Federal Energy Regulatory Commission
Office of Energy Projects
Washington, DC 20426

ANNOVA LNG BROWNSVILLE PROJECT

Draft Environmental Impact Statement

Volume I

Annova LNG Common Infrastructure, LLC
Annova LNG Brownsville A, LLC
Annova LNG Brownsville B, LLC
Annova LNG Brownsville C, LLC

Docket No. CP16-480-000
FERC\EIS: 0291D
December 2018

Cooperating Agencies:

U.S. Army Corps of Engineers

National Park Service

U.S. Environmental Protection Agency

U.S. Fish and Wildlife Service

U.S. Coast Guard

U.S. Department of Energy

U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration

National Oceanic and Atmospheric Administration - National Marine Fisheries Service

Federal Aviation Administration

FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, D.C. 20426

OFFICE OF ENERGY PROJECTS

<u>In Reply Refer To</u>:
OEP/DG2E/Gas Branch 3
Annova LNG Common Infrastructure, LLC
Annova LNG Brownsville A, LLC
Annova LNG Brownsville B, LLC
Annova LNG Brownsville C, LLC
Annova LNG Brownsville Project
Docket No. CP16-480-000

TO THE INTERESTED PARTY:

The staff of the Federal Energy Regulatory Commission (FERC or Commission) has prepared a draft environmental impact statement (EIS) for the Annova LNG Brownsville Project (referred to as the Annova LNG Project, or Project). Annova LNG Common Infrastructure, LLC; Annova LNG Brownsville A, LLC; Annova LNG Brownsville B, LLC; and Annova LNG Brownsville C, LLC (collectively Annova), request authorization to site, construct, and operate a liquefied natural gas (LNG) export facility in Cameron County, Texas. The Project would include a new LNG export terminal capable of producing up to 6.95 million metric tons per year of LNG for export. The LNG terminal would receive natural gas to the export facilities from an as-yet undetermined third-party intrastate pipeline.

The draft EIS assesses the potential environmental effects of the construction and operation of the Project in accordance with the requirements of the National Environmental Policy Act (NEPA). The FERC staff concludes that approval of the Project would result in some adverse environmental impacts. However, with the mitigation measures recommended in the EIS and Annova's proposed mitigation measures, impacts in the Project area would be avoided or minimized and would not be significant. In addition, the Annova LNG Project combined with other projects within the geographic scope, including the Texas LNG and Rio Grande LNG Projects, would result in certain significant cumulative impacts. Construction and operation of the Project would result in mostly temporary or short-term environmental impacts; however, some long-term and permanent environmental impacts would occur.

The U.S. Army Corps of Engineers; U.S. Coast Guard; U.S. Department of Transportation; U.S. Environmental Protection Agency; U.S. Fish and Wildlife Service; National Parks Service; the National Oceanic and Atmospheric Administration, National Marine Fisheries Service; Federal Aviation Administration; and U.S. Department of Energy participated as cooperating agencies in the preparation of the EIS. Cooperating agencies have jurisdiction by law or special expertise with respect to resources potentially affected by the proposal and participate in the NEPA analysis.

The draft EIS addresses the potential environmental effects of the construction and operation of the following Project facilities:

- pipeline meter station;
- liquefaction facilities;
- two LNG storage tanks;
- marine and LNG transfer facilities;
- control room, administration/maintenance building;
- site access road; and
- utilities (power, water, and communication systems).

The Commission mailed a copy of the *Notice of Availability* of the draft EIS to federal, state, and local government representatives and agencies; elected officials; environmental and public interest groups; Indian Tribes; potentially affected landowners and other interested individuals and groups; and newspapers and libraries in the area of the Annova LNG Project. The draft EIS is only available in electronic format. It may be viewed and downloaded from the FERC's website (www.ferc.gov), on the Environmental Documents page (https://www.ferc.gov/industries/gas/enviro/eis.asp). In addition, the draft EIS may be accessed by using the eLibrary link on the FERC's website. Click on the eLibrary link (https://www.ferc.gov/docs-filing/elibrary.asp), click on General Search, and enter the docket number in the "Docket Number" field, excluding the last three digits (i.e., CP16-480). Be sure you have selected an appropriate date range. For assistance, please contact FERC Online Support at FercOnlineSupport@ferc.gov or toll free at (866) 208-3676, or for TTY, contact (202) 502-8659.

Any person wishing to comment on the draft EIS may do so. Your comments should focus on the draft EIS's disclosure and discussion of potential environmental effects, reasonable alternatives, and measures to avoid or lessen environmental impacts. The more specific your comments, the more useful they will be. To ensure consideration of your comments on the proposal in the final EIS, it is important that the Commission receive your comments on or before 5:00 p.m. Eastern Time on **February 4, 2019**.

For your convenience, there are four methods you can use to submit your comments to the Commission. The Commission will provide equal consideration to all comments received, whether filed in written form or provided verbally. The Commission encourages electronic filing of comments and has staff available to assist you at (866) 208-3676 or FercOnlineSupport@ferc.gov. Please carefully follow these instructions so that your comments are properly recorded.

1) You can file your comments electronically using the eComment feature on the Commission's website (www.ferc.gov) under the link to Documents and Filings. This is an easy method for submitting brief, text-only comments on the Project;

2) You can file your comments electronically by using the eFiling feature on the Commission's website (www.ferc.gov) under the link to Documents and Filings. With eFiling, you can provide comments in a variety of formats by attaching them as a file with your submission. New eFiling users must first create an account by clicking on "eRegister." If you are filing a comment on a particular project, please select "Comment on a Filing" as the filing type; or

3) You can file a paper copy of your comments by mailing them to the following address. Be sure to reference the Project docket number (CP16-480-000 with your submission: Kimberly D. Bose, Secretary, Federal Energy Regulatory Commission, 888 First Street NE, Room 1A, Washington, DC 20426.

4) In lieu of sending written or electronic comments, the Commission invites you to attend the public comment session its staff will conduct in the Project area to receive comments on the draft EIS, scheduled as follows:

Date and Time	**Location**
Thursday, January 10, 2019 5:00 - 9:00 p.m. CST	Port Isabel Convention Center 309 E. Railroad Ave, Port Isabel, TX 78578 956-433-7195

The primary goal of the comment session is to have you identify the specific environmental issues and concerns with the draft EIS. Individual verbal comments will be taken on a one-on-one basis with a court reporter. This format is designed to receive the maximum amount of verbal comments, in a convenient way during the timeframe allotted.

The comment session is scheduled from 5:00 p.m. to 9:00 p.m. CST. You may arrive at any time after 5:00 p.m. There will not be a formal presentation by Commission staff when the session opens. If you wish to provide comments, the Commission staff will hand out numbers in the order of your arrival. Comments will be taken until the closing hour for the comment session. However, if no additional numbers have been handed out and all individuals who wish to provide comments have had an opportunity to do so, staff may conclude the session 30 minutes before the closing hour.

Your verbal comments will be recorded by the court reporter (with FERC staff or representative present) and become part of the public record for this proceeding. Transcripts will be publicly available on FERC's eLibrary system (see below for instructions on using eLibrary). If a significant number of people are interested in providing verbal comments in the one-on-one settings, a time limit of 5 minutes may be implemented for each commentor.

It is important to note that verbal comments hold the same weight as written or electronically submitted comments. Although there will not be a formal presentation, Commission staff will be available throughout the comment session to answer your questions about the environmental review process.

Any person seeking to become a party to the proceeding must file a motion to intervene pursuant to Rule 214 of the Commission's Rules of Practice and Procedures (18 CFR 385.214). Motions to intervene are more fully described at http://www.ferc.gov/resources/guides/how-to/intervene.asp. Only intervenors have the right to seek rehearing or judicial review of the Commission's decision. The Commission grants affected landowners and others with environmental concerns intervenor status upon showing good cause by stating that they have a clear and direct interest in this proceeding which no other party can adequately represent. **Simply filing environmental comments will not give you intervenor status, but you do not need intervenor status to have your comments considered.**

Questions?

Additional information about the Project is available from the Commission's Office of External Affairs, at **(866) 208-FERC**, or on the FERC website (www.ferc.gov) using the eLibrary link. The eLibrary link also provides access to the texts of all formal documents issued by the Commission, such as orders, notices, and rulemakings.

In addition, the Commission offers a free service called eSubscription that allows you to keep track of all formal issuances and submittals in specific dockets. This can reduce the amount of time you spend researching proceedings by automatically providing you with notification of these filings, document summaries, and direct links to the documents. Go to www.ferc.gov/docs-filing/esubscription.asp.

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TECHNICAL ACRONYMS AND ABBREVIATIONS

AADT	average annual daily traffic
ACHP	Advisory Council on Historic Preservation
ACT	Antiquities Code of Texas
AEP	American Electric Power Service Corporation
AERMOD	American Meteorological Society/EPA Regulatory Model
Annova Plan	Annova's *Upland Erosion Control, Revegetation, and Maintenance Plan*
Annova Procedures	Annova's *Wetland and Waterbody Construction and Mitigation Procedures*
Annova	Annova LNG Common Infrastructure, LLC; Annova LNG Brownsville A, LLC; Annova LNG Brownsville B, LLC; and Annova LNG Brownsville C, LLC
Annova LNG Project	Annova LNG Brownsville Project
ANSI	American National Standards Institute
APCI	Air Products & Chemicals Incorporated
AQCR	Air Quality Control Region
APE	area of potential effect
AST	Office of Commercial Space Transportation
BA	biological assessment
B&A	Blanton and Associates, Inc.
BACT	Best Available Control Technology
Bcf	billion cubic feet
Bcf/d	billion cubic feet per day
BCR	Bird Conservation Region
BGCC	Bahia Grande Coastal Corridor
BGEPA	Bald and Golden Eagle Protection Act
BIH	Brazos Island Harbor
BLEVE	boiling liquid expanding vapor explosion
BLM	Bureau of Land Management
BMP	best management practice
BND	Brownsville Navigation District
BOG	boil-off gas
BSC	Brownsville Ship Channel
BU	beneficial use
CAA	Clean Air Act of 1970
CAAA	Clean Air Act Amendments
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
Coast Guard	U.S. Coast Guard
COE	U.S. Army Corps of Engineers

COTP	Captain of the Port
CP	calculation point
CPT	cone penetration test
CWA	Clean Water Act
CZMA	Coastal Zone Management Act of 1972
CZMP	Coastal Zone Management Program
dB	decibel
dBA	A-weighted decibels
DE	Design Earthquake
DEIS	draft Environmental Impact Statement
DHS	Department of Homeland Security
DMPA	Dredged Material Placement Area
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOE/FE	U.S. Department of Energy, Office of Fossil Energy
DOT	U.S. Department of Transportation
DPS	distinct population segment
EA	Environmental Assessment
ECOS	Environmental Conservation Online System
EEZ	Exclusive Economic Zone
EFH	essential fish habitat
EI	environmental inspector
EIS	Environmental Impact Statement
EMST	Ecological Mapping System of Texas
Eos	Eos LNG, LLC
EPA	U.S. Environmental Protection Agency
ERCOT	Electric Reliability Council of Texas
ERP	Emergency Response Plan
ESA	Endangered Species Act of 1973
ESD	emergency shutdown
FAA	Federal Aviation Administration
FEED	front-end engineering design
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Administration
FERC or Commission	Federal Energy Regulatory Commission
FERC Plan	FERC's *Upland Erosion Control, Revegetation, and Maintenance Plan*
FERC Procedures	FERC's *Wetland and Waterbody Construction and Mitigation Procedures*
FHWA	Federal Highway Administration
FIS	Flood Insurance Study
FLEX	Freeport LNG Expansion, LP and FLNG Liquefaction, LLC
FLNG	floating liquefied natural gas
FM	Farm to Market Road
FR	*Federal Register*
FSA	Facility Security Assessment
FSP	Facility Security Plan

FTA	Free Trade Agreement
FWS	U.S. Fish and Wildlife Service
FY	fiscal year
g	factor of gravity
g/bhp-hr	gram per brake horsepower-hour
GE	General Electric
GHG	greenhouse gas
GMD	geomagnetic disturbance
Gulf Coast LNG	Gulf Coast LNG, LLC
H_2S	hydrogen sulfide
HAP	hazardous air pollutant
HAZOP	hazard and operability
HGB	Houston-Galveston-Brazoria
HILFD	Homeland Infrastructure Foundation Level Data
HMB	heat and material balance
HUC	Hydrologic Unit Code
Hz	hertz
hp	horsepower
IBC	International Building Code
ICC	International Code Council
IMO	International Maritime Organization
IMR	Inter-Mountain Region
ISA	International Society for Automation
ISD	Independent School District
kHz	kilohertz
KOP	key observation point
kPa	kilopascals
kV	kilovolt
L_{50}	median sound pressure level
L_{dn}	day-night average sound level
L_{eq}	equivalent continuous sound level
L_{max}	maximum sound level
lb	pound
LNG	liquefied natural gas
LOD	Letter of Determination
LOI	Letter of Intent
LOR	Letter of Recommendation
LOS	level of service
µPa	micropascal
m^3	cubic meter
MACT	Maximum Achievable Control Technology
MBTA	Migratory Bird Treaty Act
mg/L	milligram per liter
MLLW	mean lower low water
MMBtu	million British thermal units
MMBtu/hr	million British thermal units per hour

MMPA	Marine Mammals Protection Act
MOF	material offloading facility
MOU	Memorandum of Understanding
MOVES	Motor Vehicle Emission Simulator
MPGF	multipoint ground flare
m/s	meter per second
MSA	Magnuson-Stevens Fishery Conservation and Management Act of 1976
MSS	maintenance, start-up, and shut-down (events)
mtpa	million tonnes per annum
MTSA	Maritime Transportation Security Act of 2002
MW	megawatt
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NAISA	National Aquatic Invasive Species Act of 2003
NANPCA	Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990
NAVD88	North American Vertical Datum of 1988
NBSIR	National Bureau of Standards Information Report
NEHRP	National Earthquake Hazards Reduction Program
NEPA	National Environmental Policy Act of 1969
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFIA	National Flood Insurance Act of 1968
NFIP	National Flood Insurance Program
NFPA	National Fire Protection Association
NGA	Natural Gas Act
NHD	National Hydrography Dataset
NHL	National Historic Landmark
NHPA	National Historic Preservation Act of 1966
NHTSA	National Highway Traffic Safety Administration
NISA	National Invasive Species Act
NLCD	National Land Cover Database
nm	nautical mile
NML	noise monitoring location
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries	National Oceanic and Atmospheric Administration National Marine Fisheries Service
NOI for the Annova LNG Project	Notice of Intent to Prepare an Environmental Impact Statement for the Planned Annova LNG Brownville Project, Request for Comments on Environmental Issues, and Notice of Public Scoping Meeting
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NSA	noise sensitive area
NSNSD	Natural Sounds and Night Skies Division

NSPS	New Source Performance Standards
NSR	New Source Review
nT	nano-Tesla
NWI	National Wetlands Inventory
NWR	National Wildlife Refuge
O_2	oxygen
O_3	ozone
OBE	operating basis earthquake
OEP	Office of Energy Projects
P&ID	piping and instrumentation diagram
PEM	palustrine emergent
PFD	process flow diagram
PHMSA	United States Department of Transportation's Pipeline and Hazardous Materials Safety Administration
PJD	Preliminary Jurisdictional Determination
$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
PM_{10}	particulate matter less than 10 microns in diameter
ppm	part per million
PRICO®	Poly Refrigerant Integrated Cycle Operation
Project	Annova LNG Brownsville Project
PSD	Prevention of Significant Deterioration
PTE	potential to emit
PUC	Public Utility Commission
RCRA	Resource Conservation and Recovery Act
re 1 $\mu Pa^2/Hz$	in reference to 1 μPa squared per hertz
RHA	Rivers and Harbors Act
RMP	Risk Management Plan
RMS	root mean squared
RRC	Railroad Commission of Texas
RV	recreational vehicle
SAFE Port Act	Security and Accountability For Every Port Act
SAL	State Antiquities Landmark
SCPT	seismic cone penetration test
SGCN	species of greatest conservation need
SH	State Highway
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SO_2	sulfur dioxide
SOC	species of concern
SOI	Secretary of Interior
SOLAS	International Convention for the Safety of Life at Sea
SpaceX	Space Exploration Technologies Corporation
SPL	sound pressure level
SPCC Plan	Spill Prevention, Control, and Countermeasure Plan
SSE	safe shutdown earthquake
SSURGO	Soil Survey Geographic

STEC	South Texas Electric Cooperative
SWEL	stillwater elevation
SWPPP	Stormwater Pollution Prevention Plan
TAC	Texas Administrative Code
TAHC	Texas Animal Health Commission
TCEQ	Texas Council on Environmental Quality
TDS	total dissolved solids
Texas LNG	Texas LNG Brownsville LLC
TEGF	totally enclosed ground flare
TGLO	Texas General Land Office
THC	Texas Historical Commission
TPWD	Texas Parks and Wildlife Department
tpy	ton per year
TSS	total suspended solids
TWIC	Transportation Worker Identification Credential
TxDOT	Texas Department of Transportation
TXNDD	Texas Natural Diversity Database
UDP	Unanticipated Discovery Plan
U.S.	United States
USC	United States Code
USGS	United States Geological Survey
VCP	Valley Crossing Pipeline, LLC
VIA	visual impact assessment
VOC	volatile organic compound
VRM	Visual Resource Management
WMA	Wildlife Management Area
WSA	Waterway Suitability Assessment

EXECUTIVE SUMMARY

The staff of the Federal Energy Regulatory Commission (FERC or Commission) prepared this draft Environmental Impact Statement (EIS) to assess the environmental issues associated with the construction and operation of facilities proposed by Annova LNG Common Infrastructure, LLC; Annova LNG Brownsville A, LLC; Annova LNG Brownsville B, LLC; and Annova LNG Brownsville C, LLC, which are collectively referred to as Annova. The EIS was prepared in accordance with the requirements of the National Environmental Policy Act of 1969 (NEPA) and the Commission's implementing regulations under Title 18 of the Code of Federal Regulations, Part 380 (18 CFR 380). On July 13, 2016, Annova filed an application with the FERC in Docket Number CP16-480-000 pursuant to Section 3(a) of the Natural Gas Act (NGA) and under Title 18 CFR, Part 153 of the Commission's regulations to construct and operate liquefied natural gas (LNG) export facilities. This project is referred to as the Annova LNG Brownsville Project (Project) and consists of a new natural gas liquefaction facility and a LNG export terminal on the west side of the Brownsville Ship Channel (BSC), near Brownsville, Cameron County, Texas.

The purpose of this EIS is to inform the FERC decision-makers, the public, and the permitting agencies about the potential adverse and beneficial environmental impacts of the proposed Project and its alternatives, and recommend mitigation measures that would reduce adverse impacts to the extent practicable. We[1] prepared our initial analysis based on information provided by Annova and further developed the analysis using information from data requests, field investigations, scoping, literature research, and communications with federal, state, and local agencies, Native American tribes, and individual members of the public.

The FERC is the federal agency responsible for authorizing onshore LNG facilities, and is the lead federal agency for the preparation of this EIS in compliance with the requirements of NEPA. The U.S. Army Corps of Engineers (COE); U.S. Coast Guard (Coast Guard); U.S. Department of Energy (DOE); U.S. Environmental Protection Agency (EPA); U.S. Fish and Wildlife Service (FWS); National Parks Service (NPS); the National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NOAA Fisheries, or NMFS); Federal Aviation Administration (FAA); and the U.S. Department of Transportation (DOT) are cooperating agencies for the development of this EIS consistent with 40 CFR 1501.6(b). A cooperating agency has jurisdiction by law or has special expertise with respect to environmental resource issues associated with the Project.

PROPOSED ACTION

The Project includes two principal parts: the LNG facilities and the associated marine transfer facilities. The LNG facilities are designed to receive 0.9 billion cubic feet per day of feed gas via an intrastate pipeline and would have an LNG export capacity of 6.95 million metric tons per year.[2] The LNG would be pumped from the storage tanks to the marine transfer facilities where it would be loaded for export onto LNG carriers at the berthing dock using cryogenic piping.

[1] "We," "us," and "our" refer to the environmental and engineering staff of the FERC's Office of Energy Projects.

[2] The Project would receive natural gas supply from an as-yet undetermined third-party–owned and –operated intrastate pipeline that would connect to the Valley Crossing Pipeline System.

Annova would construct the Project on a 731-acre property adjacent to the BSC on land owned by the Brownsville Navigation District (BND). The property, located at approximate mile marker 8.2 on the BSC, has direct access to the Gulf of Mexico via the Brazos Santiago Pass. The property would be obtained through a long-term lease with the BND. The facilities for the Project include the following major components:

- gas pretreatment facilities;
- liquefaction facilities (six liquefaction trains and six approximately 72,000 horsepower [hp] electric motor-driven compressors);
- two LNG storage tanks;
- boil-off gas handling system;
- flare systems;
- marine facilities;
- control, administration, and support buildings;
- access road;
- fencing and barrier wall; and
- utilities (power, water, and communication).

PUBLIC INVOLVEMENT

On March 11, 2015, the FERC began its pre-filing review of the Project and established the pre-filing Docket Number PF15-15-000 to place information related to the Project into the public record. As part of the pre-filing process, Annova sponsored a public open house in Brownsville, Texas on April 21, 2015. The purpose of the open house was to provide the general public and government and agency officials with information about the Project and to give them an opportunity to ask questions and express their concerns. We participated in the open house and provided information regarding the Commission's environmental review process to interested stakeholders.

On July 23, 2015, the FERC issued a *Notice of Intent to Prepare an Environmental Impact Statement for the Planned Annova LNG Brownsville Project, Request for Comments on Environmental Issues, and Notice of Public Scoping Meeting* (NOI). The NOI was sent to over 400 interested parties including federal, state, and local officials; agency representatives; conservation organizations; Native American tribes; local libraries and newspapers; and interveners in the proceeding. There was a 30-day comment period on the NOI which ended on August 24, 2015. On August 5, 2015, the FERC issued a *Notice of Extension of Time* which extended the comment period on the NOI to September 4, 2015. We received over 6,000 comment letters in response to the NOI. On August 11, 2015, the FERC staff held a public scoping session in Port Isabel, Texas, to provide an opportunity for the public to learn more about the Project and provide verbal comments on environmental issues to be addressed in the EIS. Ninety-five people provided verbal comments at the scoping session and a transcript was entered into the public record for the Project, as noted below.

On August 12, 2015, the FERC staff participated in a site visit to the Project site along with representatives from the FWS, NPS, and Annova. On August 12, 2015, the FERC's staff also held an interagency meeting to solicit comments and concerns regarding the Project from other jurisdictional agencies. In addition to the FERC staff, representatives from four federal and state agencies were present at this meeting including the FWS, Coast Guard, NPS, and Texas Parks and Wildlife Department (TPWD). On February 4, 2016, the FERC's staff participated in a second site visit that included representatives from the FWS, NPS, EPA, FAA, NOAA Fisheries, TPWD, and the Texas Historical Commission.

Through the scoping and agency comment process, we received comments on a variety of environmental issues. We continued to receive and consider public comments during the entire pre-filing period, and throughout development of this EIS. Substantive environmental issues identified through this public review process are addressed in this EIS. The transcripts of the public scoping session and all written comments are part of the FERC's public record for the Project and are available for viewing under the Project docket numbers. [3,4]

PROJECT IMPACTS

We evaluated the potential impacts of construction and operation of the Project on geologic resources; soils; water resources; wetlands; vegetation; wildlife and aquatic resources; threatened, endangered, and other sensitive species; land use, recreation, and visual resources; socioeconomics; cultural resources; air quality and noise; safety and reliability; and cumulative impacts. Where necessary, we recommend additional mitigation to minimize or avoid these impacts. Section 5.2 of the EIS contains a compilation of our recommendations.

Overall, construction of the Project facilities would temporarily disturb approximately 550 acres for construction. About 412 acres of the areas disturbed during construction would either contain permanent facilities or be permanently maintained as either concrete, paved, or gravel surfaces, or maintained in an herbaceous state. The remaining disturbed areas would be stabilized and restored to native salt prairie. Following the completion of construction, the site would shift from undeveloped to industrial land use. The Coast Guard Letter of Recommendation estimated an average of 2 to 6 LNG carriers per month would call on the terminal, up to a maximum of 80 carriers per year. Therefore, some of the impact analyses found in this EIS (e.g., the air quality impact assessment) used 80 LNG carriers per year to ensure a conservative estimate of impacts.

Based on our analysis, Project scoping, agency consultations, and public comments, the major Project construction and operational issues are impacts on wetlands, wildlife and aquatic resources, federally listed species, onshore traffic, visual resources, air quality and noise, safety and reliability, and cumulative impacts.

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[3] Transcript of the public scoping meeting for the Project (Docket No. PF15-15-000) is available on the FERC website at http://ferc.gov/docs-filing/elibrary.asp. To access public documents on the FERC website, select "General Search" from the eLibrary menu, and enter the docket number, excluding the last three digits, in the "Docket Number" field (i.e., PF15-15 or CP16-480). Be sure to select an appropriate date range.

[4] Comments submitted after the Project application was filed with the FERC are part of the public record for the Project (Docket No. PF15-15-000 and CP16-480-000) and are available on the FERC website at http://ferc.gov/docs-filing/elibrary.asp.

Geologic Resources

The Project site would be graded to the extent necessary to construct Project facilities, and, as a result, the LNG facilities would permanently alter the existing surface conditions at the site. Based on Annova's proposal, and in consideration of its proposed mitigation and design criteria, we conclude that potential impacts on geological conditions would be minimized to the extent practical and would not result in significant geologic impacts.

Soils

Project site soils would be permanently affected by Project facilities, paved or gravel roads, stormwater retention and evaporation ponds, or other impervious surfaces. Construction at the Project site would involve grading and raising the site elevation with fill material, excavating for building foundations, compacting soils, creating impermeable surfaces, and trenching to install necessary piping and utilities. Clearing, grading, and construction activities could cause a temporary loss of soil structure, and increase the potential for erosion, compaction, and mixing of topsoil. Annova would adhere to the best management practices contained in its *Upland Erosion Control, Revegetation, and Maintenance Plan* (Annova's Plan) and *Wetland and Waterbody Construction and Mitigation Procedures* (Annova's Procedures), as well as a preliminary draft Construction Spill Prevention, Control, and Countermeasures (SPCC) Plan, which was developed in accordance with applicable regulations and permit requirements to minimize soil impacts. Adherence to these measures would minimize soil impacts during construction and operation through sedimentation control and workspace restoration. Annova would also develop and implement a separate Operation SPCC Plan. Based on Annova's proposal, and in consideration of its proposed mitigation measures and design criteria, we conclude that the Project would have a permanent effect on soils but that potential impacts would be minimized to the extent practical and would not result in significant soil impacts.

Water Resources

No potable water supply wells are located within the Project site or within 150 feet of Project. The nearest "domestic water supply well" is located over 4 miles north of the Project. The majority of Project-related excavation would occur adjacent to the BSC where groundwater is located near the surface. Excavation, the addition of fill, and the installation of foundations and underground utilities would have localized and short-term effects on the groundwater during construction with effects to local water table elevations. The shallow aquifer could sustain minor, temporary indirect impacts from changes in overland water flow and recharge caused by clearing and grading of the work areas. Near-surface soil compaction caused by heavy construction vehicles could cause a localized reduction in the soil's ability to absorb water. Implementation of mitigation measures included in Annova's *Plan* would reduce the potential for groundwater contamination. Because of the temporary localized effects of construction on groundwater, implementation of mitigation, and the relatively large distance between the Project site and any water supply wells, we conclude that the potential impacts on groundwater resources due to Project-related construction and operation activities would be minimal.

Construction and operation of the Project would result in decreased water quality of the BSC within the vicinity of the site as a result of initial dredging and maintenance dredging, as well as vessel traffic, site modification and stormwater runoff, and hydrostatic testing.

Sediment-laden water could be transported into the Bahia Grande and result in a potential for some increased turbidity and sedimentation effects near the channel entrance to the Bahia Grande Wetland Mitigation Site adjacent to the Project area. However, the potential impact would be only a moderate increase in total suspended solids and limited to near the channel entrance; therefore, we conclude the impact on water quality within the Bahia Grande would not be significant. Based on Annova's proposal, and in consideration of its proposed mitigation measures and design criteria, we conclude that impacts on surface water resources as a result of construction and operation of the Project would not be significant.

<u>*Wetlands*</u>

Construction and operation of the Project would result in the disturbance of 57.7 acres of wetlands, with 52.8 acres of permanent wetland loss. The entirety of impact on vegetated wetlands would occur to estuarine emergent marsh wetlands. Annova is consulting with the COE and other relevant agencies regarding impacts on wetlands. In addition, Annova has prepared a draft *Conceptual Mitigation Plan* that identifies preliminary Project mitigation requirements and proposed compensation for the Project's impacts on wetlands and waters under the COE's jurisdiction. The acceptability of any proposed compensatory mitigation measures would be determined by the COE prior to construction. Annova is still refining the mitigation plan, which has not yet been approved by the COE.

Adherence to measures contained in Annova's *Procedures* would adequately address wetlands that are only temporarily affected by Project construction, such that impacts on temporally affected wetlands would be less than significant. Loss of nearly 53 acres of wetland would be a permanent impact. However, we anticipate that, if the COE issues a Section 404/Section 10 permit for the Project, it would be conditioned upon Project-related adverse impacts on waters of the United States being effectively offset by wetland mitigation similar to what Annova has identified in its draft *Conceptual Mitigation Plan*; therefore, the permanent wetland impacts would be reduced to less than significant levels.

<u>*Vegetation*</u>

Construction of the Project would temporarily impact approximately 462 acres of vegetation, with approximately 409 acres permanently affected during Project operation. The majority of these impacts would be to the following vegetative communities: South Texas Loma Evergreen Shrubland, Gulf Coast Salty Prairie, South Texas Loma Grassland/Shrubland, and Coastal Sea Ox-eye Daisy Flats. Lomas are dunes formed from wind-blown clay that support dense shrub vegetation communities that provide important habitat for protected wildlife species in the region. To minimize impacts on vegetation from construction and operation of the Project, Annova would implement measures described in its *Plan and Procedures*, which include measures that address erosion control, revegetation procedures, and post-construction monitoring of revegetation success. No state-designated vegetation communities of special concern (including rare, threatened, or endangered plants) occur in the Project area. Although approximately 409 acres of vegetation communities would be permanently lost, with implementation of Annova's minimization and mitigation measures, including implementation of measures within its *Conceptual Mitigation Plan*, we have determined that construction and operation of the Project would not significantly impact vegetation. Annova is also evaluating off-site lands for conservation, either through purchase or conservation easement, to compensate for loss of loma vegetation and wildlife habitat.

Wildlife and Aquatic Resources

Construction and operation of the Project would result in the removal and/or conversion of wildlife habitats at the site. Annova would minimize impacts on wildlife through implementation of some TPWD recommendations during construction and restoration, as well as through development and implementation of a *Facility Lighting Plan* for operation of the LNG terminal. Because Annova has not yet developed the *Facility Lighting Plan,* we recommend that, prior to construction, Annova file its *Facility Lighting Plan* for operation of the LNG terminal for our review and approval. At the request of the FWS, we recommend that the *Facility Lighting Plan* also address construction and commissioning.

Construction and operation of the Project could affect migratory bird species through permanent and temporary removal of habitat and Project lighting. In accordance with FWS recommendations, Annova would attempt to limit clearing on the Project site to between September 1 through and February 28 to avoid impacts on migratory bird nesting. We recommend that prior to construction Annova consult with the FWS to develop a Project-specific *Migratory Bird Plan* to include measures to avoid and minimize impacts on migratory birds, and that the *Migratory Bird Plan* should include details from the *Facility Lighting Plan* that are intended to reduce impacts on wildlife and birds. The occasional use of warm/cold gas flares could impact some migratory birds if present during the flaring event but is not expected to substantially impact migratory bird populations.

Construction and operation activities with the potential to affect aquatic resources, including managed species and essential fish habitat, include excavation and dredging of the marine berth, driving of piles, hydrostatic testing of the LNG tanks, additional vessel traffic in the BSC, discharge of ballast water, cooling water intake and discharge, increased noise levels, stormwater runoff or spills, and lighting. With mitigation measures in place, impacts on aquatic resources, including managed species and essential fish habitat, would vary depending on the species but are expected to range from negligible to short-term and minor. Impacts from pile driving are expected to be less than significant considering the short in-water work schedule and the implementation of best management practices. Noise-related mitigation measures for in-water pile driving during construction, if appropriate would be determined based on consultation with NOAA Fisheries.

Threatened, Endangered, and Other Sensitive Species

Based on information obtained from the FWS and NOAA Fisheries, 21 federally listed, proposed, and candidate threatened and endangered species could potentially be affected by the Project. This total includes 18 federally listed, two proposed, and one candidate species. We have determined that construction and operation of the Project would: have *no effect* on 2 of the federally listed species; *may affect, but is not likely to adversely affect* 16 of the federally listed species as well as the proposed species; and *may affect, and is likely to adversely affect* 2 federally listed species (Ocelot and Gulf Coast jaguarondi). We also determined that the Project *would not contribute to a trend toward federal listing* for the identified candidate species. Potentially suitable habitat is present in the Project area for 45 of the 54 state-listed species in Cameron County.

Measures proposed by Annova to minimize impacts on federally and state-listed species include implementation of conservation measures, and providing LNG carrier captains with a NOAA-issued guidance document that outlines collision avoidance measures to be implemented in order to minimize impacts on marine mammals and sea turtles. Consultation with NOAA Fisheries and the FWS is ongoing; therefore, we recommend that Annova should not begin construction until the FERC staff completes consultation with the FWS and NOAA Fisheries under section 7 of the Endangered Species Act.

Land Use, Recreation, and Visual Resources

Lands permanently affected during operation would either contain permanent facilities or be permanently maintained as concrete, paved, or gravel surfaces, or maintained in an herbaceous state. Following the completion of construction, the site would shift from undeveloped to industrial land use in accordance with its current designation. The lands surrounding the Project site are largely undeveloped providing a variety of dispersed outdoor recreational activities, including fishing and bird/wildlife watching. Increases in dust, noise, and traffic during construction would likely affect some recreationists, but the duration would be temporary. Project construction and operation would not permanently affect access to the majority of regional fishing locations in the waters located in the vicinity of the Project site. The increase in the number of large vessels transiting the BSC during Project operation could potentially result in additional delays for other traffic within the BSC but is not expected to substantially affect recreational fishing. Annova's Visual Impact Assessment evaluated 10 Key Observation Points (KOP) at representative visually sensitive areas, including areas used for recreation and wildlife viewing, key travel routes, and other public gathering areas. Potential visual impacts occurred at all KOPs and ranged from low to moderate at most locations. However, the visual impacts at KOP 8 at the State Highway 48 pull-off near Bahia Grande Channel would be moderately high. Based on our analysis, Project construction and operation would not result in significant impacts on current land use, visual resources, and recreation.

Socioeconomics

Project construction would result in a short-term, moderate increase to the local population, and Project operation would result in a negligible, long-term increase to the local population. Construction and operation would generate local and state tax revenues from sales and payroll taxes, and support some local employment. In addition, construction and operation of the Project would not be expected to have high and adverse human health or environmental effects on any nearby communities. Annova proposes to stagger construction shifts to mitigate impacts from Project-related vehicles, as well as transport construction workers to and from the construction site from an off-site centralized location via passenger buses, which would reduce potential delays at key intersections and the Border Patrol checkpoint on State Highway 4 (Boca Chica Boulevard). Annova proposes to use off-site location(s) for construction worker parking and bus workers to the site to reduce impact from construction traffic. However, Annova has not yet identified the off-site location; therefore, we recommend that prior to the end of the draft EIS comment period, Annova should file the specific location(s) of any off-site centralized parking sites. Construction and operation of the Project would result in an increase in marine traffic in the area, with minor impacts on other vessels.

Although the demographics indicate that potential environmental justice communities are present within the census blocks near the Project site, there is no evidence that these communities would be disproportionately affected by the Project or that impacts on these communities would appreciably exceed impacts on the general population. It is not anticipated that the Project would cause significant adverse health or environmental harm to any community with a disproportionate number of minority or low-income populations. We conclude that the Project would not have disproportionate adverse effects on minority and low-income residents in the area.

Cultural Resources

Cultural resource surveys conducted for the Project identified eight sites that the Texas State Historic Preservation Office (SHPO), agreed are not eligible for listing on the National Register of Historic Places or as State Antiquities Landmarks. The SHPO determined that the area around another site (41CF48) is considered unevaluated due to the inability to survey the area. If this site cannot be avoided, the SHPO must be consulted and a survey plan for this area implemented prior to construction in order to ascertain the site's eligibility. If the Project is approved, we recommend that Annova survey the area prior to construction. Annova contacted several Native American tribes to identify properties of traditional, religious, or cultural importance that may be affected by the proposed Project. To date, only two tribes have responded; both indicated that they do not have resources that would be affected by the Project. Additionally, no traditional cultural resources, burials, or sites of religious significance to Indian tribes were identified within areas of the site that were surveyed.

Annova prepared a Visual Impact Assessment for three historic resources in the vicinity of the site and we used the assessment to evaluate potential visual effects on the viewshed from these properties. We conclude that the Project would not affect the essential features of the Palmito Ranch Battlefield for the period of significance (the Civil War) or the Palo Alto Battlefield for the period of significance (the Mexican War), and the overall integrity of these properties would remain intact. While the Project may be visible from the location of the Brazos Santiago Depot, construction and operation would not affect the site's potential to provide information about its period of significance or to yield information about the past.

Compliance with Section 106 of the National Historic Preservation Act is not complete for the Project. Therefore, we recommend that Annova file all outstanding reports and agency comments with the FERC and that FERC staff complete the Section 106 consultation process before construction may begin.

Air Quality and Noise

Air quality impacts associated with construction of the Project would include emissions from fossil-fueled construction equipment and fugitive dust. The five-year Project construction period would result in short-term, localized impacts on air quality. These impacts would transition to permanent operational-phase emissions after commissioning and initial start-up. Annova would comply with all air permit requirements for the Project. Air dispersion modeling that included both the Project's stationary sources and emissions from the marine vessels that would operate as part of the Project's activities demonstrated that the stationary sources plus mobile source emissions would not cause or contribute to an exceedance of the National Ambient Air Quality Standards at any location.

With the exception of pile-driving activities, the maximum noise levels attributable to Project construction would be equal or similar to existing noise levels. To ensure that the noise resulting from pile driving is not significant, we recommend that Annova monitor pile-driving activities and file the results in weekly reports to the Commission. If observed levels exceed the noise levels with the potential to impact nearby noise sensitive areas, we recommend that Annova cease pile driving and implement noise mitigation measures. Operation and maintenance of the Project is not expected to cause significant noise impacts although certain short-term activities such as flaring would be distinctly noticeable to residents or the public in the vicinity of the Project. To ensure that noise from operation of the Project is not significant, we recommend that Annova file a noise survey with the FERC no later than 60 days after placing each liquefaction unit and the entire Project in service. With the inclusion of our recommended pile-driving noise measures and terminal noise surveys, we conclude that Project noise would not result in a significant impact on any nearby noise sensitive areas.

Reliability and Safety

We assessed the potential impact on the human environment in terms of safety and whether the Project would operate safely, reliably, and securely. As a cooperating agency, the DOT assisted the FERC staff by determining whether Annova's proposed design would meet the DOT's 49 CFR 193 Subpart B siting requirements. The DOT will provide a Letter of Determination[5] on the Project's compliance with 49 CFR 193 Subpart B prior to the final EIS. This determination will be provided to the Commission as further consideration to the Commission on its decision to authorize or deny the Project. If the Project is authorized and constructed, the facility would be subject to the DOT's inspection and enforcement program; final determination of whether a facility is in compliance with the requirements of 49 CFR 193 would be made by the DOT staff.

As a cooperating agency, the Coast Guard also assisted the FERC staff by reviewing the proposed LNG terminal and the associated LNG marine vessel traffic. The Coast Guard reviewed a Waterway Suitability Assessment submitted by Annova that focused on the navigation safety and maritime security aspects of LNG marine vessel transits along the affected waterway. On February 13, 2018, the Coast Guard issued a Letter of Recommendation that recommended that the BSC be considered suitable for accommodating the type and frequency of LNG marine traffic for the Project based on the Waterway Suitability Assessment and in accordance with the guidance in the Coast Guard's NVIC 01-11. If the Project is authorized and constructed, the facilities would be subject to the Coast Guard's inspection and enforcement program to ensure compliance with the requirements of 33 CFR 105 and 33 CFR 127.

As a cooperating agency, the FAA assisted FERC staff in evaluating impacts on and from the Space Exploration Technologies Corporation (SpaceX) rocket launch facility in Cameron County. We are including specific recommendations to address potential impacts from rocket launch failures on the Project. However, the extent of impacts on SpaceX operations, the National Space Program, and to the federal government would not fully be known until SpaceX submits an

[5] The Aug 31, 2018 Memorandum of Understanding between FERC and DOT states DOT will issue a Letter of Determination to FERC no later than 30 days prior to the estimated issuance date of the final NEPA document.

application with the FAA requesting to launch and whether the LNG terminal is under construction or in operation at that time.

We conducted a preliminary engineering and technical review of the Annova design, including potential external impacts based on the site location. Based on this review, we recommend a number of mitigation measures to ensure continuous oversight prior to initial site preparation, prior to construction of final design, prior to commissioning, prior to introduction of hazardous fluids, prior to commencement of service, and throughout life of the facility, in order to enhance the reliability and safety of the facility to mitigate the risk of impact on the public. With the incorporation of these mitigation measures and oversight, we conclude that Annova's terminal design would include acceptable layers of protection or safeguards that would reduce the risk of a potentially hazardous scenario from developing into an event that could impact the offsite public.

Cumulative Impacts

We considered the contributions of the proposed Project in conjunction with other projects in the Project area to determine the potential for cumulative impact on the resources affected by the Project. As part of that assessment, we identified existing projects, projects under construction, projects that are proposed or planned, and reasonably foreseeable future projects – including proposed LNG terminals, currently operating and future oil and gas projects, land transportation projects, commercial and industrial developments, and dredging projects. Reasonably foreseeable projects that might cause cumulative impacts in combination with the proposed Project include the Rio Grande LNG Project and the Texas LNG Project. Many of the identified cumulative impacts would be temporary and minor. Cumulative impacts have the potential to be more substantial for water resources, protected wildlife, visual resources, noise, and transportation, as discussed below.

