliver. Capacity is measured in megawatts and is limited by the current (in amperes) that the facility can carry or the minimum voltage levels present at a substation (under either steady-state or outage conditions).
CDE (Carbon Dioxide Equivalent)	Carbon dioxide equivalency is a quantity that describes, for a given mixture and amount of greenhouse gas, the amount of carbon dioxide that would have the same global warming potential, when measured over a specified timescale (generally, 100 years).

Centerline	A line on a map or flagged on the ground that indicates the location of a linear feature such as a road or a transmission line. The linear feature is further defined by its total width, either for construction or operation, which is bisected into two equal parts by the centerline.
Century Farm	State-level Century Farms programs provide recognition to self-nominated agricultural operators who can document at least 100 years of continuous operation of a farm or ranch by a single family. These programs are honorary, voluntary, and do not afford legal protections.
CEQ (Council on Environmental Quality)	Coordinates federal environmental efforts and works closely with agencies and other White House offices in the development of environmental policies and initiatives. CEQ was established within the Executive Office of the President by Congress as part of the National Environmental Policy Act of 1969 (NEPA) and additional responsibilities were provided by the Environmental Quality Improvement Act of 1970.
Circuit	An electrical device that provides a path for electrical current to flow, or along which an electrical current can be carried. In the case of high-voltage transmission, a set of wires energized at transmission voltages extending beyond a substation which has its own protection zone and set of breakers for isolation.
Clean Line	Clean Line Energy Partners LLC of Houston, Texas, is the parent company of Plains and Eastern Clean Line LLC and Plains and Eastern Clean Line Oklahoma LLC (collectively referred to as Clean Line). Clean Line develops long-haul transmission lines to connect renewable energy resources in North America to communities and cities that lack access to affordable renewable power.
CO (Carbon Monoxide)	An odorless and colorless gas formed from one atom of carbon and one atom of oxygen. CO is typically released as an air emission from internal combustion engines.
Colluvium	Rock fragments, sand, etc., that accumulate on steep slopes or at the foot of cliffs.
Concrete Batch Plant	Concrete would be obtained from commercial ready-mix concrete producers to the extent practicable. In locations where haul times exceed 45 minutes, concrete would be dispensed from portable concrete batch plants located within a multi-use construction yard. The batch plants would consist of bins of materials that when combined in a mixer, form concrete (e.g., sand, water, aggregate, cement, etc.). Concrete would be required for construction of foundations for transmission structures, foundations for transformers and electrical equipment at converter stations, and foundations at fiber optic regeneration sites. Concrete would be delivered to structure sites and ancillary facilities in concrete trucks.
Conductor	The wire cable strung between transmission towers through which electric current flows.
Contrast	The degree of visual change that occurs in the landscape due to the construction and operations and maintenance of a project.
Contrast Rating	A method of analyzing the potential visual impacts of Project components.
Connected Actions	Connected actions are those that are “closely related” to the proposal. Actions are considered connected if they automatically trigger other actions which may require environmental impact statements, cannot or will not proceed unless other actions have been taken previously or simultaneously, or are interdependent parts of a larger action and depend on the larger action for their justification (40 CFR 1508.25).

Converter Station	Converter stations are similar to a typical AC substation, with additional equipment to convert between AC and DC. Ancillary facilities such as communications equipment and cooling equipment would be required at each converter station. In addition, AC transmission lines would connect each converter station to the existing grid. Each converter station would include: • DC switchyard • DC smoothing reactors • DC filters • Valve hall(s) (which contain the power electronics for converting AC to DC and vice versa) • Ancillary building(s) (containing control and protection equipment, cooling, etc.) • AC switchyard • AC filter banks • AC circuit breakers and disconnect switches • Transformers
Cooperating Agency	Any federal agency other than a lead agency which has jurisdiction by law or special expertise with respect to any environmental impact involved in a proposal (or a reasonable alternative) for legislation or other major Federal action significantly affecting the quality of the human environment. The selection and responsibilities of a cooperating agency are described in 40 CFR 1501.6. A state or local agency of similar qualifications or, when the effects are on a reservation, an Indian Tribe, may by agreement with the lead agency become a cooperating agency (40 CFR 1508.5).
Corona	Corona occurs in regions of high electric field strength on conductors, insulators, and hardware when sufficient energy is imparted to charged particles to cause ionization (molecular breakdown) of the air.
Corresponding Links	Links or portions of the Applicant Proposed Route similar in length to the alternative routes. Alternative routes are compared to corresponding links of the Applicant Proposed Route in the impact analysis for each resource.
Criteria Pollutants	The U.S. Environmental Protection Agency has set NAAQS for seven principal pollutants, which are called "criteria" pollutants. The six air pollutants listed below are criteria pollutants for which the agency has developed NAAQS: • Sulfur Dioxide (SO_2) • Carbon monoxide (CO) • Nitrogen Dioxide (NO_2) • Ozone (O_3) • Particulate matter with a diameter equal to or smaller than 10 micrometers (PM_{10}) • Particulate matter with a diameter equal to or smaller than 2.5 micrometers ($PM_{2.5}$) • Lead and its compounds (measured as lead)
Critical Habitat	For Endangered Species Act (ESA)-listed species consists of: (1) the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the provisions of section 4 of the act on which are found those physical or biological features (constituent elements) (a) essential to the conservation of the species and (b) which may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 4 of the act, upon a determination by the Secretary that such areas are essential for the conservation of the species (ESA §3 (5)(A)). Designated critical habitats are described in 50 CFR §17 and 226.
CRP (Conservation Reserve Program)	CRP lands are administered by the USDA Farm Service Agency. The CRP provides technical and financial assistance to eligible farmers and ranchers to address soil, water, and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner. The CRP encourages farmers to convert highly erodible cropland or other environmentally sensitive acreage to vegetative cover, such as tame or native grasses, wildlife plantings, trees, filter strips, or riparian buffers. Farmers receive an annual rental payment for the term of the multi-year contract.

Cultural Modification	Human/man-made modifications to the landscape.
Cultural Resources	The term “cultural resource” includes all landscapes, buildings, sites, districts, structures, or objects that have been created by or associated with humans and are considered to have historical or cultural value. Cultural resources also include Traditional Cultural Properties.
Culvert	A corrugated metal or concrete pipe used to carry or divert runoff water from a drainage; usually installed under roads to prevent washouts and erosion.
Cumulative Effects (Impacts)	Effects that result when the effects of an action are added to or interact with other effects in a particular place and within a particular time. Such impacts may individually have minor impacts, but collectively may have significant impacts.
Current	The amount of electrical charge flowing through a conductor (as compared to voltage, which is the force that drives the electrical charge), which is measured in amperes or amps.
CWA (Clean Water Act)	The framework that regulates water quality standards and pollutant discharges into waters of the United States. Sections 303d and 305b require that water quality of streams, rivers, and lakes are assessed on a regular basis, that waters found to be in violation of water quality standards are listed as impaired, and that priorities be set for actions to improve the water quality.
dB(A)	Sound levels measured as A-weighted decibels. Used to measure sound level via a logarithmic unit used to describe a ratio and weighted based on the human response to sound.
Decibel (dB)	A decibel is a unit for expressing relative difference in power, usually between acoustic signals, equal to 10 times the common logarithm of the ratio of two levels.
Decommissioning	Removal of Project facilities at the end of the operational life of the facilities.
Dewatering	Removal or draining groundwater or surface water from a construction site by pumping or evaporation.
Direct Effects or Direct Impacts	Direct effects are those caused by the Project at the same time and place as the impact, such as soil disturbance.
Distance Zone	A subdivision of the landscape as viewed from an observer position. The subdivision (zones) includes foreground-middleground (0-3 miles), background (3 miles or more) and seldom seen.
Distribution Line	The structures, insulators, conductors, and other equipment used to deliver electricity directly to the customer, including commercial facilities, small factories, or residences.
DOE (U.S. Department of Energy)	DOE is the lead federal agency for the preparation of this Plains & Eastern EIS. DOE has prepared this EIS pursuant to NEPA, the Council on Environmental Quality (CEQ) NEPA regulations (40 Code of Federal Regulations [CFR] Parts 1500 through 1508), and the DOE NEPA implementing regulations (10 CFR Part 1021). DOE’s purpose and need for agency action is to implement Section 1222 of the EPAct.
DOE Alternatives	DOE has chosen to analyze potential environmental impacts for several alternatives in addition to the Applicant Proposed Project. These alternatives include an Arkansas converter station and alternative routes for the HVDC transmission line. The DOE Alternatives are described in Section 2.4.3.
DOE’s Proposed Action	To participate, acting through and in consultation with the Administrator of Southwestern, in the Applicant Proposed Project in one or more of the following ways: designing, developing, constructing, operating, maintaining, or owning a new electric power transmission facility and related facilities located within certain states in which Southwestern operates, namely Oklahoma, Arkansas, and possibly Texas.
Double-Circuit Transmission Line	A transmission line composed of six electrical phases (two independent circuits of three phases each) and two lightning protection shield wires. One of the lighting protection shield wires is a steel overhead ground wire, and the other is an optical ground wire (OPGW).
Early Successional (or Early Seral)	An immature forest often characterized by a single-age class and open canopies; stands are between 1 and 30 years old.

Ecoregion	Area where the ecosystems, and the type, quality, and quantity of environmental resources are generally similar as defined by the analysis of patterns and composition of biotic and abiotic phenomena including geology, physiography, vegetation, climate, soils, land use, wildlife, and hydrology.
Edge Effect	The gradual to abrupt transition from one habitat type to a different habitat type. Edge effects can include obvious changes in the structure of vegetation, such as an abrupt change from forest to herbaceous cover, but the effects can be more subtle and include differences in temperature, humidity, and plant and wildlife species use of an area.
EIS (Environmental Impact Statement)	Part of compliance with the National Environmental Policy Act (NEPA), an EIS is a comprehensive public document that analyzes the impacts of a major federal action that may significantly affect the quality of the human environment. When complete, it is a tool for decision making as the EIS describes the positive and negative environmental effects of a proposed action, describes alternative actions and provides an analysis of environmental impacts and ways to mitigate such impacts across all alternatives considered in detail.
Emergent	Plants that have their bases submerged in water.
EMF (Electric and Magnetic Fields)	Fields describing properties of a location or point in space and its electrical environment, including the forces that would be experienced by a charged body in that space by virtue of its charge or the movement of charges. The voltage, which is the “pressure,” produces an electric field that moves the electricity through wires. The current produces a magnetic field, which is a measure of how much electricity is flowing. Thus, wherever there is electric current flowing (including through any type of wiring), there is both an electric and a magnetic field.
Endangered species	Any species officially listed pursuant to the Endangered Species Act (ESA) (16 USC § 1531 et seq.) by the U.S. Fish and Wildlife Service or NOAA Fisheries as being in danger of extinction throughout all or a significant portion of their range.
Energy	In the electric utility industry, it represents the amount of power used or transmitted over a given amount of time.
Environmental Justice	As defined by the EPA, environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, sex, national origin, or income with respect to the development, implementation and enforcement of environmental laws, regulations, and policies. Executive Order 12898 was issued in 1994 and directs federal agencies to identify and address the disproportionately high and adverse human health or environmental effects of their actions on minority and low-income populations, to the greatest extent practicable and permitted by law.
EPA (Environmental Protection Agency)	The EPA is a federal agency that was created in 1970 for the purpose of protecting human health and the environment. The EPA is recognized to have jurisdiction by law and/or has special expertise in environmental laws, Executive Orders, and NEPA assessment and procedures. Under Section 309 of the Clean Air Act, the EPA is required to review and publicly comment on the environmental effects of major federal actions, including actions that are the subject of EIS documents. If the EPA determines that the action is environmentally unsatisfactory, it is required by Section 309 to refer the matter to the CEQ.
Ephemeral Stream	A stream that flows only in direct response to precipitation and whose channel is at all times above the water table.
EPMs (Environmental Protection Measures)	EPMs are measures developed by the Applicant to avoid or minimize potential adverse effects of the Project resulting from construction, operations and maintenance, and decommissioning. EPMs are an integral part of the Project and their implementation was assumed throughout the impact analysis of the EIS.
ERS (U.S. Department of Agriculture Economic Research Service)	The mission of the ERS is to inform and enhance public and private decision making on economic and policy issues related to agriculture, food, the environment, and rural development.