The greatest potential for cumulative impacts associated with surface water resources would be during dredging activities, as well as during operation. Concurrent dredging of the maneuvering basin for the proposed Project as well as the Rio Grande LNG, Texas LNG, Bahia Grande Estuary Channel Widening/Restoration, and Brazos Island Harbor Channel Improvement Project would result in increased turbidity and sedimentation, resulting in short-term impacts on water quality. The Brazos Island Harbor Channel Improvement project is not expected to result in sediment accumulation during dredging as the purpose of the project is to deepen the main channel and any accumulated sediments would likely be accounted for with the allowed over-dredge depth to achieve the final design depth. While the BSC is a routinely maintained, manmade channel, concurrent dredging activities and other impacts on surface water resources during construction activities, as described above, are anticipated to be temporary and moderate.

The operation of all three proposed Brownsville LNG projects would also result in a substantial increase in the number of large, ocean-going vessels transiting the BSC (estimated to be about 467 LNG carriers per year combined). During operation, increased vessel traffic would result in a cumulative impact on surface water resources from increases in turbidity and shoreline erosion. Each of the three LNG projects has designed its respective facilities to minimize shoreline erosion through placement of rock riprap along the shoreline, or similar measures. Cumulative impacts on surface water quality during operation would be permanent and moderate to significant due to the persistent transit of LNG carriers and other large vessels within the BSC resulting in the potential increased erosion of the shoreline along unarmored portions of the BSC.

The proposed Project, Rio Grande LNG, and Texas LNG Projects, as well as the pipeline projects proposed in the area, are anticipated to have the greatest cumulative impacts on ocelot habitat through removal and conversion to industrial uses and fragmentation, respectively. In addition, these projects along with several of the transportation projects could result in increased road traffic and/or additional roads for transiting ocelots and jaguarundis to cross, thus increasing the potential for vehicle strikes. The current remaining habitat corridor in the region to connect U.S. and Mexico populations of these federally listed species is within and adjacent to the proposed Annova Project site on the south side of the BSC, and adjacent to and within the proposed Rio Grande LNG and Texas LNG Project sites north of the BSC. Other impacts, such as those associated with noise, would be minimized by the projects to the extent practicable; however, due to the proximity of the proposed Annova Project and Rio Grande LNG Project to the wildlife corridors, facility-generated noise during construction and operation would still be audible to ocelots and jaguarundis utilizing the wildlife corridor. Due to the past, present, and proposed future development throughout the geographic scope for assessing cumulative impacts on ocelots and jaguarundis, as well as the associated increases in road traffic, light, and noise, we have determined that cumulative impacts on ocelots and jaguarundis would be permanent and significant.

Projects with permanent aboveground components, such as the Texas LNG and Rio Grande LNG terminals, have the most potential to contribute, along with the proposed Project, to cumulative impacts on visual resources. In particular, motorists on State Highway 48 and visitors to the nearby recreation areas where two or three LNG Terminals would be visible (including the National Wildlife Refuges [NWR], Loma Ecological Preserve, and South Bay Coastal Preserve and South Bay Paddling Trail) would experience a permanent change in the existing viewshed during construction and operation of the projects. The proposed Annova Project would have a low to moderate impact on visual resources in the area. Due to the proximity of the Rio Grande LNG and Texas LNG Projects to the same visual receptors as the Annova Project, we conclude that significant cumulative impacts on visual resources are anticipated.

Cumulative noise impacts would primarily occur as a result of the concurrent construction and operation of the Annova LNG Project, and the Texas LNG and Rio Grande LNG Projects. For simultaneous construction activities at all three LNG projects, the predicted sound level increase over the existing ambient ranges from 2.2 to 9.8 A-weighted decibels (dBA) day-night sound level (L_{dn}) at the noise sensitive areas and sound levels of slightly over 55 dBA L_{dn} are predicted for several noise sensitive areas, and range from less than noticeable increases in ambient noise to a doubling of noise at specific noise sensitive areas. For construction activities that are not simultaneous but incremental, the predicted sound level increase ranges from 1.0 to 8.6 dBA L_{dn} at the noise sensitive areas. These increases would result in a minor to moderate impact; however, all levels would be below 55 dBA L_{dn}. For the Palmito Ranch Battlefield National Historic Landmark, the predicted cumulative construction increase was 10.1 dBA L_{dn} over the existing ambient, which could result in periods of perceived doubling of noise. At the Laguna Atascosa NWR, there is a higher ambient sound level so the predicted increase due to cumulative construction noise would be 2.7 dBA L_{dn}, resulting in a minor impact.

For operational noise with all three projects fully operational, the predicted sound level impacts are much lower than construction impacts, with potential increases over the existing ambient of between 0.3 and 1.5 dBA L_{dn} at noise sensitive areas, resulting in minor impacts.

Operational impacts would be slightly higher at the Palmito Ranch Battlefield National Historic Landmark and the Laguna Atascosa NWR, with possible increases in sound levels due to operation of all three LNG projects of between 1.3 and 4.8 dBA L_{dn}. This is generally considered a minor to moderate long-term impact.

If the three LNG projects were constructed concurrently, the combined impact of construction traffic would be approximately 14,624 daily trips during active construction, with the Annova Project accounting for approximately 14 percent of this total. This cumulative impact would result in increased wait times and congestion on local roadways during construction. If all three proposed LNG projects were authorized and go into operation, and the other identified dredging projects also occur, there would be a substantial increase of large and ocean-going vessel traffic on the BSC. The three LNG projects combined would support an estimated 467 LNG carrier trips per year, with periodic channel maintenance dredging activities, on average, contributing about 420 vessel trips per year. This cumulative impact would represent a substantial increase in the number of large and ocean-going vessels in the BSC, and small vessels and recreational boaters attempting to access South Bay and the BSC would likely experience delays, ranging from 11 to 32 percent of daylight hours per year.

ALTERNATIVES CONSIDERED

In accordance with NEPA and our policies, we evaluated alternatives to the Project to determine whether an alternative would be environmentally preferable, reasonable, and/or technically and economically feasible. We considered: a no action alternative; system alternatives; alternative sites; access road alternatives; process and design alternatives; and dredged material placement area alternatives.

While the no action alternative would avoid the environmental impacts identified in this EIS, the objectives of the Project would not be met. Further, the objectives could be met by similar development elsewhere with associated environmental impacts, and site-specific impacts would likely result if the Project site were developed for other industrial or commercial purposes. System alternatives considered in this analysis are those alternatives to the proposed action that would make use of other existing, modified, or proposed facilities to meet the stated purpose and need of the proposed action. Our evaluation of potential system alternatives to the Project did not identify any existing, proposed, or planned LNG export facilities in the region that could be considered a viable system alternative.

We received comments from the public and other federal agencies during the scoping period regarding the need for an evaluation of alternative sites such as industrial areas that are not in proximity to communities and important wildlife habitat. Based in part on the information provided by Annova, we evaluated alternative sites that may also meet the stated objectives of the Annova Project. We applied screening criteria to identify sites that would be reasonable and most likely to provide some environmental advantage over the proposed terminal site. Based on this analysis, we conclude that the proposed site represents an acceptable site for the proposed LNG terminal, and that the alternative sites are either not feasible or are not environmentally preferable to the proposed site.

Based on scoping comments, Annova (in consultation with the FWS) identified two alternatives to its proposed access road from State Highway 4 to the Project site. The two alternative routes (Access Road Alternatives 1 and 3) reflect possible modifications to minimize potential impacts on wildlife movement through the area. We conclude that neither alternative access road would be environmentally preferable to the proposed access road. However, use of the proposed access road would require an appropriateness determination and a compatibility determination from the FWS. Annova has stated it is in discussion with the FWS regarding the appropriateness determination for use of the proposed access road. Annova states that it would construct and operate its access road on the route identified as Access Road Alternative 1 in the event the FWS regulatory process precludes use of the proposed access road.

At our request, Annova evaluated process and design alternatives that include an on-site power plant versus grid-supplied power as proposed, gas-fired compressors versus electric compressors as proposed, and several flare design alternatives. We conclude that neither an on-site power plant, or gas-fired compressors would provide a significant environmental advantage over the proposed design when comparing local air quality impacts. Based on our analysis of alternative flare designs we conclude that a Totally Enclosed Ground Flare design would not result in a significant environmental advantage over the proposed combined warm/cold flare stack.

Annova proposes to use the existing Dredged Material Placement Area 5A located along the BSC just west of the Project site for placement of dredged material not used as fill on site. Annova's proposed *Dredged Material Transport Plan* includes evaluation of three alternative placement area also located along the BSC which we summarize in our EIS. We conclude that none of the three alternative placement areas would provide an environmental advantage over the proposed placement area.

CONCLUSIONS

We determined that construction and operation of the Annova LNG Project would result in some unavoidable adverse environmental impacts. We conclude that impacts on the environment from the proposed Project would be reduced to less than significant levels with the implementation of Annova's proposed impact avoidance, minimization, and mitigation measures and the additional measures recommended by FERC staff.

In addition, the Annova LNG Project, combined with other projects in the geographic scope, including the Rio Grande LNG and Texas LNG Projects, would result in significant cumulative impacts from sedimentation/turbidity and shoreline erosions within the BSC during operations from vessel transits and on the federally listed ocelot and jaguarundi from habitat loss and potential for increased vehicular strikes during construction, and on visual resources from the presence of aboveground structures. We based our conclusions upon information provided by Annova and through environmental information requests; field visits; literature research; geospatial analysis; alternatives analysis; public comments and scoping session; and coordination with federal, state, and local agencies and Native American tribes. The following factors were also considered in our conclusions:

- impacts on wetlands and aquatic habitat, including Essential Fish Habitat, would be mitigated per Annova's draft *Conceptual Mitigation Plan*;

- Annova would implement its Project-specific *Upland Erosion Control, Revegetation, and Maintenance Plan* and *Wetland and Waterbody Construction and Mitigation Procedures* to minimize construction impacts on soils, wetlands, and waterbodies;
- we recommend that all appropriate consultations with the FWS and NOAA Fisheries under the Endangered Species Act should be completed before construction is allowed to begin;
- we recommend that Annova file all outstanding cultural resource reports and agency comments for our review before construction is allowed to begin;
- the Coast Guard issued a Letter of Recommendation indicating the BSC would be considered suitable for the LNG marine traffic associated with the Project;
- the LNG Terminal design would include acceptable layers of protection or safeguards that would reduce the risk of a potentially hazardous scenario from developing into an event that could impact the offsite public; and
- FERC's environmental and engineering inspection and mitigation monitoring program for this Project would ensure compliance with all mitigation measures and conditions of any FERC Authorization.

In addition, we developed site-specific mitigation measures that Annova should implement to further reduce the environmental impacts that would otherwise result from construction and operation of the Project. We recommend these mitigation measures, presented in section 5.2 of this EIS, be attached as conditions to any authorization issued by the Commission for this Project.

1.0 INTRODUCTION

The staff of the Federal Energy Regulatory Commission (FERC or Commission) prepared this draft Environmental Impact Statement (EIS) to describe our assessment of the potential environmental impacts that may occur from constructing and operating the Annova LNG Brownsville Project liquefied natural gas (LNG) export terminal in Cameron County, Texas (referred to as the Annova LNG Project, or Project).

On July 13, 2016, Annova LNG Common Infrastructure, LLC; Annova LNG Brownsville A, LLC; Annova LNG Brownsville B, LLC; and Annova LNG Brownsville C, LLC (collectively Annova) filed an application with the FERC, in Docket No. CP16-480-000, under Section 3(a) of the Natural Gas Act (NGA) and under Title 18 of the Code of Federal Regulations (CFR), Parts 153 and 380 of the Commission's regulations to construct and operate an LNG export terminal. This application was noticed in the *Federal Register* (FR) on July 27, 2016.

As part of the Commission's consideration of the application, we[1] prepared this EIS to assess the potential environmental impacts resulting from construction and operation of the proposed Project in accordance with the National Environmental Policy Act of 1969 (NEPA).

The new liquefaction facility would include six liquefaction "trains" (each train being the liquefaction process facilities arranged in a linear relationship), each with a nameplate capacity of 1.0 million metric tons per annum (mtpa), for an aggregate nameplate capacity of 6 mtpa and a maximum output at optimal operating conditions of 6.95 mtpa (approximately 0.9 billion cubic feet per day). The facility would be located on a 731-acre site on the south bank of the Brownsville Ship Channel (BSC) at approximately mile marker 8.2 on the Brazos Santiago Pass. Natural gas would be delivered to the Annova LNG facility via a new intrastate pipeline to be constructed by an as-yet undetermined third party. More detailed information regarding the proposed facility components is provided in section 2.1 of this EIS.

In its July 13, 2016 application with the FERC, Annova anticipated that the Project would be fully operational in 2022. On September 10, 2018, Annova filed with the Commission an updated Project development schedule that included an estimated start of commercial operation in 2024.

Figure 1-1 shows the general location of the proposed facilities and figure 1-2 shows the general site plan.

[1] "We", "us", and "our" refer to the environmental staff of the FERC's Office of Energy Projects.

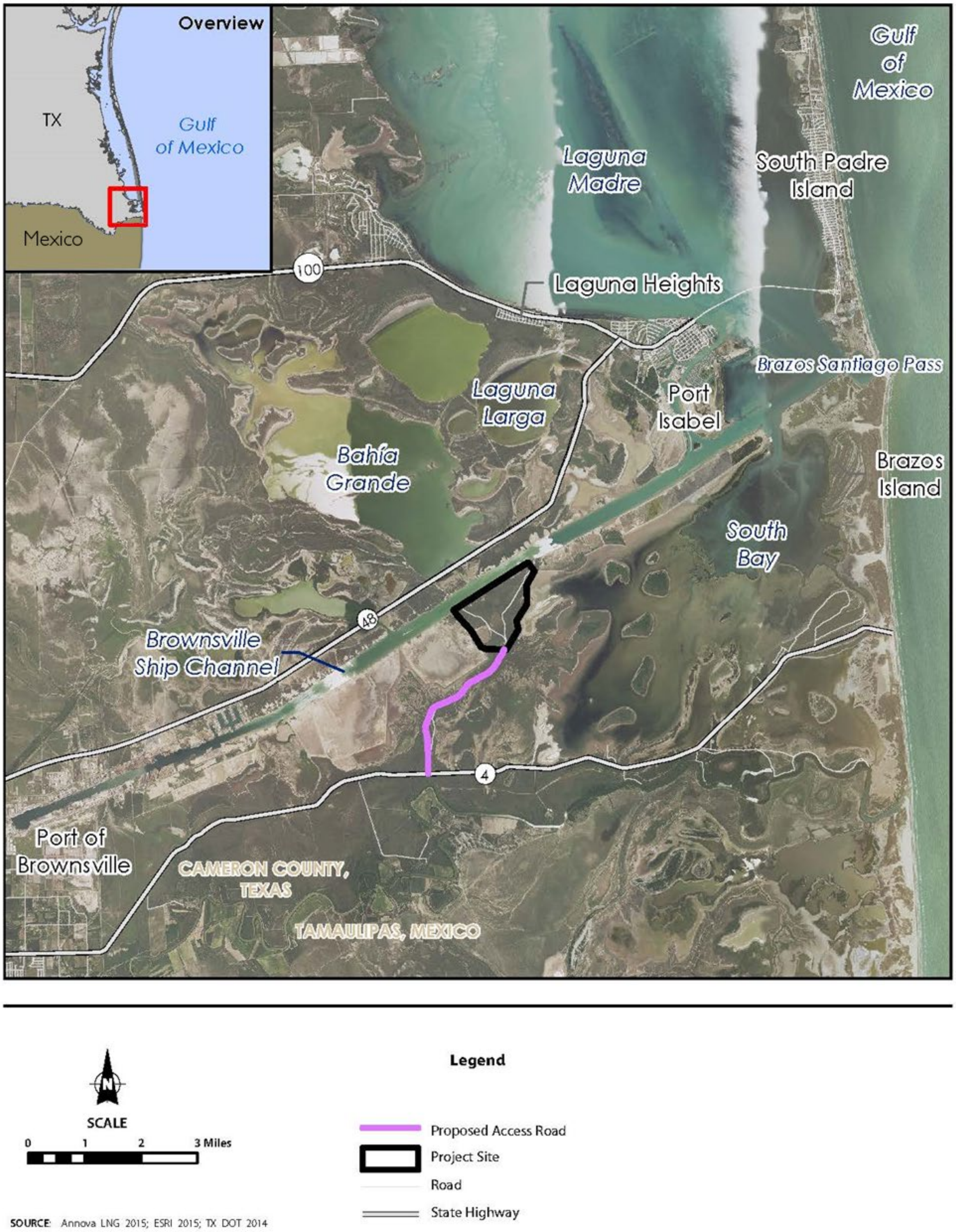


Figure 1-1 Annova LNG Brownsville Project General Location

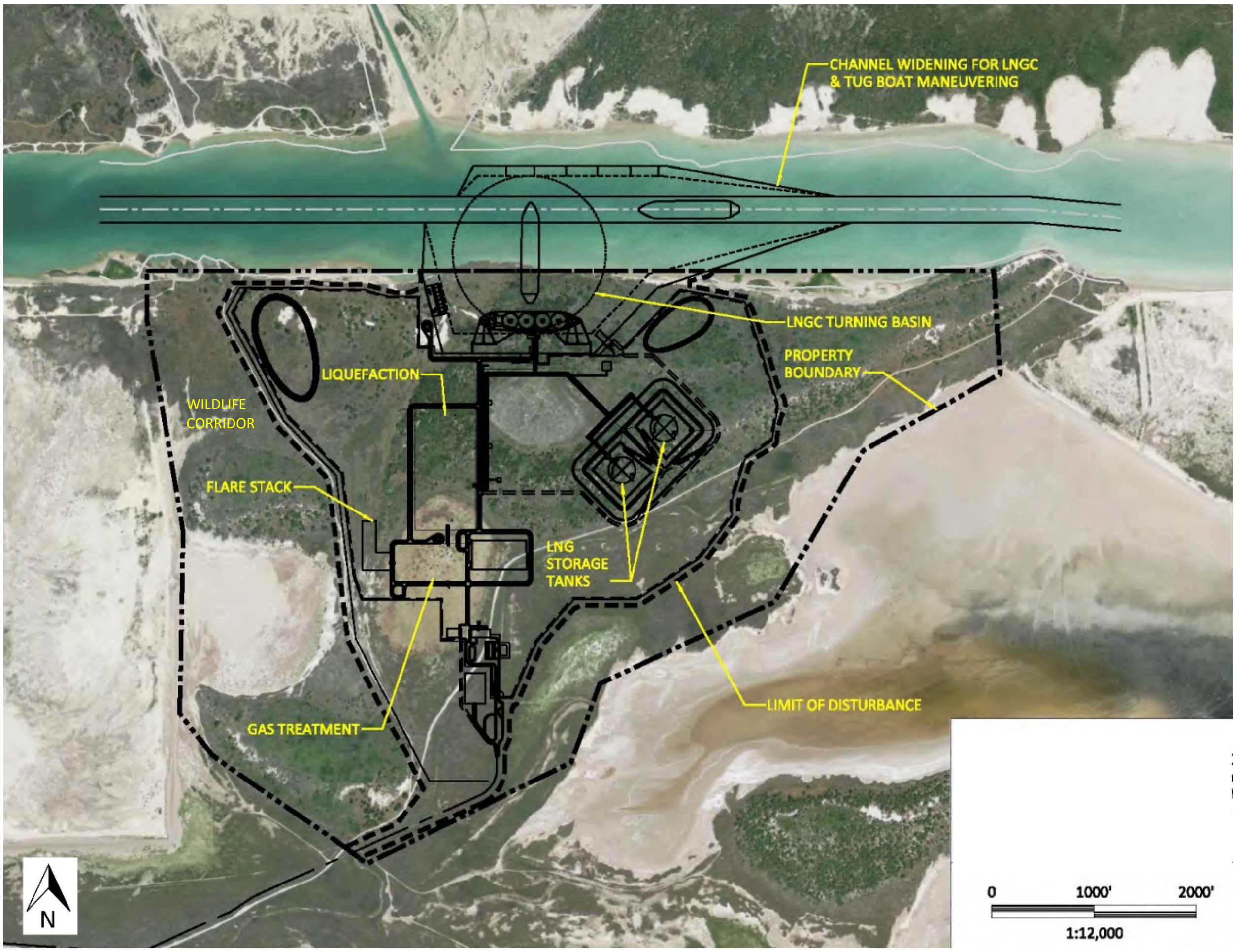


Figure 1-2 General Site Plan for Proposed Facilities

1.1 PROJECT PURPOSE

Section 3 of the NGA, as amended, requires that authorization be obtained from the U.S. Department of Energy (DOE) prior to importing or exporting natural gas, including LNG, from or to a foreign country. For applicants that have, or intend to have, a signed gas purchase or sales agreement/contract for a period of time longer than two years, long-term authorization is required. Under Section 3 of the NGA, the FERC considers, as part of its decision to authorize natural gas facilities, all factors bearing on the public interest. Specifically, regarding whether to authorize natural gas facilities used for importation or exportation, the FERC shall authorize the proposal unless it finds that the proposed facilities would not be consistent with the public interest.

The FERC is the federal agency responsible for authorizing onshore LNG facilities. As such, the FERC is the lead federal agency for the preparation of this EIS in compliance with the requirements of the NEPA, the Council on Environmental Quality's (CEQ) regulations for implementing the NEPA (40 CFR 1500-1508), and the FERC's regulations for implementing the NEPA (18 CFR 380). Because the proposal under consideration is conceived, designed, and funded by the applicant, the project purpose considered in this EIS is defined by the project proponent. Annova stated that the purpose of the Project is to construct and operate a mid-scale natural gas liquefaction facility to source natural gas from the South Texas Gulf Coast region and export LNG to international markets. Annova further states that the mid-scale size of the facility would meet the requirements of multiple foreign purchasers whose annual demand is best met with increments of 1 mtpa. We have reviewed this purpose statement and find it to be reasonable and sufficient to support our analysis in this EIS.

1.2 AGENCY PURPOSE AND SCOPE OF THE EIS

The EIS describes the affected environment as it currently exists, the environmental consequences of the Project, and compares the Project's potential impact with various alternatives. The EIS also presents our conclusions and recommended mitigation measures.

Our principal purposes in preparing this EIS are to:

- identify and assess potential impacts on the human environment that would result from the implementation of the proposed action;
- identify and assess reasonable alternatives to the proposed action that would avoid or minimize adverse impacts on the human environment;
- identify and recommend specific mitigation measures to minimize environmental impacts; and
- facilitate public involvement in identifying significant environmental impacts on specific resources.

Topics addressed in this EIS include alternatives; geology; soils and sediments; water resources; wetlands; vegetation; wildlife and aquatic resources; threatened, endangered, and other special status species; land use, recreation, and visual resources; socioeconomics; transportation and traffic; cultural resources; air quality and noise; reliability and safety; and cumulative impacts. Our analysis in this EIS focuses on facilities that are under the Commission's jurisdiction (i.e., the proposed LNG facility). Non-jurisdictional facilities would also be constructed in association with the Project (see section 1.4). Non-jurisdictional facilities are not under the Commission's jurisdiction and are not part of the proposed action reviewed by this EIS. The Commission has no authority to approve, modify, or deny these facilities. However, we are providing the public and the Commission with the available information on the impacts of the non-jurisdictional facilities, as appropriate, in section 4.13, Cumulative Impacts.

1.2.1 Federal Energy Regulatory Commission Purpose and Role

The Commission's purpose for reviewing the Annova LNG Project is based on its obligations under the NGA. Under Section 3 of the NGA, the Commission considers as part of its decision to authorize natural gas facilities, all factors bearing on the public interest. Specifically, regarding whether to authorize siting of natural gas facilities used for exportation, the Commission would authorize the proposal unless it finds the proposed facilities would not be consistent with the public interest. The purpose and role of the cooperating agencies for the Project is provided below.

Several agencies are cooperating agencies for the development of this EIS. A cooperating federal agency has jurisdiction by law or special expertise with respect to environmental impacts associated with the proposal. Cooperating agencies for the Project include: the U.S. Army Corps of Engineers (COE); U.S. Coast Guard (Coast Guard); U.S. Department of Transportation (DOT); U.S. Environmental Protection Agency (EPA); U.S. Fish and Wildlife Service (FWS); National Parks Service (NPS); the National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NOAA Fisheries)[2]; Federal Aviation Administration (FAA); and DOE.

1.2.2 U.S. Army Corps of Engineers Purpose and Role

The COE has jurisdictional authority pursuant to Section 404 of the Clean Water Act (CWA) (Title 33 of the United States Code [USC], Section 1344 [33 USC 1344]), which governs the discharge of dredged or fill material into waters of the U.S., and Section 10 of the Rivers and Harbors Act (RHA) (33 USC 403), which regulates any work or structures that potentially affect the navigable capacity of a waterbody. Because the COE would need to evaluate and approve several aspects of the Project and must comply with the requirements of NEPA before issuing permits under the above statutes, it has elected to participate as a cooperating agency in the preparation of this EIS. The COE would adopt the final EIS (FEIS) to satisfy its requirements under NEPA per 40 CFR 1506.3 if, after an independent review of the document, it concludes that the FEIS satisfies the COE's comments and suggestions. The Project occurs within the Galveston District of the COE. Staff from this COE district participated in the NEPA review and would evaluate COE authorizations, as applicable.

The primary decisions to be addressed by the COE include:

- issuance of a Section 404 Permit for wetland impacts associated with construction of the Project; and
- issuance of Section 10 Permit for construction activities within navigable waters of the U.S.

This EIS contains information needed by the COE to reach decisions on these issues. Through the coordination of this document, the COE would obtain the views of the public and natural resource agencies prior to reaching the COE's decisions on the Project.

As an element of its review, the COE must consider whether a proposed project avoids, minimizes, and compensates for impacts on existing aquatic resources, including wetlands, to strive to achieve a goal of no overall net loss of values and functions. Based on its participation as a cooperating agency and its consideration of the final EIS (including responses to public comments), the COE would issue a Record of Decision to formally document its decision on the proposed action, including a Section 404 (b)(1) analysis and required environmental mitigation commitments.

1.2.3 U.S. Coast Guard Purpose and Role

The Coast Guard is the federal agency responsible for determining the suitability of waterways for LNG marine traffic. The Coast Guard exercises regulatory authority over LNG facilities that affect the safety and security of port areas and navigable waterways under Executive Order 10173, the Magnuson Act (50 USC 191), the Ports and Waterways Safety Act of 1972, as

[2] May also be abbreviated as "NMFS."

amended (33 USC 1221, et seq.), and the Maritime Transportation Security Act of 2002 (MTSA) (46 USC 701). The Coast Guard is responsible for matters related to navigation safety, vessel engineering and safety standards, and all matters pertaining to the safety of facilities or equipment in or adjacent to navigable waters up to the last valve immediately before the LNG storage tanks. The Coast Guard also has authority for LNG facility security plan reviews, approval and compliance verification as provided in 33 CFR 105, and siting as it pertains to the management of vessel traffic in and around LNG facilities to a point 12 nautical miles (nm) seaward from the coastline (to the territorial seas). As appropriate, the Coast Guard (acting under the authority in 33 USC 1221 et seq., and under a 2004 Interagency Agreement[3]) also would inform the FERC of design and construction related issues identified as part of safety and security assessments. If the Annova LNG Project is approved, constructed, and operated, the Coast Guard would continue to exercise regulatory oversight of the safety and security of the LNG Terminal facilities, in compliance with 33 CFR 127.

As required by its regulations, the Coast Guard is responsible for issuing a Letter of Recommendation (LOR) as to the suitability of the waterway for LNG marine traffic following a Waterway Suitability Assessment (WSA). On February 23, 2015, Annova submitted to the Coast Guard a Letter of Intent pursuant to 33 CFR 127.007 and a preliminary WSA for the Project. The preliminary WSA provided information on the port, assessment of maritime safety and security, risk management strategies, and resources required for safety, security, and response. The Coast Guard reviewed the preliminary WSA and responded to Annova that it had no comments. On February 13, 2018, the Coast Guard issued an LOR that recommended that the BSC be considered suitable for accommodating the type and frequency of LNG marine traffic for the Project.

1.2.4 U.S. Department of Transportation Purpose and Role

The DOT has prescribed the minimum federal safety standards for LNG facilities in compliance with 49 USC 60101. Those standards are codified in 49 CFR Part 193 and apply to the siting, design, construction, operation, maintenance, and security of LNG facilities. The National Fire Protection Association (NFPA) Standard 59A, *Standard for the Production, Storage, and Handling of Liquefied Natural Gas* (2001 ed.), is incorporated into these requirements by reference, with regulatory preemption in the event of conflict. In accordance with the 2004 Interagency Agreement, the DOT participates as a cooperating agency on the safety and security review of waterfront import/export LNG facilities. The DOT does not issue a permit or license but, as a cooperating agency, assists FERC staff in evaluating whether an applicant's proposed siting criteria meets the DOT requirements in Part 193, Subpart B. On August 31, 2018, the DOT and FERC signed a new Memorandum of Understanding (MOU) to improve coordination throughout the LNG permit application process for FERC jurisdictional LNG facilities. Under the 2018 MOU, the DOT will issue a Letter of Determination, which FERC will rely upon in determining whether a proposed LNG facility will be capable of complying with Part 193, Subpart B, Siting.

[3] Interagency Agreement among the FERC, Coast Guard, and DOT Research and Special Programs Administration, for the Safety and Security of Waterfront Import/Export of LNG Facilities (https://www.ferc.gov/industries/gas/indus-act/lng/2004-interagency/2004-interagency.pdf?csrt=14440234472018644188).

1.2.5 U.S. Environmental Protection Agency Purpose and Role

The EPA has delegated water quality certification, under Section 401 of the CWA, to the jurisdiction of individual state agencies. The EPA may assume Section 401 authority if no state program exists, if the state program is not functioning adequately, or at the request of the state. The EPA also oversees the issuance of a National Pollutant Discharge Elimination System (NPDES) permit by the state agency, under Section 402 of the CWA, for point-source discharge of used water into surface waters of the U.S. In addition to its authority under the CWA, the EPA also has jurisdictional authority under the Clean Air Act of 1970 (CAA) to control air pollution by developing and enforcing rules and regulations for all entities that emit toxic substances into the air. Under this authority, the EPA has developed regulations for major sources of air pollution and has delegated the authority to implement these regulations to state and local agencies. State and local agencies are allowed to develop and implement their own regulations for non-major sources of air pollutants.

In addition to its permitting responsibilities, the EPA is required under Section 309 of the CAA to review and publicly comment on the environmental impacts of major federal actions including actions that are the subject of draft and final EISs, and responsible for implementing certain procedural provisions of NEPA (e.g., publishing Notices of Availability of the draft and final EISs) to establish statutory timeframes for the environmental review process.

1.2.6 U.S. Fish and Wildlife Service Purpose and Role

The FWS is responsible for ensuring compliance with the Endangered Species Act (ESA) for most listed terrestrial and freshwater species, but also several marine mammal species. Section 7 of the ESA, as amended, states that any project authorized, funded, or conducted by any federal agencies should not "…jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined…to be critical…" (16 USC 1536(a)(2)). The FWS also reviews project plans and provides comments regarding protection of fish and wildlife resources under the provisions of the Fish and Wildlife Coordination Act (16 USC 661 et seq.). The FWS is responsible for the implementation of the provisions of the Migratory Bird Treaty Act (MBTA) (16 USC 703) and the Bald and Golden Eagle Protection Act (BGEPA) (16 USC 688).

Section 7 of the ESA requires identification of and consultation on aspects of any federally authorized action that may have effects on federally listed species, species proposed for federal listing, and their habitat. The ultimate responsibility for compliance with section 7 remains with the lead federal agency (i.e., the FERC for this project).

FERC consulted with the FWS pursuant to section 7 of the ESA to determine whether federally listed endangered or threatened species or designated critical habitat are found in the vicinity of the Project, and to evaluate the proposed action's potential effects on those species or critical habitats. The FERC coordinated with the FWS regarding other federal trust wildlife resources, such as migratory birds, the Migratory Bird Treaty Act (MBTA), the Bald and Golden Eagle Protection Act (BGEPA), the Fish and Wildlife Coordination Act, and NEPA.

1.2.7 National Parks Service Purpose and Role

The NPS manages four sites in the Project vicinity: the Palo Alto Battlefield National Historical Park, the Palmito Ranch Battlefield National Historic Landmark (NHL), the Resaca de la Palms Battlefield NHL, and the Padre Island National Seashore. The NPS elected to cooperate in preparing this EIS because of potential impacts on these four sites. Section 110(f) of the National Historic Preservation Act (NHPA) requires that "prior to the approval of any Federal undertaking, which may affect any National Historic Landmark, the head of the responsible Federal agency shall, to the maximum extent possible, undertake such planning and actions as may be necessary to minimize harm to such landmark, and shall afford the Advisory Council on Historic Preservation a reasonable opportunity to comment on the undertaking." Also, as stated in 36 CFR Part 800.10(c), federal agencies are required to notify the Secretary of the Interior (delegated to the NPS) of any consultation involving an undertaking at an NHL and invite the Secretary to participate in the consultation. Effects include visual, night sky light pollution, noise, and cumulative effects.

The Natural Sounds and Night Skies Division of the NPS is tasked with managing, protecting, and restoring the nighttime photic environment and naturally dark skies in national park units. Due to the large outputs of artificial lighting associated with some LNG facilities and the great distances that artificial light can travel, the Project has the potential to adversely affect the resources of Palo Alto Battlefield National Historical Park and Padre Island National Seashore.

1.2.8 National Oceanic and Atmospheric Administration, National Marine Fisheries Service Purpose and Role

NOAA Fisheries is responsible for ensuring compliance with the ESA for marine and anadromous species. NOAA Fisheries is also responsible for implementing the Magnuson-Stevens Fishery Conservation and Management Act of 1976 (MSA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267). The MSA requires federal agencies to consult with NOAA Fisheries on all actions or proposed actions authorized, funded, or undertaken by the agency that may adversely impact essential fish habitat (EFH) (MSA Section 305(b)(2)). Compliance with the MSA and summary of EFH is included in section 4.6.2.1 of this EIS.

As the lead federal agency for the Project, the FERC consulted with NOAA Fisheries pursuant to Section 7 of the ESA to determine whether federally listed endangered or threatened species or designated critical habitat are found in the vicinity of the Project, and to evaluate the proposed action's potential effects on those species or critical habitats. NOAA Fisheries elected to cooperate in preparing this EIS because it has special expertise with respect to environmental impacts associated with the Project. We also consulted with NOAA Fisheries regarding the MSA and NEPA.

1.2.9 Federal Aviation Administration Purpose and Role

The FAA Office of Commercial Space Transportation (AST) has special expertise and responsibilities related to issuing launch licenses and/or experimental permits to allow Space Exploration Technologies Corporation (SpaceX) to conduct launches from a launch site that is under construction and located east-southeast of the Project. The FAA AST's responsibilities are authorized by Executive Order 12465 (Commercial Expendable Launch Vehicle Activities, 49 FR 7099, 3 CFR, 1984 Comp., p. 163) and the Commercial Space Launch Act (51 USC Subtitle V, ch. 509 §§50901-50923) for oversight of commercial space launch activities, including issuing launch licenses and experimental permits to operate reusable orbital and suborbital launch vehicles. The FAA AST has special expertise related to potential future space launch missions, including quantification of risk (likelihood and consequences) in accordance with 14 CFR Parts 415 and 417. The FAA AST elected to cooperate in preparing this EIS to ensure it meets its responsibilities related to future operation of the SpaceX launch facility.

1.2.10 U.S. Department of Energy Purpose and Role

The DOE, Office of Fossil Energy (DOE/FE) must meet its obligation under Section 3 of the NGA to authorize the import and/or export of natural gas, including LNG, unless it finds that the proposed import or export is not consistent with the public interest. By law, under Section 3(c) of the NGA, applications to export natural gas to countries with which the United States has Free Trade Agreements (FTA) that require national treatment for trade in natural gas are deemed to be consistent with the public interest and the Secretary must grant authorization without modification or delay. In the case of applications to export LNG to non-FTA nations, NGA Section 3(a) requires the DOE/FE to conduct a public interest review and to grant the applications unless the DOE/FE finds that the proposed exports will not be consistent with the public interest. Additionally, the NEPA requires DOE/FE to consider the environmental effects of its decisions regarding applications to export natural gas to non-FTA nations.

On February 20, 2014, in Order No. 3394, DOE/FE authorized Annova LNG, LLC, an affiliate of the Annova entities, to export up to approximately 342 billion cubic feet per year of natural gas to FTA nations. On July 17, 2014, in Order No. 3464, DOE/FE approved the transfer of the FTA authorization to Annova LNG Common Infrastructure, LLC. Annova has stated that it also intends to request DOE/FE authorization to export LNG to non-FTA nations. The purpose and need for DOE action for the current proposal is to enable DOE's public interest evaluation and NEPA review of Annova's anticipated application to export LNG to non-FTA countries.

The DOE has exclusive jurisdiction over the export of natural gas as a commodity. DOE has delegated to the Commission authority to approve or disapprove the construction and operation of particular facilities. The facilities are considered the site at which such facilities would be located, and with respect to natural gas that involves the construction of new domestic facilities, the place of entry for imports or exit for exports. However, the DOE Secretary has not delegated to the Commission any authority to approve or disapprove the import or export of the commodity itself as part of the Commission's public interest determination. The Commission's authorization alone would not enable the export of any additional volumes of LNG.

The DOE conducts its review under Section 3 of the NGA. Additionally, NEPA requires the DOE to consider the environmental impacts of its decisions on non-FTA export applications. In this regard, the DOE acts as a cooperating agency with FERC in the preparation of the EIS pursuant to the requirements of NEPA. In accordance with 40 CFR 1506.3, after an independent review of the FEIS, DOE may adopt the FEIS to satisfy its requirements under NEPA.

1.3 PUBLIC REVIEW AND COMMENT

Annova initiated the FERC pre-filing process for the Project on March 11, 2015. On March 27, 2015, the Director of the Office of Energy Project granted Annova's request to utilize the pre-filing process and assigned Docket No. PF15-15-000. The pre-filing process ended on July 13, 2016, when Annova submitted its application to the FERC. The pre-filing process allows the FERC staff to become involved with scoping of environmental issues before the applicant files its application, thus overlapping the applicant's planning process with the NEPA process.

During the pre-filing process we conducted biweekly conference calls with Annova to discuss the then-planned Project's progress and identify and address issues and concerns that had been raised. Interested agencies were invited to participate on these calls. Summaries of biweekly conference calls, and scoping comments, are part of the public record for the Project and are available for viewing on the FERC website (http://www.ferc.gov) under the prefiling Docket No. PF15-15-000.

Annova hosted an open house information session for landowners, agencies, and other interested stakeholders on April 21, 2015, in Brownsville, Texas, at which FERC staff also participated. The open house provided stakeholders the opportunity to learn about the Project and ask questions in an informal setting. Notification of the open house was mailed to stakeholders and published in local newspapers. On July 23, 2015, the FERC issued a *Notice of Intent to Prepare an Environmental Impact Statement for the Planned Annova LNG Brownville Project, Request for Comments on Environmental Issues, and Notice of Public Scoping Meeting* (NOI). The NOI was sent to over 400 interested parties including nearby landowners, federal, state, and local officials; agency representatives; conservation organizations; local libraries and newspapers, and tribal representatives. There was a 30-day comment period on the NOI which ended on August 24, 2015. On August 5, 2015, the FERC issued a *Notice of Extension of Time,* which extended the comment period on the NOI to September 4, 2015. We received over 6,000 comment letters in response to the NOI.

Of the comment letters filed during the public scoping period, 16 were from state or federal agencies, and the remaining were from interested parties or individuals. The majority of comments indicated concerns regarding safety, air quality, commercial and recreational fishing, tourism, fish and wildlife, visual resources, and noise and light pollution. Annova filed a letter that addressed comments filed during the public scoping period in a submittal to the Commission on September 18, 2015.

On August 11, 2015, the FERC conducted a public scoping meeting in Port Isabel, Texas, to provide an opportunity for the public to learn more about the Project and provide comments on environmental issues addressed in the EIS. Ninety-five people provided verbal comments at the scoping meeting. Transcripts of the scoping meeting have been entered into the public record for the Project, under Docket No. PF15-15-000.

On August 12, 2015, the FERC's staff participated in a site visit of the Project site along with representatives from the FWS, NPS, and Annova. On August 12, 2015, the FERC's staff also held an interagency meeting to solicit comments and concerns regarding the Project from other jurisdictional agencies. In addition to the FERC's staff, representatives from four federal and state agencies were present at this meeting including the FWS, Coast Guard, NPS, and Texas Parks and Wildlife Department (TPWD). On February 4, 2016, the FERC's staff participated in a second site visit that included representatives from the FWS, NPS, EPA, FAA, NOAA Fisheries, TPWD, and the Texas Historical Commission (THC).

On August 4, 2015, FERC staff issued a letter to the U.S. Department of Defense requesting comments on whether the Project could potentially have an impact on the test, training, or operational activities of any active military installation. On September 18, 2015, the U.S. Department of Defense Siting Clearinghouse responded stating that, based on an informal review, the Project would have minimal impact on military training and operations conducted in the area.

On December 16, 2015, December 1, 2016, July 19, 2017, and May 2, 2018, we issued a Project update to inform the public and agencies of the status of the FERC review process. These documents, as well as all documents and comments submitted as a part of the Project pre-filing and application processes, are publicly available online at www.ferc.gov/docs-filing/ elibrary.asp.

We developed a mailing list for the Project that includes nearby landowners, federal, state, and local officials; agency representatives; conservation organizations; local libraries and newspapers, and tribal representatives. The mailing list also includes parties that have commented on the Project and that provided a complete mailing address with their comments. The mailing list has been maintained and updated since the start of the pre-filing process and the current list is included in Appendix A.

Table 1.3-1 lists the environmental issues that were identified during the scoping process described above, as well as comments received in response to our Notice of Application issued on July 27, 2016. Table 1.3-1 also indicates the section of this EIS in which each issue is addressed. Additional issues that we independently identified are also addressed as appropriate in this EIS.