Federal Aviation Act	This act was passed to continue the Civil Aeronautics Board as an agency of the United States, to create a Federal Aviation Agency, to provide for the regulation and promotion of civil aviation in such manner as to best foster its development and safety, and to provide for the safe and efficient use of the airspace by both civil and military aircraft, and for other purposes (P.L. 85-726, 72 Stat. 731).
Farmland of Statewide Importance	This is land, in addition to prime and unique farmland, that is of statewide importance for the production of food, feed, fiber, forage, and oil seed crops. Criteria for defining and delineating this land are to be determined by the appropriate state agency or agencies. Generally, additional farmlands of statewide importance include those that are nearly prime farmland and that economically produce high yields of crops when treated and managed according to acceptable farming methods. Some may produce as high a yield as prime farmlands if conditions are favorable. In some states, additional farmlands of statewide importance may include tracts of land that have been designated for agriculture by state law.
Fault	A planar fracture or discontinuity in a volume of rock, across which there has been significant displacement along the fractures as a result of earth movement. Energy release associated with rapid movement on active faults is the cause of most earthquakes. A fault line is the surface trace of a fault, the line of intersection between the fault plane and the Earth's surface.
Feasible	Capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, legal, regulatory, technical, and safety factors.
Federally Listed	Species listed as Threatened or Endangered pursuant to the Endangered Species Act (ESA) (16 USC § 1531 et seq.) by the U.S. Fish and Wildlife Service or NOAA Fisheries.
FHWA (U.S. Department of Transportation, Federal Highway Administration)	The Federal Highway Administration is an agency within the Department of Transportation that would be responsible for issuing encroachment permits if the proposed Project crosses federally funded highways.
Fiber Optic Regeneration Sites	As a data signal passes through fiber optic cable, the data signal degrades with distance. The signal must be regenerated or amplified every 180 to 200 miles at fiber optic regeneration sites. A typical fiber optic regeneration site is approximately 100 feet by 100 feet with a fenced area of approximately 75 feet by 75 feet.
Floodplain	That portion of a river valley adjacent to the stream channel which is covered with water when the stream overflows its banks during flood stage.
Fly yard	A Project-material staging area used specifically to support helicopter use.
Forb	An herbaceous plant that is not a grass or not grasslike.
Forest/Woodland	A habitat type characterized by being dominated by trees. Forests are densely covered by trees and have a continuous or nearly continuous canopy and little shade reaching the forest floor. In a woodland, trees are more widely scattered and sunlight reaches the floor, often supporting an understory of shrubs, grasses, and/or forbs.

FPPA (Farmland Protection Policy Act)	The Farmland Protection Policy Act (FPPA) authorizes the USDA to develop criteria for identifying the effects of federal programs on the direct or indirect conversion of farmland to nonagricultural uses. For the purposes of the law, federal programs include construction projects—such as highways, airports, dams, and federal buildings—sponsored or financed in whole or part by the federal government and the management of federal lands. Federal agencies are directed to: (1) use the developed criteria, (2) identify and take into account the adverse effects of federal programs on the preservation of farmland, (3) consider appropriate alternative actions that could minimize potential adverse effects to farmland, and (4) ensure that such federal programs, to the extent practicable, are compatible with state and local units of government, as well as private programs and policies, so that farmland is protected. Farmland protected by the FPPA is either: (1) prime or unique farmland, which is not already committed to urban development or water storage, or (2) other farmland, which is of statewide or local importance as determined by the appropriate local governmental agency with the concurrence of the Secretary of Agriculture. Farmland subject to FPPA is not required to be currently used for cropland. Farmland can be forestland, pastureland, cropland, or other land.
Fragmentation	The breaking up of contiguous areas of vegetation/habitat into smaller patches.
FSA (Farm Service Agency)	The Farm Service Agency ensures the well-being of American agriculture, the environment, and the American public through the administration of farm commodity programs; farm ownership, operating, and emergency loans; conservation and environmental programs; emergency and disaster assistance; and domestic and international food assistance.
Fugitive Dust	Visible emissions released from sources other than stacks; for instance, dust blown from storage piles, road dust, or emission leaking from sides of buildings or open areas in buildings.
Gauss	A unit of magnetic induction.
GHG (Greenhouse Gas)	Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include, but are not limited to, carbon dioxide, methane, nitrous oxide, and ozone.
GIS (Geographical Information System)	A computer representation of data that is geographically distributed in three dimensions. These data can be generated and displayed to show their physical location. Each data set with a certain type of information constitutes a “layer” in the GIS. GIS layers can be superimposed to show the spatial relationships of different items.
Grasslands	Habitat types dominated by grasses (family Poaceae) with little woody vegetation or other forbs. In the regions of influence, most grasslands are dominated by introduced grass species, though some native grasslands are present.
GRP (Grassland Reserve Program)	The GRP was established to prevent grazing and pasture land from being converted into cropland, used for urban development, or developed for other non-grazing uses. Participants in the program voluntarily limit future development of their grazing and pasture land, while still being able to use the land for livestock grazing and activities related to forage and seed production.
Habitat Types	Generally described as place(s) where a plant or animal naturally or normally lives or grows. Habitat types also includes the physical elements of the environment, as well as the biotic elements that a given species interacts with.
Hazardous Materials	Defined in various ways under a number of regulatory programs, can represent potential threats to both human health and the environment when not properly managed. Includes hazardous waste.
High Voltage	Lines with 230kV or above electrical capacity.
Historic	Period wherein non-native cultural activities took place, based primarily upon European roots, having no origin in the traditional Native American culture(s).

Historic Property	Any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior.
HVDC (High Voltage Direct Current) Transmission Line	Unlike an AC transmission line, the voltage and current on a direct current (DC) transmission line are not time varying, meaning they do not change direction as energy is transmitted. DC electricity is the constant, zero-frequency movement of electrons from an area of negative (-) charge to an area of positive (+) charge. HVDC transmission facilities include: • ROW easements for the transmission line, with a typical width of approximately 150 to 200 feet • Tubular and lattice steel structures used to support the transmission line • Electrical conductor and metallic return • Communications/control and protection facilities (optical ground wire [OPGW, static wire,] and fiber optic regeneration sites)
Hydric Soils	Soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part. These soils are typically associated with jurisdictional wetlands, which must meet three required criteria: hydric soils, wetland hydrology, and hydrophytic vegetation, except in "difficult wetland situations" where not all criteria are evident.
Hydrology	The science of dealing with the properties, distribution, and circulation of water.
Hz (Hertz)	The unit of frequency in cycles per second; power systems in the U.S. operate with a frequency of 60 Hz.
Indian Tribe	An Indian tribe, band, nation, or other organized group or community, including a native village, regional corporation, or village corporation, as those terms are defined in section 3 of the Alaska Native Claims Settlement Act (43 USC 1602), which is recognized as eligible for the special programs and services provided by the United States to Indians because of their status as Indians. Government-to-government consultation is required for any project between the federal government and the government of any potentially impacted tribe.
Indirect Effects	Effects caused by the action that are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems.
Insulator	A ceramic or other non-conducting material used to keep electrical circuits from jumping over to ground.
Intentional Destructive Acts	Security of the components of the Project facilities can involve a variety of different regulatory and reporting structures, authorities, and agencies. Intentional acts of destruction, sabotage, vandalism, theft, or other mischief, whether from terrorist activities or other criminal behavior, would be addressed through law enforcement and Project design protocols.
Interconnections	The electric transmission system provides a pathway for power among interconnected power producers, or generators, and distribution companies, or load. For power generation and delivery electric transmission interconnections are required. The Project includes are three possible points of interconnection: the Oklahoma Southwestern Public Service/Southwest Power Pool Interconnection, the Arkansas/Entergy/Mid-Continent Independent System Operator Interconnection, and the Tennessee Valley Authority Interconnection. System planning studies and system impact studies are required for interconnection.
Intermittent or Seasonal Stream	One which flows only at certain times of the year when it receives water from springs or from some surface source such as melting snow in mountainous areas.
Invasive Species	A species that is not native to the habitat under consideration and whose introduction causes, or is likely to cause, economic or environmental harm (Executive Order 13112). Invasive plants are typically adaptable, aggressive, and have a high reproductive capacity.

Invertebrates	Animals that lack a back bone and are represented by a wide variety of taxonomic groups in freshwater environments.
Irreversible and Irretrievable Commitment of Resources	A commitment of resources is irreversible when its primary and secondary impacts limit the future options for a resource. An irretrievable commitment refers to the use or consumption of a resource that is neither renewable nor recoverable for use by future operations.
KOP (Key Observation Point)	Viewing locations chosen to be generally representative of visually sensitive areas where it can be assumed that viewers may be affected by a change in the landscape setting from the Project. Views from KOPs are described by distance zones and are based on perception thresholds (changes in form, line, color, and texture).
kV (kilovolt)	One thousand volts (see volt).
Landslide	Any mass-movement process characterized by downslide transport of soil and rock, under gravitational stress, by sliding over a discrete failure surface; or the resultant landform. Can also include other forms of mass wasting not involving sliding (rockfall, etc.).
Lattice Tower	A freestanding steel framework tower that is often used to support electrical transmission lines with voltages above 100 kilovolts.
L_{dn}	The day-night sound level comprised of average hourly L_{eq} sound levels with a 10 dB penalty added to sound levels at night.
Lead Agency	The agency or agencies preparing, or having taken primary responsibility for preparing an environmental document as required by NEPA. For the Plains & Eastern Clean Line Transmission Project, DOE is the lead agency
L_{eq}	The energy averaged sound level for a given period of time.
Lithic Scatter	Consists of stone material that has been left behind or dropped and can include stone tools such as projectile points, knives, or simply debris from stone tool manufacture or lithic procurement activities.
Load	The amount of electrical power or energy delivered or required at any specified point or points on a system. Load originates primarily at the energy-consuming equipment of customers.
MBTA (Migratory Bird Treaty Act)	A law enacted in 1918 that prohibits pursuing, hunting, taking, capturing, killing, possessing, selling, bartering, purchasing, delivering, transporting, and receiving any migratory birds, parts, nests, or eggs.
mG (MilliGaus)	A unit used to measure magnetic field strength; one- thousandth of a gauss.
Migratory Bird	A bird that moves seasonally to different ranges to maximize breeding and feeding opportunities.
Mineral Resources	In the ROI, the primary mineral resource production is from the fossil fuels oil, natural gas, and coal. Additional minerals mined include limestone, building stone, sand and gravel, gypsum, clay and shale, granite, volcanic ash, tripoli, salt, bentonite, iron ore, and chat.
Mitigation	(1) Avoiding or reducing possible adverse impacts to a resource by limiting the timing, location, or magnitude of an action and its implementation. (2) Rectifying possible adverse impact by repairing, rehabilitating or restoring the affected environment or resource. (3) Reducing or eliminating adverse impacts by preservation and maintenance operations during the life of an action.
MSA (Metropolitan Statistical Area)	MSAs have at least one urbanized area with 50,000 or more residents, plus adjacent territory that has a high degree of social and economic integration with the core as measured by commuting ties. These areas represent larger communities that form regional markets for labor, goods and services, and information. MSAs typically include an urbanized node and economically related surrounding counties.

Multi-use Construction Yards	Multi-use construction yards are for staging of construction personnel and equipment and for material storage to support construction activities. Multi-use construction yards would be used for temporary concrete batch plants, where needed. The multi-use construction yards would be located outside of the ROW at intervals of approximately 25 miles. Typical sites would include areas designated for a field office, crew parking, sanitation, waste management, fueling, equipment wash, material storage, and equipment storage.
MW (Megawatts)	A megawatt is one million watts, or one thousand kilowatts; an electrical unit of power.
NAAQS (National Ambient Air Quality Standards)	Established by the U.S. Environmental Protection Agency, the NAAQS represent maximum acceptable concentrations that generally may not be exceeded more than once per year, except the annual standards, which may never be exceeded (40 CFR 50).
NAGPRA (Native American Graves Protection and Repatriation Act)	NAGPRA was established in 1990 to provide a means for museums and curation facilities to return certain collected items to Native American and Native Hawaiian groups. The act pertains to the repatriation of human remains, funerary objects, sacred objects, and objects of cultural patrimony. Federal grants are awarded to indigenous groups and institutions holding collections under the act to assist in the repatriation process, which is overseen by the Native American Graves Protection and Repatriation Review Committee.
National Emissions Standards for Hazardous Air Pollutants	National Emission Standards for Hazardous Air Pollutants (NESHAPS) are stationary source standards for hazardous air pollutants. Hazardous air pollutants (HAPs) are those pollutants that are known or suspected to cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental effects. NESHAPs are found in 40 CFR Part 61 and 40 CFR Part 63.
National Scenic Byway	To be designated as a National Scenic Byway, a road should have at least one of six scenic byway intrinsic qualities (archaeological, cultural, historic, natural, recreational, and scenic) that is regionally significant (DOT 2008). The Federal Highway Administration is responsible for administering the National Scenic Byways Program (23 USC 162) through the Intermodal Surface Transportation Efficiency Act of 1991 (IS TEA; PL 102-240). A scenic byway is a public road with special scenic, historic, recreational, cultural, archaeological, and/or natural qualities that have been recognized as such through legislation or official declaration. Easements associated with scenic byway ROWs may prohibit construction of transmission structures or other structures that degrade the scenic quality of the road.
National Wild and Scenic Rivers System	A system of nationally designated rivers and their immediate environments that have outstanding scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values and are preserved in a free-flowing condition.
NEPA (National Environmental Policy Act of 1969)	Federal statute that contains procedures to ensure that federal agency decision makers take environmental factors into account. The two major purposes of the NEPA process are citizen involvement and better informed decisions. The act establishes national environmental policy and goals for the protection, maintenance, and enhancement of the environment, and it provides a process for implementing these goals within the federal agencies. The act also establishes the Council on Environmental Quality (CEQ) and requires an environmental impact statement on all major Federal actions significantly affecting the quality of the human environment (42 USC 4332 2(2)(C)).
New Source Performance Standards	Section 111 of the Clean Air Act authorized the EPA to develop technology based standards which apply to specific categories of stationary sources. These standards are referred to as New Source Performance Standards (NSPS) and are found in 40 CFR Part 60. The NSPS apply to new, modified and reconstructed affected facilities in specific source categories such as manufacturers of glass, cement, rubber tires and wool fiberglass. The NSPS are developed and implemented by EPA and are delegated to the states. However, even when delegated to the states, EPA retains authority to implement and enforce the NSPS.
NHL (National Historic Landmark)	A historic property that the Secretary of the Interior has designated a National Historic Landmark.