TABLE 1.3-1

Issues Identified and Comments Received During the Scoping Process for the Annova LNG Project

Topic/Sub-Topics	Percent of Comments	EIS Section Addressing Comment
General	20%	Chapter 1 and 2
Purpose and Need of the Project		
Mitigation for all impacted resources		
Abandonment plan and identification of company liability		
Right of eminent domain		
Out of scope comments		
General support/opposition to the Project		
Alternatives	<1%	Chapter 3
Alternative facility locations		
Alternative Project design and layout		
Alternative placement or use of dredged materials		
Renewable energy alternatives		
Geology and Soils	<1%	4.1
Use of fill materials to stabilize the site		
Potential for toxic sediments in dredging area		
Water Resources	<1%	4.3
Impacts on surface waters, including drainage patterns and water quality		
Impacts on ground water, including local wells		
Water use during construction and operation		
Surface water and groundwater contamination		
Hydrostatic testing		
Impacts associated with ballast water		
Wetlands	10%	4.4
Impacts on wetlands, including their function and values		
Impacts on the Bahia Grande Wetland Mitigation site		

TABLE 1.3-1 (continued)		
Issues Identified and Comments Received During the Scoping Process for the Annova LNG Project		
Topic/Sub-Topic	Percent of Comments	EIS Section Addressing Comment
Vegetation	<1%	*4.5*
Impacts on vegetation communities including sensitive resources (e.g., lomas)		
Development of an invasive species control plan that addresses both terrestrial and aquatic species		
Wildlife and Aquatic Resources	<1%	*4.6*
Impacts on terrestrial wildlife		
Impacts on migratory birds		
Impacts on waterbirds		
Impacts on marine mammals		
Impacts on aquatic species (e.g., fisheries and marine invertebrates)		
Impacts on nocturnal species		
Impacts on unique, pristine, or sensitive wildlife habitats		
Impacts of habitat loss on fauna		
Threatened and Endangered Species	10%	4.7
Impacts on federal and state listed species		
Impacts on the piping plover, Aplomado falcon, marine mammals, sea turtles, ocelot (including the migration corridor), and jaguarondi.		
Measures to avoid/minimize impacts on listed species		
Land Use, Recreation, and Aesthetics	11%	4.8
Location of the Project near incompatible land-uses (e.g., National Wildlife Refuges, Boca Chica State Park, Brazos Island State Park, Bahia Grande Wetland Mitigation site, Las Palomas Wildlife Management Area, South Bay Texas Coastal Preserve, and SpaceX)		
Visual impacts of the Project on adjacent lands and uses (comments specifically called-out the following areas: boy-scout camps, Boca Chica Boulevard; Brownsville-Port Isabel Highway, Isla Blanca Beach; Schlitterbahn Waterpark; Jaime Zapata Boat ramp, Palmito Ranch Battlefield, South Bay Coastal Preserve, Resaca de la Palms NHL)		
Light pollution levels and their extent		
Impacts on recreational fishing and boating		
Impacts to tourism and recreation		
Socioeconomics	24%	4.9
Economic impacts on the local economy and taxes		
Potential effects on recreation and tourism industry (including ecotourism)		
Available workforce		
Economic impacts of LNG exports on local and global prices		
Impacts on property values		
Impacts on insurance rates		
Impacts on local job growth		
Impacts on public services		
Impacts on commercial fishing/shrimping		
Impacts on agricultural areas		
Impacts on communities covered by Environmental Justice regulations		
Transportation and Traffic	<1%	4.9
Impacts of construction on access to roads and areas in the region		
Safe navigation of the BSC		
Impacts of LNG ship traffic and security zones on existing ship traffic		
Maintaining vehicular access to recreational areas		
Cultural Resources	<1%	4.10
Impacts to cultural sites within the Rio Grande Watershed, including need to consult with local resources and entities		
Air Quality	12%	4.11
Air quality attainment status		
Fugitive dust mitigation		
Greenhouse gas emissions and mitigation		
Climate change		
Impacts of hazardous chemical air pollutants on human health		
Impacts of the flares on air quality		
Noise	<1%	4.11
Impacts from noise during construction		
Impacts from noise during operations		
Reliability and Safety	11%	4.12
Emergency response and evacuation plan		
Spill contingency plan		

TABLE 1.3-1 (continued) **Issues Identified and Comments Received During the Scoping Process for the Annova LNG Project**		
Topic/Sub-Topic	Percent of Comments	EIS Section Addressing Comment
Hurricane and earthquake response plan		
Procedures to maintain worker safety		
Emergency notification systems		
Catastrophic system failures		
Risk of hazardous spills to occur		
Potential for the Project to be a terrorist target		
Proximity to SpaceX		
Proximity to a densely populated area		
The company's past safety record		
Cumulative Impacts	<1%	4.13
The cumulative effect of multiple LNG facilities being approved along the BSC		
The cumulative effect of this Project combined with other actions/facilities in the area (such as SpaceX).		
The need to include the associated LNG pipelines in the analysis		
Induced natural gas production or increased hydraulic fracturing		
Effect of predicted sea-level rise on the Project		

1.4 NON-JURISDICTIONAL FACILITIES

Under Section 7 of the NGA, the FERC is required to consider, as part of a decision to authorize jurisdictional facilities, all facilities that are directly related to a proposed project where there is sufficient federal control and responsibility to warrant environmental analysis as part of the NEPA environmental review for the proposed project. Some proposed projects have associated facilities that do not come under the jurisdiction of the Commission. These "non-jurisdictional" facilities may be integral to the need for the proposed facilities, or they may be merely associated as minor components of jurisdictional facilities that would be constructed and operated as a result of authorization of the proposed facilities. Non-jurisdictional facilities associated with the Project are addressed below as well as in our cumulative impacts analysis in section 4.13 of this EIS.

1.4.1 Natural Gas Supply Lateral

The Project would receive natural gas supply from an as yet undetermined third-party–owned and –operated intrastate pipeline that would connect to the Valley Crossing Pipeline System. This information was gathered from a COE permit application a copy of which was filed with FERC. The approximately 9-mile-long, 36-inch-diameter natural gas supply lateral would begin at an existing Valley Crossing compressor station north of Highway 48 within the boundary of the Port of Brownsville, cross the BSC, and continue generally south and then east to the Project site. The supply lateral would be an intrastate pipeline and therefore would not be under the FERC's jurisdiction. The general location of the supply lateral is shown on figure 1.4.1-1.

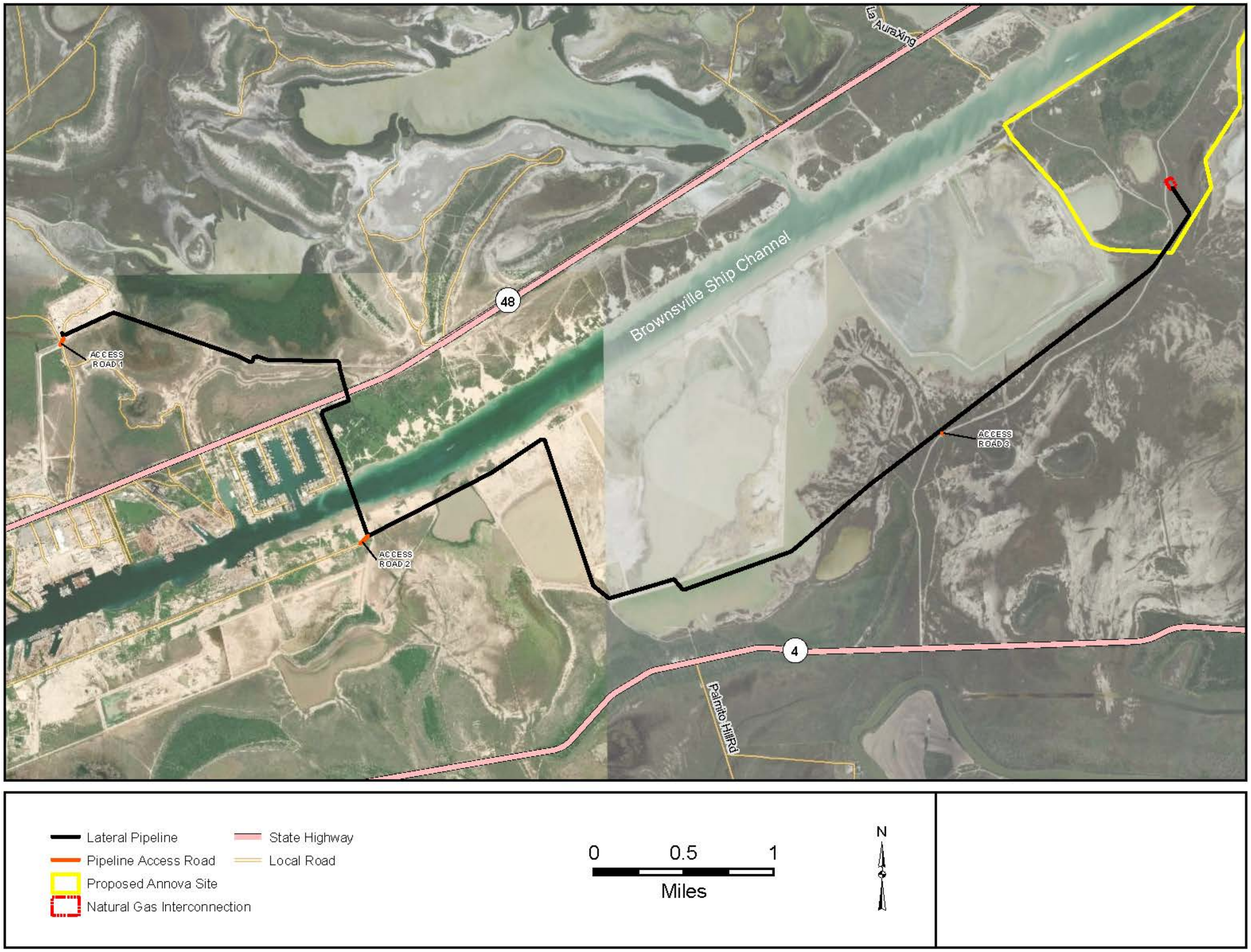


Figure 1.4.1-1 General Location of the Natural Gas Supply Lateral

1.4.2 Natural Gas Interconnection Facilities

Annova would take custody of natural gas delivered to the LNG terminal through interconnection and metering facilities constructed and operated by the owner and operator of the natural gas supply lateral. The interconnection facilities would be located in a 200-foot by 300-foot fenced yard within the southwest corner of the proposed LNG terminal site. The interconnection facilities would include valves and gas measurement devises, and related instrumentation and communications equipment. The interconnection facilities would also provide the necessary infrastructure for the supply lateral to measure and receive compressed boil-off gas (BOG) from the Project. The location of the natural gas interconnection facilities is shown on figure 1.4.2-1.

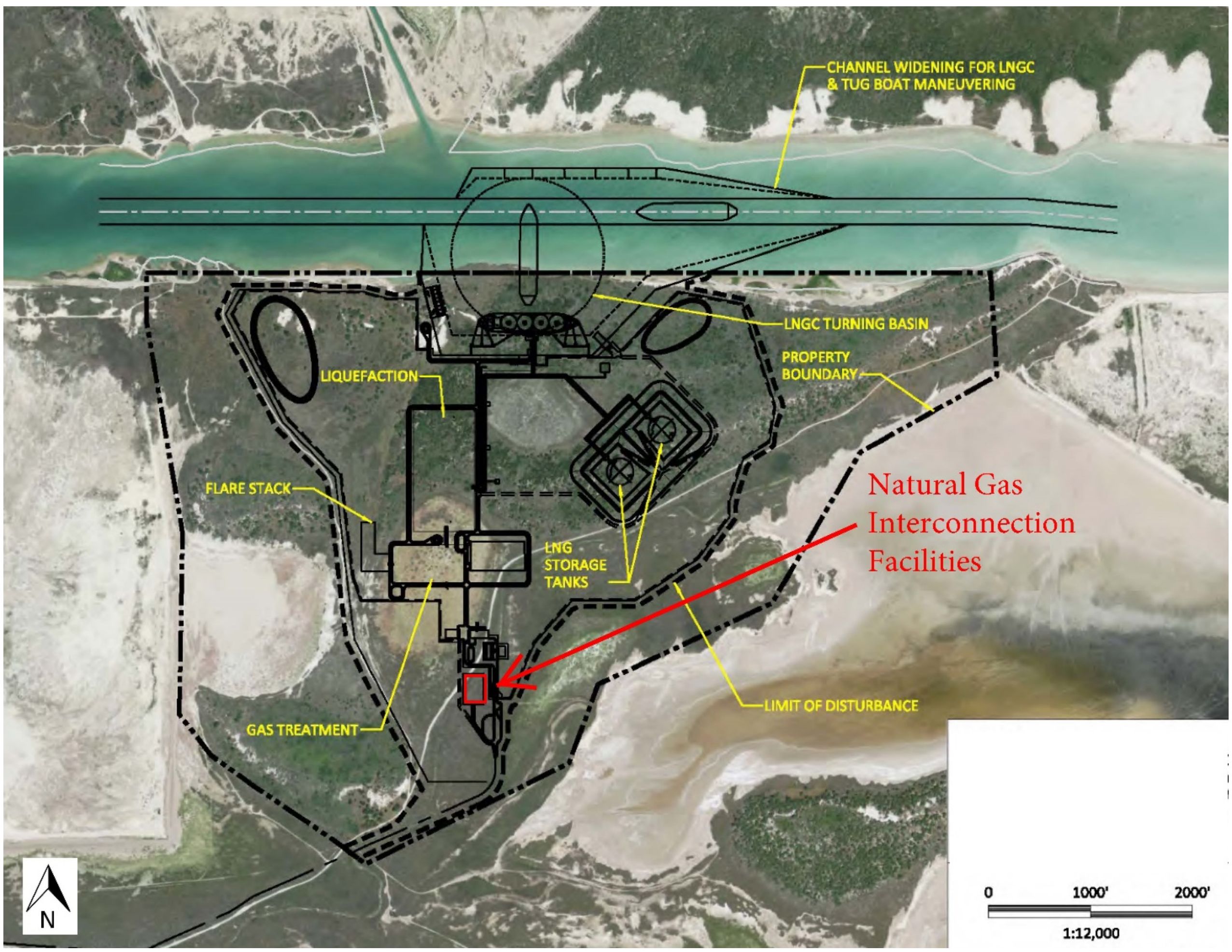


Figure 1.4.2-1 Location of Natural Gas Interconnection Facilities

1.4.3 Electric Transmission Line and Switchyard

The South Texas Electric Cooperative (STEC) would provide the electric transmission service to the Project. Supplying power to the Project would require a tie-in to STEC's existing transmission system and construction of a new electric transmission line to the Project site. Project power service needs would require:

- modifications of the existing Highway 511 and Waterport Electric Substations to provide interconnection to the new 138-kilovolt (kV) line;
- construction of a new 138-kV switchyard within the Project site; and
- installation of a new 138-kV line between the existing STEC system and the new switchyard.

STEC would permit, construct, own, operate, and maintain the new transmission line and switchyard. Annova indicates that STEC would conduct a routing study, including a public information meeting, and analyze several potential routes for the new transmission line, and would then file an application for the facilities with the Public Utility Commission (PUC) of Texas to initiate the regulatory process. The PUC would then select the final location of the transmission line route. Annova anticipates that STEC will file an application with the PUC in 2019. Pending completion of the review and approval, STEC would need to complete construction of the electric transmission line and switchyard prior to operation of the Project.

The new 138-kV transmission line would be approximately 15 miles long. The poles supporting the transmission line wires would be 90 to 110 feet in height and spaced approximately 600 feet apart within a right-of-way width of about 100 feet. Annova identified a potential route for the transmission line for the purpose of describing non-jurisdictional facilities and evaluating cumulative impacts. See figure 1.4.3-1.

1.4.4 Potable Water Pipeline

Annova would obtain potable water to support construction and operation of the Project through a water pipeline that would be constructed and operated by the Brownsville Navigation District (BND). The new water pipeline would be an extension of an existing water pipeline and would be about 5.9 miles long. Annova identified a potential route for the water pipeline for the purpose of describing non-jurisdictional facilities and evaluating cumulative impacts. See figure 1.4.4-1.

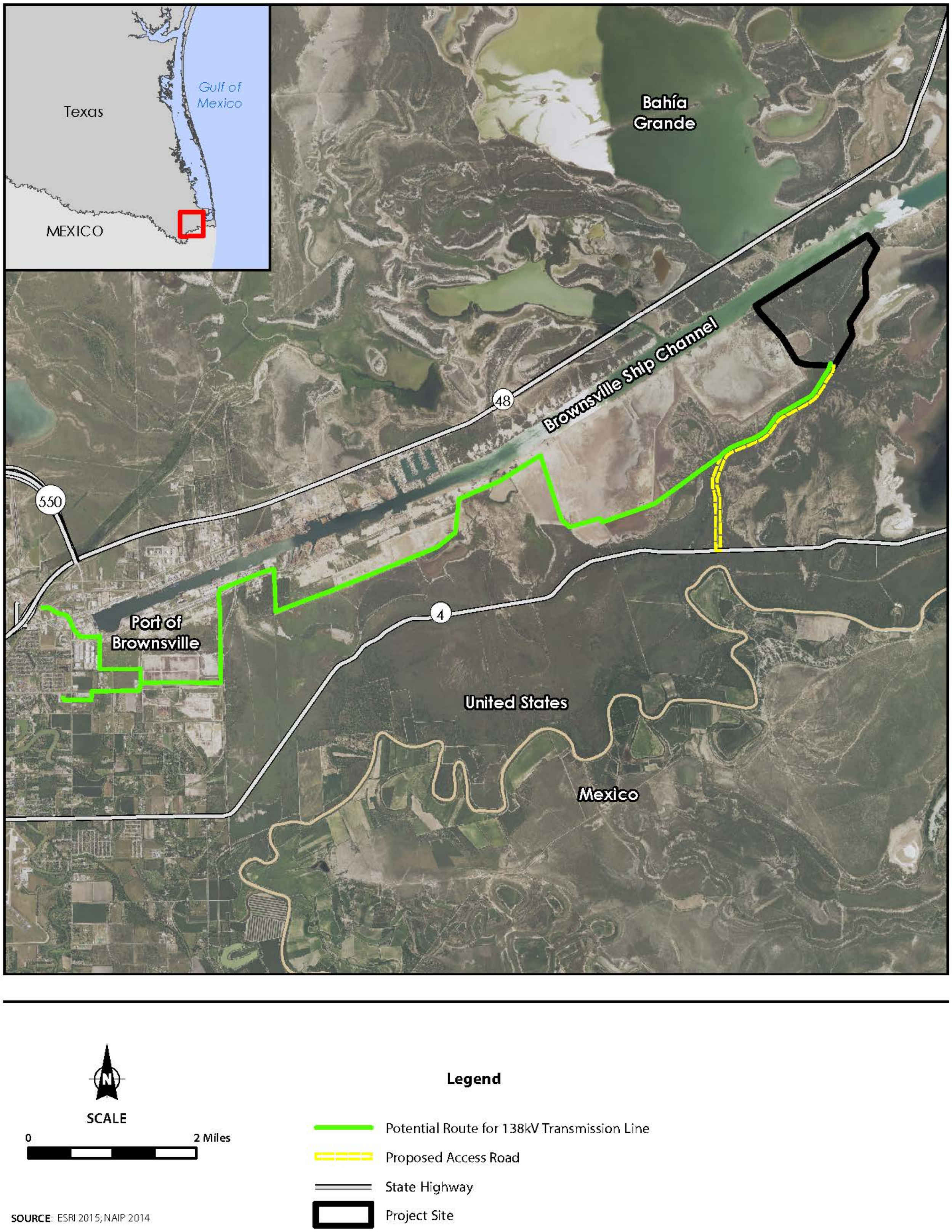


Figure 1.4.3-1 Potential Route for 138-kV Electric Transmission Line

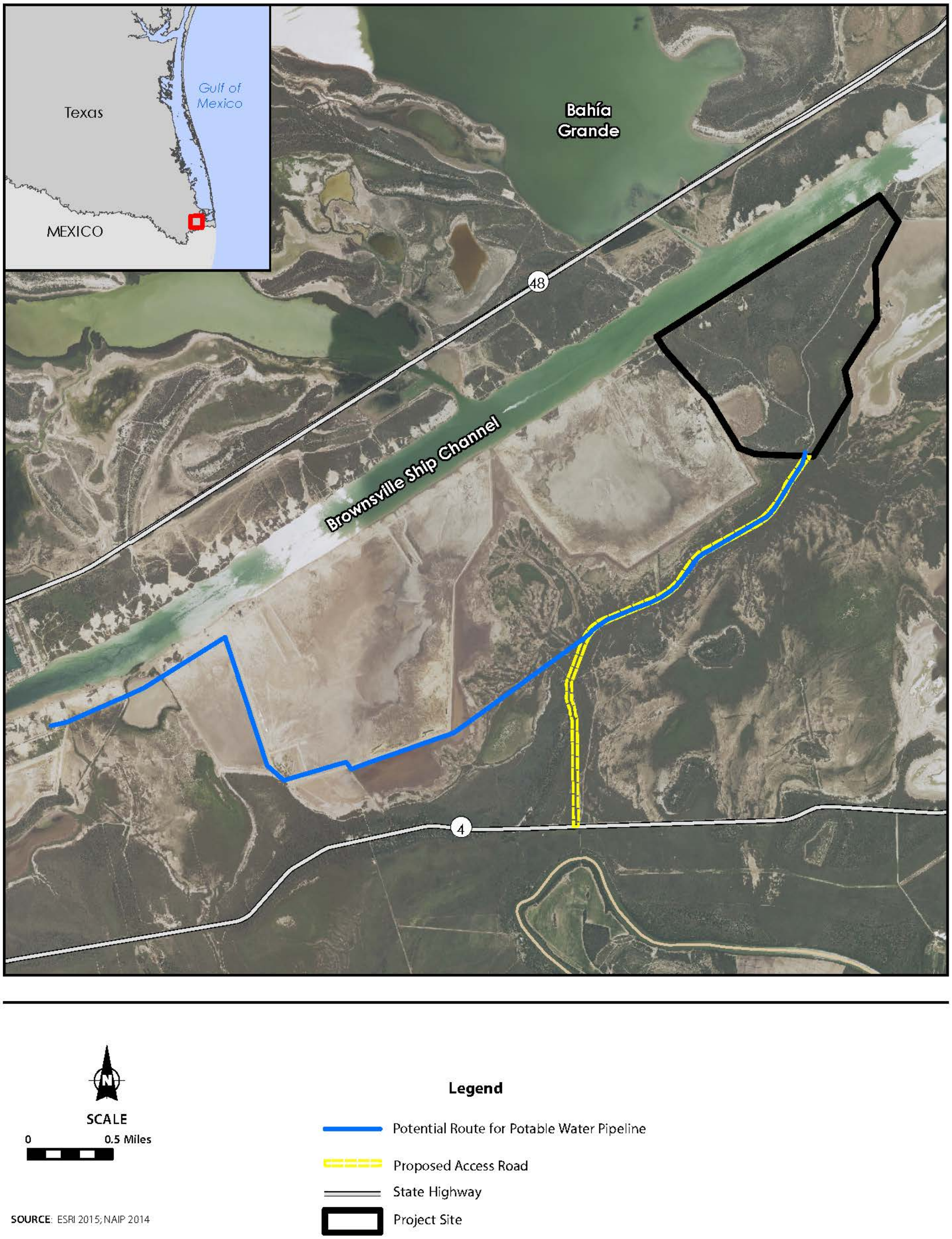


Figure 1.4.4-1 Potential Route for Potable Water Pipeline

1.5 PERMITS, APPROVALS, AND REGULATORY REVIEWS

As the lead federal agency for the Project, the FERC is required to comply with various federal environmental laws and regulations, including but not limited to, the ESA, the MSA, the RHA, the CWA, the CAA, the Federal Aviation Act of 1958, the NGA, the MTSA, the NHPA, the Coastal Zone Management Act of 1972 (CZMA), and the National Flood Insurance Act of 1968 (NFIA). Each of these statutes has been taken into account in the preparation of this document.

Major permits, approvals, and consultations for the Project are identified in table 1.5-1 and discussed below. The FERC encourages cooperation between applicants and state and local authorities, but this does not mean that state and local agencies, through applications of state and local laws, may prohibit or unreasonably delay the construction or operation of facilities approved by the FERC. Any state or local permits issued with respect to jurisdictional facilities must be consistent with the conditions of any authorization issued by the FERC.

TABLE 1.5-1

Environmental Permits and Agency Reviews for the Annova LNG Brownsville Project

Agency	Regulation/Permit/Approval	Agency Actions	Submission Date/Status
Federal			
COE	Section 404 of the CWA; Section 10 of the Rivers and Harbors Act	Consider issuance of Section 404/10 Individual Permit	Annova submitted application on July 21, 2016; on May 21, 2018 the COE requested additional information on the supply pipeline; on July 31, 2018 the COE notified Annova the application was withdrawn without prejudice pending receipt of information on the supply pipeline. On November 21, 2018, Annova submitted application for the supply pipeline lateral, and on December 3, 2018 the COE acknowledged receipt of applications for the LNG terminal and supply pipeline.
Coast Guard	33 CFR 105; 33 CFR 127; Notice to mariners; Maritime Transportation Security Act	Consider issuance of Letter of Recommendation	Annova submitted Preliminary Waterway Suitability Assessment submitted to Coast Guard on February 23, 2015; on February 13, 2018, the Coast Guard issued LOR stating the BSC is suitable for LNG marine traffic.
EPA	NPDES	NPDES Stormwater Construction General Permit	Annova would provide notification prior to construction, anticipated 2018.
		Consider issuance of NPDES Hydrostatic Testwater Discharge Permit	Annova anticipates application to be submitted 2020.
		Consider issuance of NPDES Industrial Wastewater Permit	Annova anticipates application to be submitted 2021.
FWS	Section 7 of the ESA	Threatened and endangered species consultation	Annova submitted initial consultation request letter to FWS on March 27, 2015; followed by correspondence and meetings between Annova and FWS (see complete list filed by Annova in accession number 20180119-5058). BA will be prepared by FERC and submitted to FWS.
	Special Use Permit	Crossing or use of National Wildlife Refuge lands	Annova submitted request for use of access road to conduct surveys on April 18, 2016; follow-up responses and submittals occurred through December 2017 (see list filed by Annova in accession number 20180119-5058).

TABLE 1.5-1 (continued)

Environmental Permits and Agency Reviews for the Annova LNG Brownsville Project

Agency	Regulation/Permit/Approval	Agency Actions	Submission Date/Status
NOAA Fisheries	Section 7 of the ESA; Section 305 of the MSA; Marine Mammal Protection Act; Fish and Wildlife Coordination Act	Marine threatened and endangered species consultation	Annova submitted initial consultation request letter to NOAA Fisheries Habitat Protection Division, and Protected Resources Division, on March 27, 2015.
Federal Aviation Administration	Section 1101 of the Federal Aviation Act	Notice of proposed construction of a structure (flare stacks) exceeding airspace obstruction standards	Annova would submit application prior to construction.
DOE	Section 3 of the NGA; 15 USC Section 717b	Consider authorization to export LNG to Free Trade Agreement countries	Annova submitted application on October 9, 2013. DOE granted authorization on February 20, 2014.
		Consider authorization to export LNG to Non-Free Trade Agreement countries	Annova indicates it intends to submit application but has not identified a date.
State			
Railroad Commission of Texas	Section 401 of the CWA;	Consider Issuance of Water Quality Certification	Review concurrent with COE CWA Section 404 permit application. See status above.
	Coastal Zone Management Program	Determine Consistency with Coastal Zone Management Program	Review concurrent with COE CWA Section 404 permit application. See status above.
Texas Council on Environmental Quality	Texas Clean Air Act; CAA; 40 CFR 50-99	PSD Air Permit for Construction	Annova submitted air permit application to TCEQ in January 2017; TCEQ issued Declaration of Administrative Completeness on January 25, 2017; Annova submitted air quality impact modeling report to TCEQ on July 31, 2017.
		Consider issuance of Title V Operating Permit	Annova anticipates submitting application in 2020.
		Consider issuance of Temporary Water Rights Permit	Annova anticipates submitting application prior to construction.
		Consider issuance of Permanent Water Rights Permit	Annova anticipates submitting application in 2020.
Texas Historical Commission	Section 106 of the NHPA; Antiquities Code of Texas	Comment on archaeological investigations within Area of Potential Effect	Annova submitted bathymetric survey report for ship channel impacts to THC on August 4, 2015; and draft reports for Project site to THC on September 2, 2015. THC provided comments on Project site report on October 1, 2015.
TPWD	Chapters 67, 68, and 88 of Texas Parks and Wildlife Code, and Sections 65.171 - 65.176 of Title 31 of the Texas Administrative Code	Comment on potential impacts on state-listed species	Annova submitted initial consultation request letter to TPWD on March 27, 2015. TPWD provided response on July 30, 2015.
Local			
Cameron County	44 CFR 60 Floodplain Management	Consider issuance of Commercial Construction and Floodplain Permit	Annova anticipates submitting application prior to construction.
	On-Site Sewage Facility Requirements	Consider issuance of On-Site Sewage Facility Permit	Annova anticipates submitting application prior to construction.

2.0 DESCRIPTION OF PROPOSED ACTION

The Project consists of a new natural gas liquefaction and LNG export terminal located in Cameron County, at approximate mile marker 8.2 on the BSC, near Brownsville, Texas. The Project includes two principal parts: the LNG facilities and the associated marine transfer facilities. The LNG facilities are designed to receive 900 million cubic feet per day of natural gas from a third party–owned and –operated non-jurisdictional intrastate pipeline lateral. The natural gas would be treated, liquefied, and stored on-site in two single-containment LNG storage tanks, each with a net capacity of approximately 160,000 cubic meters (m^3). The LNG would be pumped from the storage tanks to the marine transfer facilities where it would be loaded onto LNG carriers at the berthing dock using cryogenic piping.

A general location map of the Project is provided as figure 1-1 and a general site plan is provided as figure 1-2. The following sections describe the proposed facilities associated with the Project, construction procedures and schedule, environmental compliance and inspection monitoring, operation and maintenance procedures, safety controls, and land requirements.

2.1 PROPOSED FACILITIES

Combined, Annova's proposed facilities are characterized as an LNG terminal. The LNG terminal would be made up of various component facilities, the details of which are described below.

2.1.1 Gas Pretreatment Facilities

Pipeline quality natural gas consists primarily of methane, with smaller amounts of ethane and propane; with small amounts of heavier hydrocarbons. Pipeline quality natural gas also contains trace amounts of other constituents such as carbon dioxide (CO_2), nitrogen, water, and sulfur. The pretreatment process would remove constituents that would freeze during the liquefaction or affect the liquefaction process, primarily CO_2, hydrogen sulfide (H_2S), water, mercury, and heavy hydrocarbons.

An amine treatment system would remove CO_2 and H_2S (i.e., acid gases) from the natural gas stream. The amine would be regenerated to release the absorbed acid gas. The acid gas would then be routed through a sulfur removal unit to remove H_2S before being incinerated in the thermal oxidizer. The natural gas stream would then pass through a dehydration system to remove water using a molecular sieve and solid adsorbents, and downstream of the dehydration system an activated carbon bed would remove any trace amounts of mercury. Any mercury or nongaseous H_2S captured during gas pretreatment would be handled and disposed of by licensed personnel per applicable federal and state regulations, including 40 CFR Parts 239-282 Resource Conservation and Recovery Act (RCRA) and 30 TAC 335, Industrial Solid Waste and Municipal Hazardous Waste.

2.1.2 Liquefaction Facilities

Annova would utilize Black & Veatch's PRICO® technology for natural gas liquefaction. The essential components of the liquefaction facilities would include refrigeration through compression and removal of heat. By cooling to a temperature of minus 260 degrees Fahrenheit (°F), the methane stream from the Gas Treatment Facilities would change from a gas to a liquid.

The liquefaction facilities would consist of six liquefaction trains, with each train employing a closed-loop refrigeration system using a mixed refrigerant consisting of nitrogen and a combination of hydrocarbons such as methane, ethane or ethylene, propane, butane, and pentane. Power for the liquefaction process would be grid-sourced electricity. There would be one 72,000-hp electric motor-driven compressor per liquefaction train to provide needed compression.

Heavy hydrocarbons would be removed at an intermediate temperature during the liquefaction process. Heavy hydrocarbon vapors would be routed to the fuel gas system. Heavy hydrocarbon liquids would be stored in a condensate storage tank and would be moved off-site via truck for sale or disposal by licensed personnel per applicable federal or state regulations. No other byproducts would result from the liquefaction process.

After removal of heavy hydrocarbons, the refrigeration process would cool the gas further. LNG would exit the liquefaction train and enter an LNG expander to reduce the system pressure to atmospheric pressure, which would further lower the LNG temperature before placement into LNG storage tanks.

2.1.3 LNG Storage Tanks

The LNG would be stored in two single-containment LNG storage tanks, each designed to store approximately 160,000 m^3 to provide sufficient inventory to accommodate the anticipated loading schedule for typical LNG carriers. Each tank would consist of a primary inner container of 9 percent nickel steel and an outer container of carbon steel. The insulation in the annular space between the inner and outer containers would consist of expanded perlite and resilient glass wool. The LNG storage tanks would maintain the LNG at minus 260°F.

The tank foundations would be concrete supported by piles and elevated approximately 6 feet above ground level. This design would prevent freezing of the ground by allowing ambient air to flow underneath the tanks and eliminate the need for a heating system within each tank foundation. The height of each LNG storage tank would be approximately 186 feet above grade and would have a diameter of approximately 260 feet. In addition, a 15-foot-tall winch crane on the top of each LNG storage tanks would be used for maintenance purposes. Figure 2.1.3-1 shows the major components of a typical single-containment LNG storage tank.

49 CFR Part 193.2181 specifies that the impoundment system around the LNG storage tanks must contain 110 percent of the maximum liquid capacity in one LNG storage tank. An engineered earthen berm around each LNG storage tank would contain 110 percent of the tank capacity of stored LNG. The top elevation of the containment berms would be approximately +36 feet (elevations in North American Vertical Datum of 1988 [NAVD88]).

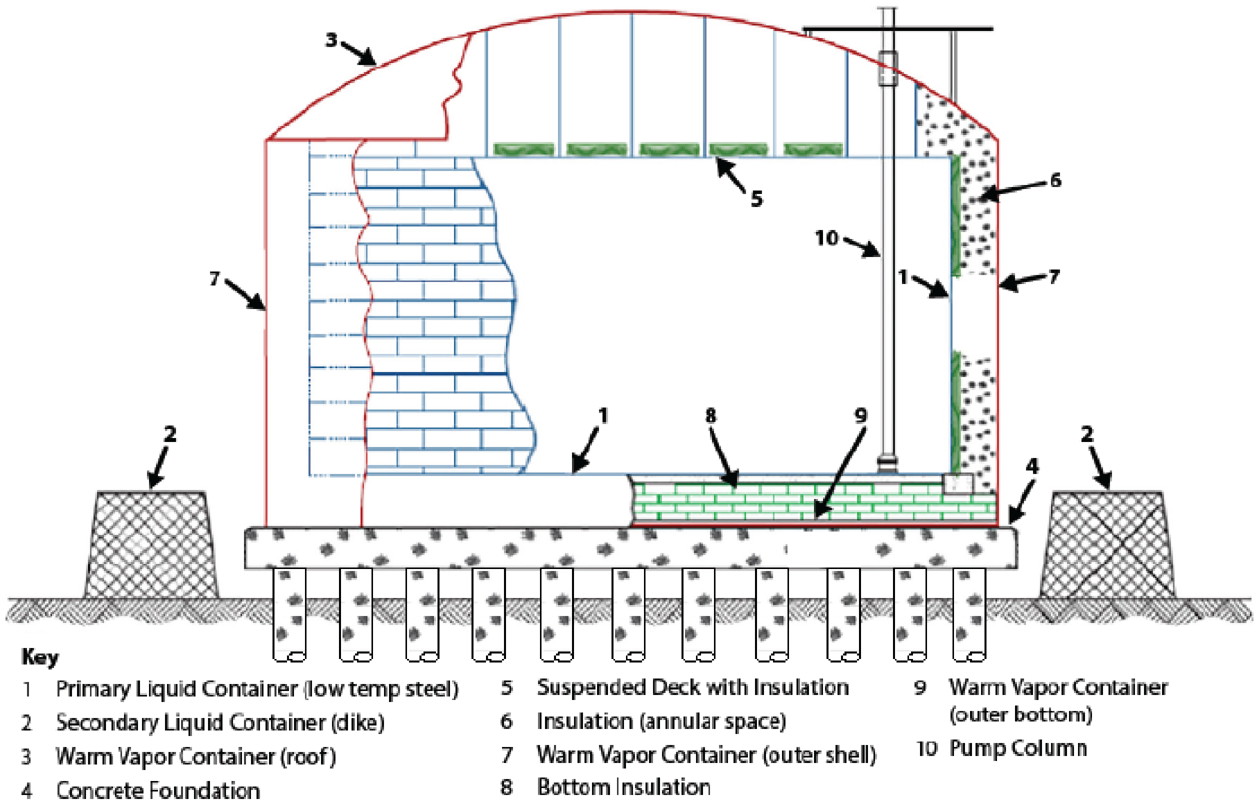


Figure 2.1.3-1 Typical Single-Containment LNG Storage Tank

2.1.4 Boil-Off Gas Handling System

During normal operation, a portion of the produced LNG vaporizes and is referred to as boil-off gas, or BOG. BOG results from changes in pressure and ambient heat gain during the transfer of LNG from storage tanks to an LNG carrier, and displacement of vapors returned from loading to an LNG carrier.

The BOG handling system would recover these vapors for reliquefaction or use as fuel gas. Because the gas must be compressed before being returned to the liquefaction process, there would be one BOG compressor plus a stand-by compressor for each liquefaction train. Also, a separate pipeline compressor would compress the BOG for re-injection back into the intrastate pipeline lateral as per contractual terms during periods when the BOG system is not operating.

2.1.5 Flare System

Flaring would be required during commissioning, cool downs, start-up, planned maintenance shutdowns, and during certain LNG carrier loading operations. The flare system would include a cold flare system, a warm flare system, and a marine flare system. The cold flare system would collect dry or cryogenic fluids (i.e., liquefied gases maintained at cryogenic temperatures) relieved from the liquefaction trains. The warm flare system would collect wet or non-cryogenic relief fluids (i.e., fluids that are liquid at non-cryogenic temperatures) during plant start-up or conditions other than normal operation. The marine flare would operate during the transfer of LNG to an LNG carrier that is arriving at port with warm LNG cargo tanks, which typically occurs on the first visit following dry dock. Each flare system would have separate multiple flare pilots and redundant flame-detection systems to ensure integrity. There would be two flare stack structures, a single combined warm and cold flare measuring 160 feet in height, and a marine flare measuring 45 feet in height.

Flaring from the warm/cold flare stack would occur during initial Project start-up and intermittently during subsequent routine operation. During routine operation, flaring would only occur during planned maintenance, shutdown, and start-up (MSS) events, which would be scheduled to occur during daytime hours. Although not planned, MSS flaring during nighttime may occasionally occur. Annova estimates that flaring would occur at intervals of once every 6 months, once every 2 to 4 years, and once every 10 years for various MSS activities. MSS flaring would typically occur for up to 12 hours each year (i.e., 6 hours for each biannual MSS event) with a worst-case scenario of up to 40 hours during a year when all MSS flaring events coincide. In that case, the 40 hours would be discontinuous, occurring intermittently during the year.

Flaring from the marine flare would occur during the transfer of LNG from the marine terminal to an LNG carrier that arrives with warm cargo tanks. LNG initially introduced into warm LNG carrier tanks would vaporize to produce gas in sufficient volume requiring treatment by flaring before discharge to the atmosphere. Annova estimates these marine flaring events would occur up to two times per year, with the flaring operating continuously for up to 25 hours per event for an annual total of up to 50 hours per year. Because the marine flare would operate continuously for up to 25 hours, nighttime flaring would occur approximately twice per year.

2.1.6 Marine Facilities

The marine facilities would include a 1,500-foot-diameter turning basin and widened channel approach areas to the turning basin. LNG carriers would dock on the loading platform at the south side of the turning basin. The marine facilities would also include a material offloading facility (MOF) on the west side of the berth. The MOF would accommodate delivery by barge of major equipment and modular plant components during construction and would also be maintained for use during operation as needed. The marine facilities include the following components:

- loading platform and berth for one LNG carrier, including turning basin and access areas along the BSC;
- cryogenic pipelines and vapor return lines;
- aids to navigation;
- MOF;
- mooring dolphins;
- breasting dolphins;
- fire protection equipment; and
- tug berth area.

LNG transfer would occur through one cryogenic loading line positioned on the north side of the LNG storage tanks. The design loading rate would be a maximum of 13,500 m^3 per hour.

The loading platform would include four 16-inch-diameter marine loading arms: two for loading LNG to the LNG carriers, one for vapor return to the LNG storage tanks, and one dual-service arm capable of loading LNG or returning vapor. The vapor return line would transfer BOG from the LNG carrier to the BOG compressors. Each loading arm would be fitted with a hydraulically interlocked double ball valve and powered emergency release coupling to isolate the arm and the ship in the event of any condition requiring rapid disconnection.

2.1.7 Control, Administrative, and Support Buildings

The proposed LNG facilities include a control room, administration building, guard building, maintenance workshop, and various equipment shelters. The control room would include control and monitoring stations for facility operators as well as instrumentation, electrical equipment, and power systems. The administration building would include personnel offices, meeting rooms, workstations, a break room, and restroom facilities. The guard building would house guard staff at the entrance gate to the facility. The maintenance workshop would be co-located with the administration building and would support repairs and maintenance of facility equipment. Equipment shelters would consist of firewater pump shelters, generator shelters, electric motor control center enclosures, compressor shelters, and additional small buildings designed to comply with safety standards and guidelines.

2.1.8 Access Road

Annova would construct one new access road off State Highway 4 (Boca Chica Boulevard) that would be used as the access road for both construction and operation. Initially, an existing unpaved road would provide temporary access until construction of the permanent main access road is complete. The site plan also includes interior plant roads that would be used to access facility components, the marine berth, and site perimeter. Figure 2.1.8-1 shows the location of the access road.

In its application, Annova identified two options for the location of the site access road. Annova stated that access road alternative 2 is preferred; however, either road would be feasible. In a data request dated October 20, 2016, we requested clarification for which alternative Annova considers the proposed access road. In response, Annova confirmed that access road option 2 is the proposed access road, and alternative 2 is evaluated in this EIS as the proposed action. The alternative access road location is evaluated in section 3 of this EIS. Figure 3.5-1 shows the locations of access road alternatives.

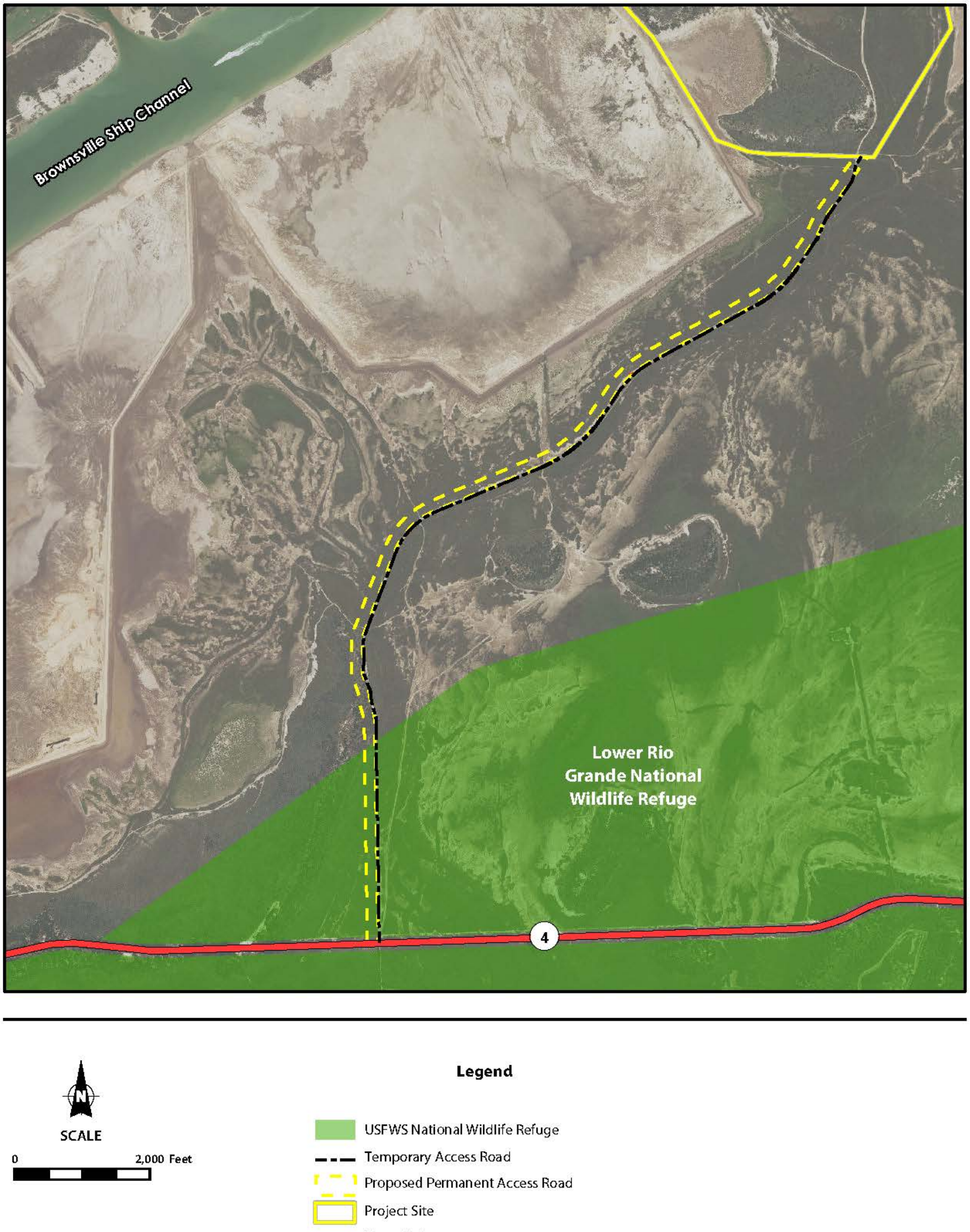


Figure 2.1.8-1 Access Road Location

The proposed width of the access road is the result of several factors, including raising the road elevation as needed to be above the 100-year flood elevation, and Cameron County standard specifications for rural roads more than 2 miles in length. Annova anticipates that two, 12-foot-wide paved travel lanes would be required to accommodate regular two-way industrial traffic, including tractor-trailers. Each side of the road would also have a 10-foot-wide gravel shoulder able to accommodate a disabled tractor-trailer without blocking incoming or outgoing traffic. Installation of fill needed to raise the road elevation to meet Cameron County specifications for a 100-year flood event would result in an additional width of 46.5 feet on either side of the road. Construction would also disturb 10 additional feet on either side of the access road. In total, this would result in a 157-foot-wide construction impact, and a 137-foot-wide operational impact for the access road. Figure 2.1.8-2 shows a typical cross section of the proposed access road.

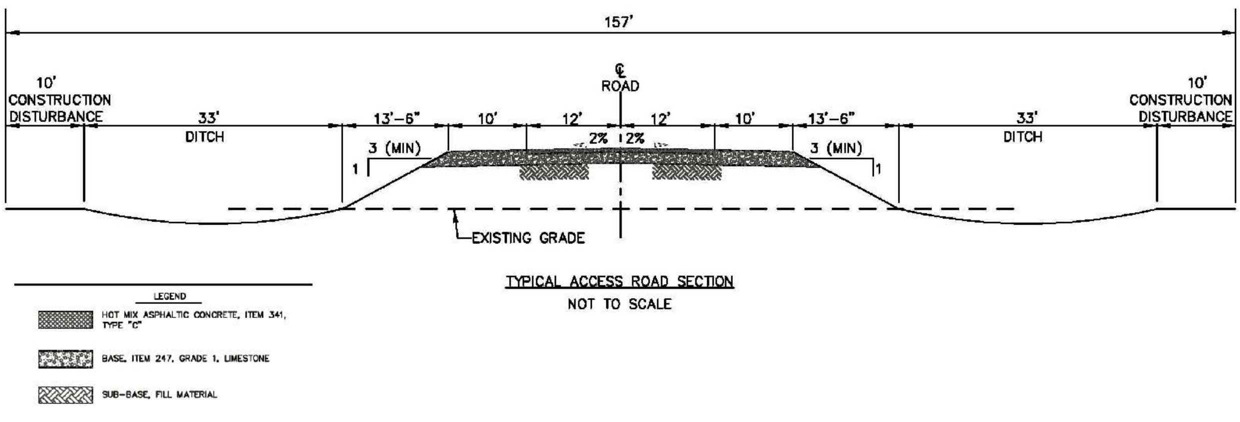


Figure 2.1.8-2 Typical Access Road Cross Section

2.1.9 Fencing and Barrier Wall

Fencing would consist of the two different types of fencing. The perimeter of the maintained LNG facilities would be surrounded by an approximately 7-foot-tall chain-link security fence with 1 foot of barbed wire at the top. This fence would prevent access to the facility except through a controlled gate. A second fence farther away from the LNG facilities would be installed around the boundary of the real estate lease option agreement area with the BND (shown as Property Boundary on figure 1-2), which would consist of a smooth-wire boundary fence (cattle-type fence with two to three wires spaced apart). This fence would mark the property and deter trespassing but would not inhibit wildlife movement.

As a result of consultation with the FWS regarding potential impact on wildlife movement, Annova revised the site plan to include an undisturbed corridor of vegetation in the southwest side of the site, between the outer smooth wire boundary fence and the inner chain-link security fence, to allow for potential ocelot movement through the area. Annova proposes to install approximately 6,000 feet of barrier wall along the west edge of the inner security fence, between the maintained LNG facilities site and the wildlife corridor, to reduce light and noise impacts on wildlife using the corridor. The barrier wall would generally follow what is shown on figure 1-2 as the westernmost Limit of Disturbance. The barrier wall would consist of posts drilled into the ground and approximately 25-foot-tall concrete panels between the posts. The barrier wall would include three-inch-high cut outs spaced along the base of the wall to allow for stormwater drainage.

2.1.10 Utilities

2.1.10.1 Power

Annova would use power from the electric grid to operate the facility, including motor drives for refrigeration compressors. STEC would deliver power to an electrical switchyard located within the Project site through a new 138-kV electric transmission line that would be permitted, constructed, owned, operated, and maintained by STEC (see discussion of non-jurisdictional facilities in section 1.4). The switchyard would include switching, protection, and control equipment, as well as transformers and a grounding system. The Project would also include a standby generator and uninterruptable power supplies to ensure back-up power would be available for critical loads and for safe shutdown of the facility in the event of loss of the STEC power supply.

2.1.10.2 Potable Water

Potable water would be delivered by the BND through an underground pipeline and stored on the site. During construction, Annova would use potable water for hydrostatic testing of pipes and some tanks, drinking water, soil conditioning, and dust control. Annova would not use potable water for hydrostatic testing of LNG storage tanks. During operation, Annova would use potable water for demineralized water, staff drinking water, sanitation, and for testing of the fire water system. See additional discussion of the non-jurisdictional water supply pipeline in section 1.4.

2.1.10.3 Communication

The telecommunication systems for the Project would include a telephone exchange, radio system, computer network, plant telecommunications network, e-mail system, and closed-circuit television system. All telecommunication systems required for Project construction and operation would comply with applicable governmental rules and regulations. In addition, marine band very-high-frequency radios would provide for communication with the LNG carriers.

2.2 LNG CARRIERS

A maximum of 80 LNG carriers per year are anticipated to call on the Annova LNG terminal, based on the maximum output at optimal operating conditions of the facility.[4] The LNG carriers that would transit to and from the terminal are expected to be foreign-flagged and are not under the jurisdiction of the Commission. As discussed in section 1.2.3, on February 13, 2018, the Coast Guard issued an LOR that recommended that the BSC be considered suitable for accommodating the type and frequency of LNG marine traffic associated with the Project. The Project would be designed to accommodate 138,000 m^3 to 177,000 m^3 LNG carriers. Smaller or larger LNG carriers than this range would require confirmation of the carrier's compatibility with

[4] The Coast Guard LOR estimated an average of 2 to 6 LNG carriers per month would call on the terminal, up to a maximum of 80 carriers per year. Therefore, the impact analyses found in this EIS (e.g., the air quality impact assessment) used 80 LNG carriers per year to ensure a conservative estimate of impacts.

the marine facility design characteristics and that the carrier's mooring system meets the Oil Companies International Marine Forum (OCIMF 2008) requirements.

The ships that transport LNG are specially designed and constructed to carry LNG for long distances. LNG carrier construction is highly regulated and consists of a combination of conventional ship design and equipment, with specialized materials and systems designed to safely contain liquids stored at a temperature of –260°F. Additional information on LNG carrier regulations and safety measures is presented in section 4.12.

2.3 LAND REQUIREMENTS

Annova estimates that approximately 550 acres would be affected by construction of the LNG terminal facilities and access road. Operation of the Project would affect approximately 412 acres. Table 2.3-1 lists the land requirements for the Project by facility.

TABLE 2.3-1

Land Requirements for the Annova LNG Brownsville Project

Facility	Land Impacted by Construction (acres)	Land Impacted During Operation (acres)	Water Impacted by Construction (acres)	Water Impacted During Operation (acres)	Total Area Impacted by Construction (acres)	Total Area Impacted During Operation (acres)
LNG Terminal, Land-Based Facilities	363	327	1	0	364	327
Marine Facilities	37	16	21 a/	21 a/	58	37
Temporary Access Road	14	0	0	0	14	0
Permanent Access Road	55	48	0	0	55	48
Brownsville Ship Channel a/	0	0	59	0	59	0
Total	**469**	**391**	**81**	**21**	**550**	**412**

a/ Impact related to dredging within the BSC for the proposed turning basin. This area is submerged and is not vegetated; therefore, this value is not included in the impact values reported in the vegetation, wetland, land-use, or soil sections of section 4.

2.4 CONSTRUCTION SCHEDULE AND WORKFORCE

As previously indicated, on September 10, 2018, Annova filed with the Commission an updated Project development schedule that included an estimated start of commercial operation in 2024. Annova estimates the total construction period would be about 48 months, from the start of site ground work for the first stage, to completion of structural, mechanical, and electrical installations for the last stage. The Project would be commissioned to allow commercial operation to start in three stages of two trains each, with the first commissioning activities for the first two trains overlapping the later construction activities.

The construction workforce would peak at 1,200 personnel during the height of construction, with an average of 700 on-site workers per month. Annova anticipates that about 65 percent of the average 700 on-site jobs would be hired from the local area (see section 4.9.1). Annova states that most construction would occur for 50 hours per week Monday through Friday, and work would not take place on federal holidays. Dredging for the marine berth is estimated to occur in two, 10-hour shifts, 6 days per week.

Annova is proposing to use some prefabricated components, assembled off-site, to reduce on-site construction time and on-site lay-down space. Components that are prefabricated off-site would be delivered by barge or ocean-going cargo vessels and may include the liquefaction trains, gas pretreatment units, BOG compressors, and pipe racks. The modules would be prefabricated and preassembled at existing commercial facilities.

2.5 ENVIRONMENTAL COMPLIANCE AND MONITORING

The FERC may impose conditions on any authorization it may grant for the Project. These conditions may include additional requirements and mitigation measures recommended in this EIS to minimize the environmental impact that would result from construction and operation of the Project (see individual recommendations in various discussions in section 4 and a complete listing of recommendations in section 5.2).

Annova developed a Project-specific *Upland Erosion Control, Revegetation, and Maintenance Plan* (Annova Plan) and *Wetland and Waterbody Construction and Mitigation Procedures* (Annova Procedures) based, respectively, on FERC's *Upland Erosion Control, Revegetation, and Maintenance Plan* (FERC Plan; FERC 2013a) and *Wetland and Waterbody Construction and Mitigation Procedures* (FERC Procedures; FERC 2013b). The Annova *Plan and Procedures* include a number of Project-specific revisions to the FERC *Plan* and FERC *Procedures*. In an October 20, 2016, Environmental Information Request we requested clarification of several items contained in the Annova *Plan and Procedures*. Annova filed revisions to its *Plan and Procedures* on November 9, 2016. We have reviewed the revised Annova *Plan and Procedures* and find them acceptable. Differences between the Annova *Plan and Procedures* and FERC *Plan* and FERC *Procedures* are summarized in table 2.5-1, and copies are included in appendix B.

TABLE 2.5-1

Summary of Annova's Requested Changes to FERC's Plan and Procedures

Section Number	Annova Requested Change	Justification
Plan (Upland Erosion Control, Revegetation, and Maintenance Plan)		
III.B.8.	Test subsoil and topsoil as appropriate to measure compaction for preparation of seed bed.	This change reflects that there are no agricultural or residential areas within the Project site.
III.B.10	Ensure final contours are in accordance with final project grading plans (rather than pre-construction contours).	Project site would be re-contoured as needed to support facility structures and prevent potential flooding.
IV.B.5.	Segregated topsoil may not be used for constructing temporary slope breakers, improving or maintaining roads, or as a fill material, without prior approval.	Topsoil segregation not required because site does not include agricultural or residential areas.
IV.E.3.	Amend to specify hardtop (asphaltic or concrete) roadways.	This change is to specify that this requirement is specific to paved roads.
IV.F.4.c(1)	Mulch is to be applied to disturbed upland areas where needed to prevent erosion.	Due to extensive earthwork required on portions of the site, this change would allow for disturbed areas to be mulched based on temporary and permanent stabilization conditions.

TABLE 2.5-1 (continued)

Summary of Annova's Requested Changes to FERC's Plan and Procedures

Section Number	Annova Requested Change	Justification
IIV.F.4.c(2)	Mulch disturbed upland areas if construction activity is interrupted for a period of 14 days or more, such that soil stabilization becomes necessary.	This change adopts this section of the Plan to fit LNG terminal construction rather than pipeline construction and would comply with the EPA 2012 NPDES General Permit for Discharges from Construction Activities.
V.A.5.	Grade the disturbed areas to direct stormwater flows in accordance with stormwater management plans and leave the soil in the proper condition for planting.	This change adopts this section of the Plan to fit LNG terminal construction rather than pipeline construction and would be consistent with required stormwater management plans.
V.D.1.b.	Complete landscaping in accordance with final project plans.	This change adopts this section of the Plan to fit LNG terminal construction rather than pipeline construction.
VII.A.2.	Continue revegetation efforts in areas formerly disturbed by construction until groundcover provides similar pre-construction stabilization.	This change adopts this section of the Plan to fit LNG terminal construction rather than pipeline construction.
Procedures (Wetland and Waterbody Construction and Mitigation Procedures)		
IV.A.1.e.	The EI would determine if there is no reasonable alternative for hazardous materials to be stored within 100 feet of a wetland or waterbody with verification that appropriate steps (including secondary containment structures) have been taken to prevent spills and provide for prompt cleanup in the event of a spill. This applies to storage of these materials and does not apply to normal operation or use of equipment in these areas.	This change accommodates required construction immediately adjacent to the BSC, including construction of the marine berth and site earthwork activities.
V.B.1.	Dredging operations and installation of pilings within the BSC would occur during the timeframe outlined in the permit issued by the appropriate federal or state agency.	This change accommodates terminal construction and waterway work within and immediately adjacent to the BSC. The timing of work within the BSC would be in accordance with Project-specific requirements.
V.B.4.c.	Dredged spoil material would be placed on-site and into Port of Brownsville (Port) placement areas, as authorized by applicable regulatory agencies and the Port.	This change accommodates Project-specific LNG terminal dredging and construction requirements, including potential beneficial use of dredged material for fill on-site.
V.B.10.c.	Use silt/turbidity curtains as necessary to minimize transport of displaced silt, sediment, or solids while construction activities are occurring in or directly adjacent to a waterway or waterbody.	Use of silt fences and turbidity curtains are recognized industry measures for inhibiting the transport of sediment off-site for site development activities occurring in or adjacent to waterbodies.
VI.A.3	Limit disturbance to wetland areas in accordance with USACE permits and approved drawings.	This change accounts for Project-specific wetland impacts and marine dredging activities.
VI.D.1.	To facilitate perimeter patrols and security observations, a corridor external and adjacent to the primary security fence line up to 20 feet wide may be cleared at a frequency necessary to maintain the 20-foot-wide corridor in an herbaceous state.	This change adopts this section of the Plan to account for vegetation maintenance required for the Project-specific LNG terminal site rather than a pipeline right-of-way.
VII.B.1.	Perform testing and inspections of welded and non-welded pipeline systems in accordance with appropriate engineering codes and standards, before installation under waterbodies or wetlands.	This change adopts this section of the Plan to account for integrity testing of LNG terminal site components rather than a transmission pipeline.

Based on FERC's *Upland Erosion Control, Revegetation, and Maintenance Plan* (FERC 2013a) and FERC's *Wetland and Waterbody Construction and Mitigation Procedures* (FERC 2013b).

Annova also developed a preliminary Construction Spill Prevention, Control, and Countermeasure (SPCC) Plan for the Project to comply with regulations in 40 CFR Part 112, which includes measures to prevent spills from equipment and material storage areas containing oil. As defined by 40 CFR Part 112, oil includes all grades of motor oil, hydraulic oil, lube oil, fuel oil, gasoline and diesel, automatic transmission fluid, used oil, transformer mineral oil, and non-petroleum oils such as animal or vegetable oils and synthetic oils. The preliminary Construction SPCC Plan also specifies procedures, methods, and equipment requirements to prevent spills, including secondary containment and earthen berms to prevent and minimize impacts from spills during construction. We have reviewed the preliminary Construction SPCC Plan and find it acceptable, and we are recommending that Annova file its final Construction SPCC Plan prior to construction (see section 4.2.3).

Annova would employ at least one full-time environmental inspector (EI) dedicated to the Project throughout construction. The primary responsibility of the EI(s) would be to ensure all construction activities comply with environmental obligations, conditions, and other requirements of environmental permits and authorizations, document compliance, and oversee any corrective actions where needed. The EI(s) would also oversee installation and maintenance of sediment and erosion controls. Additional details of the responsibilities of the EI(s) are described in the Annova *Plan and Procedures*.

Prior to construction Annova would prepare a Project-specific Implementation Plan for review and approval by FERC. The Implementation Plan would provide details and procedures for implementing required environmental construction procedures and mitigation measures. Annova would also develop an environmental training program designed to ensure that all individuals receive training tailored to their particular role before beginning on-site work. Annova's preliminary Construction SPCC Plan also includes a requirement that the construction contractor develop a training program for job-specific personnel for oil spill prevention, preliminary response procedures, and applicable pollution control laws, rules, and regulations.

In addition to Annova's environmental compliance activities, FERC staff would conduct field inspections during construction. Other federal and state agencies may also conduct oversight or inspections to the extent determined necessary by the individual agency. After construction is completed, FERC staff would continue to monitor affected areas during operation to verify successful restoration. Additionally, FERC staff would conduct annual engineering safety inspections of the LNG terminal throughout the life of the facility.

2.6 CONSTRUCTION PROCEDURES

This section describes the general construction procedures proposed by Annova. Refer to section 4 for more detailed discussions of proposed construction and restoration procedures as they apply to specific resources, as well as additional measures that we are recommending to avoid or reduce environmental impacts.

Under the provisions of the Natural Gas Pipeline Safety Act of 1968, as amended, the proposed LNG terminal would be designed, constructed, operated, and maintained in accordance with the DOT's *Liquefied Natural Gas Facilities: Federal Safety Standards* (49 CFR 193) and the NFPA's *Standards for the Production, Storage, and Handling of LNG* (NFPA 59A, 2001 ed.). These standards specify siting, design, construction, equipment, and fire protection requirements for new LNG facilities. The LNG ship loading facilities and any appurtenances located between the LNG ships and the last valve immediately before the LNG storage tanks would comply with applicable sections of the Coast Guard regulations in *Waterfront Facilities Handling Liquefied Natural Gas* (33 CFR 127) and Executive Order 10173.

To prevent contamination of soils or surface waters during construction, Annova would implement project-specific spill prevention and response procedures in accordance with the requirements of 40 CFR 112. Annova would implement its project-specific Construction SPCC Plan during construction and would develop and implement a separate SPCC Plan during operation. The intent of these plans is to outline potential sources of hydrocarbon releases at the site, measures to prevent a release to the environment, and initial responses in the event of a spill.

Annova would also implement conditions resulting from other permit requirements and its project-specific plans and measures developed to avoid or minimize environmental impacts during construction, which are discussed throughout this EIS.

2.6.1 Land-based Facilities

2.6.1.1 Site Preparation and Workspace

Initially, the existing unpaved road leading from SH 4 (i.e., Boca Chica Boulevard) would serve as a temporary access road to convey personnel and equipment to the site. Construction of the permanent access road would occur adjacent to the temporary access road. Upon completion of the permanent access road, the temporary road would be decompacted, seeded, and allowed to revegetate naturally.

Construction would progress with clearing of vegetation and grading of the Project site. Clearing of vegetation would be limited to the areas necessary to accommodate the liquefaction facilities, marine facilities, and associated workspaces. During construction, Annova would use areas within the Project site for equipment and materials laydown, contractor yard, soil stockpiling, soil borrow, and parking. These areas would be graded and covered with gravel as appropriate. Cleared debris would be chipped and stored for use as mulch or burned.

The existing natural ground surface elevation on the site ranges from 0 feet to +29 feet (elevations in NAVD88). The elevation of the liquefaction trains would be raised +16.5 feet and the LNG storage tank area would be raised to +6 feet above ground level (the height of the top of the LNG storage tank would be approximately 186 feet NAVD88). Excavation within the Project site would provide fill material that would be used in part to raise the elevation of these components (in addition to the use of pilings). Conventional mechanical earthmoving equipment such as scrapers, bulldozers, backhoes, excavators, and front-end loaders would be used. Following initial excavation and grading activities, security fencing would be installed to control site access. Construction of the marine facilities would occur at the same time as site clearing and grading (see below). Once the MOF is constructed, materials for the facility installation would arrive via the BSC, and construction of the aboveground facilities would begin.

2.6.1.2 Construction of Aboveground Facilities

The general construction process for aboveground facilities at the LNG facility would include the following activities:

- installation of piles and underground utilities during both the excavation and raising of the site elevation;
- foundation work in areas where the site elevation is raised, beginning in the LNG storage tank area and progressing outward to include process equipment sites;
- installation of major equipment, including process modules, and construction of the LNG storage tanks and installation of pipe racks;
- installation of process equipment, utility piping, and electrical instrumentation; and
- construction of buildings, including the control, maintenance, and administration buildings.

2.6.1.3 Foundations

Foundations would consist of both deep foundations for large, heavily loaded structures and shallow foundations for lightly loaded structures. Annova performed site-specific geotechnical evaluations to determine the soil conditions and the appropriate foundation design. The major site components requiring pile foundations include process equipment, equipment and pipe rack modules, the LNG loading platform, and the LNG storage tanks. The Project would require 7,817 concrete piles for the foundations. Table 2.6.1-1 provides additional information on the number and type of piles required to support foundations of the LNG storage tanks and the liquefaction facilities. The pile design and installation would comply with the *Draft Seismic Design Guidelines and Data Submittal Requirements for LNG Facilities* and applicable federal and state codes (FERC 2007). Following installation of the piles, installation of the LNG storage tank foundations would include installation of sand beds, formwork and reinforcement steel, settlement monitoring system, and pouring of the concrete slabs.

TABLE 2.6.1-1

Estimated Pilings Required for LNG Storage Tanks and Liquefaction Process Facilities

Facility	Pile Type	Depth	Dimension	Number	Installation Method	No. Blows per Pile	Duration (days)
LNG Storage Tanks	Concrete	-77 feet	14x14 inch	2,808	Impact hammer	1,275	132
Liquefaction Process Facilities	Concrete	-27 feet	14x14 inch	7,009	Impact hammer	650	176

2.6.1.4 LNG Storage Tank Construction

Construction of each of the two single-containment LNG storage tanks on the pile foundations would consist of installing the outer carbon-steel tank walls and roof dome, insulation, a 9 percent nickel steel secondary bottom, and inner container annular and bottom plates. Next would include installation of internal accessories, including pump columns, instrument wells, and purge and cool-down piping. The final phase would be installation of external accessories, including roof platforms, walkways, and piping. After completion of all insulation system installations, the tanks would be visually inspected and cleaned.

Milled perlite would be thermally expanded on site. The temporary on-site perlite expansion would use a tractor-trailer-mounted mobile expander unit and a mobile delivery unit. The expander package would include perlite ore receiving equipment, a natural gas-fired furnace, conveyors, cyclones, and bag filters. The delivery unit would include bins for expanded perlite, valving, and air compressors for delivery. The perlite ore would be fed from the delivery truck to the expander unit by conveyance, heated to allow expansion, conveyed through a series of cyclones to a set of tanks that would then be pressurized with air to allow the expanded perlite to flow to the tank top and into the annular space. The perlite expansion operations would require approximately 4 to 6 months to complete, after which the tractor-trailer-mounted mobile expander unit and mobile delivery unit would be removed from the site.

2.6.1.5 Hydrostatic Testing

The LNG storage tanks would be hydrostatically tested in accordance with the requirements of the American Petroleum Institute Standard 620. The inner tank would be filled with water from the BSC at an estimated rate of 2,000 gallons per minute and pressurized to verify its strength. Annova does not anticipate the need to add biocides or corrosion inhibitors or perform desalination of the hydrostatic test water. The inner tank would be comprised of nickel alloy, which would resist corrosion for the short duration of the testing, and the tanks would be flushed and cleaned with fresh water following completion of testing. The estimated duration of the entire hydrostatic testing program for the two LNG storage tanks would be approximately 8 weeks.

Upon completion of hydrostatic testing, the test water would be discharged back into the BSC at a rate of approximately 1.8 million gallons per day. Annova would submit an application for the NPDES permit and the Railroad Commission of Texas (RRC) Hydrostatic Test Water Discharge permit and comply with testing and monitoring requirements prior to discharge.

Piping would be tested using hydrostatic testing at 1.5 times design pressure (for piping carrying natural gas) or pneumatic testing methods (for cryogenic piping carrying LNG). Pneumatically tested cryogenic piping would be filled with dry air or nitrogen at 1.1 times design pressure. Testing would be performed in accordance with American Society of Mechanical Engineers Standard B31.3.

2.6.1.6 Site Restoration

Following construction, site restoration would include clean-up, grading to the final design elevations, installing permanent erosion control measures, and revegetation. Stabilization of disturbed areas would be in accordance with the Annova *Plan* and *Procedures*. Upon completion of final site stabilization, land within the Project site would be in one of the conditions listed below:

- built facilities, including concrete or gravel – would include the liquefaction facilities and buildings, or any concrete, paved, or gravel surfaces;
- mowed or highly maintained – would include areas revegetated with turf grasses such as Bermuda grass, and would be mowed regularly;

- non-mowed or low maintenance – would include areas revegetated with native meadow grasses such as buffalo grass, which would be mowed infrequently only to prevent growth of brush or trees;
- restored temporary workspace (fence lines) – would include areas revegetated with native grasses and allowed to revert to pre-construction land covers with no planned vegetation maintenance. This would include about 4.9 acres of wetland; and
- restored temporary workspace (borrow area) – would include area planted in native grasses with the goal of restoring to a Gulf Coast: Salty Prairie land cover per the TPWD's *Ecological Mapping System of Texas* with no planned vegetation maintenance.

2.6.2 Marine Facilities

A description of the construction of the major marine facility components is below.

2.6.2.1 Marine Berth

The marine berth would be constructed using both land-based excavation and dredging. Land-based excavation would occur in land areas and the excavated material would be stored for later use on the Project site. A portion of the shoreline would be retained as excavation begins and serve as an earthen berm to isolate the excavated area of the berth from the BSC; however, it is expected that once excavation reaches a depth below +2 feet the excavation would require dewatering. Land-based excavation would remove the material to a depth of about -21 feet, at which point the earthen berm would be removed and the remainder of the berth would be dredged using a hydraulic cutter dredge. The berth would be dredged to the final design depth of -45 feet mean lower low water (MLLW), plus 3 feet for advance maintenance and over depth, with side slopes at a ratio of 3:1 where sheet piling is not used.

Material removed by land-based excavation would be used for on-site fill where possible or placed on the Project site to support landscaping and final grading. Annova proposes to use the existing 704-acre Dredged Material Placement Area (DMPA) 5A, just west of the Project site, for dredged material not used as fill on site. Annova evaluated the use of other dredged material placement options, including use of DMPA 4A, 4B, and 5B (see the *Dredged Material Transport Plan* included in appendix C). Dredged material would be moved to the DMPA through an approximately 1.6-mile-long, floating dredged material pipeline that would be temporarily anchored along the south shore of the BSC. The dredged material pipeline would be marked with navigation lights and reflective signs and monitored to ensure the safety of area traffic. Use of DMPA 5A would require a relatively low levee crest elevation increase over the life of the project and comply with the COE requirements for levee raising over a 50-year life of the placement area. Annova also evaluated the potential for beneficial use of dredged and excavated material, and states that it is coordinating with the COE, EPA, and state and local entities to evaluate the potential for beneficial use. Potential beneficial use of dredged material is described in detail in section 2.4 of the *Dredged Material Transport Plan* in appendix C of this EIS, and in Annova's application to the COE.

Table 2.6.2-1 provides estimates of the areas and volumes of excavated and dredged materials, by method and placement.

TABLE 2.6.2-1 **Summary of Excavated and Dredged Material**						
Project Facility	Method and Depth	Area (acres)	Duration (working days)	Volume (cubic yards)	Volume by Soil Texture a/ (cubic yards)	Placement Location
Marine Berth and Turning Basin (South)	Excavation of Topsoil	39	39	60,000	Clay	Project site
	Excavation to +2 feet NAVD88			530,000	Clay	
	Excavation from +2 feet NAVD88 to 20.85 NAVD88	76	90	1,125,000	Clay	
	Dredging to -45 feet MLLW b/		145	3,520,000	Sand – 3,520,000	Dredged Material Placement Area 5A
Turning Basin (North)	Dredging to -45 feet MLLW b/	20	31	726,000	Clay – 573,000 Sand – 153,000	Dredged Material Placement Area 5A
Total Excavation for Placement on the Project site				1,715,000	Clay -1,715,000	
Total Material for Dredged Material Placement Area 5A				4,246,000	Clay – 573,000 Sand – 3,673,000	
Total Material Excavated and Dredged				5,961,000	Clay – 2,288,000 Sand – 3,673,000	

a/ Volume includes advance maintenance and overdepth volumes.
b/ Based on soil borings that show clay layers to -35 feet North American Vertical Datum of 1988 (NAVD88) and sand from -35 to -65 feet NAVD88.
Key: MLLW = mean lower low water

The marine berth would also require installation of pilings. Pilings for the mooring dolphins and access trestle would be installed from land following land-based excavation but prior to removal of the earthen berm. Pilings for the breasting dolphins would be installed using in-water equipment. Table 2.6.2-2 summarizes the number, type, and installation methods for pilings required for the marine berth.

TABLE 2.6.2-2 **Pilings Required for the Marine Facilities**							
Facility	Pile Type	Depth (feet NAVD88)	Diameter (inches)	Number	Installation Method	Blows per Pile	Duration (days)
Breasting dolphins	Monopiles	-133	96	4	Impact hammer, in water	3,625	5
Dolphin walkway support	Steel piles	-76	42	3	Impact hammer, on land	2,900	2
Mooring dolphins	Steel piles	-131	42	24	Impact hammer, on land	3,360	6
Trestle	Steel piles	-152	36	12	Impact hammer, on land	3,190	3
MOF	Steel piles	-156	30	241	Impact or vibratory hammer a/, on land	3,725	60
MOF	Steel sheet piles	-63	700 mm (Type AZ-37-700)	923 linear feet	Impact or vibratory hammer a/, on land	1,000	20
LNG Carrier Loading Platform	Steel piles	-152	42	28	Impact hammer, on land	3,400	7

a/ To be determined during engineering.
mm = millimeters

2.6.2.2 Material Offloading Facility

The initial excavation and dredging of the marine berth would create a berth of sufficient size to accommodate the MOF, which would be constructed on the west side of the marine berth.

The MOF would include a retaining wall consisting of a combination of piles and steel sheet bulkhead. The MOF deck would consist of a series of driven piles. The number, type, and installation methods for pilings required for the MOF are included in table 2.6.2-2.

2.6.2.3 LNG Carrier Loading Platform

Pilings for the LNG carrier loading platform would be installed following completion of dredging. Installation of berth piping, equipment, utility hookup, and commissioning of the loading system would follow pile installation. The number, type, and installation methods for pilings required for the LNG carrier loading platform are included in table 2.6.2-2.

2.6.2.4 Shoreline Protection

Scour protection analysis completed by Annova indicates that protection from wind waves, vessel wakes, and LNG carrier and tug propeller scour would be required from the base of the LNG loading platform to above the water line at approximately +20 feet. Accordingly, shoreline protection would be installed at the base of the steel sheet pile bulkhead wall for the MOF, the shoreline at each end of the marine berth, and the base of the LNG loading platform and breasting dolphin piles. The shoreline protection would consist of rock riprap armoring installed by crane or long-reach backhoe. The rock for the armoring would be delivered to the site by barge.

2.6.3 Water Supply and Demand

During construction, water would be required for hydrostatic testing of pipes and tanks, drinking water, dust control, and general use. Annova would use water from the BSC for hydrostatic testing of the LNG storage tanks and would use potable water from the BND for hydrostatic testing of facility piping and other requirements. Table 2.6.3-1 provides estimates of water use requirements during construction.

TABLE 2.6.3-1

Water Supply and Demand Requirements During Construction

Component/ Use	Source	Volume - one-time use (million gallons)	Volume per Month (million gallons)	Volume - total for construction (million gallons)	Discharge Location	Discharge Rate (million gallons per day)
LNG storage tanks/ hydrostatic testing	BSC	56	NA	56	BSC	1.8
LNG facility piping/ hydrostatic testing	BND	1	NA	1	BSC	1
Potable	BND	NA	0.1	4.9	Holding tanks	NA
Dust control	BND	NA	2.7	83.2	None	NA
General uses during construction	BND	NA	1.3	110.4	None	NA
Total		**57**	**4.1**	**255.5**		

2.6.4 Stormwater Management

Annova would obtain an NPDES General Permit for Storm Water Discharges from Construction Activities and conduct activities in accordance with applicable federal and state regulations, including the development of a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP would include practices to minimize exposure of construction materials to stormwater and measures to reduce the risk of spills. In addition, Annova's preliminary Construction SPCC Plan specifies procedures, methods, and equipment requirements to prevent spills, including secondary containment and earthen berms to prevent and minimize impacts from spills during construction.

2.6.5 Solid and Hazardous Waste Management

Examples of solid waste that may be generated during construction activities include wood, metals, glass, asphalt, plastics, insulation, cardboard, paper, and rubber. Examples of hazardous waste materials that may be generated during construction activities include used oils, transmission and hydraulic fluids, antifreeze, greases, paints, and cleaning agents. Hazardous waste management is also addressed in the preliminary Construction SPCC Plan.

Annova would establish nonhazardous (solid) and hazardous waste management areas at the Project construction site for accumulation and management of the wastes pending transportation and proper disposal off site in accordance with applicable regulatory requirements and best management practices. Prior to creating or designating such areas, suitable locations would be identified based on access and suitability, and proximity to waste-producing activities or environmental features.

All solid and hazardous wastes would be collected regularly and disposed of in accordance with applicable federal and state requirements. Recyclable materials would be separated from the solid waste stream produced during construction. Solid waste and hazardous wastes would be transported in accordance with applicable DOT regulations for recycling, treatment, or disposal in compliance with federal, state, and local regulations.

2.7 OPERATION AND MAINTENANCE PROCEDURES

2.7.1 LNG Marine Traffic Along the Waterway

Annova anticipates that it would load approximately two to four LNG carriers per month when operating at full plant capacity, though the actual number of port calls would depend on future offtake agreements and the capacity of the specific vessels. At maximum output, Annova would load up to a maximum of 80 LNG carriers per year based on 138,000 m^3 vessels.

As previously indicated, although LNG carriers and their operation are directly related to the use of the proposed LNG terminal, they are not subject to the NGA Section 3 authorization sought by Annova. The LNG carriers arriving at the LNG terminal must comply with all federal and international standards regarding LNG shipping. A detailed discussion of design and safety features of LNG carriers is presented in sections 2.2 and 4.12 of this EIS.

The LNG carriers would navigate through the Gulf of Mexico and the U.S. Exclusive Economic Zone (EEZ) using designated fairways and typical vessel routes to avoid obstructions and to maximize efficiency, considering distance and currents. Figure 2.7.1-1 shows anticipated routes for LNG carriers through the Gulf of Mexico. Before entering the BSC, all inbound LNG carriers would be boarded by a local Brazos-Santiago Pilot one mile east of the BS Buoy about 4 nautical miles offshore, who would then pilot the carrier to the Project site. LNG carriers would transit about 1.4 miles of the entrance channel before reaching the jetty channel through the Brazos-Santiago Pass. After transiting about 1 mile through the jetty channel the LNG carriers would begin transit of the main channel for about 7.5 miles to the Project site. LNG carriers would be restricted to daylight transits only to allow adequate visibility. Figure 2.7.1-2 shows the route from the Brazos Santiago Pass into the BSC.

Once at the Project site, tugs would maneuver the vessel within the berthing area, the pilot would direct the securing of the lines, and would turn navigational control back to the captain when the carrier is fastened. Following loading at the LNG terminal, a pilot would resume navigational control of the vessel when the mooring lines are let go. Loaded LNG carriers would transit outbound along the reverse route described for inbound LNG carriers.

In accordance with the Coast Guard's regulations under 33 CFR 165.805(a)(2), LNG carriers would have a moving security zone during transit through the BSC. As a safety and security precaution, typically no vessels are allowed to meet, cross, or overtake LNG carriers in transit or otherwise enter the security zone without the express permission of the Coast Guard. At its discretion, the Coast Guard may elect to provide escort boats during LNG carrier transits to enforce the moving security zone. See additional discussion in section 4.12.

The COE is responsible for maintenance dredging of the BSC, and during Project operation Annova would be responsible for maintenance dredging of its marine berth and associated turning basin. Annova estimates that shoaling rates in the marine berth would be greater than those in the main channel. Based on estimated current annual shoaling rates within the BSC of approximately 10 cubic yards per linear foot, Annova estimates that maintenance dredging would generate up to 100,000 cubic yards of material annually. Material from maintenance dredging would be placed into DMPA 5A. See additional discussion in section 4.3.2.2.