NHPA (National Historic Preservation Act of 1966, as amended)	Act directing federal agencies to consider the effects of their programs and projects on properties listed or eligible for listing on the National Register of Historic Places. If a proposed action might impact any archaeological, historical, or architectural resource, this act mandates consultation with the proper agencies.
NHTs (National Historic Trails)	A congressionally designated trail that is an extended, long-distance trail, not necessarily managed as continuous, that follows as closely as possible and practicable the original trails or routes of travel of national historic significance.
Nitrogen Oxide	A group of compounds consisting of various combinations of nitrogen and oxygen atoms.
No Action Alternative	This Plains & Eastern EIS analyzes a No Action Alternative, under which DOE would not participate with Clean Line in the Project. DOE assumes for analytical purposes that the Project would not move forward and none of the potential environmental effects associated with the Project would occur.
NOI (Notice of Intent)	A public notice, published in the *Federal Register*, that an environmental impact statement will be prepared and considered in the decision making for a proposed action. It also provides background information on the proposed project in preparation for the scoping process.
Nonattainment Area	An area that does not meet air quality standards set by the Clean Air Act for specified localities and periods.
Noxious Weed	A legal term, meaning any plant officially designated by a federal, state, or local agency as injurious to public health, agriculture, recreation, wildlife, or property.
NPS (National Park Service)	Established in 1916, the purpose of the National Park Service is to "conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such a manner and by such means as will leave them unimpaired for the enjoyment of future generations".
NRCS (Natural Resources Conservation Service)	The NRCS is a federal agency within the Department of Agriculture and is a conservation leader in all natural resources; ensuring that private lands are conserved, restored, and more resilient to environmental challenges. NRCS is recognized to have jurisdiction by law and/or has special expertise in the following areas: a. Farmland Protection Policy Act (7 USC 4201 et seq.; 7 CFR Part 658) b. Watershed and Flood Prevention Act, Public Law 83-566, as amended (16 USC 1001–1009) c. Wetland Reserve Program (16 USC 3837, et seq.) d. Grassland Reserve Program (16 USC 3838N-3838q.) e. Healthy Forests Restoration Act of 2003, Public Law 108–148 (16 USC § 6501) f. The 1996 U.S. Farm Bill, Public Law 104–127 (110 Stat. 888–1197)
NRHP (National Register of Historic Places)	The official register of districts, sites, buildings, structures, and objects significant in American history, architecture, archaeology, and culture, established by the National Historic Preservation Act of 1966, as amended, and maintained by the National Park Service on behalf of the Secretary of the Interior.
NSTs (National Scenic Trails)	A congressionally designated trail that is a continuous and uninterrupted extended, long-distance trail so located as to provide for maximum outdoor recreation potential and for the conservation and enjoyment of the nationally significant resources, qualities, values, and associated settings and the primary use or uses of the areas through which such trails may pass.
NWR (National Wildlife Refuge)	NWRs are administered by the USFWS under the National Wildlife Refuge System Administration Act (16 USC 668dd). The National Wildlife Refuge System's purpose is to administer a national network of lands and waters for the conservation, management, and restoration of fish, wildlife, and plant resources and their habitats for the benefit of present and future generations. Each NWR is to be managed to fulfill the specific purposes for which the refuge was established. This act allows easements or ROWs for power lines so long as it is determined the power line is compatible with the purposes for which an NWR was established.
Oklahoma AC Interconnection Siting Area	An approximate 870-acre corridor within which an AC transmission interconnection route from the Oklahoma converter station to the future Optima Substation would be sited.

Oklahoma Converter Station Siting Area	An approximate 620-acre area in Texas County, Oklahoma, within which the converter station and associated AC switchyard (45 to 70 acres total) and access road(s) would be sited.
OPGW (Optical Ground Wire)	Optical ground wire would be installed to protect the transmission line from direct lightning strikes. The ground wires and structures would transfer current from the lightning strikes though the ground wires and structures into the ground.
OSHA (Occupational Safety and Health Administration)	OSHA has jurisdiction over most occupational health and safety issues within each state crossed by the Project. Industrial construction and routine workplace operations are governed by the Occupational Safety and Health Act of 1970, specifically 29 CFR 1910 (general industry standards) and 29 CFR 1926 (construction industry standards).
Original Applicant Proposed Route	Throughout the Final EIS, the term "original Applicant Proposed Route" refers to the centerline of the representative ROW that was shown and analyzed in the Draft EIS.
Outage	Events caused by a disturbance on the electrical system that requires the provider to remove a piece of equipment or a portion or all of a line from service. The disturbances can be either natural or human-caused.
Overstory	The overstory is a layer of tall mature trees that rise above the shorter understory trees, including the trees in a timber stand.
Ozone	Relatively unstable form of oxygen (O_3) that is associated with the corona discharge of high-voltage transmission lines. Rapidly recombines back to the more stable oxygen (O_2).
Palustrine	National Wetlands Inventory system that includes wetlands dominated by trees, shrubs, and persistent emergent plants associated with water bodies that cover less than 20 acres or with water less than 6.6 feet deep.
Parturition Areas	Areas where habitat is appropriate for female big game animals to seclude themselves while giving birth to young in late spring or early summer. Such areas are usually characterized by ample hiding cover and forage.
Peak Hour	The hour of the day that observes the highest traffic volumes for a roadway or intersection. Typically two peak hours are reported, one in the AM and one in the PM.
Perennial Stream	One that flows with water present continuously during an average water year.
Physiographic	Pertaining to the features and phenomena of nature.
Plant Protection Act	Under the Plant Protection Act of 2000 (7 USC 104), which encompasses the Federal Noxious Weed Act of 1974 (7 USC 2801 et seq.), the federal government lists 137 regulated noxious weeds. States typically have their own noxious weed lists and county weed control boards or districts that monitor weed infestations and provide guidance on weed control.
Prevention of Significant Deterioration	Federal pre-construction review for affected sources located in attainment areas for air quality. It is intended to prevent a new source from causing air quality to deteriorate beyond acceptable levels.
Prime Farmland	As defined by the USDA (7 CFR §657.5), prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses (the land could be cropland, pastureland, rangeland, forest land, or other land, but not urban built-up land or water).