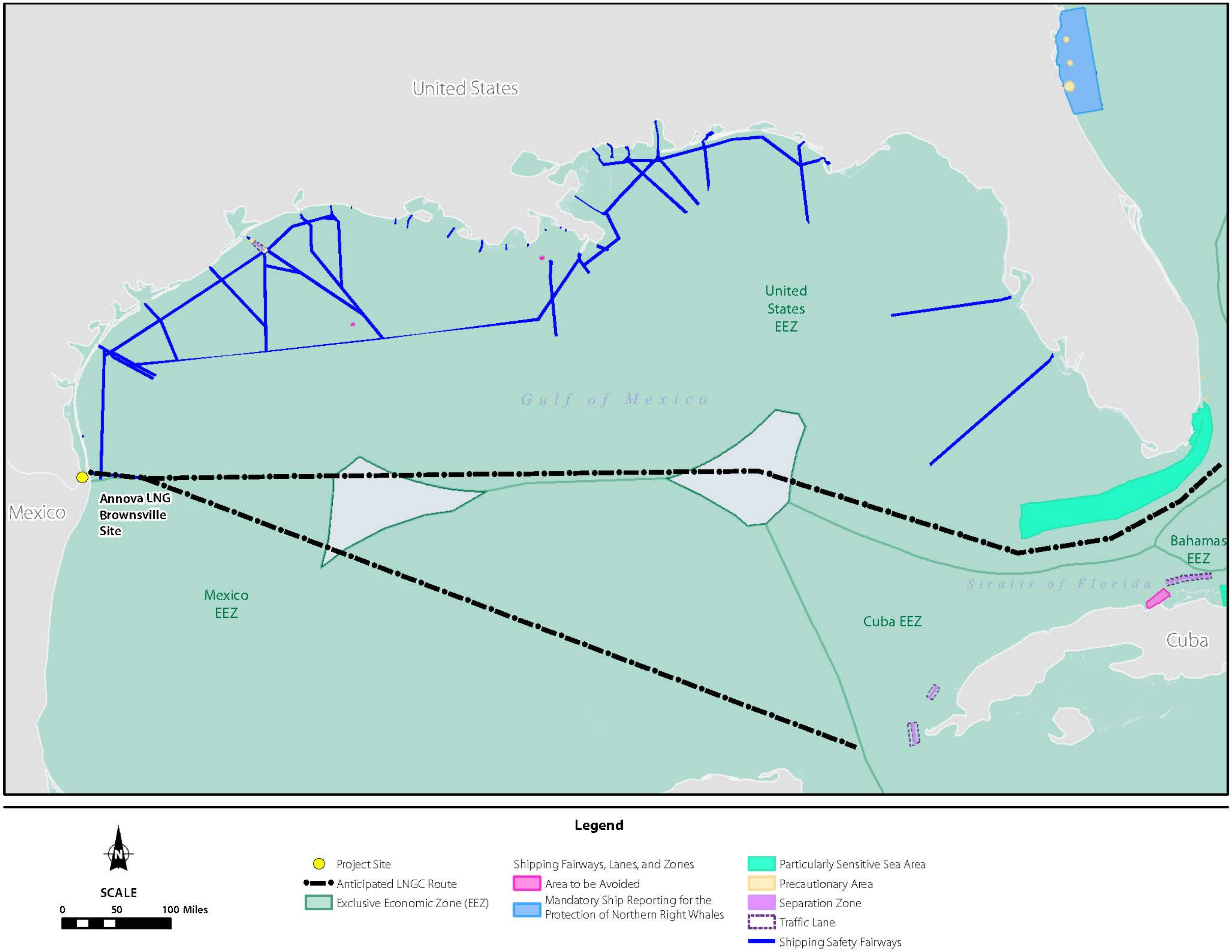


Figure 2.7.1-1 Anticipated LNG Carrier Routes in the Gulf of Mexico

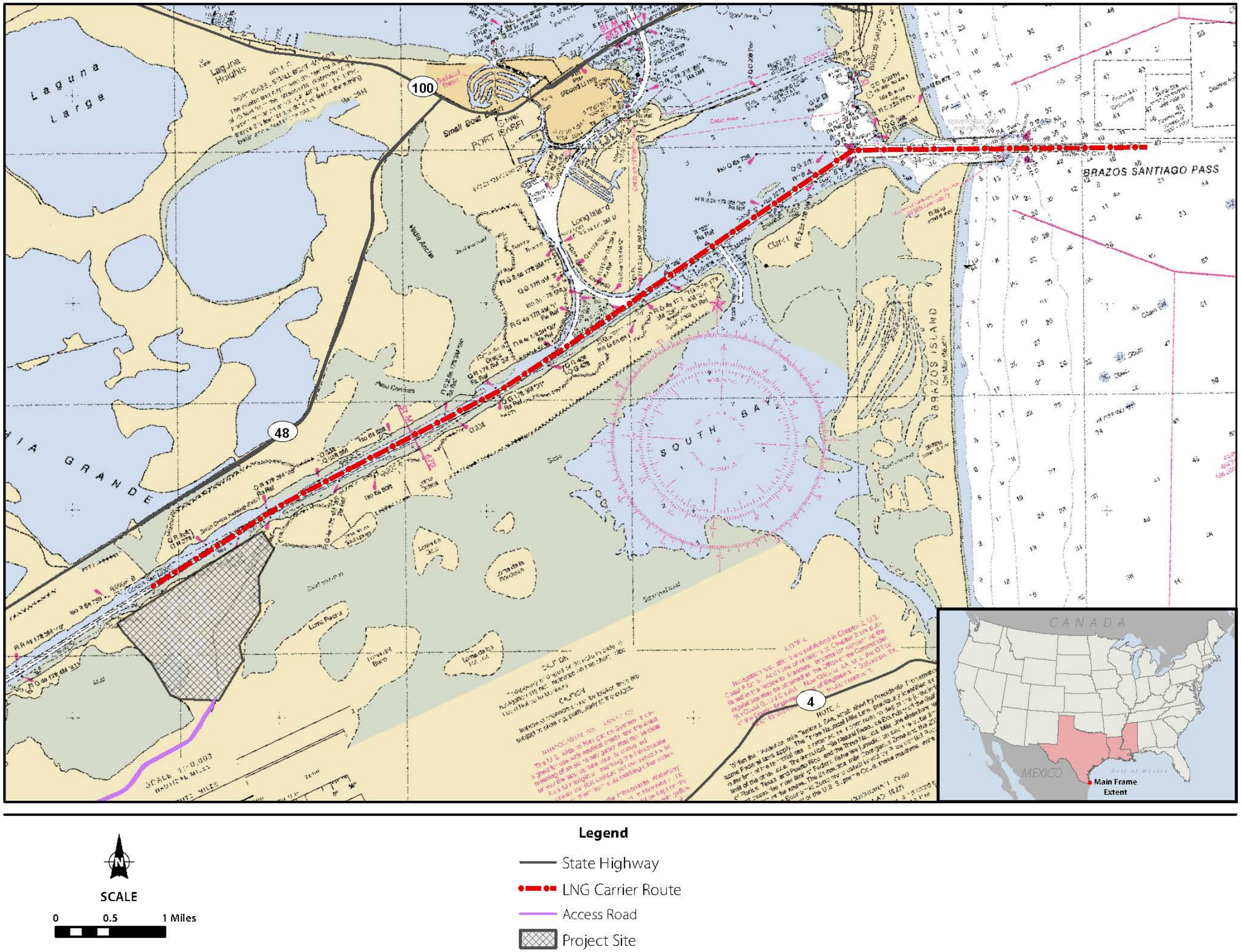


Figure 2.7.1-2 LNG Carrier Route within the Brownsville Ship Channel

2.7.2 LNG Terminal Facilities

Annova would operate and maintain its facilities in compliance with 49 CFR 193, 33 CFR 127, 40 CFR 68, NFPA 59A, and other applicable federal and state regulations. Annova would prepare operating procedures in accordance with 33 CFR §127.305, which addresses regulatory requirements and industry standards and implement extensive training for LNG facility personnel. These procedures would address safe start-up, shutdown, cool down, and other activities, as well as routine operation and monitoring.

Operation and maintenance would initially require about 115 personnel, which would increase to up to 165 personnel when fully operational. Early staffing plans assume that the liquefaction facility would operate 24 hours a day, 7 days a week. Annova anticipates hiring approximately 35 percent of these workers from the local area. The remaining positions would likely be filled by workers with specialty skills who would relocate to the region from outside the Project area. The full-time maintenance staff would conduct routine maintenance and minor repairs, while specialized contract personnel would handle major overhauls and maintenance.

2.7.3 Water Supply and Demand

During operation, the Project would use water to support operations, for drinking and sanitary purposes, and testing of fire water pumps. Annova would obtain water from the BND during operation. Fire suppression equipment would use potable water for flushing and testing purposes. An on-site 250,000-gallon potable water storage tank would provide water necessary to conduct the monthly fire suppression system test. In an emergency, water would be withdrawn from the BSC. Table 2.7.3-1 provides estimated water consumption requirements during Project operation.

TABLE 2.7.3-1

Estimated Water Use During Project Operation

Service	Consumption (gallons/month)	Source	Continuous or Intermittent Use	Discharge
Amine system	337,000	Brownsville Navigation District a/	Continuous	None
Steam make-up b/	104,000	Brownsville Navigation District	Continuous	None
Potable c/	250,000	Brownsville Navigation District	Continuous	Wastewater Package Treatment System
General Washdown	45,000	Brownsville Navigation District	Intermittent	Wastewater Package Treatment System
Fire suppression system testing d/	69,000	Brownsville Navigation District	Intermittent	Oil Water Separator
Total	**805,000**			

a/ BND obtains potable water from the Brownsville Public Utility Board.
b/ Assumes a 3 percent blowdown requirement. To be confirmed during detailed engineering.
c/ Assumes 50 gallons/day/individual for 165 employees.
d/ Assumes a 10- to 15-minute system test.

2.7.4 Sanitary Waste

An on-site packaged sewage treatment plant would treat sanitary wastewater, which would discharge through the stormwater management system to the BSC. Sludge and solids would be directed to an on-site holding tank. Annova would contract with a sanitary waste contractor who would remove the contents of the holding tank as necessary and dispose of the contents at authorized disposal sites through the contractor's permits.

2.7.5 Ballast Water and Cooling Water

LNG carriers would arrive at the Project with empty cargo tanks and onboard ballast water to compensate for the empty tanks. Ballast water would be discharged as the LNG is loaded. The Coast Guard regulates ballast water management and established mandatory ballast water management requirements for all ships entering U.S. waters from outside the U.S. EEZ pursuant to 33 CFR 151. Ballast water discharges would also comply with International Maritime Organization standards for ballast water management as well as ballast water regulations contained in the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 as amended by the National Invasive Species Act of 1996. The Coast Guard ballast water management guidelines also include reporting and record-keeping requirements for all vessels that take up and/or discharge ballast water. See additional discussion in section 4.6.2.2.

During arrival, loading, and departure from the berth, LNG carriers would draw water (cooling water) from the BSC to keep their main engines and auxiliary equipment cool and within prescribed operating temperatures. The cooling water flow rate and volume of water required for cooling the machinery varies depending on the type of vessel propulsion and the mode of operation. Impacts and mitigation associated with cooling water are discussed further in section 4.6.2.2 of this EIS

2.8 SAFETY AND SECURITY PROCEDURES

Annova must site, design, construct, operate, and maintain the Project in accordance with the DOT Pipeline and Hazardous Materials Safety Administration's (PHMSA) *Federal Safety Standards for Liquefied Natural Gas Facilities*, 49 CFR Part 193. In addition, the Project design would meet all Coast Guard standards in 33 CFR Part 127, *Waterfront Facilities Handling Liquefied Natural Gas and Liquefied Hazardous Gas*. In particular, pursuant to the provisions of the Natural Gas Pipeline Safety Act (49 USC § 60101 et seq.) amended in 2011, the Project would be operated and maintained in accordance with the Federal Safety Standards for Liquefied Natural Gas Facilities (and as referenced in 49 CFR 193, the NFPA 59A-2001).

Coordination with and involvement of local officials would be an important component of operational safety. Annova worked with the Coast Guard and state and local agencies to prepare a draft Emergency Response Plan (ERP) that provides a framework for the guidelines and procedures to be developed (see additional discussion in section 4.12). The ERP would provide on-scene incident protocol and actions to implement during a maritime or on-land emergency. Should the Commission grant Annova's request for Section 3 authorization for the Project, Annova would submit the final ERP to FERC for approval approximately nine months prior to Project commissioning. Annova would furnish the Captain of the Port at Coast Guard Sector Corpus Christi with copies of the ERP and the Operations Manual at least 60 days prior to commencing LNG transfer operations.

2.8.1 Spill Containment

All LNG equipment and piping systems holding LNG in the process area would include a spill containment system utilizing curbed areas, troughs, open drains, and an impoundment basin to hold LNG spills.

The facility would also include a spill containment system for each process area. The condensate storage tank and the amine make-up tank would be surrounded by a perimeter concrete containment wall. Each process area would either direct liquid releases to spill containment basins or contain liquid releases within perimeter curbs. Each basin would contain stormwater removal pumps designed to remove stormwater from a 10-year, one-hour storm event. Stormwater from perimeter curbs around equipment containing oil or grease would flow or be pumped to the oily water collection sumps. Additional information regarding spill containment system operation, maintenance, and safety information is presented in section 4.12.

2.8.2 Thermal Exclusion and Vapor Dispersion Zones

The LNG facility must comply with the DOT's siting requirements in 49 CFR 193, Subpart B, which incorporates the 2001 edition of the NFPA 59A. As specified in 49 CFR 193.2057, thermal radiation protection exclusion zones must be calculated for each LNG container and LNG transfer system based on three radiation flux levels in accordance with Section 2.2.3.2 of NFPA 59A (2001 ed.) Additionally, as prescribed in 49 CFR 193.2059 and Sections 2.2.3.3 and 2.2.3.4 of NFPA 59A (2001 ed.), vapor-gas dispersion exclusion zones must be calculated for each LNG container and LNG transfer system. These LNG exclusion zones are designed to protect people and property in the event of an accident and fire at an LNG facility. More specific information regarding vapor dispersion zones and thermal radiation is provided in section 4.12.

2.8.3 LNG Carrier Safety and Facility Security

The security and safety requirements for the onshore components of the Project are governed by PHMSA regulations in 49 CFR Part 193, Subpart J – Security. This subpart includes requirements for conducting security inspections and patrols, liaison with local law enforcement officials, design and construction of protective enclosures, lighting, monitoring, alternative power sources, and warning signs. The requirements for safety and security of the marine facilities are contained in Coast Guard regulations in 33 CFR Part 127 and 33 CFR Part 105, respectively. Annova would develop and implement a Facility Security Plan (FSP), which must be approved by the Coast Guard, and would implement any applicable PHMSA security requirements not otherwise covered by the FSP.

Safety and security features would include security fencing, lighting, access control, and closed-circuit television. Access through the plant gate and buildings would be in accordance with the FSP. Closed-circuit television cameras would permit viewing of the Project site, and a security staff would man the facility at all times. The facility would include sirens audible in all locations, in compliance with Coast Guard LNG facility regulations (33 CFR Part 127). Plant security would include a perimeter fence consistent with established BND protocol.

When an LNG carrier is at the marine berth, the gate at the jetty shore side entrance would close with security present as long as the LNG carrier remains at the facility. A standby tug at the marine berth would provide any operational support, and security vessels would keep other marine traffic on the BSC away from the LNG carrier while docked.

2.8.4 Hazard Detection System

Hazard detectors for the LNG terminal would be installed throughout the facilities to give operations personnel a means for early detection and location of released flammable gases and fires. The hazard detection system would be designed in accordance with NFPA requirements and other applicable standards. The hazard detection system would include detectors/sensors for:

- flammable gas;
- fire and flame;
- leak detection;
- high temperature;
- low temperature;
- smoke; and
- toxic gas.

Additional detail regarding the hazard detection system is provided in section 4.12.

2.8.5 Fire Protection System

The LNG terminal would include an independent fire protection system that would use water, foam, and chemical agents. The firewater supply and distribution component of this system would include water intake structures and three diesel-fired and one electric motor-driven emergency firewater pumps on the BSC and a 250,000-gallon potable water storage tank. Hydrants and monitors would be strategically located and installed to protect plant equipment and facilities. In addition, dry chemical extinguishers would be provided in each process area to allow onsite staff to address small, incipient fires. Additional detail regarding the fire protection system is provided in section 4.12.

2.9 FUTURE PLANS AND ABANDONMENT

Annova has no reasonably foreseeable plans for expansion or abandonment of the Project facilities. If future expansion plans are developed, Annova would seek the appropriate authorizations from federal, state, and local agencies. Annova anticipates at least a 25-year life span for the Project, but the facilities would be designed and capable of operating for 50 years or more with proper maintenance.

3.0 ALTERNATIVES

3.1 INTRODUCTION

In this section, we evaluate a range of reasonable alternatives, as required by NEPA (at 40 CFR 1502.14) and Commission po1icy. We also discuss other alternatives that were eliminated from detailed review because they were not reasonable or practicable. The alternatives may have been presented by Annova, cooperating and other governmental resource agencies, affected landowners, the public, and FERC staff. The range of alternatives we evaluated include the no action alternative, system alternatives, access road alternatives, and LNG process and design alternatives.

Each of the cooperating agencies with obligations under NEPA can use this alternatives analysis as part of their decision-making process. Individual agencies would ensure consistency with their own administrative procedures prior to accepting the conclusions in this draft EIS.

Evaluation Process

The purpose of this evaluation is to determine whether an alternative would be preferable to the proposed action. We generally consider an alternative to be preferable to a proposed action using three evaluation criteria, as discussed in greater detail below. These criteria include:

1. the alternative meets the stated purpose of the project;
2. is technically and economically feasible and practical; and
3. offers a significant environmental advantage over a proposed action.

The alternatives were reviewed against the evaluation criteria in the sequence presented above. The first consideration for including an alternative in our analysis is whether it could satisfy the stated purpose of the Project. An alternative that cannot achieve the purpose for the project cannot be considered as an acceptable replacement for the project. All the alternatives considered here are able to meet the project purpose stated in section 1.0 of this draft EIS.

For further consideration, an alternative has to be technically and economically feasible. Technically practical alternatives, with exceptions, would generally require the use of common construction methods. An alternative that would require the use of a new, unique, or experimental construction method may not be technically practical because the required technology is not available or is unproven. Another component of feasibility is whether characteristics of an alternative are sufficient and compatible with the proposed action. For example, based on Annova's proposed design, a waterfront site of at least 400 acres would be preferable to allow for placement of all Project components and the construction laydown area. A smaller alternative site may not be feasible.

Economically practical alternatives would result in an action that generally maintains the price competitive nature of the proposed action. Generally, we do not consider the cost of an alternative as a critical factor unless the added cost to design, permit, and construct the alternative would render the project economically impractical.

Determining if an alternative provides a significant environmental advantage requires a comparison of the impacts on each resource as well as an analysis of impacts on resources that are not common to the alternatives being considered. The determination must then balance the overall impacts and all other relevant considerations. In comparing the impact between resources (factors), we also considered the degree of impact anticipated on each resource. Ultimately, an alternative that results in equal or minor advantages in terms of environmental impact would not compel us to shift the impacts from the current set of stakeholders to a new set of stakeholders.

We considered a range of alternatives in light of the Project's objectives, feasibility, and environmental consequences. Through environmental comparison and application of our professional judgment, each alternative is considered to a point where it becomes clear if the alternative could or could not meet the three evaluation criteria. To ensure a consistent environmental comparison and to normalize the comparison factors, we generally used desktop sources of information (e.g., publicly available data, aerial imagery) and assumed the same general site area requirements. We evaluated data collected in the field if surveys were completed for both the proposed site and alternative sites. Where appropriate, we also used site-specific information (e.g., detailed designs). Our environmental analysis and this evaluation considers quantitative data where available (e.g., counts, acreage, or mileage) and uses common comparative factors such as land requirements.

Our evaluation also considers impacts on both the natural and human environments. The natural environment includes water resources and wetlands, vegetation, wildlife and fisheries habitat, soils, and geology. The human environment includes nearby landowners, residences, land uses and recreation, utilities, and industrial and commercial development near construction workspaces. In recognition of the competing interests and the different nature of impacts resulting from an alternative that sometimes exists (i.e., impacts on the natural environment versus impacts on the human environment), we also consider other factors that are relevant to a particular alternative or discount or eliminate factors that are not relevant or may have less weight or significance. In our alternatives analyses, we often have to weigh impacts on one kind of resource (e.g., habitat for a species) against another resource (e.g., residential land use impact).

The following sections discuss and analyze each of the alternatives we evaluated in sufficient detail to explain why they were eliminated from further consideration or are recommended for adoption into the Project.

Public Comments

Prior to the issuance of our draft EIS, we received about 70 comments related to Project alternatives. In response to some comments, we requested that Annova provide additional environmental information to enable us to compare alternatives to the proposed action. Annova participated in our pre-filing process (see section 1.3) during the preliminary design stage of the Project. This process emphasizes identification of potential stakeholders early in the development of a project, identification and resolution of issues before a formal application is filed with the Commission, and identification and evaluation of alternatives that may avoid or minimize environmental impact. During this process, Annova made some modifications to the proposed site layout to address stakeholder concerns identified during scoping. The changes were made to minimize impacts on wetlands and wildlife habitat on the LNG terminal site. These changes were subsequently made a part of Annova's proposed action when it filed its formal application and supplements, and as such are evaluated in section 4 of this draft EIS.

The Commission also received comments during scoping suggesting that electricity generated from solar panels, wind farms, and/or other renewable energy sources, or implementing energy conservation or efficiency measures to reduce energy use, could eliminate the need for the Annova Project. Annova's stated purpose of the Project is to operate a mid-scale natural gas liquefaction facility along the South Texas Gulf Coast for exporting natural gas to international markets. The generation of electricity from renewable energy sources or energy conservation are reasonable alternatives for a review of power-generating facilities, and states or federal entities that are contemplating new fossil-fuel based power plants may indeed decide to consider alternate forms of energy or energy conservation for a comparison of overall impacts and benefits. However, authorizations related to how the markets will meet demands for electricity are not part of the application before the Commission and their consideration is outside the scope of this EIS. Therefore, because the purpose of the Annova Project is to export natural gas to international markets, and the generation of electricity from renewable energy sources or the gains realized from increased energy efficiency and conservation are not consistent with this purpose, they cannot function as a substitute for the Project. These alternatives cannot meet the purpose for the Project and are not considered or evaluated further in this analysis.

3.2 NO-ACTION ALTERNATIVE

Our evaluation of the no-action alternative primarily addresses the effects and actions that may result if the Project is not constructed. Under the no-action alternative, the environmental impacts described in this EIS would not occur; however, the stated purpose of the Annova proposal would not be met.

In an order issued February 20, 2014, the DOE authorized the export of LNG from the Annova facility to FTA nations (DOE 2014). By law, under Section 3(c) of the NGA, applications to export natural gas to countries with which the United States has FTAs that require national treatment for trade in natural gas are deemed to be consistent with the public interest. It is reasonable to expect that if the Annova Project is not constructed (the no-action alternative), export of LNG from one or more other mid-scale LNG export facilities located near a natural gas production and distribution hub along the South Texas Gulf Coast could also be authorized by the DOE and eventually be constructed. Thus, although the environmental impacts associated with constructing and operating the Annova Project would not occur under the no-action alternative, similar impacts could occur at other location(s) in the region as a result of another LNG export project seeking to meet the demand identified by Annova. That is, LNG terminal developments of similar scope and magnitude to the proposed Project would likely result in environmental impacts of comparable significance, especially those projects in a similar regional setting.

We conclude that the no-action alternative does not meet the Project objective, and it was thus eliminated. Therefore, we do not consider it further.

3.3 SYSTEM ALTERNATIVES

To analyze system alternatives, we evaluated potential impacts associated with alternatives to the proposed action that would make use of other authorized, or proposed LNG export facilities, or possible expansion of those other facilities, that would meet the stated purpose and need of the proposed action. By definition, implementation of a system alternative would make it unnecessary to construct part or all of the proposed action. However, additions or modifications to the system alternatives may be required to increase capacity or provide receipt and delivery capability consistent with that of the proposed Project. These additions or modifications could result in environmental impacts that are less than, similar to, or greater than the environmental impacts of the proposed facility. The proponent of a system alternative would also have to be willing to undertake the financial and regulatory requirements associated with the additions or modifications.

Our analysis of system alternatives considers currently authorized, proposed, or planned[5] LNG export facilities located in the Texas Gulf Coast region of the U.S. to replace all or part of the Project. Annova's stated purpose is to source natural gas from the South Texas Gulf Coast region, however we believe it is reasonable to expand the area of our analysis of potential system alternatives to include the entire Texas Gulf Coast. We believe that the existing supply and pipeline network in the Texas Gulf Coast could meet Annova's objective for the source of natural gas, and this slightly larger region of analysis would not significantly change the duration of LNG carrier transits. We considered whether any of the recently authorized, proposed, or planned LNG export terminal projects in this region could be viable system alternatives to the Project. To be considered a viable system alternative, the other projects in this region would need to provide LNG send-out capacities similar to Annova's proposal, in addition to current or planned expansion capacities for the other terminals.

The system alternatives considered in this analysis are shown on figure 3.1-1, summarized in table 3.3-1, and described below. Although we have considered each of the authorized, proposed, or planned projects below as potential system alternatives, the market would ultimately decide which and how many of these facilities are built.

The DOE considers applications to export LNG to FTA or Non-FTA nations for proposed LNG export projects. Annova's authorization from the DOE to export natural gas to FTA nations is based on the export of approximately 342 billion cubic feet (Bcf) of natural gas per year, or up to 7.0 mtpa of LNG (DOE 2014).

To be a viable system alternative, other authorized, proposed, or planned LNG export facilities must be able to meet the same export capacity and customer base as the Project. We recognize that LNG capacity may not be fully subscribed at all facilities based on contracts executed as of the writing of this EIS. However, because the DOE's export approval is a determination that the export is in the public interest, we will not speculate that any portion of other LNG terminals' LNG capacity is in "excess" or available for use by Annova to meet its objectives. We evaluated the potential system alternatives below.

[5] Proposed projects are projects for which the proponent has submitted a formal application with the FERC; planned projects are projects that have been announced or are in the FERC's Pre-Filing phase but for which no formal application has been filed with the FERC.

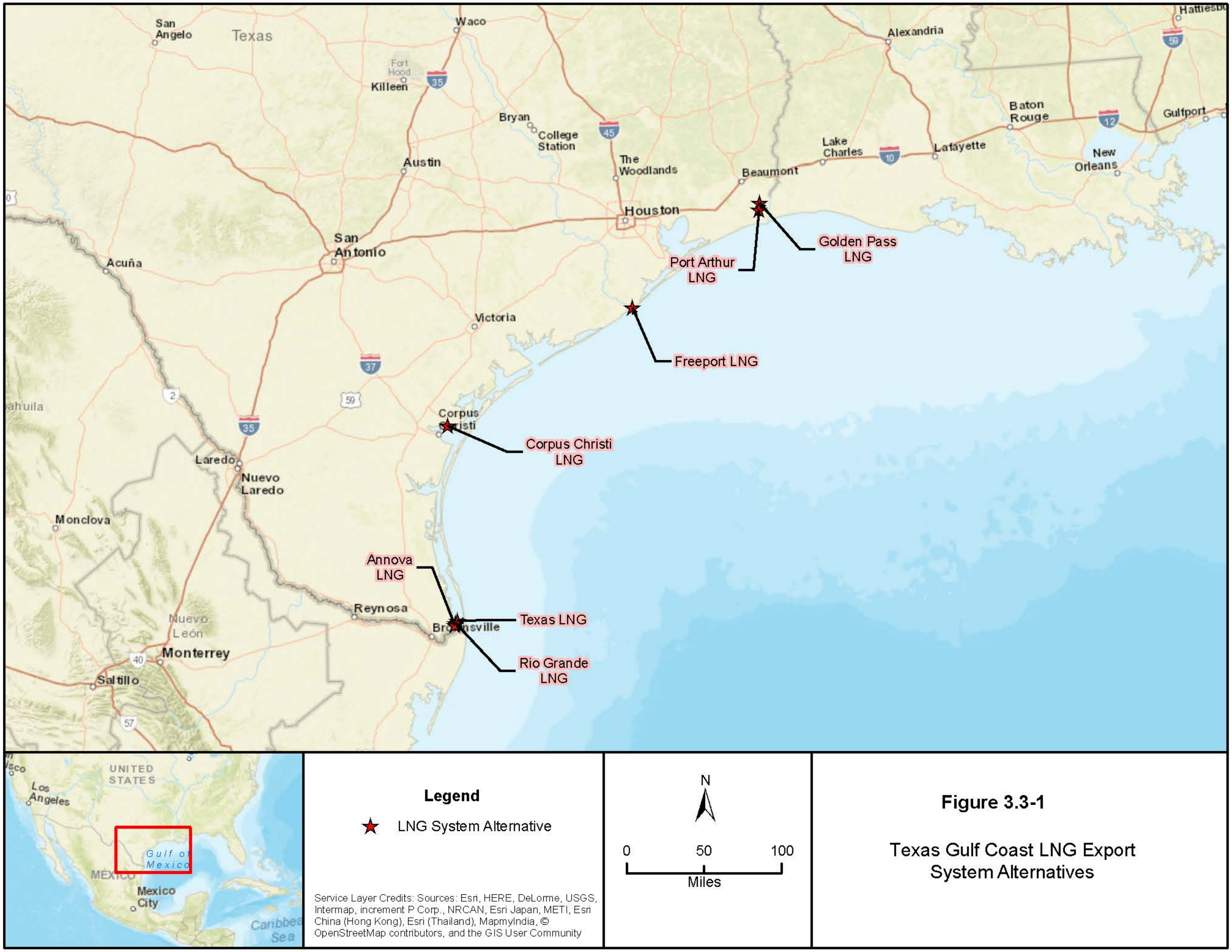


Figure 3.3-1

Texas Gulf Coast LNG Export System Alternatives

TABLE 3.3-1 Existing, Proposed, and Planned LNG Export Projects Along the Texas Gulf Coast				
Project	Location (County, State)	Distance from Project (miles)	Projected In-Service Date	FERC Docket Number
Annova Project				
Annova LNG Brownsville	Cameron, TX	0	2021	CP16-480
LNG Export Projects Approved by FERC				
Corpus Christi Liquefaction	San Patricio, TX	125	2018	CP12-507
Freeport LNG	Freeport, TX	235	2018	CP12-509, CP15-518
ExxonMobil-Golden Pass	Sabine Pass, TX	340	2020	CP14-517
Proposed LNG Export Projects (currently filed applications with FERC)				
Texas LNG	Cameron, TX	0.8	2020	CP16-116
Rio Grande LNG	Cameron, TX	0.4	2020	CP16-454
Port Arthur LNG	Port Arthur, TX	340	2023	CP17-20
Freeport LNG Train 4	Freeport, TX	235	2020	CP17-470
Corpus Christi Stage 3 Project	San Patricio, TX	125	2021	CP18-512, CP18-513

3.3.1 Currently Authorized LNG Export Facilities

There are currently three LNG export facilities authorized by FERC for construction and operation along the Texas Gulf Coast. The potential for each of these facilities to serve as system alternatives to the proposed Annova Project is described below.

3.3.1.1 Corpus Christi Liquefaction

DOE authorized Corpus Christi Liquefaction to export 767 Bcf per year, or 15 mtpa, of natural gas (DOE 2015a). In order for Corpus Christi Liquefaction to meet the export capacity and purpose of the Project, it would need to expand in size and design beyond its DOE authorized capacity to match the 7.0 mtpa required by Annova. In addition, Corpus Christi Liquefaction uses 4.5 mtpa trains, whereas the Project would use 1 mtpa trains. Annova's Project is designed with 1 mtpa liquefaction trains to target the LNG market segment of customers whose annual demand ranges from 1 to 2 mtpa. Since contracts are based on a per-liquefaction-train annual output, the 4.5 mtpa trains used for the Corpus Christi Liquefaction project could not meet the same export capacity requirement and customer base as proposed for the Annova Project, and therefore the Corpus Christi Liquefaction project is not considered a viable system alternative.

It is possible that the currently authorized Corpus Christi Liquefaction Project could be expanded, and that the expanded project could serve as a system alternative to the Annova Project. In fact, on June 28, 2018, Corpus Christi Liquefaction filed an application with the FERC for an expansion, called the Stage 3 Project (FERC Docket Numbers CP18-512 and CP18-513). See section 3.3.2 for a discussion of the potential for the Stage 3 project to serve as a system alternative.

3.3.1.2 Freeport LNG

The existing Freeport LNG terminal is on Quintana Island in Brazoria County, Texas. The import terminal started operations in 2008 and includes two 160,000 m^3 LNG storage tanks and a single berth capable of handling LNG carriers in excess of 200,000 m^3. It has a peak send out capability of approximately 1.5 Bcf of natural gas.

Freeport LNG Expansion, LP and FLNG Liquefaction, LLC (collectively, FLEX) have been authorized to add liquefaction facilities to the existing terminal to provide export capacity of up to approximately 15 mtpa of LNG. The existing Freeport LNG terminal is about 235 miles northeast of the proposed Project site (see figure 3.3-1). The authorized expansion project requires approximately 86 acres for three proposed trains, each with a capacity of 4.4 mtpa. The DOE has approved two applications for export of LNG to FTA nations, each for 511 Bcf per year, and has also approved an application to export LNG to non-FTA nations. Construction began in late 2014.

It is possible that the currently authorized Freeport LNG Expansion project could be further expanded using 1 mtpa liquefaction trains, and that the expanded project could serve as a system alternative to the Annova Project. In fact, FLEX has currently proposed a further expansion that would involve addition of a fourth liquefaction train (FERC Docket Number CP17-470). See section 3.3.2 below.

3.3.1.3 ExxonMobil-Golden Pass

The Golden Pass LNG terminal is near the town of Sabine Pass, Texas, on the western shore of Sabine Pass Channel, about 340 miles northeast of the proposed Project site (see figure 3.3-1). Operations started in 2010 on the approximately 477-acre site. The import terminal includes five 155,000 m^3 LNG storage tanks and two LNG carrier berths. It has a maximum send-out capacity of 2.5 Bcf per day (Bcf/d) of natural gas. On December 21, 2016 FERC authorized the addition of 15.6 mtpa of LNG export capacity to the LNG terminal, with the export facility using the existing LNG storage tanks, berthing facilities, and pipeline infrastructure of the import terminal. Golden Pass received approval from DOE to export LNG to FTA nations in 2012, and to non-FTA nations in April 2017. Construction of the export facility has not begun as of the date of this EIS, however start of service is projected for 2020.

DOE authorized Golden Pass to export up to 740 Bcf per year, or approximately 15.6 mtpa, of natural gas (DOE 2012). It is possible that the currently authorized Golden Pass LNG export project could be expanded using 1 mtpa liquefaction trains to add additional export capacity, and that the expanded project could serve as a system alternative to the Annova Project. It is not clear if the Golden Pass LNG terminal site could support the addition of new facilities required to add the capacity proposed by Annova. Any such project would need to be evaluated but would likely result in similar or greater environmental impacts and would not provide a significant environmental advantage over the proposed location. Therefore, the Golden Pass system alternative was not evaluated further.

3.3.2 Proposed and Planned LNG Export Projects

There are currently five LNG export facilities proposed before the FERC for construction and operation along the Texas Gulf Coast (see table 3.3-1 and figure 3.3-1). The potential for each of these proposed projects, or an expansion of these projects, to serve as system alternatives to the proposed Annova Project is described below. There are also two projects that have been announced as contemplated for development at the Port of Brownsville, Eos LNG and Gulf Coast LNG Export. Neither of these projects have begun the FERC pre-filing process, and in June 2016, Gulf Coast LNG's authorization from the DOE for FTA countries was vacated it its request. Because neither of these projects have progressed to the point they can be considered reasonable alternatives, they are not addressed further in this analysis.

3.3.2.1 Texas LNG

The Texas LNG export project is proposed to be sited on the BSC, about 3 miles northeast of the proposed Annova site. DOE has authorized Texas LNG to export 4 mtpa of natural gas (DOE 2015b). On March 31, 2016, Texas LNG filed an application with FERC in Docket Number CP16-116. The Texas LNG project would be developed in two phases, with phase 1 designed for 2 mtpa, and phase 2 designed for an additional 2 mtpa at some point in the future.

We considered whether an expansion of the proposed Texas LNG project could serve as a system alternative. Texas LNG proposes to use approximately 240 acres of its 625-acre site for permanent facilities, with the balance of the parcel (385 acres) used for temporary construction areas or retained as undisturbed lands. Over one-half of the 385 unused acres are wetlands or tidal mudflats, leaving less-than 200 acres potentially available for expansion. For an expanded Texas LNG project to meet the export capacity of 7 mtpa and serve as a system alternative to the Annova LNG Project, it would have to nearly triple in size and design beyond its DOE authorized capacity. The unused portion of the Texas LNG site would not be large enough to support the expansion needed to add 7 mtpa of additional capacity. Therefore, an expansion of the proposed Texas LNG project is not technically feasible and is not considered further.

3.3.2.2 Rio Grande LNG

The Rio Grande LNG export project is proposed to be sited on the BSC, west of the Texas LNG site, and nearly directly across from the proposed Annova site. Rio Grande LNG applied to DOE to export 27 mtpa of LNG (DOE 2015c), and on May 5, 2016 filed an application with FERC in Docket Number CP16-454.

We considered whether an expansion of the proposed Rio Grande LNG project could serve as a system alternative. Rio Grande LNG proposes to use approximately 770 acres of its 985-acre site, with the balance of the parcel (approximately 215 acres) retained as a narrow natural buffer between the site and State Route 48 to the north and between the site and the Bahia Grande pilot channel to the west, or part of the planned and permitted widening of the pilot channel. For an expanded Rio Grande LNG project to meet the export capacity and serve as a system alternative to the Project, it would have to expand in size and design beyond its DOE authorized capacity by an additional 7 mtpa. The remaining acreage within the Rio Grande LNG project site does not include enough land to add one or two additional 4.5 mtpa liquefaction trains (using Rio Grande LNG's design model), or six additional 1 mtpa liquefaction trains (using Annova's design model), and the one or two additional LNG storage tanks, that would be required to add the 7 mtpa capacity needed to be an alternative to the Project. In addition, Rio Grande LNG proposes to use 4.5 mtpa trains, whereas the Annova Project would use 1 mtpa trains. Annova's Project is designed with 1 mtpa liquefaction trains to target the LNG market segment of customers whose annual demand ranges from 1 to 2 mtpa. Since contracts are based on a per-liquefaction-train annual output, the 4.5 mtpa trains proposed for the Rio Grande LNG project could not meet the same export capacity and customer base as proposed for the Annova Project. For the reasons described above, the Rio Grande LNG project is not a feasible system alternative and is not considered further.

3.3.2.3 Port Arthur

On November 29, 2016 Port Arthur filed an application with FERC in Docket Number CP17-20 for authorization to site, construct, and operate its proposed Port Arthur LNG export project located about 6 miles north of Sabine Pass, in Jefferson County, Texas. The project includes two 6.7 mtpa liquefaction trains and total LNG production capacity of approximately 13.5 mtpa. Port Arthur has received authorization from DOE on August 20, 2015 to export up to 10 mtpa LNG to those countries with which the U.S. currently has, or in the future will have, a free trade agreement. Port Arthur has also filed an application with DOE on June 15, 2015 seeking authorization to export LNG from the project to any country with which the U.S. does not have a free trade agreement. A DOE decision on that application is pending.

We considered whether an expansion of the proposed Port Arthur LNG project could serve as a system alternative. The Port Arthur project would be within an approximately 937-acre site, the majority of which would be used for both construction and operation of the project. However, Port Arthur classifies approximately 416 acres of its proposed operation footprint as "mixed use" that does not include permanent facilities, and it is possible that additional facilities could be located within this space. Port Arthur's proposed liquefaction facilities and LNG storage tanks (for 13.5 mtpa of capacity) require about 178 acres of its total site footprint, therefore it may be possible that facilities required for an additional 7 mtpa of production (Annova's proposed capacity) could be installed within the 416 acres of mixed use. Such an alternative would require redesign and engineering and an assessment of location and size of property. In addition, any expansion of the proposed facilities at the Port Arthur site to accommodate the proposed capacity for the Annova Project would need to be fully evaluated by FERC and other applicable agencies, but such an expansion would likely result in similar or greater environmental impacts and would not provide a significant environmental advantage over the proposed location. Therefore, it was not evaluated further as a system alternative.

3.3.2.4 Freeport LNG Train 4 Expansion

On June 29, 2017, Freeport LNG filed an application with FERC in Docket Number CP17-470 for authorization to site, construct and operate Train 4 at the existing Freeport LNG facility currently under construction on Quintana Island, Texas. The proposed Train 4 Expansion would add 5 mtpa of capacity, increasing the project's total LNG export capacity to approximately 20 mtpa. On March 6, 2018, Freeport filed an application with DOE seeking authorization to export LNG, specifically associated with Train 4, from the project to any country with which the U.S. does not have a free trade agreement. That application is under DOE review. On September 5, 2018, Freeport LNG announced that it has entered into a binding agreement with Sumitomo Corporation of Americas for 2.2 mtpa of the Train 4 Expansion LNG capacity.

Although the Train 4 Expansion project is already an expansion of a previously authorized project, we considered whether an expansion of the proposed Train 4 Expansion project could serve as a system alternative to the Annova Project. The Train 4 Expansion project would require a construction footprint of about 175 acres (not including the associated pipeline), the majority of which would be located within the site of the existing facilities. For an expanded Train 4 Expansion project to meet the export capacity of 7 mtpa and serve as a system alternative to the Annova LNG Project, it would have to at least double (from 5 to 12 mtpa) in size and design beyond its proposed capacity. Based on review of the Train 4 Expansion site it does not appear there is space available to accommodate such an expansion. Therefore, an expansion of the Train 4 Expansion project is not a feasible system alternative and is not considered further.

3.3.2.5 Corpus Christi Stage 3

In June 2015, Corpus Christi Liquefaction entered into the FERC's pre-filing process (Docket Number PF15-26) and in June 2018 filed an application (Docket Number CP18-512) for the Corpus Christi Stage 3 project, which would add seven additional LNG trains with approximately 9.5 mtpa of capacity at the existing site of the Corpus Christi Liquefaction project. With the addition of the Stage 3 project, the Corpus Christi Liquefaction project would have three 4.5 mtpa LNG trains and seven 1.36 mtpa LNG trains, with a total LNG production capacity of approximately 25.4 mtpa. Corpus Christi Liquefaction has also initiated FTA and non-FTA applications with the DOE. The targeted in-service date is 2022.

Although the Corpus Christi Stage 3 project is already an expansion of a previously authorized project, we considered whether an expansion of the proposed Corpus Christi Stage 3 project could serve as a system alternative to the Annova Project. The Corpus Christi Stage 3 project would require a construction footprint of about 1,009 acres (not including the associated pipeline) and an operation footprint of about 239 acres, the majority of which would be located within areas previously disturbed during construction of the Corpus Christi Liquefaction project. For an expanded Stage 3 project to meet the export capacity of 7 mtpa and serve as a system alternative to the Annova LNG Project, it would require about a 40 percent increase in size and design beyond its proposed capacity. Any expansion of the proposed facilities at the Corpus Christi Stage 3 project to accommodate the proposed capacity for the Annova Project would need to be fully evaluated by FERC and other applicable agencies, but such an expansion would likely result in similar or greater environmental impacts and would not provide a significant environmental advantage over the proposed location. Therefore, it was not evaluated further as a system alternative.

3.4 ALTERNATIVE SITES

We received comments from the public and other federal agencies during the scoping period regarding the need to evaluate alternative sites such as industrial areas that are not in proximity to communities and important wildlife habitat. Based in part on the information provided by Annova, we evaluated alternatives sites that may also meet the stated objectives of the Annova Project. We applied screening criteria to identify sites that would be reasonable and most likely to provide some environmental advantage over the proposed terminal site. The screening criteria included:

- **Waterfront Access.** This criterion is required to allow LNG carrier access to the site. Sites with existing deepwater waterfront access via a deep-draft navigable waterway (water depths greater than 40 feet below mean sea level) were considered preferable to avoid or minimize the need for extensive new dredge work.
- **Available Land.** Siting an LNG facility requires suitable property available for development. Availability is critical since section 3 of the NGA does not grant the authority of eminent domain. In some cases, a site may be of adequate size for an LNG terminal, but the owner is unwilling to sell or lease the property.
- **Waterway Obstructions.** Waterway obstructions could impede navigation to and from the site and cause safety concerns. Although bridges with adequate clearance and spans do not present obstructions to an LNG carrier, bridges can present

navigational challenges and preference is given to sites that are free of waterway obstructions and can be reached without transit under a bridge.

- **Proximity to Natural Gas Supplies.** Sites located near sufficient natural gas supplies and existing infrastructure were considered preferable in order to provide a source of natural gas to the Project site.
- **Property Size.** Based on Annova's proposed design and the objective of providing up 7.0 mtpa of LNG, a site of at least 400 acres would be preferable to allow for placement of all Project components and the construction laydown area, and to ensure compliance with regulatory requirements for LNG vapor dispersion and thermal radiation exclusion zones.

A number of sites warranted initial consideration, but ultimately failed to satisfy all the criteria identified above. For instance, we screened four alternative sites along the Texas Gulf Coast (Port Lavaca, Port of Corpus Christi – Ingleside, Port Aransas, and Powderhorn Ranch) that were identified in other pending applications. All of these were dropped from consideration because they either lacked sufficient size or were not currently available for development. We also reviewed other sites along the Texas coast that Annova identified in its application, but none of those sites met the criteria described above and therefore they are not described in detail here.

We also evaluated whether a site in Port Mansfield approximately 30 miles north of the proposed site might be feasible. While Port Mansfield has waterfront access it would require significant dredging of the channel to meet deep-draft vessel requirements and therefore we eliminated this site from further analysis.

Finally, we identified five alternative sites for further consideration using the criteria described above. All of the sites are located on the BSC. The general locations of the proposed and alternative sites, and a comparison of each alternative site to the proposed site, are presented in figure 3.4-1 and table 3.4-1 and discussed below.

3.4.1 Proposed Site

The proposed site is located on the south/west side of the BSC, near Brownsville, Cameron County, Texas, on a site leased from the Port of Brownsville. The site is bordered to the north by the BSC, to the west by an active dredged material placement area, and to the south and east by undeveloped land. The proposed site is fully described in chapters 2 and 4 of this EIS. The proposed site meets the screening requirements described above.

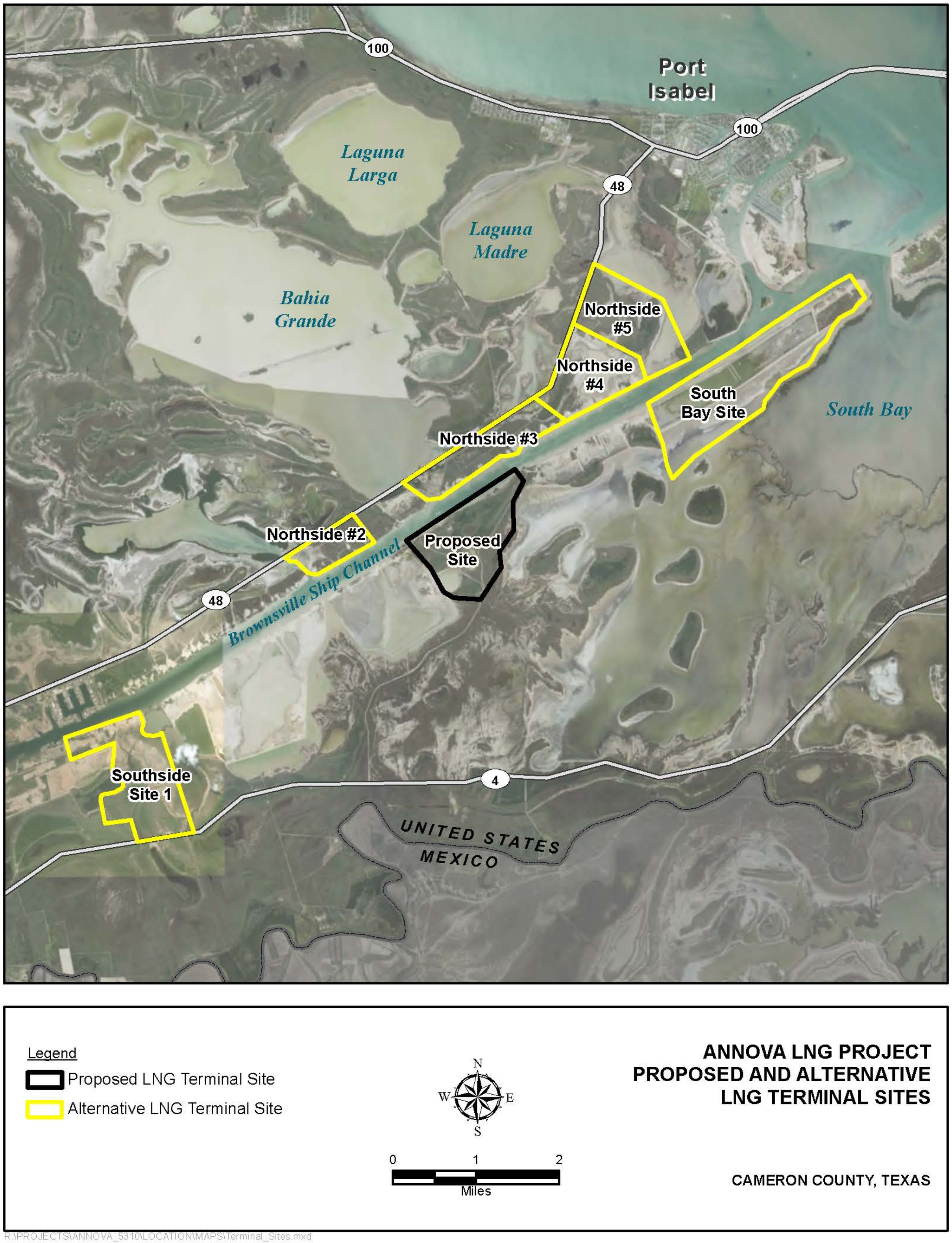


Figure 3.4-1 Proposed and Alternative LNG Terminal Sites

TABLE 3.4-1 **Comparison of the Proposed and Alternative Sites**						
Factor	Proposed Site	Northside Site 3	Northside Site 4	Northside Site 5	Southside Site 1	South Bay Site
Screening Criteria						
Waterfront access	Yes	Yes	Yes	Yes	Yes	Yes
Available land	Yes	No, under agreement	No, under agreement	No, under agreement	Yes	Yes
Waterway obstructions	No	No	No	No	No	No
Proximity to natural gas supply	Yes	Yes	Yes	Yes	Yes	Yes
Property size (acres)	655	470	503	602	770	1,280
Located in an Environmental Justice Community	Yes	Yes	Yes	Yes	Yes	Yes
Nearest noise sensitive area (NSA) (miles)	2.3	2.8	1.8	1.1	3.6	1.0
Number of NRHP-Listed or Eligible Sites within Alternative Site boundaries a/	0	0	0	1	0	0
Land Use/Land Cover (acres) (% of site acreage) b/						
Forest	4.2 (0.6)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	2.4 (0.3)	0.0 (0.0)
NWI-Mapped Wetlands c/ (acres) (% of site acreage)						
Estuarine and Marine Wetland	74.8 (11.4)	67.5 (14.4)	207.9 (41.4)	173.6 (28.7)	0.0 (0.0)	726.6 (56.7)
Freshwater Emergent Wetland	58.7 (9.0)	18.5 (3.9)	17.8 (3.5)	125.6 (20.8)	221.3 (28.7)	32.8 (2.6)
Total	**133.5 (20.4)**	**86.0 (18.3)**	**225.7 (44.9)**	**299.2 (49.5)**	**221.3 (28.7)**	**759.4 (59.3)**
Lomas and Mature, Dense Thornshrub Vegetation (acres) (% of site acreage)						
Lomas/Point Isabel clay loam (acres)	308.3 (47.1)	28.6 (6.1)	136.9 (27.2)	137.7 (22.8)	40.8 (5.3)	0.0 (0.0)
South Texas Loma Evergreen Shrubland (acres)	205.8 (31.4)	25.7 (5.5)	24.3 (4.8)	81.0 (25.0)	48.6 (6.3)	0.0 (0.0)

Sources:
a/ NPS 2015
b/ NLCD 2011
c/ National Wetland Inventory mapping

3.4.2 Northside Site 3

Northside Site 3 is on the north/east side of the BSC across the channel from the proposed site. The site is a 470-acre parcel owned by the Port of Brownsville that is currently undeveloped land. The site is bordered to the north by SR 48, to the south by the BSC, to the west by the Bahia Grande channel and undeveloped land, and to the east by undeveloped land

Northside Site 3, combined with Northside Site 4 (see below), make up the site of the proposed Rio Grande LNG Project currently being reviewed by FERC under Docket Number CP16-454. While the site is available for development, the site is currently under a lease agreement between Rio Grande LNG and the Port of Brownsville. Because the site is currently proposed for another LNG project and is under agreement, it fails to meet the availability criterion and we do not consider Northside Site 3 further.

3.4.3 Northside Site 4

Northside Site 4 is on the northeast side of the BSC about 2 miles northeast from the proposed site. The site is immediately adjacent to the northeast edge of Northside Site 3. Northside Site 4 is a 503-acre parcel owned by the Port of Brownsville that is currently undeveloped land. The site is bordered to the northwest by SR 48, to the south by the BSC, and to the east and west by undeveloped land.

Northside Site 4, combined with Northside Site 3 (see above), make up the site of the proposed Rio Grande LNG Project currently being reviewed by FERC under Docket Number CP16-454. While the site is available for development, it is currently under a lease agreement between Rio Grande LNG and the Port of Brownsville. Because the site is currently proposed for another LNG project and is under agreement, it fails to meet the availability criterion and we do not consider Northside Site 4 further.

3.4.4 Northside Site 5

Northside Site 5 is on the northeast side of the BSC about 3 miles northeast of the proposed site. The site is immediately adjacent to the northeast edge of Northside Site 4. Northside Site 5 is a 602-acre parcel owned by the Port of Brownsville that is currently undeveloped land. The site is bordered to the northwest by SR 48, to the south by the BSC, and to the east and west by undeveloped land.

Northside Site 5 is the site of the proposed Texas LNG Project currently being reviewed by FERC under Docket Number CP16-116. While the site is available for development, it is currently under a lease agreement between Texas LNG and the Port of Brownsville. Because the site is currently proposed for another LNG project and is under agreement, it fails to meet the availability criterion and we do not consider Northside Site 5 further.

3.4.5 Southside Site 1

The Southside Site 1 is on the southwest side of the BSC directly across from the Port of Brownsville Shrimp Basin, approximately 4.5 miles southwest of the proposed site. The site is approximately 770 acres owned by the Port of Brownsville that is currently undeveloped land. The site is bordered to the north by the BSC, to south by SR 4, and to the east and west by undeveloped land and open water. The site meets the screening requirements described above.

The primary disadvantages of the Southside Site 1 are its location directly across from the entrance to the Port of Brownsville Shrimp Basin, and its location 4.5 mile farther along the BSC than the proposed site. These factors would result in a greater impact on other users of the BSC during passage of LNG vessels to and from the site as a result of the moving safety exclusion zone that would be associated with each LNG vessel passage. The Southside Site 1 also abuts SR 4 directly across from the Palmito Ranch Battlefield National Historic Landmark, and the aboveground terminal facilities at the alternative site would be significantly closer to the landmark than the proposed site increasing the potential for visual impacts on the landmark. The Southside Site 1 would be about 5 miles closer to Brownsville (approximately 4.5 miles distant) compared to the proposed site (approximately 9.5 miles distant). Finally, based on NWI wetland mapping, the Southside Site 1 contains more wetlands (approximately 29 percent of the site) than the proposed site (approximately 20 percent of the site). For the reasons described above, the Southside Site 1 would not provide a significant environmental advantage to the proposed site.

3.4.6 South Bay Site

The South Bay Site is on the south/west side of the BSC approximately 4 miles northeast of the proposed site. The site is approximately 1,280 acres owned by the Port of Brownsville that is currently undeveloped land, portions of which have been previously used for dredged material disposal (placement area 4A). The site is bordered to the north by the BSC, to the south by South Bay, to the east by the channel into South Bay, and to the west by undeveloped land. The site meets the screening requirements described above.

The primary advantage of the South Bay Site is its closer proximity to the entrance of the BSC. Constructing the Project at this site would require LNG vessel passage of about 4.5 miles from the entrance of the BSC compared to about 8 miles for the proposed site. Reducing the length of LNG vessel passage within the BSC would result in potentially reduced impact on other vessel traffic during passage of LNG vessels to and from the site as a result of the moving safety exclusion zone that would be associated with each LNG vessel passage.

The disadvantages of the South Bay Site include closer proximity to the communities of Port Isabel (less than 2 miles) and South Padre Island (3 miles) compared to the proposed site (5 miles and 8 miles, respectively). The South Bay Site is also directly across the BSC from the boat channel to Port Isabel and, depending on where the LNG carrier marine berth would be located within the site, its proximity to the boat channel could increase impact on existing boat traffic within the BSC and the Port Isabel boat channel. Also, based on NWI wetland mapping, the South Bay Site contains more wetlands (approximately 59 percent of the site) than the proposed site (approximately 20 percent of the site). Finally, the entire South Bay Site is within designated critical habitat for the federally threatened piping plover. For the reasons described above, the South Bay Site would not provide a significant environmental advantage to the proposed site.

3.4.7 Conclusion on Alternative Sites

We conclude that the proposed site represents an acceptable site for the proposed LNG terminal, and that the alternative sites are either not feasible or are not environmentally preferable to the proposed site. While the Northside Sites 3, 4, and 5 are acceptable sites for an LNG terminal these sites are the subject of other proposed LNG projects and are under lease agreements with the Port of Brownsville. The proposed site is geographically separated from the populated areas of Brownsville, Port Isabel, and South Padre Island when compared to the Southside Site 1 and South Bay site.

3.5 ACCESS ROAD ALTERNATIVES

We received comments during the scoping process on the location of the access road. In consultation with the FWS, Annova identified two potential alternative access road routes in addition to its proposed route to identify potential options to minimize potential impacts on wildlife movement through the area.

Table 3.5-1 summarizes and compares the environmental features that would be affected by construction and operation of each access road alternative. Figure 3.5-1 shows the location of the proposed and alternative access roads.

TABLE 3.5-1

Comparison of Access Road Alternatives

Feature	Unit	Proposed Access Road a/	Access Road Alternative 1	Access Road Alternative 3
Total Length	Miles	3.0	3.3	2.6
Collocation with Existing Roads	Miles	3.0	2.4	0
Land Cover				
South Texas: Loma Evergreen Shrubland (dense thornshrub)	Acres b/	0.2	5.1	0
South Texas: Loma Grassland/Shrubland	Acres b/	3.7	2.7	0.4
Delineated Wetlands				
Emergent Wetlands	Acres b/	2.2	2.4	34.1
NHD Waterbodies				
Streams	Linear feet	665.2	25.1	159.8
Ponds	Acres	0.0	0.1	0.0
Wildlife Exposure to Traffic				
Total Road Distance Traveled c/	Miles	3.8	3.3	5.2
Land Ownership				
Brownsville Navigation District	Miles along centerline	2.5	3.3	0.2
FWS Owned Property – Lower Rio Grande Valley National Wildlife Refuge	Miles along centerline	0.5	0.0	1.3
Loma Ecological Preserve (owned by Brownsville Navigation District and leased by FWS)	Miles along centerline	0.0	0.0	1.1

a/ Called Alternative 2 in Annova's application.
b/ Based upon 157-foot-wide corridor for equal comparison between alternatives. Actual area of impact would be somewhat less.
c/ Total distance traveled represents the potential for exposure of wildlife to vehicular traffic. Total distance traveled was calculated along SH 4 and the access road alternative beginning from the intersection of the westernmost alternative (Access Road Alternative 1) and SH 4.

No trails or residential areas are within 0.5 mile of the three access road alternatives. The proposed access road and the other access road alternatives are located within 200 feet of the border of the Palmito Ranch Battlefield, a National Historic Landmark listed on the NRHP.

Access Road Alternative 1 is collocated with approximately 2.4 miles of existing roads, the proposed access road is collocated with approximately 3.0 miles of existing roads, and Access Road Alternative 3 is not collocated with any existing roads. The proposed access road and Access Road Alternative 1 would generally disturb a similar acreage of wetlands, but both would disturb approximately 32 fewer acres of total wetlands than Access Road Alternative 3. Additionally, Access Road Alternative 1 would impact 640 and 135 fewer linear feet of streams than the proposed access road and Access Road Alternative 3, respectively; however, Access Road Alternative 1 would impact an additional 0.05 acre of ponds than the proposed access road and Access Road Alternative 3.

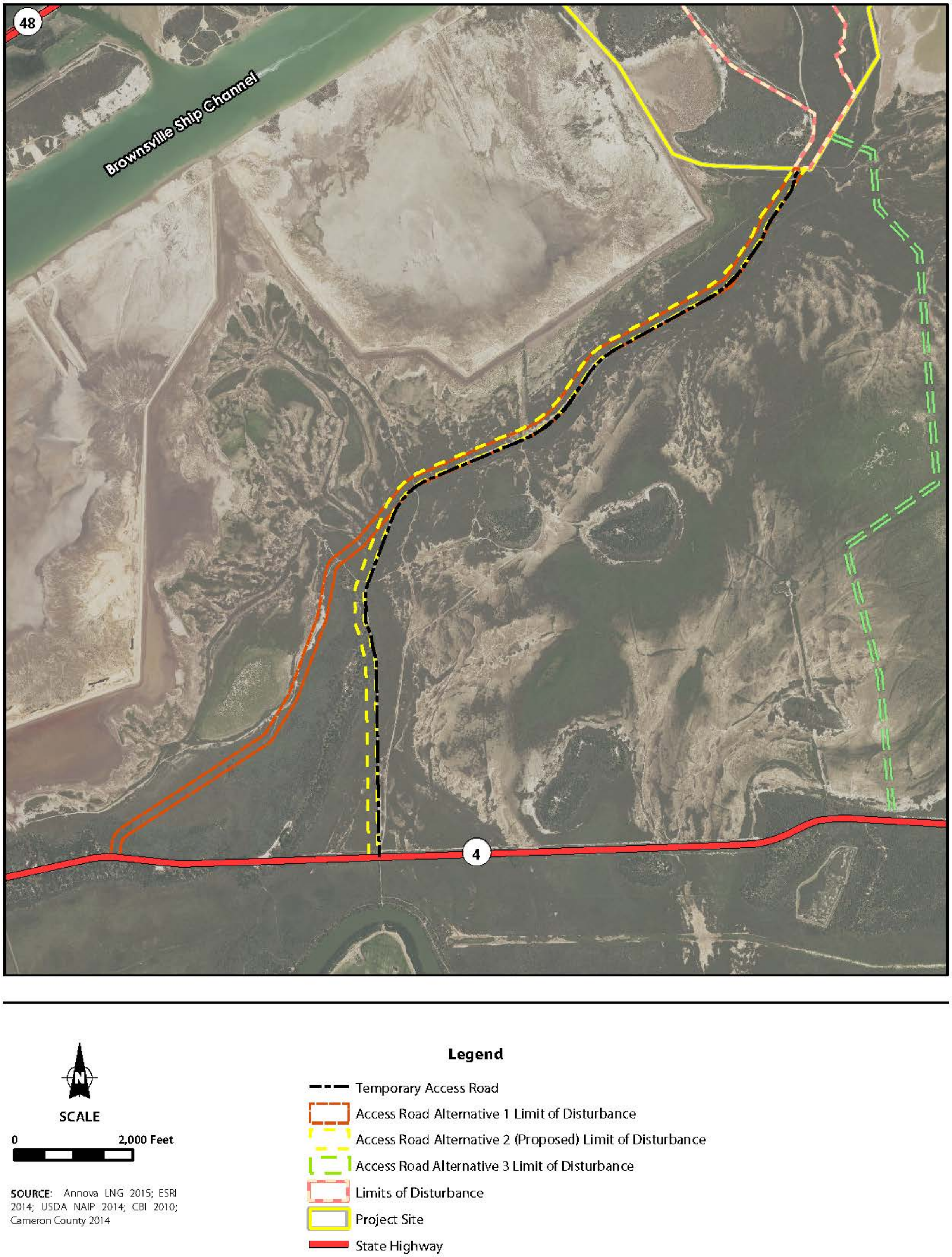


Figure 3.5-1 Location of Proposed and Alternative Access Roads

Access Road Alternative 1 is 0.36 mile longer than the proposed access road and 0.74 mile longer than Access Road Alternative 3. However, Access Road Alternative 1 would require fewer miles traveled overall than the proposed access road and Access Road Alternative 3 because the entrance to Access Road Alternative 1 is the westernmost route along State Highway (SH) 4. Therefore, vehicles would have to travel additional miles along SH 4 to reach the entry points for the proposed access road and Access Road Alternative 3, a critical factor related to the potential for ocelot mortality. Access Road Alternative 1 would require approximately 0.5 mile less of travel than the proposed access road, and 1.8 fewer miles traveled than Access Road Alternative 3. However, Access Road Alternative 1 would traverse the greatest amount of ocelot habitat, approximately 5.1 acres, compared to little or none by the other alternatives.

Access Road Alternative 1 crosses property solely owned by the BND, whereas the other access roads also cross property owned or leased by the FWS. Therefore, obtaining an easement for the proposed access road and Access Road Alternative 3 would result in additional regulatory processes and the fragmentation of FWS-managed properties.

Based on the overall analysis of these criteria and the minimization of impacts on waterbodies, wetlands, and biological resources, we believe that neither Access Road Alternative 1 nor 3 would provide a significant environmental advantage over the proposed access road. However, use of the proposed access road would require an appropriateness determination and a compatibility determination from the FWS. Annova has stated it is in discussion with the FWS regarding the appropriateness determination for use of the proposed access road. Annova states that it would construct and operate its access road on the route identified as Alternative Access Road 1 in the event the FWS' regulatory process precludes use of the proposed access road.

3.6 PROCESS AND DESIGN ALTERNATIVES

3.6.1 On-site Power Plant versus Grid-Supplied Power

At our request, Annova provided a quantitative estimate of the emissions that would result from an alternative that would use a purpose-built on-site gas-fired power plant to generate the electricity required by the Project, versus exclusive use of grid-supplied electric power as proposed. For this analysis, Annova assumed the on-site gas-fired power plant would be a nominal 400 MW combined-cycle gas-fired power plant, with a configuration and emission rates based on those recently approved for the nearby Tenaska Brownsville combined cycle power plant. Table 3.6.1-1 presents estimated emissions for a purpose-built on-site power plant, with a comparison to the potential emissions from the grid-supplied power. Emissions from grid-sourced electricity emissions were estimated using emission factors provided in the EPA's eGRID database, which provides system-wide average emission factors for regional grids across the United States, reflecting the different fuel mix used by electric generators in each region. However, eGRID emission factors are only available for nitrogen oxides (NO_x), sulfur dioxide (SO_2), and greenhouse gases (GHG), so they do not allow comparisons for emissions of other pollutants such as particulate matter and volatile organic compound (VOC). FERC staff updated Annova's analysis and selected eGRID emission factors for the Electric Reliability Council of Texas (ERCOT) region, which serves most of the state of Texas. The indirect emissions presented below have been updated to use EPA's latest eGRID 2016 emission factors, which were updated in February 2018 (EPA 2018).

TABLE 3.6.1-1

Potential Emissions Associated with On-Site Generation Alternative vs Proposed Grid-Sourced Electricity

	Annual emissions (tpy)	
Pollutant	400 MW On-Site Combined Cycle Power Plant (Alternative) a/	Indirect Emissions from 400 MW of Off-Site Generation (Proposed) b/
NO_x	125	955
VOC	431	Not available (N/A)
CO	1,134	N/A
SO_2	9	1,813
PM_{10}	40	N/A
$PM_{2.5}$	36	N/A
Ammonia	179	N/A
Sulfuric Acid Mist	7.2	N/A
CO_2e	1,703,274	1,777,000

a/ Example power plant employs BACT for NO_x control, which utilized selective catalytic reduction. Based on publicly available data for the Tenaska Brownsville natural gas combined-cycle gas turbine power plant in a 1-on-1 configuration (1 gas turbine with 1 duct burner for supplemental heat) producing approximately 400 MW. See Tenaska Brownsville Partners LLC PSD Application dated February 2013, proposed State Air Quality Permit Number 108411 and PSD Air Quality Permit Number PSDTX1350.

b/ Grid emissions would be produced by existing power generation facilities distributed across the regional grid service area. Emissions based on eGRID 2016 factors for the Electric Reliability Council of Texas (ERCOT) region (EPA 2018), assuming 8,760 hours per year utilization.

As shown in table 3.7.1-1, while the use of a purpose-built, on-site power plant would result in net emission reductions of NO_x and SO_2, and about the same amount of CO_2e emissions spread across the entire regional grid service area (which covers almost the entire state of Texas). This larger amount of emissions represents the fact that a 28.8 percent of power generated by ERCOT in 2016 was coal-fueled (ERCOT 2017), which emits larger amounts of NO_x, SO_2, particulate matter less than 10 microns in diameter (PM_{10}), and particulate matter less than 2.5 microns in diameter ($PM_{2.5}$). Additionally, 43.7 percent of power generated by ERCOT in 2016 was natural gas fueled. Many older natural gas power plants may not have emission controls as efficient as new combined cycle gas-fired plants.

Emission impacts can have both local impacts as well as regional impacts. While a small 400 MW power plant would result in local emissions increases in the area around the power plant (similar to the modeling analysis in section 4.12), it is unlikely to cause problems on a regional basis. The grid-based emissions would likely cause increased utilization of multiple power plants spatially distributed across the ERCOT grid in Texas, with only incremental increases at any one power plant site. Additionally, it is possible that the grid power would be derived from ERCOT's utility scale wind plants (15.1 percent of generated electricity in 2016). Therefore, a purpose-built gas-fired power plant would cause increases in local emission impacts around the LNG facility. It would also result in increased local noise, increased water usage to provide cooling for the power plant, and increased physical footprint and visual impacts for the Project. This is compared to the grid-derived power as proposed, where any emissions would be distributed across the ERCOT grid. Therefore, we conclude the purpose-built, on-site power plant alternative would not provide a significant environmental advantage when comparing local air quality impacts with those of the proposed generation.

3.6.2 Gas-Fired Compressors versus Electric Compressors

In response to our information request dated October 20, 2016, Annova provided a quantitative estimate of the emissions from the use of natural gas-fired turbine compressors, as an alternative to the proposed use of electric motor-driven compressors using grid-based electricity, as above. Annova determined that six General Electric (GE) model LM6000 PF+ simple cycle gas turbines would be required, one for each liquefaction train. It was assumed that each GE turbine would be equipped with dry low NO_x combustors and no post-combustion emission controls. Table 3.6.2-1 presents a comparison between the alternative of using six GE LM6000 PF+ turbines and the potential indirect emissions associated with the proposed use of grid-based electricity generation for electric motor-driven compressors. The indirect emissions presented below have been updated to use EPA's latest eGRID 2016 emission factors.

As shown in table 3.6.2-1, while the use of natural gas–fired turbine compressors would result in net emission reductions of SO_2 and CO_2e across the entire ERCOT grid, local NO_x emissions would have a net increase. The grid-based emissions would likely cause increased utilization of multiple power plants across the grid, and incremental increases at any one power plant site. Additionally, it is possible that the grid power would be derived from ERCOT's utility scale wind plants (15.1 percent of generated electricity in 2016). Therefore, , local emission impacts around the LNG facility would increase due to the gas-fired compressors. It would also result in increased local noise, increased water usage to provide cooling for the power plant, and increased physical footprint and visual impacts for the Project. This is compared to the grid-derived power as proposed, where any emissions would be distributed across the ERCOT grid. Therefore, we conclude the purpose-built, on-site power plant alternative would not provide a significant environmental advantage when comparing local air quality impacts with those of the proposed generation.

Therefore, the alternative of using gas-fired compressors would not provide a significant environmental advantage when comparing local air quality impacts with those of the proposed use of electric motor-driven compressors using grid-supplied generation.

TABLE 3.6.2-1

Comparison of Compressor Technology Emissions

	Annual emissions (tpy)	
Pollutant	Estimated Emissions from Six GE LM6000 PF+ Gas-Fired Turbines (Alternative) a/	Indirect Emissions from Electric Motor-Driven Compressors using Grid-Based Electricity Generation (Proposed) b/
NO_x	1,074	860
SO_2	18	1,632
CO_2e	1,321,404	1,599,000

a/ Emissions based on GE LM6000 PF+ air permit BACT analysis for Cheyenne Generating Station. NO_x emission rate reflects use of dry/low NO_x emission controls.

b/ Indirect emissions would be produced by existing power generation facilities distributed across the regional grid service area. Six electric motor-driven compressors are estimated to require 360 MW, or 3,153,600 MWh per year. Emissions based on eGRID 2016 factors for the Electric Reliability Council of Texas (ERCOT) region (EPA 2018).

3.6.3 Flare Design

Because of concerns about visual impact and potential impact on migrating birds from the combined warm and cold flare stack that would be 160 feet in height, we asked Annova in an environmental information request to evaluate the alternative of using a ground flare system. Annova provided an analysis of a multipoint ground flare (MPGF) system, and totally enclosed ground flare (TEGF) system, which we have used for our alternative analysis below. Table 3.6.3-1 provides an analysis and comparison of the proposed flare stack with the two ground flare design alternatives.

The primary advantage of the MPGF and TEGF alternatives would be that the flare structures would be shorter than the proposed flare stack. The shorter structures would reduce visibility of the flares and reduce the potential for migrating birds to strike the tall flare structure as proposed). As discussed in section 4.8.5 and shown on visual simulations included in appendix E, the 160-foot-tall proposed flare stack would be visible during the day from several locations surrounding the site. The flare would also be visible at night during limited flaring events which would typically only occur up to 12 hours each year, but could occur with a worst-case scenario of up to 40 hours per year (see section 2.1.5). However, the reduced visibility of the ground flares would not eliminate visual impact of the Project since the plant design includes other tall equipment such as the 186-foot-tall LNG storage tanks.

TABLE 3.6.3-1

Comparison of Proposed Flare Stack and Ground Flare Design Alternatives

Engineering Consideration	Proposed (Flare Stack)	Multipoint Ground Flare (MPGF)	Totally Enclosed Ground Flare (TEGF)
Required Quantity	2	2	2
Approximate Height	160 feet	58 feet	115 feet
Approximate Footprint	~500-foot-diameter exclusion zone	270-foot by 262-foot area	90-foot-diameter area for each
Pilot Flame Visible	No	No	No
Relief Flame Visible	Yes	No	No
Smokeless	Yes	Yes	Yes
Safety Concerns	None	Introduces 140-foot open flames near grade where a vapor cloud could accumulate	None
Process Implications	Operates at minimal flare header pressure	Requires 20-25 psi of pressure at the flare inlet, prompting larger flare headers and potentially balanced bellows or pilot relief valves	Operates at minimal flare header pressure

Disadvantages of the MPGF option include higher flare operating pressure, increased space required, and the additional safety protocols required for a ground-based flare system. Measures would also be required to prevent birds and other wildlife from entering the burner zone. Additionally, Annova states the cost of installing the MPGF alternative would be approximately three times that of the proposed flare stack. We conclude that the MPGF alternative would not provide a significant environmental advantage over the proposed flare design because it would require the largest footprint (approximately 4.5 acres of exclusion zone, compared to 1.6 acres) and would increase the area of disturbance at the site.

The primary advantage of the TEGF would be the reduced height of 115 feet compared to 160 feet for the proposed flare stack. The reduced height would reduce visibility and potential impact on migrating birds. The TEGF would also have a reduced footprint (exclusion zone) when compared to the proposed flare stack. We conclude these would not result in a significant environmental advantage over the proposed flare stack.

3.7 DREDGED MATERIAL PLACEMENT AREA ALTERNATIVES

Annova's proposed Dredged Material Transport Plan is included in appendix C and alternative placement sites evaluated in that plan are summarized here. Annova proposes to use the existing DMPA 5A located along the BSC just west of the Project site for placement of dredged material not used as fill on site. We evaluated the use of DMPA 4A, 4B, and 5B also located along the BSC as summarized below. The locations of the proposed and alternative placement areas are shown on figures 1 and 4 in appendix C.

3.7.1 Proposed Dredged Material Placement Area

The proposed dredged material placement area, DMPA 5A, is approximately 704 acres in size and is located directly west of the Project site. DMPA 5A is surrounded by a containment dike with an average height of 6 feet above the existing grade and a length of about 21,690 linear feet. The site is used for placement of maintenance dredged material from the adjacent section of the BSC. The drop-outlet structure was recently refurbished and is functioning.

3.7.2 DMPA 4A and DMPA 4B

DMPA 4A is approximately 469 acres in size and is located about 2 miles east of the Project site and south of the Port Isabel Channel. DMPA 4A was last used for dredged material placement in 2009. The drop-outlet structure is currently known to be silted and in need of refurbishment. DMPA 4B is approximately 243 acres in size and is located directly east of the Project site. DMPA 4B is surrounded by a containment dike with an average height of 7 feet above the existing grade and a length of about 16,340 linear feet. The site has not been used for maintenance dredging for several years and the drop-outlet structure is currently not functioning. Both DMPA 4A and 4B are located in federally listed endangered piping plover critical habitat unit TX-01 which would restrict use of these DPMAs for future dredge material disposal. Because DMPA 4A and 4B would be located within piping plover critical habitat, the use of these alternative areas would not provide an environmental advantage over the proposed placement area.

3.7.3 DMPA 5B

DMPA 5B is approximately 1,020 acres in size and is located west of DMPA 5A. The site is surrounded by a containment dike with an average height of 12 feet above the existing grade and a length of about 29,343 linear feet (based upon post-construction surveys provided by the BND). The site is used for placement of maintenance dredged material from the adjacent section of the BSC. The drop-outlet structure was recently refurbished and is functioning. DMPA 5B currently would have capacity to handle the proposed volume of dredged material and appears to be an acceptable alternative to the proposed area. It would require about 3.5 miles of dredge slurry pipeline to reach the center of DMPA 5B, whereas Annova's Dredged Material Transport Plan includes about 1.6 miles of dredge slurry pipeline required to reach the proposed DMPA 5A. Because it would require a longer dredge slurry pipeline, this alternative area would not provide an environmental advantage over the proposed placement area.

3.7.4 Dredged Material Placement Area Conclusions

As described above, none of the alternative dredged material placement areas would provide an environmental advantage over the proposed placement area DMPA 5A.

3.8 CONCLUSION

We reviewed alternatives to the applicant's proposals based on our independent analysis and comments received. Although many of the alternatives appear to be technically feasible, we identified no alternatives that would provide a significant environmental advantage over the Project. Based on these findings, we conclude that the proposed Project, as modified by our recommended mitigation measures, is the preferred alternative than can meet the project objectives.

4.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

In the following sections, we address direct and indirect effects collectively, by resource. In section 4.13, we also analyze the Project's contribution to cumulative impacts, by resource. The environmental consequences of constructing and operating the proposed Project would vary in duration and significance. Four levels of impact duration were considered: temporary, short term, long term, and permanent. Temporary impacts generally occur during construction, with the resource returning to pre-construction conditions almost immediately afterward. Short-term impacts could continue for up to 3 years following construction. Impacts are considered long-term if the resource would require more than 3 years to recover. A permanent impact could occur as a result of any activity that modified a resource to the extent that it would not return to pre-construction conditions during the 25-year life of the Project, such as within the footprint of the LNG terminal. We considered an impact to be significant if it would result in a substantial adverse change in the physical environment.

In this section, we discuss the affected environment, general construction and operational impacts, and proposed mitigation for each resource. We evaluated the applicant's proposed mitigation measures to determine whether additional measures would be necessary to reduce impacts; if we deemed additional measures to be appropriate, we have included them as bulleted, boldfaced paragraphs in the text. We will recommend that these measures be included as specific conditions to any authorization that the Commission may issue.

4.1 GEOLOGIC RESOURCES

4.1.1 Geologic Setting

The Project site is located on the West Gulf Coastal Plain Section of the Coastal Plain Province. The surficial geology consists of Quaternary Holocene sediments, notably alluvium of the Rio Grande valley and coastal deposits of deltaic, tidal-flat, beach, barrier island, lagoon, estuary, and dune environments. Surficial geologic units in the vicinity of the Project site include muddy floodplain alluvium; silty and sandy floodplain alluvium; clay dune and clay to sand dune deposits; undivided Holocene alluvium; and artificial fill and spoils. These sediments are underlain by the Pleistocene Beaumont and Lissie Formations, the Pliocene Goliad Sand, and the Miocene Fleming Formation and Oakville Sandstone (Page et al. 2005).

The topography of the West Gulf Coastal Plain has minimal relief. The elevation in the Project vicinity (5-mile radius) ranges from 0 to 40 feet NAVD88. The low hills in the area are aeolian (wind-deposited) landforms, referred to as lomas, with maximum elevations ranging from 15 to 40 feet NAVD88. The Project site includes three distinct lomas: Loma del Potrero Cercado, Loma del Divisadero, and the eastern portion of Loma de la Juaja.

Annova has performed a geotechnical investigation of the site (Black & Veatch 2016a) including the following components:

- Twenty-seven geotechnical borings and standard penetration tests from the surface to depths ranging between 38.5 feet (elevation of -33.2 feet NAVD88) and 200 feet (elevation of -194.3 feet NAVD88);
- soil samples for laboratory analysis and 15 pressure-meter modulus tests in conjunction with the geotechnical borings at four locations;
- thirty cone penetration tests (CPTs) to depths from 10.5 feet (elevation of -4.1 feet NAVD88) to 119.3 feet (-113.0 feet NAVD88) and three seismic CPTs to depths ranging from 90.2 feet (-83.8 feet NAVD88) to 100.5 feet (-97.7 feet NAVD88) below the existing grade to determine the dynamic properties of the soil;
- three seismic cone penetrometer test soundings;
- thirty-four vane shear tests at eight locations; and
- seventeen dynamic cone penetrometer tests.

The results of the subsurface exploration were used to characterize the site stratigraphy. Geologic sections that show the soil borings, CPTs, and stratigraphic layers are included in the Geotechnical Investigation Report (Black & Veatch 2016a). The subsurface stratigraphy consists of four distinct layers and four sublayers within the top layer (Black & Veatch 2016a). The top layer in the stratigraphy (Layer 1) consists of clay material that extended from the existing ground surface to elevations of -20 to -50 feet NAVD88. The next layer down in the stratigraphy (Layer 2) consists of sand with a bottom elevation ranging from -40 to -60 feet NAVD88. The next layer down in the stratigraphy (Layer 3) consists of a clay material extending to -150 feet NAVD88. This stratum appears interlayered with sand layers, especially on the northern portion of the site. The bottom layer (Layer 4) consists of a sand material below the elevation of -150 feet NAVD88. More information on soils and sediments is contained in section 4.2.

4.1.2 Mineral Resources

Texas is the largest producer in the nation of lignite coal, which is mostly found in narrow bands in the Texas Gulf Coast region (USEIA 2015); however, there are no known lignite coal reserves on the Project site. The nearest coal mines are located more than 150 miles northwest; while the nearest active oil/gas well is located 4.5 miles southeast of the Project site (RRC 2015). Two dry oil/gas wells are located on the Project site and one directional well is located 2,100 feet to the northwest. Based on a review of the USGS Mineral Resources Data System (USGS 2014), no mineral commodity resources occur within 0.25 mile of the Project. The nearest nonfuel industrial mineral resources (i.e., barite and strontium sulfate) are processed at the Brownsville Mineral Plant, located 15 miles west-southwest of the Project site.

Based on the lack of mineral resources around the Project site, no impacts on mineral resources are anticipated as a result of construction or operation of the Project.

4.1.3 Blasting

Based on available soils and geologic maps, and the geotechnical investigations conducted by Annova (Black & Veatch 2016b), there are no bedrock, glacial moraines, or similar obstructions within the proposed construction depth, so the need for blasting is not anticipated. Therefore, adverse impacts from blasting are not expected.

4.1.4 Paleontological Resources

No paleontological resources have been identified within the Project site. The fossil-bearing formation nearest to the surface at the Project site is the Lissie Formation, which may contain Pleistocene vertebrate fauna (USGS 2018). The Lissie Formation is expected to have more than 300 feet of overburden at the Project site (Baker 1995), which is well beyond the depth of proposed excavation or dredging. Therefore, no impacts on paleontological resources are anticipated from constructing and operation.

4.1.5 General Impacts and Mitigation

The Project site would be graded to the extent necessary to construct Project facilities including grading of all but the northeast and southwest portions of Loma Del Potrero Cercado. As a result, the LNG facilities would not alter the existing geologic conditions at the site. The final Project site would include asphalt-surfaced roads, gravel-surfaced roads, general gravel surfacing, and application of top soil, seed, and mulch for planned vegetated areas.

Construction of the marine berth and turning basins would include excavation and dredging as well as installation of pilings. Land-based excavation would occur in terrestrial areas and excavated material would be used for fill where possible or placed on the Project site.

Two dry oil/gas wells are located on the Project site and one directional well located 2,100 feet to the northwest. In accordance with TAC 16 Rule §3.14, cement plugs would be set to isolate each productive horizon and usable quality water strata in the dry oil/gas wells. Usable quality water strata is defined as all strata determined by the Groundwater Advisory Unit of the Oil and Gas Division to contain usable quality water generally less than 1,000 mg/L total dissolved solids (TDS) but can be up to 3,000 mg/l TDS. Additionally, a 10-foot cement plug would be placed in the top of abandoned wells, and casing cut off three feet below the ground surface. Since there are no other known mineral resources at the Project site, we do not anticipate that there would be impacts on mineral resources in the area.

4.1.6 Conclusion

The potential for geologic hazards such as seismicity, shoreline erosion, and flooding to impact the proposed Project facilities and measures that would be implemented to minimize those impacts is discussed in section 4.12. Based on the above discussion, and in consideration of Annova's proposed mitigation and design criteria, we conclude that the Project would have a permanent effect on geological conditions but that potential impacts would be minimized to the extent practical.

4.2 SOILS

4.2.1 Existing Soil Resources

Project site soils are derived from a mix of natural and anthropogenic processes. Historically, the Project site was a coastal floodplain comprising a mix of marshes, flats, and lomas (unique clay dunes that develop over time in arid regions through wind-driven depositional processes). However, channel dredging activities conducted during the construction of the BSC in the early 1930s introduced disturbed, saline, poorly developed dredge material to portions of the Project site (Ferguson 1976).