Programmatic Agreement (PA)	DOE is developing a Programmatic Agreement (PA) pursuant to 36 CFR 800.14(b) to address its obligations under NHPA Section 106, including government-to-government consultation with Indian Tribes and Nations that may attach religious and cultural significance to historic properties that may be affected by the undertaking, and consultation with the Arkansas, Oklahoma, Tennessee, and Texas SHPOs as well as the Federal agencies listed above. Clean Line will also be a party to the PA (Appendix P). The PA addresses resource identification and evaluation, assessment of effects, and resolution of effects, including avoidance, minimization, and mitigation. Development of a PA under 36 CFR 800.14(b) is appropriate for the Project because its potential effects on historic properties are multi-state and regional in scope, because of the complex nature of the undertaking, and because effects on historic properties cannot be fully determined prior to approval of the undertaking. In such situations, the regulations allow development of a PA to address the identification of historic properties and resolution of adverse effects in a phased approach (36 CFR 800.14(b)).
Project (the)	A broad term that generically refers to elements of the Applicant Proposed Project and/or DOE Alternatives when differentiation between the two is not necessary. The term also refers to whatever combination of project elements that would be built if a decision was made by DOE to participate with Clean Line.
Purpose and Need	Under the National Environmental Policy Act of 1969 (NEPA), the need to take an action may be something the agency identifies itself, or it may be a need to make a decision on a proposal brought to it by someone outside of the agency, for example, an applicant for a permit. Alternatives are measured against how well they meet the underlying need and best achieve the purposes to be attained. DOE's purpose and need for agency action is to implement Section 1222 of the EPAct. To that end, DOE needs to decide whether and under which conditions it would participate in Clean Line's proposed Project.
Raptor	A bird of prey such as eagles, hawks, falcons, or owls.
Reclamation	Returning disturbed lands to a form and productivity that will be ecologically balanced.
Reliability	Transmission systems must be built with sufficient levels of redundancy to enable the transmission system to reliably operate in the event of the loss of any single element (i.e., transmission line segment or substation element).
Representative ROW (Right-of-Way)	The analysis of impacts for the HVDC Applicant Proposed Route, AC Collection System, and HVDC alternative routes were based on a representative 200-foot ROW (100 feet on either side of a representative centerline). Quantitative data regarding the resources directly intersected by the representative 200-foot-wide ROW were used to analyze the potential impacts of the Project.
Revegetation	The reestablishment and development of self-sustaining plant cover. On disturbed sites, this normally requires human assistance, such as reseeding.
Riparian Areas	Vegetation communities that occur adjacent to waterways such as streams, rivers, springs, ponds, lakes, or tidewater and that provide habitat for numerous plant and animal species. They generally occupy transitional areas between aquatic and upland habitats and may function as vegetative buffers for aquatic resources.
Riverine System	Wetland inventory system that includes wetlands not dominated by trees, shrubs, or persistent emergents that are contained within a river channel.
Rivers and Harbors Act	Section 10 of the act prohibits the unauthorized obstruction or alteration of any navigable water of the U.S. without a permit from the U.S. Army Corps of Engineers.
Roadless area	An area of undeveloped public land within which there are no improved roads maintained for travel by means of motorized vehicles intended for highway use.
ROD (Record of Decision)	The ROD is the formal agency decision document for the EIS process. DOE's ROD would announce and explain DOE's decision on whether to participate in the Project and describe any conditions, such as mitigation commitments, that would need to be met. DOE may issue a ROD no sooner than 30 days after EPA's Notice of Availability for the Final EIS is published in the *Federal Register.*

ROI (Region of Influence)	To examine the potential impacts of the Project components, the EIS examines the area potentially affected by the Applicant Proposed Project and the DOE Alternatives. The EIS defines the area potentially affected by the Project as the ROI. A description of the ROI is provided in Section 3.1. The ROI may be expanded or modified on a resource specific basis where appropriate as described in each resource section.
Route Variation	Modifications DOE and Clean Line made to the Applicant Proposed Route in Regions 2–7 in response to public comments on the Draft EIS. For each comment that specifically requested a re-routing consideration, DOE reviewed the information supplied with the comment and coordinated with Clean Line through a series of formal data requests. For each comment that provided new information indicating a potential conflict between a route and resources not known at the time of the Draft EIS, DOE reviewed the comment and related data request responses from Clean Line, and determined the feasibility of developing route variations to avoid those areas (e.g., previously unknown residences or structures, environmentally or culturally sensitive areas). In each instance, any consideration of a route variation needed to remain consistent with the routing criteria used for route development. Throughout the Final EIS, the term “route variation” refers to the centerline of the revised representative ROW. With one exception, route variations involve changes to the centerline outside of the 1,000-foot corridor that DOE analyzed in the Draft EIS. DOE included Applicant Proposed Route Link 5, Variation 1, which is within the 1,000-foot corridor analyzed in the Draft EIS, as a route variation so that DOE’s analyses of the representative ROW would be consistent with Clean Line’s application for a certificate of public convenience and necessity with the Tennessee Regulatory Authority.
Sage-Grouse Lek	A location used by male sage-grouse, generally every year, to assemble during the mating season and engage in competitive displays that attract females.
Scenery	The aggregate of features that give character to a landscape.
Scenic Byway	A public road having special, scenic, historic, recreational, cultural, archeological, and/or natural qualities that have been recognized as such through legislation or some other official declaration.
Sensitivity Levels	Measures (e.g., high, medium, low) of public concern for the maintenance of a particular existing landscape.
Scoping (Public Scoping)	A formal part of the federal environmental analysis process required under NEPA where issues are identified for detailed analysis. Scoping includes, but is not limited to, a formal scoping period early in the analysis process in which members of the public are invited to review the proposed action and identify possible issues or concerns with the project. Public scoping begins with the issuance of a Notice of Intent (NOI) in the *Federal Register* and includes public meetings in the vicinity of the Project. For the Plains & Eastern EIS, public scoping began with DOE’s publication of the NOI on December 21, 2012. The public scoping period continued for ninety days through March 21, 2013. DOE held 13 public scoping meetings in communities along the proposed and alternative routes and five interagency meetings during the scoping period.
Section 106 of the NHPA	Under Section 106 of the National Historic Preservation Act of 1966, as amended, federal agencies must identify and evaluate cultural resources and consider the impact of undertakings they fund, license, permit, or assist on historic properties eligible for inclusion in the National Register of Historic Places. The federal agencies must afford the State Historic Preservation Officer and the Advisory Council on Historic Preservation the opportunity to comment on these undertakings.
Section 1222 of EPAct (Energy Policy Act of 2005)	Section 1222 of the EPAct, in relevant part, authorizes the Secretary of Energy, acting through and in consultation with the Administrator of Southwestern (provided the Secretary determines that certain statutory requirements have been met), to participate with other entities in designing, developing, constructing, operating, maintaining, or owning new electric power transmission facilities and related facilities located within any state in which Southwestern operates.
Sedimentation	The deposition or accumulation of sediment.
Seismic Hazards	Seismic hazards include faults and seismicity. Seismicity refers to the intensity and geographic and historical distribution of earthquakes.