Soil characteristics were identified using the NRCS SSURGO database for Cameron County, Texas. The soils identified on the Project site consist of Barrada clay, Point Isabel clay loam, Sejta silty clay loam, and Twinpalms-Yarborough complex (NRCS 2015b). The results of geotechnical investigations conducted on the Project site (Black & Veatch 2016a) were also consistent with the NRCS Soil Survey data. The SSURGO data, described in table 4.2.1-1 and shown in figure 4.2.1-1, were used to evaluate the soils that would be most susceptible to impacts from the Project.

TABLE 4.2.1-1

Project Site Soil Characteristics

Map Unit	Soil Series	Prime Farmland	Ponding Frequency/Flooding Frequency	Wind Erosion Hazard	Water Erosion Hazard	Compaction Potential	Poor Revegetation Potential	Total Affected Construction Area (acres) c/
BA	Barrada Clay	No	Occasional/very frequent	Low	Slight	Severe	Yes	8
PO	Point Isabel clay loam	No	None/none	Moderate	High	Moderate	Yes	177
SE	Sejta silty clay loam	No	Occasional/none	Low	Slight	Severe	Yes	208
TwY	Twinpalms-Yarborough complex	No	None/occasional a/ frequent b/	High a/ Moderate b/	Slight	Moderate a/ High b/	Yes b/	35
W	Water	N/A	N/A	N/A	N/A	N/A	N/A	42

Source: NRCS (2015)

a/ Limited to the Twinpalms portion of this complex, 55 percent of the map unit.
b/ Limited to the Yarborough portion of this complex, 40 percent of the map unit.
c/ Numbers may not sum correctly due to rounding.

4.2.1.1 Prime Farmland

Prime farmland soils are defined as those that are best suited to food, feed, fiber, forage, and oilseed crops (NRCS 2015b). Prime farmland typically contains few or no rocks, is permeable, excessively erodible, or saturated for long periods, and is not subject to frequent or prolonged flooding during the growing season. Prime farmland is a soil-series attribute in the SSURGO database. None of the soils in the Project site are designated as prime farmland.

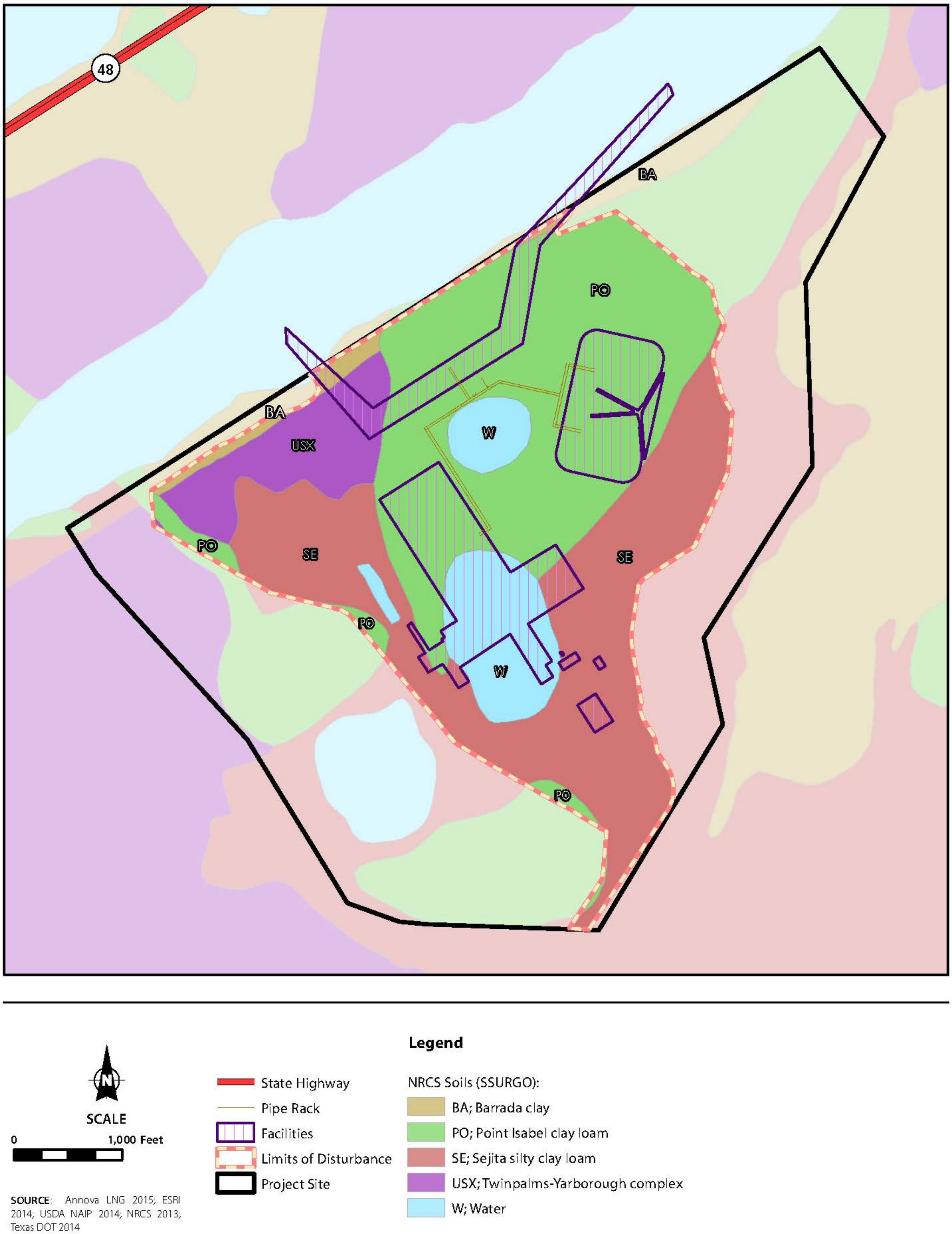


Figure 4.2.1-1 Soils Map of Project Site

4.2.1.2 Erosion

Soil erosion is a natural process driven by the action of wind or water. Factors such as rainfall intensity, wind velocity, topography, ground cover, and physical and chemical properties of the soil affect soil erosion potential. Soils most susceptible to erosion are those with bare or sparse vegetation cover, non-cohesive soils with low infiltration rates, and soils on moderate to steep slopes. As shown in table 4.2.1-1, soils found on the Project site have water erosion hazard ratings ranging from slight to high, and wind hazard ratings ranging from low to high based on soil type. The Point Isabel clay loam soils series has a high water erosion hazard rating and the Twinpalms portion of the Twinpalms-Yarborough complex has a high wind erosion hazard rating.

4.2.1.3 Compaction Potential

Compacted soils have the potential to increase stormwater runoff at the site due to the reduced infiltration rates of soils when they are compacted. Soils with fine textures and poor drainage classes are susceptible to compaction. As shown in table 4.2.1-1, all Project site soils have a moderate to severe compaction potential because they are predominantly clays or clay loams that are poorly drained and have a high shrink-swell potential.

4.2.1.4 Revegetation Potential

Successful revegetation is important for restoring soil productivity. Soil physical and chemical properties such as texture, water availability, restrictive layers, stony soil, pH, and salinity can affect revegetation success. For example, drier soils have less water available for establishing new vegetation, while coarser textured soils drain more efficiently and have less holding capacity, which can result in difficult growing conditions for many plants. The revegetation potential for soils within the Project site is generally poor, as shown in table 4.2.1-1. The revegetation potential of soils is only a concern outside of the footprint of permanent Project facilities where Annova would conduct revegetation efforts, while areas within the footprint of permanent Project facilities would not be revegetated.

4.2.2 Contaminated Soils

There are no known contaminated soils in either the Project site or the BSC. It is not expected that contaminated sediments would be found during construction based on the on-site soil investigation results and previous studies. Annova reviewed sediment sampling results from several previous efforts and all sample results were below regulatory limits for the water use. Section 4.3 provides additional information about sediment sampling results.

Waterbodies and shorelines are highly susceptible to contamination through the release of various chemicals from human activities that occur over time along, within, or near the waterbodies. Therefore, the COE conducted sediment sampling in the BSC for contaminants as part of the Brazos Island Harbor (BIH) Channel Improvement Project. The results indicate that no contaminants of concern would be expected to be found in BSC sediments (COE 2013a).

4.2.3 General Impacts and Mitigation

Project site soils would be permanently affected by Project facilities, paved or gravel roads, stormwater detention and evaporation ponds, or other impervious surfaces. Construction at the Project site would involve grading and raising the site elevation with fill material, excavating for building foundations, compacting soils, creating impermeable surfaces, and trenching to install necessary piping and utilities. About 600,000 to 700,000 cubic yards of fill material would be imported from an off-site location, to be determined prior to construction. Construction activities such as clearing and grading could accelerate soil erosion processes. Construction activities could also cause a temporary loss of soil structure, increasing the potential for erosion and compaction. Left exposed, disturbed soils and soil stockpiles may erode from both wind and water. No soils would be disturbed or exposed during operation of the Project.

Annova would adhere to its best management practices (BMP) contained in its *Plan* and *Procedures*, which were developed in accordance with applicable regulations and permit requirements to minimize soil impacts. Adherence to the measures in the Annova *Plan* and *Procedures* would minimize environmental impacts during construction and operation through sedimentation control and workspace restoration. Additionally, Annova has developed a preliminary draft Construction SPCC Plan for the Project. Annova would implement its project-specific Construction SPCC Plan during construction and would develop and implement a separate Operation SPCC Plan during operation.

Clearing of vegetation would be limited to the areas necessary to accommodate the liquefaction facilities, marine facilities, and associated workspaces. During construction, Annova would use areas within the Project site for equipment and materials laydown, contractor yard, soil stockpiling, soil borrow, and parking. These areas would be graded and covered with gravel as appropriate. Cleared debris would be chipped and stored for use as mulch or burned as appropriate (see section 2 for more details regarding the construction process). Where cut and fill would occur, topsoil would be segregated from subsoil during construction and stored for workplace restoration. The topsoil stockpiles would be stabilized to minimize erosion from wind and water using the sediment control measures used for construction-disturbed soils, as described below.

Project site soils are susceptible to wind and water erosion including areas of high erosion hazard. As required by the Annova *Plan* and *Procedures*, temporary slope breakers and sediment barriers (e.g., silt fences, straw bales, straw logs) would be used to reduce runoff velocity and divert water to protect adjacent surface waters and wetlands by controlling the movement of sediment from construction work areas. During clearing and initial grading, sediment barriers installed at the base of slopes within 50 feet of waterbodies and wetlands near the Project site, would minimize the potential for adverse impacts until permanent revegetation is determined successful. Annova's Environmental Inspectors would inspect erosion control measures for compliance with the requirements of the Annova *Plan* and *Procedures* and the required mitigation measures. Mulch (consisting of straw, erosion-control fabric, or an equivalent) would be used to reduce water and wind erosion. As outlined in the Annova *Plan* and *Procedures*, mulch would be applied to stabilize the soil surface or to reduce wind and water erosion in areas where erosion and sedimentation is not controlled with other erosion control measures. Where applied, mulch would be spread uniformly over at least 75 percent of the disturbed ground surface to minimize erosion from construction work areas.

Wave generation and propeller-induced scour from Project-related ship traffic in the BSC may cause erosion along the shoreline. During operation of the Project, vessel traffic in the BSC would increase by approximately two LNG carriers per week, along with supporting vessels as needed. LNG carriers would travel at low speeds within the BSC. Rock rip-rap protection would be placed along the terminal shoreline at the Project facilities to prevent erosion due to vessel propellers or bow thrusters. Annova developed a two-dimensional hydrodynamic model to examine Project impacts on water velocity, or current speed, in the BSC to evaluate the potential for increased shoreline erosion. The model assessed changes in BSC water velocity with and without the terminal marine slip and turning basin in place. The results indicate the water velocities in the BSC would be reduced (about 5 to 7 percent) on the shoreline opposite the Project site and relatively unchanged on the south bank adjacent to the Project site and therefore the Project would not result in increased shoreline erosion (Black & Veatch 2016c). Section 4.3 provides additional information about hydrodynamic modeling results.

Grading, spoil storage, and equipment traffic can compact soil, reducing porosity and increasing runoff potential. Soils in the Project site have a moderate compaction potential because they are predominantly clays or clay loams that are poorly drained and have a high shrink-swell potential. While the soils have a moderate compaction potential and high shrink-swell potential, they are believed to be suitable for use as fill material. On-site soil used as fill for roads or other heavy traffic areas would likely require drying or blending with lime or other material to meet compaction requirements, which Annova has agreed to implement as needed. Subsoil and topsoil would be tested to measure compaction and determine the need for corrective action prior to seeding in accordance with the Annova *Plan* and *Procedures*. Annova would also minimize the potential for impacts from compacted soils by constructing stormwater runoff systems at the Project site to reduce the potential for erosion. Significant impacts associated with the compaction potential of Project soils are not anticipated given the implementation of these measures

Annova would work to promote the rapid, successful reestablishment of vegetation of temporarily disturbed areas in accordance with its *Plan* and *Procedures* and would develop specific measures in coordination with the land-management authorities and permitting agencies. Soils within the Project site are characterized as slightly to strongly saline, which reduces revegetation potential. Annova would consult with the Cameron County office of the NRCS to identify native, salt-tolerant plant species suitable for the soils where revegetation potential is limited because of saline soils. Annova would conduct follow-up inspections of all disturbed areas, as outlined in its *Plan* and *Procedures*, to determine the success of revegetation.

The Project would include dredging of material for construction of marine facilities and turning basins (see section 2.6.2). Annova proposes to use DMPA 5A, located just west of the Project site, for disposal of dredged material not used as on-site fill. Although there are no known contaminated soils within the Project site or the BSC, dredging has the potential to expose unidentified contaminated soils. Annova has developed a Dredged Area Sampling and Analysis Plan for dredging activities as part of the COE permit application (SWG-2015-00110) and would implement the sediment sampling and analysis following COE guidance for dredged material sampling and testing to minimize the potential for the release of contaminated soils.

Spills or leaks of fuels, lubricants, and coolant from construction equipment and operating activities may contaminate soils on or adjacent to the site. Annova would develop a project-specific *Spill Prevention and Response Procedures* for construction in accordance with the SPCC Plan, as required by the Annova *Plan* and *Procedures*, and applicable federal and state requirements. The *Spill Prevention and Response Procedures* would establish procedures, methods, and equipment requirements, as well as secondary containment for fuel and chemical storage areas to prevent and minimize impacts from spills during operation; therefore, any impacts resulting from soil contamination are expected to be minor and temporary. Annova has submitted to FERC a preliminary *Construction SPCC Plan* that describes general preventive BMPs, including personnel training, equipment inspection, and refueling procedures to reduce the likelihood of a spill. It also describes the mitigation measures, including containment and cleanup, to minimize potential impacts should a spill occur. These plans would address the storage and transfer of hazardous materials and petroleum products. However, because Annova has not yet provided the final *Spill Prevention and Response Procedures* and *Construction SPCC Plan* or the *Operation SPCC Plan*, **we recommend that**:

- **<u>Prior to construction</u>, Annova should file with the Secretary of the Commission (Secretary), for review and written approval by the Director of the Office of Energy Projects (OEP), its final *Spill Prevention and Response Procedures* and *Construction SPCC Plan*, and *Operation SPCC Plan*.**

4.2.4 Conclusion

Based on the above discussion, and in consideration of Annova's proposed mitigation measures and design criteria, we conclude that the Project would have a permanent effect on soils within the terminal site but that potential impacts would be minimized to the extent practical.

4.3 WATER RESOURCES

4.3.1 Groundwater

4.3.1.1 Aquifers

The Project is located in the Coastal Lowlands aquifer system in Cameron County, Texas. The Coastal Lowlands aquifer is commonly referred to as the Gulf Coast Aquifer system, which stretches from Florida to Mexico along the Gulf of Mexico, and consists of several aquifers, including the Jasper, Evangeline, and Chicot aquifers. The aquifers are composed of mostly sand, silt, and clay (George et al. 2011). The Texas portion of the Gulf Coast Aquifer system supports a third of the state's population (Mace et al. 2006), with 1.1 million acre-feet of groundwater pumped annually, the majority of which is used for municipal and irrigation purposes (Chowdhury and Turco 2006; Ashworth and Hopkins 1995). The Gulf Coast Aquifer system increases in thickness to the southeast beneath the Project and into the Gulf of Mexico. At the Project site, groundwater is near the surface due to the proximity of the BSC (Black & Veatch 2016a). The shallow subsurface geology varies but generally consists of alternating deposits of clays, silts, and sands deposited over time by ancestral streams, tidal marshes, and/or estuarine environments, and local surficial groundwater sources consist of discontinuous beds of sand near the surface.

The portion of the Gulf Coast Aquifer system that underlie the Project is not suitable for potable uses. The Gulf Coast Aquifer system is separated into five permeable zones and two confining units (Ryder 1996) with the Chicot Aquifer nearest to the surface and the Evangeline Aquifer just below. The Chicot Aquifer in the Project area is considered saline and not suitable for potable use. The Evangeline and Chicot aquifers provide a majority of the groundwater used in Cameron County. However, because the quality of groundwater in the area does not meet Texas Department of Health standards, the Rio Grande and surface water reservoirs supply over 97 percent of the water consumed in the valley (TWDB 1990; Paine 2000).

Sole source aquifers are designated by the EPA and protected as they are the principal source of drinking water for an area and for which no other reasonably available alternative sources exist if that aquifer becomes contaminated (Section 1424(e) of the Safe Drinking Water Act of 1974). No designated sole source aquifers occur near or within the Project site (EPA 2008) as the Chicot Aquifer is not designated as a sole source aquifer in Texas (EPA 2017).

4.3.1.2 Water Supply Wells

No potable water supply wells are located within the Project site or within 150 feet of Project (TCEQ 2015a, 2015b). Based on a review of the TCEQ Well Protection Program for Cameron County, the Project is not within a groundwater conservation district (TWDB 2015), and the nearest domestic water supply well is over 4 miles north of the Project site (TCEQ 2015b; TWDB 2016).

4.3.1.3 Groundwater Quality

In coastal areas, groundwater becomes increasingly saline because of higher total dissolved solids (TDS) concentrations found near and along the coast. The concentrations of some constituents such as chloride, often exceed the Texas Department of State Health Service recommended drinking water or irrigation water quality standards. TDS concentrations in groundwater in the lower Rio Grande Valley often increase to about 3,000 milligrams per liter (mg/L) (Chowdhury and Mace 2007). The results of a survey by the Texas Water Development Board of groundwater wells within counties adjacent to the Rio Grande, including Cameron County, indicate increasing salinity closer to the coast, with wells near the Project exhibiting saline to briny (5,000 mg/L to 40,000 mg/L) groundwater (Paine 2000). The increased concentration of TDS in coastal counties is likely due to windblown salt into shallow inland aquifers or saltwater intrusion from the Gulf of Mexico (Paine 2000).

4.3.1.4 Groundwater Impacts and Mitigation

Construction

Section 2.5 of this EIS provides a detailed description of construction activities associated with the Project. The majority of the excavation would occur adjacent to the BSC where groundwater is located near the surface. Excavation, the addition of fill, and the installation of foundations and underground utilities would have localized and short-term effects on the groundwater during construction with effects to local water table elevations. The shallow aquifer could sustain minor, temporary indirect impacts from changes in overland water flow and recharge caused by clearing and grading of the work areas. Near-surface soil compaction caused by heavy construction vehicles could cause localized reduction in the soil's ability to absorb water.

Because of the temporary localized effects of construction on groundwater and the relatively large distance between the Project site and any water supply wells, we conclude that the potential impacts on groundwater resources due to Project-related construction activities would be minimal.

Contamination

Shallow groundwater areas could be vulnerable to contamination caused by inadvertent surface spills of hazardous materials used during construction and operation of the Project. Accidental spills and leaks of hazardous materials, such as fuels, lubricants, and coolants, associated with equipment trailers, the refueling of maintenance vehicles, and the storage of fuel, oil, and other fluids pose the greatest risk to groundwater resources. If not cleaned up, contaminated soil could continue to leach and add pollutants to groundwater long after a spill has occurred.

Implementation of Annova's project-specific *Plan* and *Procedures* (see appendix B), as well as their SPCC Plan, would minimize the potential impacts of spills of hazardous materials during construction and operation. As previously described, the draft SPCC Plan addresses training, prevention, and mitigation to reduce potential impacts.

All LNG equipment and piping systems holding LNG would include a spill containment system utilizing curbed areas, troughs, open drains, and an impoundment basin. An engineered earthen containment berm around each LNG storage tank would contain 110 percent of the tank capacity of stored LNG per Title 49 CFR Part 193 requirements.

Section 2 provides a description of pile-driving activities that would occur during construction. The maximum depth of pile-driving activities would extend to approximately 156 feet below ground surface. These activities would occur within the saline portion of the Chicot Aquifer, which is not used as a source of potable water. Pilings would not extend beyond the Chicot Aquifer, as the bottom of the Chicot Aquifer lies at an elevation of -1,200 feet (TWDB 2006). Therefore, pilings would not intersect with the Evangeline Aquifer, which yields moderate to large quantities of fresh to slightly saline water (TWDB 1990).

Groundwater Withdrawals

Annova would obtain potable water from the BND via the Brownsville Public Utilities Board, who obtains water (surface water) from the Rio Grande. Therefore, Annova would not use or withdraw groundwater during construction or operation of the Project.

4.3.1.5 Conclusion for Groundwater

With the implementation of measures described above and the distance to water supply wells, we conclude that the potential for the Project to contaminate aquifers or water supply wells would be minimal. As Annova would not use or withdraw groundwater during construction or operation of the Project, no impacts on groundwater resources are anticipated.

4.3.2 Surface Water

4.3.2.1 Existing Surface Water Resources

The Project is located (from large region to small sub-watershed) within the Texas-Gulf water resource region; South Laguna Madre subbasin; Brownsville Ship Channel watershed; Bahia Grande-Brownsville Ship Channel subwatershed, identified by USGS Hydrologic Unit Code (HUC) 121102080900 (USGS 2016). As shown in figure 4.3.2-1, the eastern side of the South Laguna Madre subbasin extends 59 miles southward from the Padre Island sand and mudflats to within 3 miles of the Mexican border and opens into the Gulf of Mexico through the Brazos Santiago Pass (Onuf 2002). The South Laguna Madre subbasin encompasses the Project site and four counties (Cameron, Hidalgo, Starr, and Willacy) (EPA 2016). Major waterbodies located within the north end of the subbasin include the Arroyo Colorado, the Raymondville Drain, the North Floodway, and the Hidalgo County Main Flood Channel, which are all located north of the Project site (see figure 4.3.2-1). Other major waterbodies located within the south end of the subbasin include the Resaca de Los Cuates, Resaca del Rancho Viejo, Resaca de La Palma, and the BSC. The Project would not cross any streams, Wild and Scenic Rivers, or special designation surface water protection areas. No potable surface water intakes are located within 3 miles downstream of the Project site.

Freshwater inflow events to the system are limited due to the arid conditions of the watershed. The relatively flat topography surrounding the BSC results in drainage into the BSC from South Bay and Bahia Grande. The historic average annual rainfall for the Brownsville area is approximately 27.4 inches (NOAA 2013).

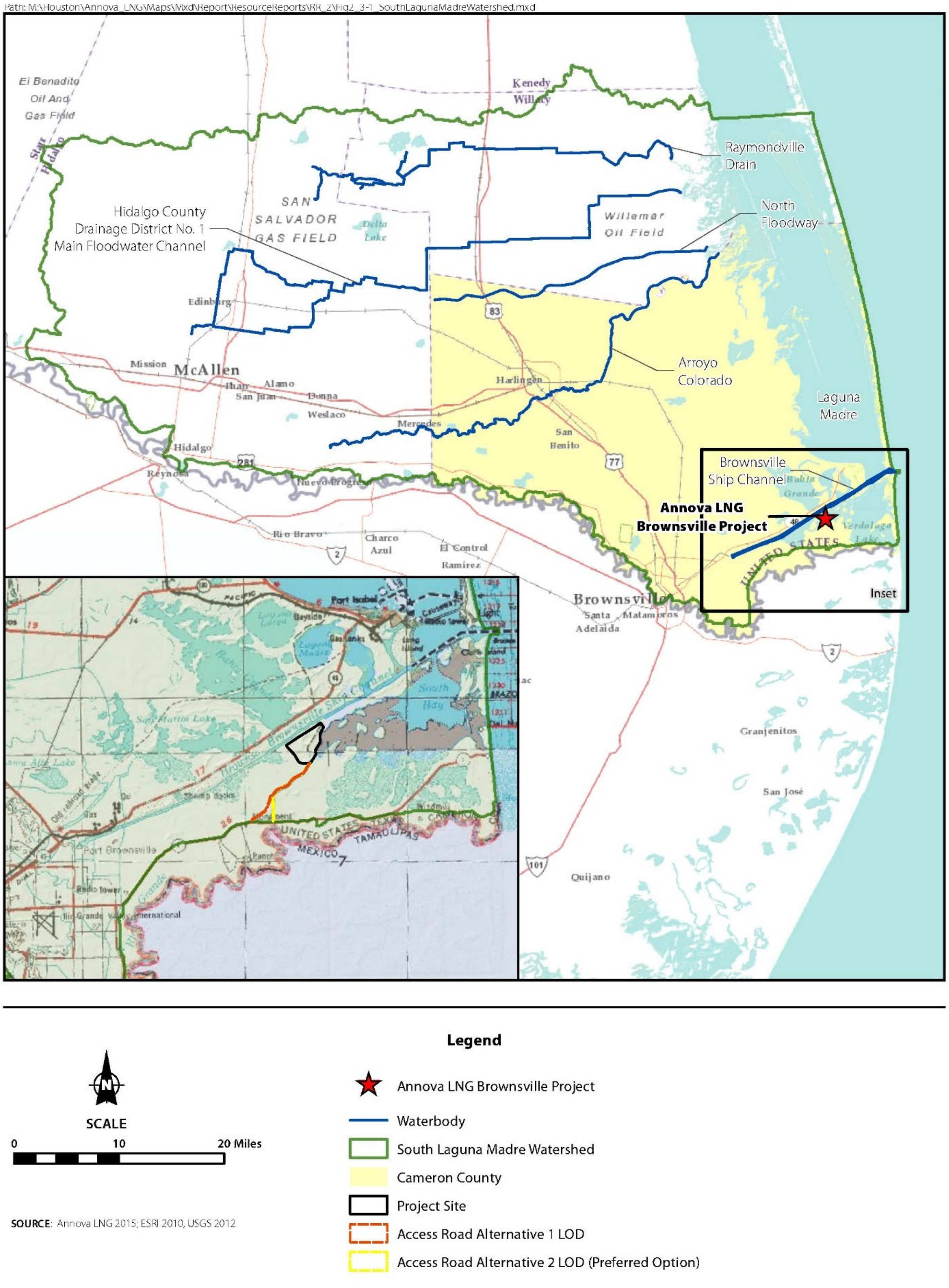


Figure 4.3.2-1 South Laguna Subbasin

The BSC is the only waterbody that occurs within the Project site. Bahia Grande and South Bay are connected to the BSC and are the nearest other waterbodies to the Project site. Figure 4.3.2-2 identifies these waterbodies in relation to the Project site, and table 4.3.2-1 provides a summary of attributes associated with these waterbodies.

The BSC is approximately 42 feet deep and 17 miles long, and includes a turning basin located at the western terminus approximately 36 feet deep and 1,200 feet wide (BND 2012). Field surveys report that open water within the Project site is non-vegetated; the channel is a poor habitat for seagrass due to the channel being disturbed by drawdowns and return surges associated with normal tidal movement and human-induced actions such as vessel traffic. Average physiochemical and water quality parameters of the BSC are provided in table 4.3.2-2 (see following subsection).

South Bay is located within the South Laguna Madre watershed and consists of approximately 3,500 surface acres of water (TPWD 2016a, b). The South Bay Coastal Preserve is bounded on the south by the Rio Grande riparian edge, on the north by the BSC, and on the east by Brazos Island (TPWD 2016a). South Bay is a shallow waterbody with unique ecological features such as seagrass beds, black mangroves (*Avicennia germinans*), and oyster reefs (TPWD 2016b). Figure 4.3.2-3 shows the known locations of nearby seagrasses. South Bay and the lower Laguna Madre, located approximately 2 and 4 miles from the Project site, respectively, contain seagrass beds that function as nursery habitat for commercially important fishes and crustaceans. Section 4.6 provides additional information on fisheries and wildlife that inhabit local waterbodies.

The Bahia Grande is located approximately 0.7 mile north of the Project site on the north side of the BSC. This waterbody is a large saline lagoon connected to the BSC via a pilot channel constructed in 2005. Between the 1930s and the 1950s, the accumulation of material along the BSC from maintenance dredging decreased the tidal flow into the small connection between Bahia Grande and the BSC. The pilot channel allowed the area to refill (FWS 2015). The Port has plans to widen the pilot channel to increase tidal flow into the Bahia Grande basin for water exchange on a daily basis (FWS 2015).

TABLE 4.3.2-1

Surface Waterbodies in the Vicinity of the Proposed Project Site

Waterbody	Type	State Water Quality Classification a/	Fishery Type
Brownsville Ship Channel	Estuary	Aquatic Life (exceptional) Recreational Use (noncontact) Additional Use (navigation)	Warmwater
South Bay	Estuary	Aquatic Life (exceptional and oyster) Recreational Use (primary contact recreation) Additional Use (seagrass propagation)	Warmwater
Bahia Grande	Estuary	none b/ Aquatic life; Additional Use (wetland water quality functions) c/	Warmwater

Source: TCEQ 2014a, b; TPWD 2016b; FWS 2004, 2015

a/ The specific "Additional Uses" are not identified in TCEQ (2014a), but "General Use" is listed in the 2014 Integrated Report (TCEQ 2014b).
b/ TCEQ (2014a) does not have a water quality classification for Bahia Grande.
c/ FWS (2015) identifies the uses of Bahia Grande, but are not regulated by TCEQ for water quality

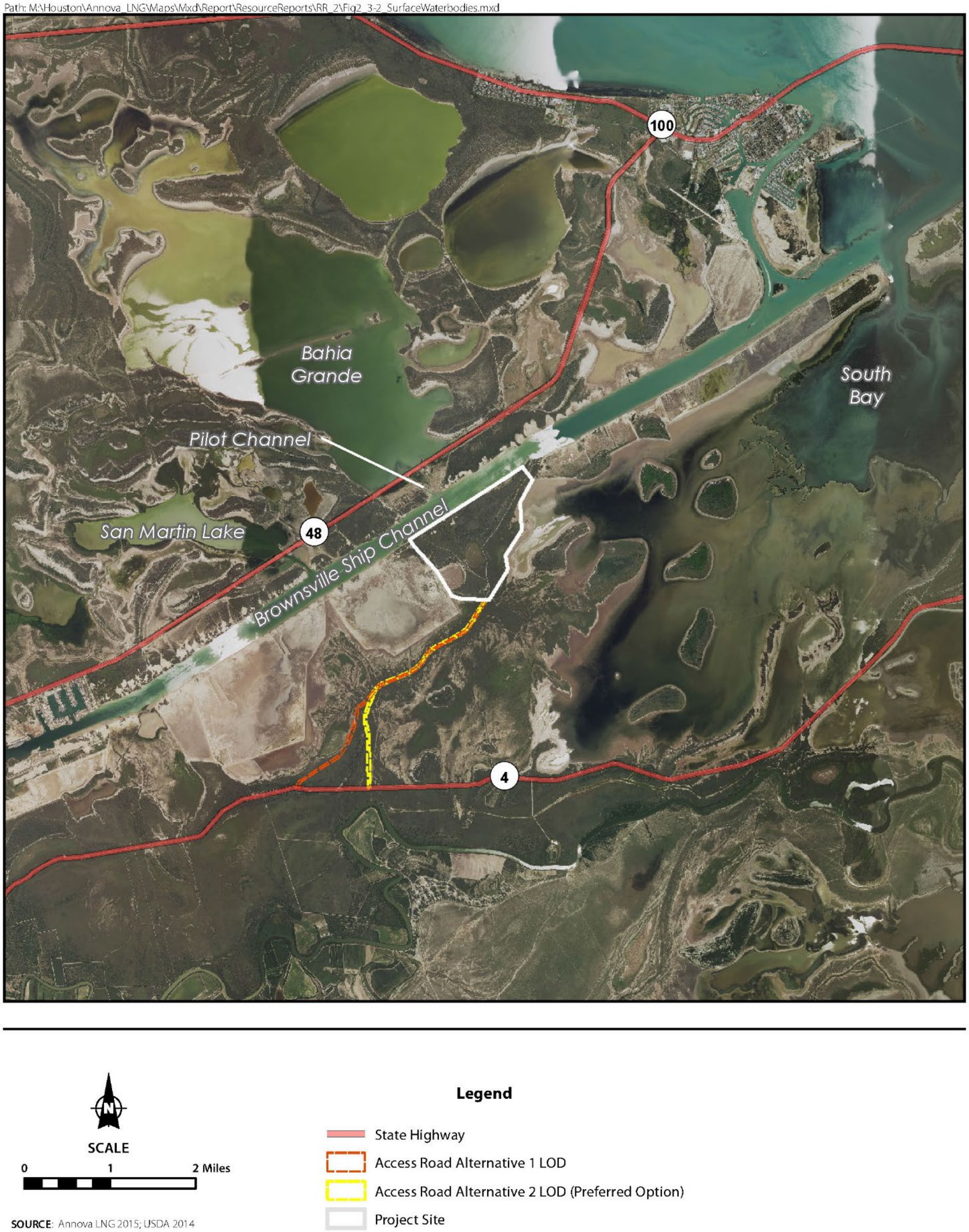


Figure 4.3.2-2 Surface Waterbodies in the Vicinity of the Proposed Project

Surface Water Quality and Designated Uses

Water quality standards are developed by states to enhance or maintain water quality, protect the public health or welfare, and provide for the designated uses of the waters of the state. In Texas, the surface water quality standards are codified in TAC 30:307. These designated uses are identified for each waterbody in table 4.3.2-1.

The TCEQ designates uses for surface waters in Texas, including:

1. Recreation (primary contact recreation 1, primary contact recreation 2, secondary contact recreation 1, secondary contact recreation 2, and noncontact recreation)
2. Domestic water supply (public water supply, sole-source surface drinking water supply, and aquifer protection)
3. Aquatic life (minimal, limited, intermediate, high, exceptional aquatic life, and oyster waters)
4. Additional uses (navigation, agricultural water supply, industrial water supply, seagrass propagation, and wetland water quality functions)

The TCEQ designates boundaries within its surface waters (called segments and subsegments) to monitor all portions of streams and waterbodies. The Project site is adjacent to the BSC stream segment 2494 (subsegment 2494_01), which includes waters from the Laguna Madre-BSC confluence upstream to the Port of Brownsville (TCEQ 2012). The TCEQ collects water quality data from a surface water quality monitoring station located northeast of the Project site within the BSC (TCEQ 2016). Similar water quality data were collected in the BSC during a pilot study for construction of a desalinization plant in south Texas (NRS Engineering 2008). Generally, water quality parameters in the BSC exhibit averages and ranges similar to nearshore marine waters, with slight variations in salinity and dissolved oxygen associated with episodic rainfall events. Table 4.3.2-2 presents water quality physiochemical data from the TCEQ monitoring station and from the Texas Water Development Board pilot study (NRS 2008).

The TCEQ considers the waters of the BSC (segment ID 2494) impaired due to the presence of *Enterococci* bacteria; because it does not meet applicable water quality standards, the BSC is on the CWA Section 303(d) list of impaired waters (TCEQ 2014b). TCEQ plans to obtain additional data concerning the non-attainment of the standard for recreational use before implementing any actions (i.e., management strategies) to correct the impairment (TCEQ 2014b). This waterway also had depressed dissolved oxygen as a listed concern for screening level (TCEQ 2014b). The South Bay meets the water quality standards and therefore is not included on the list of impaired waters. The Bahia Grande has not been evaluated by the TCEQ.

TABLE 4.3.2-2

Average Physiochemical Parameters in the Brownsville Ship Channel

Year	Temperature (°C)	Dissolved Oxygen (mg/L)	pH (standard units)	Alkalinity Total (mg/L)	Salinity (ppt)
2007-2008 a/	25.0	NA	8.0	140.9	NA
2010 b/	27.9	8.6	8.0	123.8	31.8
2011 b/	24.6	6.1	8.0	133.5	36.1
2012 b/	22.0	7.2	7.9	129.9	34.3
2013 b/	27.9	6.3	8.0	128.4	36.9
2014 b/	24.9	6.2	8.0	133.2	31.9
2015 b/	20.9	7.2	8.0	131.9	31.8

a/ NRS 2008
b/ TCEQ 2016; Surface Water Quality Monitoring Segment ID 2494

°C = degrees Celsius
mg/L = milligrams per liter
NA = data not available
ppt = parts per thousand

There are no known contaminated sediments within the BSC. Annova reviewed sediment sampling results reported in 2012 by TCEQ, in 2000 by the FWS, and in 2013 by the COE. Between December 1, 2003, and November 30, 2010, the TCEQ collected sediment samples from the BSC and tested them for metals (i.e., mercury, zinc, silver, nickel, lead, copper, chromium, arsenic, and cadmium). All of the sample results were below regulatory limits for the water use (TCEQ 2012b). Sediment sampling was also conducted in 2000 due to a nearby spill of furfural, an organic compound derived from agricultural byproducts, into storm drains in the city of Brownsville. Although the BSC was one of three possible impact zones, subsequent sediment sampling showed no evidence of furfural contamination (NOAA 2000). The COE also conducted sediment sampling for contaminants as part of the Brazos Island Harbor Channel Improvement Project. The analytical results indicated no chemical or physical concerns regarding the placement of BSC sediments in upland or offshore dredged material placement areas (COE 2014).

Annova developed a *Sampling and Analysis Plan* for dredging activities as part of the COE permit application (SWG-2015-00110). Annova would implement the sediment sampling and analysis following COE guidance for dredged material sampling and testing.

4.3.2.2 Surface Water Impacts and Mitigation

Potential impacts on surface waters during construction and operation of the Project are associated with dredging and dredge material placement, as well as construction of the LNG loading and ship berthing facilities; vessel traffic; site modification and stormwater runoff (including spills or leaks of hazardous materials); and hydrostatic testing. The following sections describe these potential impacts as well as measures that would be taken by Annova to avoid or minimize impacts on surface waters

Dredging, Dredge Material Placement, and In-Water Work

Section 2.6.2.1 of this EIS includes a summary of the estimated volumes and types of dredged and excavated material for the marine berth and turning basin. The majority of the excavation would occur on land, thereby minimizing suspension of sediment and turbidity impacts on water quality that could occur due to direct dredging within the BSC. The dredging would employ a hydraulic cutter suction dredge. Suction dredging reduces impacts on water quality compared to other dredging methods because the excavated material is suctioned into a pipeline, minimizing the loss of material and re-suspension of sediments into the water column. Additional details are included in Annova's *Dredged Material Transport Plan* in appendix C.

The BSC is not impaired for turbidity, and no total maximum daily loads (TMDLs) have been established for this waterbody. Annova would conduct sediment testing specific to the Project in accordance with the Sampling and Analysis Plan as approved by the COE to determine the characteristics of the sediments to be removed for the Project.

As described in section 2.6.2.1 of this EIS, Annova proposes to place dredged material in the Port of Brownsville DMPA 5A, located immediately west of and adjacent to the Project site. During transport of dredged material, a wye valve would evenly distribute the dredged material into internal partitions. The current configuration of DMPA 5A uses a series of internal berms (dewatering lanes) to guide water through the DMPA from the discharge point to the final outfall point, at a rate that allows the fine particles to settle out, with final discharge through the existing drop outfall structure directly to the BSC. Annova would raise the levee heights using existing material in the DMPA and re-profiling the dewatering lanes prior to the start of dredging operations to allow for appropriate residence time, such that the discharge would be limited to constrain total suspended solids to a maximum of 300 mg/L. Annova would perform column settling tests early in detailed engineering to confirm the settling characteristics of the dredged material to ensure efficient function of the DMPA. This distribution of the deposited material during dredging would ensure that the rate of particle settling upon discharge and the residence time can be appropriately managed without affecting the dredging production rate. The effluent outfall at the drop-outlet structure would be monitored for excessive turbidity and erosion issues.

Dredging activities would result in increased turbidity in the BSC, which could have localized effects. These localized effects would include reduced light penetration and a corresponding reduction in the primary production of aquatic plants, algae, and phytoplankton. As a result, a short-term reduction in dissolved oxygen concentrations in the BSC may occur, resulting in temporary displacement of motile organisms, and/or stress and reduction in numbers of sessile benthic organisms (LUMC 2016) (see section 4.6 for more details regarding impacts on organisms due to turbidity). The results of field surveys indicate that no vegetation occurs in the open water in the BSC within the Project site (see figure 4.3.2-3). Known seagrass beds are identified in the BCS at Port Isabel and the entrance to South Bay over 3 miles downstream; therefore, increases in turbidity in the BSC would not likely extend into any important seagrass nursery habitats.