Sensitivity Levels	Sensitivity levels are the measure of public concern for scenic quality. Public lands are assigned high, medium, or low sensitivity levels.
Seral	Pertaining to the stages of ecological succession occurring in communities of plants and animals until the climax is reached.
SHPO (State Historic Preservation Office[r])	Created under Section 101 of the NHPA to survey and recognize historic properties, review nominations for properties to be included in the National Register of Historic Places, review undertakings for the impact on the properties as well as support federal organizations, state and local governments, and the private sector. States are responsible for setting up their own SHPO; therefore, each SHPO varies slightly on rules and regulations.
Shrubland	A habitat type characterized by woody vegetation smaller than trees (in general, having multiple main stems and being less than 20 feet in height and six inches diameter at breast height at maturity).
Single-Circuit Transmission Line	A transmission line composed of three electrical phases and two lightning protection shield wires. One of the lightning protection shield wires is a steel overhead ground wire and the other is typically an optical ground wire (OPGW).
SIO (Scenery Integrity Objective)	To describe the goals of a landscape relative to its assumed natural state: Very High (Unaltered), High (Appears Unaltered), Moderate (Slightly Altered), Low (Moderately Altered), and Very Low (Heavily Altered). When discussing SIOs, the degree of alteration is measured in terms of visual contrast with the surrounding natural landscape.
SMS (Scenery Management System)	The SMS provides an overall framework for the orderly inventory, analysis, and management of scenery. The system applies to all national forests and grasslands administered by the Forest Service and to Forest Service management activities. This system applies only to HVDC Alternative 4-B that crosses the Ozark National Forest. The SMS process uses particular ecosystems as the environmental context for aesthetics.
SO_2 (Sulfur dioxide)	Sulfur dioxide is one of a group of highly reactive gasses known as "oxides of sulfur."
Soil Compaction	Operation of motorized vehicles on moist soils, especially heavy equipment, is likely to cause compaction of the surface layer, which may increase runoff, decrease infiltration and aeration, and reduce soil productivity by making it more difficult for plant roots to establish or obtain soil moisture and nutrients.
Soil Erosion	The movement of soil particles, usually as a result of wind or water forces. Many factors affect soil erosion, including soil grain size, cohesion factor, soil moisture content, type and amount of vegetative cover, precipitation amount and intensity, steepness of slope, and wind speed.
Soil Liquefaction	Liquefaction may occur when loose, cohesionless, and water-saturated soils lose strength and stiffness in response to stress, such as the ground shaking from an earthquake, causing the soil to behave like a liquid. It is most often observed in fluvial, lacustrine, or eolian deposits of Holocene age or younger that have not compacted or cohered. Liquefaction potential in a soil layer increases with decreasing fines content and plasticity of the soil. Cohesionless soils having less than 15 percent (by weight) of particles smaller than 0.005 millimeter, a liquid limit less than 35 percent, and an in situ water content greater than 0.9 times the liquid limit may be susceptible to liquefaction. Liquefaction is more likely to occur in soil/sediment layers with at least 80 to 85 percent saturation and located within 50 feet of the ground surface.
Span Length	The distance between two transmission support structures traveled by the conductors, measured either horizontally or along the conductors from the end of one insulator string to the end of the next insulator string.
Special Status Species	Species of plants or animals that have been designated by government agencies as needing special monitoring, conservation, or protection, usually due to declining populations. This group includes federally endangered and threatened species as well as other designations.
Species	A group of interbreeding individuals not interbreeding with another such group; similar and related species are grouped into a genus.

Staging Area	A fenced, generally flat location where materials, equipment, and vehicles are stored prior to their use in construction of the transmission line or its ancillary facilities.
Stray Voltage	Stray voltage is an extraneous voltage that appears on grounded surfaces in buildings, barns, and other structures, including utility distribution systems.
Structures	The structures used to support the HVDC or AC transmission lines would be constructed of either tubular or lattice steel and would typically range in height from 120 to 200 feet. Preliminary engineering indicates that most structures would be less than 160 feet when using lattice structures and would tend to be less than 140 feet when using monopole structures.
Subsidence (Soil)	Subsidence hazards involve either the sudden collapse of the ground to form a depression or the slow movement downward or compaction of the sediments near the earth's surface. The most common types of subsidence are the subsidence due to erosion of soil or rock and collapses involving the dissolution of carbonate rocks (limestones) beneath the surface.
Substation	A fenced site containing switching and transformation equipment needed to transform one voltage to another and for protecting and controlling transmission and distribution lines. A substation is used to raise voltages for long distance transmission and to lower transmission voltage for distribution to the end users.
Switches	Devices used to mechanically disconnect or isolate equipment; found on both sides of circuit breakers.
System planning	System planning evaluates the operations of the electric transmission system and uses that information to assess future transmission system needs. System planning studies were required to study the interconnections and between the Applicant Proposed Project and the existing electrical grid.
Tap	The point at which a transmission line is connected to a substation or other electrical device to provide service to a local load.
TCP (Traditional Cultural Property)	A property that is eligible for the NHRP because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community.
Temporary Construction Areas	Temporary construction areas would be required to support construction. Temporary multi-use construction yards and fly yards (landing areas for helicopters used during construction) would be used for staging construction personnel and equipment, and for storage of materials to support construction activities. Tensioning or pulling sites and wire-splicing sites would also be staged at 2- to 3-mile intervals along the Project ROW.
Tennessee Converter Station Siting Area	An approximate 220-acre area in Shelby County, Tennessee, within which the converter station and associated AC switchyard (45 to 60 acres total), access road(s), and substation upgrades (also referred to as direct assignment facilities) including additional bays, breakers, switches, line relays, and interchange meters would be sited.
Tensioning or Pulling Areas	Tensioning or pulling sites would be used for the tensioning equipment to establish and maintain tension on the ground wire or conductor while they are fastened to the structures. Tensioning or pulling sites would be approximately 2 to 3 miles apart and would be entirely within the ROW or partially outside the ROW.
Terrestrial	Occurring on land.
TES (Threatened and Endangered Species)	Threatened and endangered species listed or candidates for listing under the federal Endangered Species Act (ESA).
THPO (Tribal Historic Preservation Office[r])	Tribal officials tasked with advising and assisting Federal agencies in carrying out responsibilities under Section 106 of the NHPA.
Threatened Species	Those species officially listed by the U.S. Fish and Wildlife Service that are likely to become endangered within the foreseeable future throughout all or a significant portion of their range (ESA §3(20)).

Topsoil	The uppermost soil layer, generally ranging from a few inches to less than one foot in thickness. Topsoil is the site of greatest organic content, contains the most soil nutrients, and supports the greatest amount of plant life.
Toxic air Pollutants	Chemicals and chemical classes which often have carcinogenic, mutagenic, or other especially hazardous properties and are typically subsets of criteria pollutants.
Transformers	Electrical equipment usually contained in a substation that is needed to change voltage on a transmission system.
Transmission Line	A system of structures, wires, insulators, and associated hardware that carry electric energy from one point to another in an electric power system. Lines are operated at relatively high voltages varying from 69kV up to 765kV, and are capable of transmitting large quantities of electricity over long distances.
Trip	A single or one-direction vehicle movement with either the origin or the destination inside the study site.
Turbidity	The state or condition of opaqueness or reduced clarity of a fluid due to the presence of suspended matter.
TVA (Tennessee Valley Authority)	TVA is a federally owned corporation that provides electricity to about 9 million people in parts of seven southeastern states. TVA is recognized to have jurisdiction by law by virtue of the approvals that would need to be obtained from TVA before interconnecting the Project to the transmission system TVA operates in the Tennessee Valley region.
Understory	Foliage layer beneath the forest canopy. Young trees that are growing beneath the tall mature trees in a timber stand.
Undertaking	A federal undertaking is defined as a decision involving federal expenditure of funds or issuance of permit, license, or other approval.
USFS (U.S. Department of Agriculture, Forest Service)	A federal agency under the Department of Agriculture that manages 193 million acres of public land for multiple uses and benefits and for the sustained yield of renewable resources such as water, forage, wood, recreation, fish and wildlife habitat, wilderness areas, and archaeological, paleontological and historical sites.
USFWS (U.S. Fish and Wildlife Service)	USFWS is a bureau within the Department of Interior whose mission is to conserve, protect, and enhance fish, wildlife, and plants and their natural habitats for the continuing benefit of the American people. USFWS is recognized to have jurisdiction by law and/or has special expertise in the following areas: • Endangered Species Act (16 USC § 1531et seq.) • Migratory Bird Treaty Act (16 USC § 703 et seq.) • Bald and Golden Eagle Protection Act (16 USC § 668 et seq.) • The National Wildlife Refuge System Administration Act (16 USC § 668dd–68ee) • Executive Order 13186 and DOE and USFWS Memorandum of Understanding
Vegetation Communities	A combination of dominant plant species that live together in the same region or on the same landform.
Viewing Location	Public and private areas (including Key Observation Points) within a landscape where a project could be visible and where concerns for changes to the landscape exist.
Viewshed	The landscape that can be directly seen under favorable atmospheric conditions, from a viewpoint or along a transmission corridor.
Visual Elements	Form, line, color and texture of an existing landscape. Contrast in the landscape is determined by comparing visual elements of the existing landscape with the visual elements of the Project (i.e., transmission structures, converter stations, access road, etc.).
Visual Resources	Visible features of the landscape (e.g., land, water, vegetation, animals, structures, and other features).

Visual Sensitivity	A measure of viewer concern for scenic resources and potential changes to the resource and is based on volume of use, frequency of views and viewing duration.
Volt	The international system unit of electrical potential and electromotive force—a measure of electrical "pressure."
Voltage	The electrical potential difference between two points expressed in volts; the driving force that causes a current to flow in an electrical circuit.
VRM (Visual Resource Management) System	The Bureau of Land Management system identified four VRM Classes (I through IV) with specific management prescriptions for each class. The system is based on an inventory of the existing scenic quality, viewer sensitivity, and viewing distance zones. The management class for a given area is typically arrived at by comparing the scenic quality, visual sensitivity, and distance zone with the overall goals set forth for the area.
Watershed	The area that drains to a common waterway.
WDZ (Wind Development Zone)	Twelve wind development zones were identified to consider potential connected actions for the Project. These zones are areas within a 40-mile-radius of the Oklahoma Converter Station Siting Area with adequate wind resource and in which wind energy developers may consider future development of wind energy facilities.
Wetlands	The USACE and EPA jointly define wetlands as "Those areas that are inundated or saturated by surface or ground water (hydrology) at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation (hydrophytes) typically adapted for life in saturated soil conditions (hydric soils). Wetlands generally include swamps, marshes, bogs, and similar areas (CFR 328.3 and 40 CFR 232.2(r))."
Wire Splicing Sites	Conductors and shield wires are strung into their supporting structures over a length of two reels. The wire from the two reels is mechanically joined at the wire ends with a temporary wire-gripping sleeve (stringing sock) which passes through the stringing blocks. After the wire is strung and secured, the stringing sock is replaced with a compression splice connector. The location of the splice connector installation is the wire splicing site. Typical wire splicing sites include a wire splicing truck and a line truck to facilitate installation and are located within the ROW.
Wire Zone	A linear zone under the transmission wires and extending 10 feet beyond them and maintained in vegetation cover less than 5 feet high.
WMA (Wildlife Management Area)	Wildlife Management Areas are lands that are protected for conservation of sensitive resources and for their recreation opportunities.
Waters of the United States	Broadly defined by statute, regulation, and judicial interpretation to include all waters that were, are, or could be used in interstate commerce such as rivers, streams (including ephemeral streams), reservoirs, lakes, and adjacent wetlands. The USACE Wetlands Delineation Manual and its current supplements must be used to determine whether an area has sufficient wetland characteristics to be a water of the United States.
WRP–Wetland Reserve Program	The NRCS Wetlands Reserve Program (WRP) is a voluntary program offering landowners the opportunity to protect, restore, and enhance wetlands on their property. The program provides technical and financial support to help landowners with their wetland restoration efforts.
Zoning	Regulations used to guide growth and development; typically involve legally adopted restrictions on uses and building sites in specific geographic areas to regulate private land use.

8. Index

This page intentionally left blank.