Annova performed turbidity plume modeling using the COE's DREDGE model, plus a "far-field" distribution model of suspended sediment (Black & Veatch 2016d). The results were predicted using a maximum velocity of current in the BSC at 5 feet/second. We used the results to evaluate potential impact on water quality within the BSC and the Bahia Grande wetland

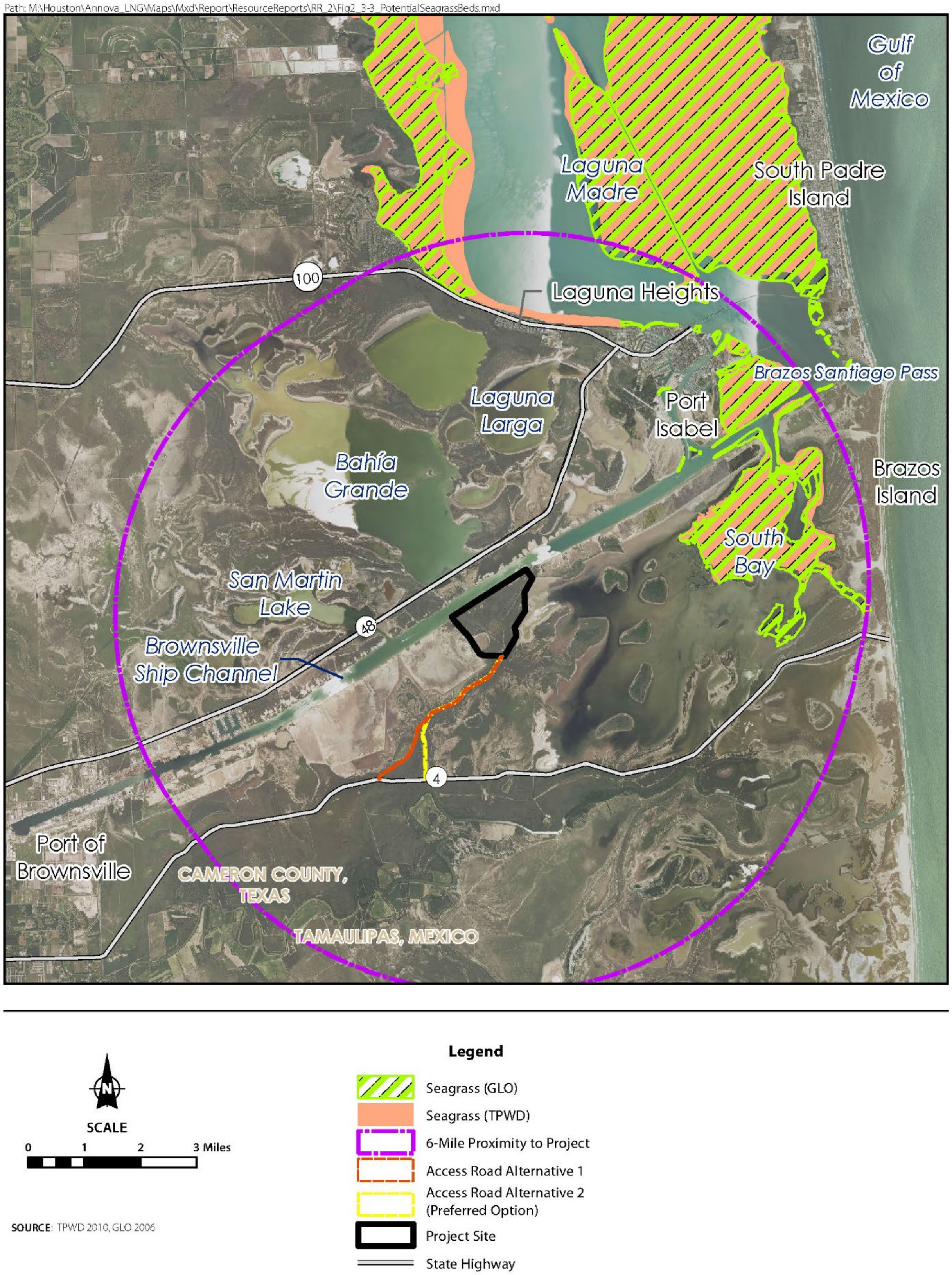


Figure 4.3.2-3 Known Seagrass Beds within the Vicinity of the Proposed Project

mitigation site. The model predicted a total suspended solids (TSS) concentration of 4 to 6 mg/L above ambient within the greatest lateral extent of the plume, 328 feet (100 meters) to either side of the plume centerline, at the surface of the BSC (Black & Veatch 2016d). The outgoing tide would transport the suspended clay particles downstream of the shallow (-3.25 to [proposed] -9 feet mean sea level) Bahia Grande Pilot Channel entrance. This, combined with the tidal flow from the Bahia Grande during an outgoing tide, would prevent particle transport into the Bahia Grande. Particle transport into the Bahia Grande would occur during an incoming tide, where effects to the Bahia Grande would likely be greater with elevated TSS concentrations of 4 to 6 mg/L at the periphery of the plume 328 feet from the dredge cutterhead, and would result in a minor impact on water quality within the portions of the Bahia Grande closest to the connection with the Pilot Channel. Similarly, although not directly modeled, particle transport during a slack tide would be limited due to the lack of water movement, which would restrict particle transport from the dredging area. As a result, there would be limited impact on the Bahia Grande from dredging during a slack tide.

Regarding downstream movement of particles during dredging activities on an outgoing tide (5 feet/second), there would be effects on water quality downstream for a distance of approximately 2.5 miles or more at the surface of the water and mid-water column (at 20 feet above the dredge cutterhead), and the effects on water quality downstream near the sediment surface (dredge cutterhead level) would extend approximately 1,600 feet downstream. Clay particles, which are re-suspended, generally do not settle out of the water column. Currents can increase re-suspension by acting directly on the newly dredged faces and affect the dispersion of the re-suspended sediments by moving particles along with the current. The mean TSS level in the BSC is approximately 36 mg/L (Dannenbaum Engineering and URS 2004). The predicted increase of 4 to 6 mg/L above ambient would represent an 11-17 percent increase over ambient within the range of impact (up to 2.5 miles downstream), which would be a moderate impact.

Annova developed a two-dimensional hydrodynamic model to assess potential changes to water velocity (current speed) and shoaling (sedimentation) rates from construction and operation of the Project (Black & Veatch 2016c, 2016e). The model also evaluated the effect of the proposed widening of the Bahia Grande Pilot Channel. The modelling predicts that water velocity at the Project site would be reduced due to the proposed dredging; however, there would be a 2 percent increase in water velocity in the BSC to the east of the Project. This change in water velocity would not be expected to significantly impact the transport distance of the turbidity plume caused by dredging. In contrast, the modeling results indicate water velocities in the BSC and the Bahia Grande Pilot Channel, which leads to the Bahia Grande wetland mitigation site, would increase considerably as a result of the widening of the Bahia Grande Pilot Channel. The water velocity in the BSC east of the Project would increase by 62 percent and the water velocity in the Bahia Grande Pilot Channel would increase by 57 percent following channel widening. The change in water velocity as a result of the proposed widening of the Bahia Grande Pilot Channel may increase the transport distance of the turbidity plume caused by Project dredging, although the extent of the turbidity plume was not evaluated in the model. The potential extent of the turbidity plume was assessed with the DREDGE model, as described above.

The hydrodynamic model developed by Annova included a sediment transport model to evaluate suspended sediment transport and deposition patterns as a result of Project dredging activities (Black & Veatch 2016e). The model simulated dredging at the Project site for a one-month period. Model results indicate a higher rate of shoaling than has been observed in the main channel of the BSC, which is 10 cubic yards per linear foot (COE 2014). Modeled shoaling rates in the BSC were 0.01 inches with a maximum of 0.05 over the one-month simulation period. The sediment transport modeling assumed the Bahia Grande Pilot Channel widening was completed and therefore shoaling rates in that channel were lower than average due to the increased water velocity that would be caused by channel widening.

Construction of the marine facilities would require installation of pilings using land-based and in-water equipment. Table 2.6.2-2 in section 2.6.2.1 identifies the number and types of pilings associated with construction of the marine facilities. In-water construction within the BSC using impact and vibratory hammers would result in increases in turbidity. Upon completion of in-water construction activities, suspended particles would settle; however, due to the nature of the new material (consisting of mostly clay), the duration of the turbidity is undetermined.

During operation of the Project, periodic maintenance dredging would be required to maintain depth in the turning basin. Maintenance dredging would only occur in areas that have been previously dredged during the initial construction of the Project. Hydraulic cutter suction dredging would also be used to limit re-suspension, and sediments would be sampled and tested for priority pollutants prior to each maintenance dredging event according to the methodology described in the Inland Testing Manual (EPA and COE 1998). During maintenance dredging, there may be an increase in turbidity in the BSC; however, the cutter of the dredge would suction most of the suspended fine-grained sediments, and the temporary increase in turbidity and suspension of solids would be contained to meet water quality criteria identified in the 401 Water Quality Certification at the edge of the work zone, resulting in localized effects.

Annova submitted permit applications for dredging activities to the COE. Annova is required to obtain several permits that would address dredging and dredged material management, including permits from the COE under Section 404 of the CWA and Section 10 of the RHA. Permits for water discharges into the BSC would be obtained from the EPA and/or the TCEQ under Section 401 of the CWA. An NPDES permit under Section 402 of the CWA issued by the RRC would be necessary to regulate return water flowing from the DMPA 5A. The issuance of these permits takes into consideration impacts on environmental resources; therefore, the permits may contain operational limitations designed to minimize or avoid environmental impacts.

To further minimize impacts, Annova would prepare a *Dredging Water Quality Monitoring Plan*. This plan would include use of BMPs during dredging and would require monitoring of turbidity, flow rate, pH, and TSS at locations near dredging operations. If monitoring indicates that TSS or turbidity levels exceed the limits established by the plan or the COE or EPA permit requirements, Annova would implement the following measures as appropriate:

- reduction of cutter rotation speed to reduce potential for side-casting sediment away from the suction entrance and resuspending sediment (typically effective on relatively loose, fine-grain sediment);
- reduction of swing speed to ensure that the dredge head does not move through the cut faster that it can hydraulically pump the sediment, thereby reducing resuspended sediment;

- reduction or elimination of bank undercutting by removing the sediment in maximum lifts equal to 75 percent of the cutterhead diameter; and/or
- termination of suction pump motor after cutterhead shutdown and commencement of the suction pump before cutterhead startup to avoid a period when materials are resuspended without active suction occurring.

Vessel Traffic

Shoreline Erosion and Resuspension of Sediments

LNG carrier and barge traffic would use the BSC and the Gulf Intracoastal Waterway, both of which are well-traveled commercial routes. Increased vessel traffic, including transit of LNG carriers during operations, could result in short-term periods of increased turbidity resulting from entrained bottom sediments (e.g., sediment on the channel bed is incorporated into the increased flow resulting from LNG carrier transit). The potential effects of vessel transit on shoreline erosion depends on the speed and distance of the propeller or jet to the sea floor or shoreline.

The hydrodynamic model developed by Annova was used to assess the impacts of the Project on shoreline erosion by evaluating changes in water velocities along the shoreline (Black & Veatch 2016c). The modeling included scenarios to evaluate the impacts of the Project and the Bahia Grande Pilot Channel widening. The results indicate the Project will decrease the water velocity about 5 to 7 percent along the north bank directly across the BSC from the Project facilities, with minimal changes elsewhere. The model did not assess the potential for localized propeller scour to cause shoreline erosion. The hydrodynamic modeling indicates the potential for shoreline erosion would not likely increase as a result of the Project provided the LNG carriers avoid shoreline erosion from propeller scour when approaching Project facilities. Rock rip-rap protection would be placed along the terminal shoreline at the Project facilities to prevent erosion due to vessel propellers or bow thrusters.

The potential for scour by propeller discharges in the BSC during LNG carrier transit would be mitigated by several factors. The BND established a vessel speed limit of 8 knots in the BSC, which would reduce impacts on water quality due to shoreline erosion resulting from vessel traffic. LNG carriers are expected to move at about 6 to 7 knots within the BSC and would operate at a low speed (i.e., approximately 15 percent of their maximum capacity) thereby significantly reducing propeller discharge force. Tug boats would escort the LNG carriers into the berth at speeds less than 5 knots, thereby minimizing the potential for erosion.

Outgoing loaded LNG carriers would have the greatest potential for disturbing bottom sediment due to their deeper draft (approximately 40 feet). Incoming, empty LNG carriers would have less draft (approximately 38 feet) and thus ride higher in the water column, allowing a greater buffer of entrained water between the propeller and the seabed (-45 feet MLLW).

It is assumed that sediment within the BSC is composed primarily (70%-80%) of stiff, consolidated clay material based on the COE (2014) statement that new work material extracted during dredging operations would be deposited as relatively firm, large pieces of clay (i.e., consolidated). Stiff, consolidated clay has been shown to be highly resistant to scour in flowing systems, especially when compared to sand. Reice et al. (1990) provides that consolidated clay has critical velocities (e.g., velocity at which particles may be entrained and transported in a current) similar to gravel. These factors would require greater current velocities (greater than 10 feet/second) to dislodge and disassociate consolidated clay (Reice et al. 1990). Outgoing LNG carrier transits represent the greater likelihood for entrainment of sediment because, again, the propeller force occurs closer to the bottom of the sea bed. This assumes that most entrained material would be silts, sand, and disassociated clay particles found at the bottom of the BSC as a result of land-based, erosional runoff. Entrainment of non-consolidated substrate would result in a short-term, but minor, impact on water quality as LNG carriers transit the BSC.

Similar analysis of incidental LNG carrier propeller wash for the Golden Pass LNG Terminal (FERC 2005) noted that there would likely be localized increases in turbidity, but these were considered minor and short term.

Ballast Water Discharge

LNG carriers docked at the marine berth would discharge ballast water that may affect the salinity, dissolved oxygen level, temperature, pH, and aquatic species in the BSC. Large vessels withdraw water and place it in separate onboard ballast tanks to provide additional draft and improve navigational performance. Once moored at the loading dock, a ship's ballast water typically discharges simultaneously with the LNG cargo loading. The marine berth would accommodate LNG carriers with cargo capacities up to 177,000 cubic meters. LNG carriers serving the Project would arrive with virtually empty cargo tanks. Assuming that an LNG carrier's ballast water would weigh approximately 50 percent of the weight of the loaded LNG cargo, a 177,000 m^3 carrier would discharge approximately 9,950,000 gallons of ballast water during LNG cargo loading. Ballast discharge periods would vary, but vessels generally would discharge a volume equal to 10 percent of their LNG capacity each hour. Therefore, a vessel of 177,000 m^3 capacity would discharge approximately 995,000 gallons per hour. By comparison, the approximate volume of the BSC is estimated as 9 billion gallons, and the ballast water discharged per vessel represents 0.1 percent of this volume.

The Coast Guard established regulations for ballast water management in 33 CFR Part 151 and 46 CFR Part 162, effective June 21, 2012, that apply to all new ships constructed on or after December 2013 and to existing ships beginning in 2014. The Coast Guard amended its ballast water management regulations by establishing a standard for the allowable concentration of living organisms in ballast discharged into U.S. waters. The Coast Guard also established engineering equipment requirements and an approval process for ballast water treatment systems installed on ships. All ships calling at U.S. ports and intending to discharge ballast water must either carry out open sea exchange of ballast water or ballast water treatment, in addition to fouling and sediment management. These discharges would also comply with International Maritime Organization standards for ballast water management and U.S. ballast water regulations contained in the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (NAISA), as amended by the National Invasive Species Act of 1996 (NISA). Federal oversight and the applicable Coast Guard regulatory requirements that govern ballast water discharges into U.S. waters would apply to all LNG carriers calling at the Project site. Additionally, upon entry into the marine berth, Annova would review all applicable documentation to ensure that the visiting vessel is operating in accordance with the federal standards and practices prior to discharging any ballast water. During ballast water exchange, water is withdrawn from below the surface, where salinities are typically higher than near the surface. Likewise, in the marine berth, LNG carriers would discharge ballast water below the surface.

Generally, in inland waterbodies, salinities are higher in the lower portions of the water column than at the surface, but in the BSC salinities are relatively constant throughout the column because of minimal freshwater intake and the low flow creating potential for evaporation. Because of this condition and the small volume of discharge relative the volume of the BSC, ballast discharged into the BSC would have little to no effect on the BSC's salinity regime. In fact, the ballast water salinities may be lower than ambient conditions within the BSC and provide a small amount of relief to elevated salinities typically observed in South Texas estuarine waterbodies. Section 4.6 discusses impacts on species tolerant of transient saline conditions.

Dissolved oxygen levels in the BSC may be influenced by the introduction of ballast water. Dissolved oxygen is essential for the respiration of aquatic marine organisms. Among many other factors, dissolved oxygen levels in water can be influenced by water temperature, water depth, phytoplankton, wind, and current. Within estuaries, many factors (e.g., air temperature, rainfall, tidal magnitude, organic enrichment) can affect a waterbody's dissolved oxygen capacity. During the summer, a distinct stratification may occur between cooler, higher-salinity bottom waters and warmer, nutrient-rich (as a result of photosynthetic activity) surface waters. Based on the seasonally variable nature of dissolved oxygen levels within an estuary, ballast discharge could result in minor, local, dissolved oxygen reductions during the winter, as well as minor, local, increases of dissolved oxygen during the summer. The actual effect on dissolved oxygen may be difficult to measure, considering the dynamic and variable nature of water quantity and quality within the BSC. Given the relatively minimal volume of discharged ballast water expected from the LNG carriers calling on the Project compared to the water volume within the BSC and the change in volume during tides, ballast discharges would have minimal impacts on dissolved oxygen levels in the BSC.

Ballast water is not expected to significantly alter water temperatures or pH in the BSC. Since ballast water is stored in the LNG carrier's hull below the water line, water temperatures would be similar to ambient temperatures of the surrounding sea water. The pH of ballast water reflects open-ocean conditions and may be slightly higher compared with the freshwater or brackish water that occurs seasonally within estuaries; however, this slight variation is not anticipated to impact water quality.

Due to the volumes of ballast water often collected by vessels, living aquatic organisms may enter ballast tanks. Some of the larger macro-organisms collected often die; however, some of the smaller planktonic organisms can survive. Vessels loaded with ballast water from the ports and coastal waters throughout the world can carry diverse marine organisms that may be foreign and exotic to the vessel's port of destination. The port-to-port transfer of water can introduce invasive aquatic species. Based on current federal and state regulations regarding ballast water discharge, no specific operational permits are required to discharge ballast water. Annova is consulting with NOAA Fisheries, the FWS, and the TPWD and would address concerns or interest in ballast water discharge as requested.

Cooling Water Discharge

During operation, LNG vessels would re-circulate water for engine cooling while loading LNG at the berth, requiring water for cooling of the main engine/condenser, diesel generators, and fire main auxiliary and hotel services (Hunt 2003). No chemicals would be added to the cooling water. The volume of cooling water to be re-circulated is a function of the mode of operation of the LNG vessel. The mode of operation would be transit in the open ocean, and maneuvering mode to get the vessel in the BSC and berth, and while in the berth would be in-port mode. Cooling water is need for the auxiliary diesel engines that are used to generate electrical power for onboard systems while loading LNG.

Table 4.3.2-3 identifies the volumes of water required for cooling. The volumes required would vary based on the type of propulsion system of the LNG vessel. Steam-powered LNG vessels (maximum LNG capacity of 138,000 m^3) would require the largest volume of 11.7 million gallons of water for engine cooling during maneuvering and while docked at the LNG terminal, assuming the vessels would leave immediately after loading. During the same period, LNG vessels with dual fuel/diesel electric engines (maximum LNG capacity of 218,000 m^3) would use 5.5 million gallons of water. LNG barges, being smaller than LNG carriers having increased maneuverability and reduced time spent at the LNG terminal, would require only 535 gallons of waters (maximum LNG capacity of 15,000 m^3).

TABLE 4.3.2-3

Estimates of LNG Carrier Cooling Water Use and Intake Rates at the LNG Terminal

Vessel Type	Time to Maneuver (hours)	Time to Load (hours)	Maneuvering Rate (gallons per hour)	Maneuvering Volume (gallons)	In-port Rate (gallons per hour)	In-port Volume (gallons)	Total Volume (gallons)
Duel fuel/diesel electric LNG carrier	2	18	1,680,000	3,360,000	120,000	2,160,000	5,520,000
Steam-powered LNG carrier	3	18	2,820,000	8,460,000	180,000	3,240,000	11,700,000
Articulated tug/barge	1.25	4	300	375	40	160	535

Impacts as a result of cooling water intake and discharge would be primarily limited to an increase in water temperature in the vicinity of the LNG vessel. Cooling water return temperatures vary widely depending on the type of LNG carrier and mode of operation. Based on a review of available information, we anticipate that cooling water discharged could range between 2.7°F and 7.2°F warmer than ambient water temperatures (Caterpillar 2007, 2011, 2012). Due to the limited temperature differences, relatively small volume of discharge compared to the total water within the BSC, and location near an active port that is already subject to withdrawals and discharges of vessel engine cooling water, we anticipate the warmer water would diminish shortly after discharge and, therefore, would have temporary and minor impact on water quality. Information on the effects of cooling water on aquatic resources is presented in section 4.6.

Site Modification and Stormwater Runoff

As stormwater runoff moves across the site surfaces, it may pick up sediment particles or soil, as well as oil, grease, and residue from materials used on the site. This occurs if materials such as fuels, grease, and lubricants incidentally leak from vehicles and equipment or accidentally spill. To minimize impacts on water resources due to erosion, Annova would install soil erosion and sediment control measures prior to initiating site development.

BMPs would be taken to prevent the spill or release of hazardous materials into waterbodies, including limiting the quantity and duration of storage, fortifying barriers or providing additional containment, using trained personnel to monitor activities, and coordinating with the Environmental Inspector during construction. In addition, Annova would have to file a variance request for any areas where hazardous materials would be stored within 100 feet of waterbodies. Clean-up materials, including absorbent spill pads and plastic bags, would be stored in these areas. Hazardous materials storage areas would be protected from flooding or inundation.

The Annova *Plan* and *Procedures* (see appendix B) include temporary erosion controls such as slope breakers, sediment barriers, and mulching. These erosion and sediment controls would reduce runoff velocity, divert water off construction work areas, and stop the flow and deposition of sediments beyond approved workspaces or into sensitive resources. Annova would obtain an NPDES General Permit for Construction Storm Water Discharge from the EPA prior to any site disturbance. The effects of stormwater runoff would be minimal and localized; therefore, no negative impacts would affect water quality in the BSC, the nearby Bahia Grande, or South Bay. Annova would follow the SWPPP required as part of the EPA NPDES General Permit for Construction Storm Water Discharge, as well as the SPCC Plan for construction to prevent and respond to spills. During operation, the Project design would direct stormwater to designated retention and detention ponds.

Annova would obtain an NPDES Industrial Waste Water Discharge Permit for facility discharges of stormwater from an oily water separator, stormwater ponds, and on-site packaged sanitary wastewater treatment pond. Annova would prepare and implement a *Stormwater Pollution Prevention Plan* describing all pollution control measures or BMPs that would control erosion, sedimentation, and pollutants in runoff from the site. In addition, Annova would prepare an SPCC Plan to establish procedures, methods, and equipment requirements, including secondary containment and earthen berms to prevent and minimize impacts from spills during operation.

Annova would not discharge untreated process-related wastewaters to the BSC or nearby Bahia Grande. Stormwater that contacts process areas would be directed to an oil/water separator prior to discharging to the BSC. Annova would adhere to all NPDES permit stipulations following monitoring and reporting requirements to the TCEQ. The effects of stormwater runoff and wastewater discharge during operation would be minimal and localized; therefore, only temporary and localized impacts would occur on water quality in the BSC, with minimal or no impacts extending into nearby Bahia Grande or South Bay.

Ship and boat traffic has the potential to adversely impact water quality in the event of an accidental release of a hazardous substance such as fuel, lubricants, coolants, or other materials on board the vessel. Annova would implement the measures outlined in its SPCC Plan in the event of a spill, as well as measures outlined in its *Plan* and *Procedures*. Annova would minimize the risk of a spill by implementing general preventive BMPs, including personnel training, equipment inspection, and refueling procedures.

Water Use

The Rio Grande provides potable water in the region including Cameron County and the surrounding counties that make up the lower Rio Grande Valley. The BND receives its water supply through a Water Service Agreement with the Brownsville Public Utilities Board Brownsville Irrigation District. The Brownsville Public Utilities Board has the capability of receiving up to 40 million gallons per day (1.2 billion gallons per month) from the Rio Grande and an additional 7.5 million gallons per day from a reverse osmosis desalination plant that withdraws water from brackish aquifers. During construction, Annova would use approximately 4 million gallons of potable water per month for dust control, sanitary purposes, and general construction needs. Potable water would be obtained from the BND. The volume needed during construction is approximately 0.3 percent of the capacity of the BND.

During operation, Annova would use approximately 805,000 gallons per month for drinking and sanitary purposes as well as testing of firewater pumps. This volume is about 0.07 percent of the total capacity of the BND's water supply. The Project's use would be a small percentage of the entire public water supply volume from the Rio Grande. Section 4.9 provides additional information on public utilities in the Project area.

Hydrostatic Testing

During construction, Annova would use water for hydrostatic testing of pipes and LNG storage tanks. See section 2.6 for general description of the hydrostatic testing process. Approximately 28 million gallons of water would be withdrawn from the BSC for hydrostatic testing of each LNG storage tank. Intake structures used for this withdrawal would be fitted with appropriate screens to limit impingement or organisms and prevent debris from collecting on the screen. The approximate volume of the BSC is 9 billion gallons, and the use of 56 million gallons for hydrostatic testing would represent 0.6 percent of the BSC volume. Annova would obtain a TCEQ temporary water rights permit for the withdrawal of water for hydrostatic testing of the LNG storage tanks. The hydrostatic test water for the LNG facility piping would use potable water obtained from the BND. No chemicals would be added to any water used for hydrostatic testing.

At the completion of all hydrostatic testing, approximately 1.8 million gallons would discharge to the BSC per day for approximately 30 days. Annova would obtain an EPA Hydrostatic Test Water Discharge Permit and an RRC permit to discharge hydrostatic test water. Prior to discharge, Annova would analyze the hydrostatic test water for total suspended solids, oil and grease, and pH, and any other parameters required by the EPA or RRC. Discharge of hydrostatic test water may cause localized, short-term turbidity in the BSC.

4.3.2.3 Conclusion for Surface Water

Surface water impacts resulting from the construction and operation of the Project could result from site grading activities, fill activities, dredging and construction activities associated with the marine facilities, vessel traffic, hydrostatic testing, and spills or leaks of hazardous materials. With implementation of the mitigation measures identified for each of the proposed activities, we have determined that construction and operation of the Project would result in primarily temporary and less than significant impacts on surface waters.

4.4 WETLANDS

As defined by the COE, wetlands are areas inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions (COE 1987). Wetlands can be a source of substantial biodiversity and serve a variety of functions that include providing wildlife habitat, recreational opportunities, flood control, and naturally improving water quality.

Wetlands are protected under Section 404 of the CWA. Section 404 establishes standards to evaluate and reduce impacts on wetlands under the jurisdiction of the COE. These standards require avoidance of wetlands where possible and minimization of disturbance where impacts are unavoidable. Annova must also demonstrate that appropriate steps have been taken to minimize wetland impacts, in compliance with the COE's section 404(b)(1) guidelines that restrict discharges of dredged or fill material where less environmentally damaging alternatives exist. Wetland impacts authorized under Section 404 of the CWA also require state water quality certification under Section 401 of the CWA. In the State of Texas, water quality certification is delegated to the TCEQ, with review by the EPA.

4.4.1 Existing Wetland Resources

Annova conducted wetland delineations of the Project site in 2014, 2015, and 2017 in accordance with the COE Wetland Delineation Manual (COE 1987) and the Regional Supplement to the *Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region* (COE 2010) and classified these wetlands according to the *Classification of Wetlands and Deepwater Habitats in the United States* (Cowardin et al. 1979). Approximately 165 acres of wetlands were delineated within the Project site, including the permanent access road. Wetlands delineated within the Project site include estuarine open water; unvegetated tidal flat; estuarine emergent marsh and estuarine scrub-shrub, each of which is briefly described below.

Non-vegetated wetlands identified within the Project site include:

- **Estuarine Open water** (E1OW): open water includes the portion of sub-tidal area adjacent to the BSC. This wetland occurs along the shore, is relatively shallow, and is periodically disturbed by drawdown and return surges associated with vessel traffic in the BSC.
- **Unvegetated tidal flats** (E2US3): unvegetated tidal flats are found in the eastern portion of the Project site adjacent to open water areas along the BSC. This wetland is characterized by sparse (less than 5 percent vegetative cover) to no vegetation. These areas are intermittently inundated by wind-driven tides.

Vegetated wetlands identified within the Project site include:

- **Estuarine emergent marsh** (E2EM1): estuarine emergent marshes are found in higher elevations along the BSC compared to the open water and tidal flats. These areas are dominated by plants that grow in waters of high salinity (halophytic plant species), including glassworts (*Salicornia depressa; S. bigelovii*), saltwort (*Batis* *maritima*), cenicilla (*Sesuvium portulacastrum*), sea purslane (*Sesuvium verrucosum*), and sea blite (*Suaeda linearis*) below the annual high tide line and seashore dropseed (*Sporobolus virginicus*), shoregrass (*Distichlis littoralis*), sea lavender (*Limonium carolinianum*), and seaside heliotrope (*Heliotropium curvassivicum*) above the high tide line. These wetlands are infrequently inundated by tides and are likely supported by a tidally influenced water table and periodic washover from vessel traffic in the BSC.

- **Estuarine scrub-shrub** (mangrove) (E2SS2): this habitat is found in the intertidal zone along the banks of the BSC on a low shelf of unconsolidated mud. These wetlands are dominated by black mangrove (*Avicennia germinans*) and saltwort. Construction and operation of the Project would not impact estuarine scrub-shrub wetlands.

4.4.2 Wetland Impacts and Mitigation

Constructing and operating the Project would temporarily and permanently disturb wetlands and non-wetland waters of the U.S. within the Project site. Construction of the facilities within the Project site, including the permanent access road, would disturb approximately 53.0 acres of vegetated wetlands and 4.7 acres of tidal flats and open water. Operation of the Project, including the permanent access road, would permanently affect approximately 50.8 acres of vegetated wetlands and 2.0 acres of non-vegetated tidal flat and open water. Table 4.4.2-1 summarizes the impacts on wetlands from construction and operation of the Project. Wetlands that would be affected by Project construction and operation are shown on figure 4.4.2-1.

TABLE 4.4.2-1

Impacts to Wetlands from Project Construction and Operation

Wetland Type	Cowardin Classification	Construction Impacts (acres) a/	Operational Impacts (acres) b/
Non-Vegetated			
Estuarine open water (within Project property)	E10W	2.0	1.0
Unvegetated tidal flat	E2US3	2.7	1.0
Vegetated Wetlands			
Estuarine emergent marsh	E2EM1	53.0	50.8
Non-vegetated and Vegetated Wetlands Total		**57.7**	**52.8**

a/ Construction impacts include all areas that would be disturbed during construction of the Project.
b/ Operation impacts include those areas that would be maintained during operation of the Project.

About 4.9 acres of wetlands would be temporarily affected. Temporary impacts would include loss of wetland vegetation and disturbance of soils, hydrology, and wetland functions during construction, which could be up to about four years. Following construction, temporarily affected wetlands would be allowed to revert to pre-construction wetland types, and would be monitored for successful revegetation per Annova's *Procedures* (see appendix B). The temporarily affected wetlands would be located outside of the 20-foot-wide corridor adjacent to the primary security fence and would include about 1 acre of estuarine open water, 1.7 acre of unvegetated tidal flat, and about 2.2 acres of estuarine emergent marsh.

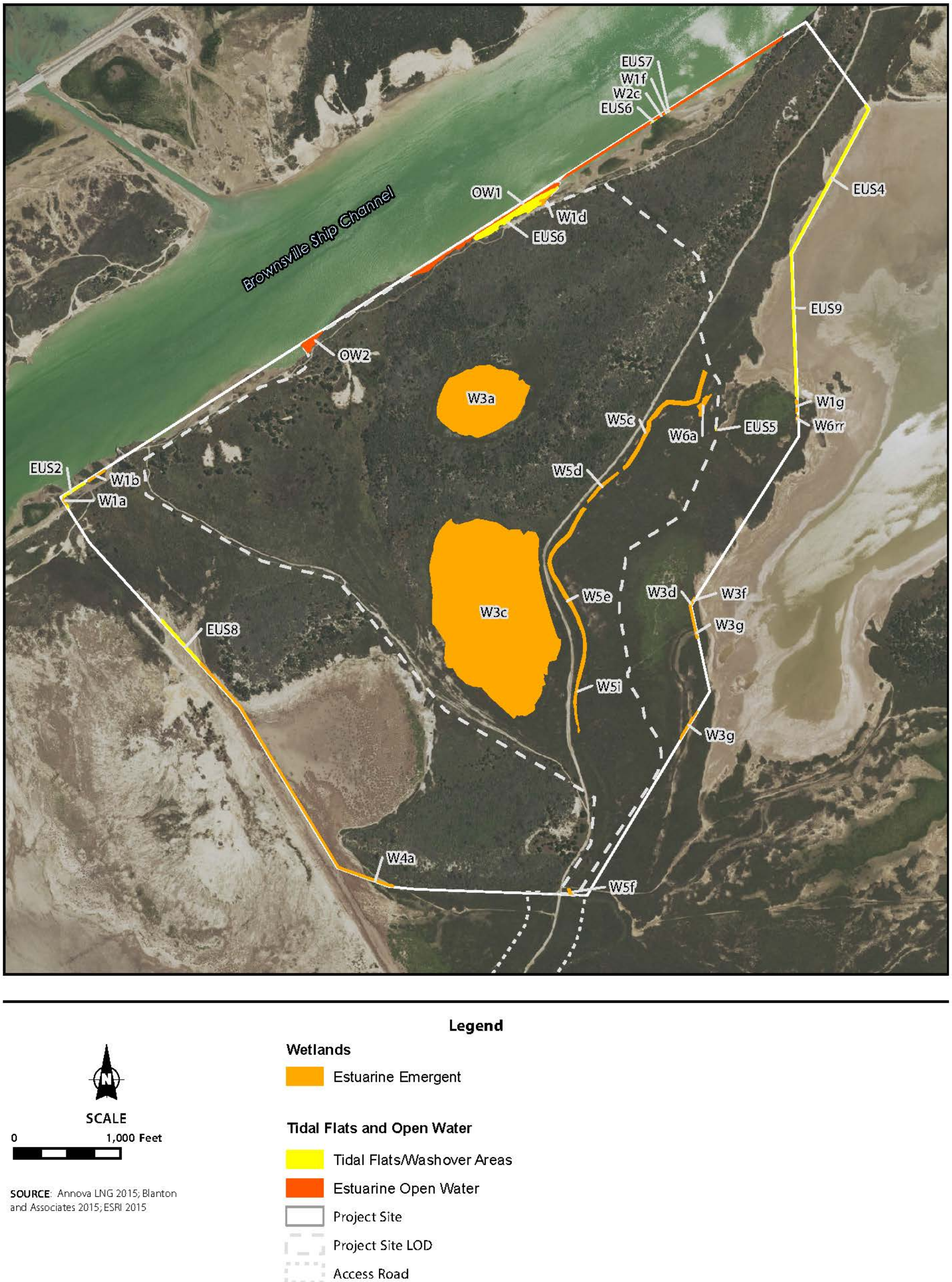


Figure 4.4.2-1 Wetlands Affected by Construction and Operation of the Project

Annova is consulting with the COE and other relevant agencies regarding permanent and temporary impacts on wetlands. Additionally, Annova has prepared a draft *Conceptual Mitigation Plan* that has identified preliminary Project mitigation requirements and proposed compensation for the Project's impacts on wetlands and waters of the U.S. (Blanton & Associates, Inc. 2017). The draft *Conceptual Mitigation Plan* proposes to enhance and restore an estimated 145 acres of estuarine open water, estuarine emergent marsh, and estuarine scrub-shrub (mangrove) marsh at the Little San Martin Lake Mitigation Site, located approximately 1.2 miles northwest of the Project site. Annova is still developing the mitigation plan and is currently collecting additional information on the baseline conditions at the proposed mitigation site, and coordinating with the COE to review and finalize functional assessments of wetlands that would be affected at the Project site to determine total mitigation needs. Based on the results of these efforts, Annova would further develop and refine the *Conceptual Mitigation Plan* as needed. Annova states that additional detailed engineering, design, construction, and monitoring information is required before it finalizes the mitigation plan, and that Annova would continue to incorporate those details as the mitigation plan develops. The COE would determine the acceptability of any proposed compensatory mitigation for wetland impacts.

4.4.3 Conclusion

We conclude that adherence to measures contained in Annova's *Procedures* would adequately address wetlands that are only temporarily affected by Project construction, such that impacts on temporally affected wetlands would be less than significant.

Construction of the Project would result in the permanent loss of 50.8 acres of emergent vegetated wetlands and 2 acres of unvegetated open water and tidal flat. This loss of nearly 53 acres of wetland would be a permanent impact. Annova used a hydrogeomorphic model to assess the existing functions of the wetlands that would be permanently affected by the Project, and is working with the COE to finalize that assessment for the purpose of identifying required mitigation. We anticipate that if the COE issues a Section 404/Section 10 permit for the Project, it would be conditioned upon Project-related adverse impacts on waters of the U.S. being effectively offset by mitigation similar to what Annova has identified in its draft *Conceptual Mitigation Plan*, such that permanent impacts on wetlands would be reduced to less than significant levels.

4.5 VEGETATION

The Project would be located within the Gulf Coast Prairies and Marshes Ecoregion (TPWD 2016c). This ecoregion is a nearly level, slowly drained plain less than 150 feet in elevation, which is dissected by streams and rivers flowing into the Gulf of Mexico (TPWD 2016c). The majority of the Project site would be less than 5 feet above sea level and is flat with shallow depressions and isolated lomas. Lomas are dunes formed from wind-blown clay that support dense shrub vegetation communities that provide important habitat for protected wildlife species (FWS 2012b). Three distinct lomas—Loma del Potrero Cercado, Loma del Divisadero, and the eastern portion of Loma de la Juaja—are located within the Project site. These lomas and their habitat value for wildlife are discussed in greater detail in section 4.5.4 and section 4.6. Portions of the Project site support emergent herbaceous wetlands or are devoid of vegetation due to high concentrations of salt.

4.5.1 Existing Vegetation Communities

No forested vegetation would be affected by construction and operation of the Project. The majority of the Project site is covered in South Texas loma grassland and shrublands, Gulf Coast salty prairie, and coastal sea ox-eye daisy flats. Vegetation communities within the Project site are summarized below. Nomenclature for vegetation communities is primarily based on the *Ecological Mapping System of Texas* (EMST; Ludeke et al. 2010); however, the names of a few of the vegetation communities diverge from the EMST name to more accurately represent the site-specific vegetation community, to separate wetland communities from upland communities, and to distinguish between similar vegetation communities that may differ in terms of wildlife habitat. Wetlands are addressed further in in section 4.4.

4.5.1.1 Emergent Herbaceous Wetland

Coastal Salt and Brackish High Tidal Marsh

Coastal salt and brackish high tidal marsh consists of tidally herbaceous wetlands in salt and brackish waters. Typical vegetation includes glassworts (*Salicornia depressa, S. bigelovii*), saltwort (*Batis maritima*), cenicilla (*Sesuvium portulacastrum*), sea purslane (*Sesuvium verrucosum*), Matamoros saltbush (*Atriplex matamorensis*), sea blite (*Suaeda linearis*), seashore dropseed (*Sporobolus virginicus*), shoregrass (*Monanthochloe* [*Distichlis*] *littoralis*), sea lavender (*Limonium carolinianum*), and seaside heliotrope (*Heliotropium curassavicum*). Approximately 10 acres[6] of coastal salt and brackish high tidal marsh vegetation is found within the Project site along the BSC; however, this vegetation community would not be affected by construction and operation of the Project.

Coastal Salty Flat/Depression

The coastal salty flat/depression community consists of shallow topographic depressions that capture and pond water, which then evaporates thereby concentrating salt. Typical vegetation is similar to the coastal salt and brackish high tidal marsh community and includes glassworts,

[6] Acres of existing vegetation communities listed in section 4.5.1 do not include unvegetated areas (i.e., barren areas, existing roads, open water, and tidal flat/washover); therefore, the sum of the acreages listed in this section are less than the total acreage of the Project site and access road.

saltwort, cenicilla, sea purslane, sea blite, and shoregrass. The BSC and dredged material has isolated these areas from tidal influence. Approximately 55 acres of this vegetation community is found along the southwest boundary of the Project site and along the access road.

Salt and Brackish Wetland

Salt and brackish wetlands are found in large depressions and vegetation is variable, depending on rainfall and standing water. In the wet season, water remains in these wetlands longer, which may shift the vegetation community toward freshwater species as salinity drops. Approximately 62 acres of this vegetation community are found in the Project site south of the Loma del Potrero Cercado. Typical vegetation includes shoregrass, saltwort, saltgrass (*Distichlis spicata*), Berlandier wolfberry (*Lycium berlandieri*), spikerush (*Eleocharis compressa*), arrowhead (*Sagittaria* sp.), and jointed flatsedge (*Cyperus articulatus*).

South Texas Saline Lake Grassland

South Texas saline lake grassland forms in bands around saline lakes or in saline depressions. Approximately 10 acres of South Texas saline lake grassland occur within the Project site, on top of Loma del Potrero Cercado. Typical vegetation includes: sea ox-eye daisy (*Borrichia frutescens*), saltwort, seashore dropseed, saltmarsh bulrush (*Bolboschoenus* [*Schoenoplectus*] *maritimus*), jointed flatsedge, shoregrass, camphor daisy (*Rayjacksonia phyllocephala*), and tornillo (*Prosopis reptans*).

4.5.1.2 Grassland/Herbaceous

Coastal Sea Ox-eye Daisy Flats

Coastal sea ox-eye daisy flats consist of grasslands adjacent to, but higher in elevation, than tidal and non-tidal wetlands and wind flats. Approximately 66 acres of this vegetation community are found interspersed throughout the western half of Project site. Typical vegetation includes sea ox-eye daisy, sacahuiste (*Spartina spartinae*), saltwort, glassworts, shoregrass, sea blite, and seashore dropseed.

Gulf Coast Salty Prairie

Gulf coast salty prairie vegetation occurs in flat uplands and is the dominant community in southeastern portion of the Project site and along the access road. Typical vegetation includes seashore dropseed, smutgrass (*Sporobolus indicus*), whorled dropseed (*S. pyramidatus*), guineagrass (*Urochloa maxima*), leatherleaf (*Maytenus phyllanthoides*), camphor daisy, tornillo, sea ox-eye daisy, Texas pricklypear (*Opuntia engelmannii* var. *lindheimeri*), Spanish dagger (*Yucca treculeana*), tasajillo (*Cylindropuntia leptocaulis*), Bermudagrass (*Cynodon dactylon*), whiplash pappusgrass (*Pappophorum vaginatum*), silver bluestem (*Bothriochloa laguroides*), witchgrass (*Panicum capillare*), short-spike windmillgrass (*Chloris X subdolichostachya*), and hooded windmillgrass (*Chloris cucullata*). Approximately 181 acres of this vegetation community occur within the Project site and along the access road.

4.5.1.3 Scrub-shrub

South Texas Loma Evergreen Shrubland

South Texas loma evergreen shrubland is an upland vegetation community consisting of dense cover of thornshrub species found at higher elevations on lomas. It occurs on top of all three lomas found within the Project site. Typical vegetation includes ebony (*Ebenopsis ebano*), granjeno (*Celtis ehrenbergiana* [*C. pallida*]), lime prickly-ash (*Zanthoxylum fagara*), honey mesquite (*Prosopis glandulosa*), desert yaupon (*Schaefferia cuneifolia*), lotebush (*Ziziphus obtusifolia*), coma (*Sideroxylon celastrinum*), coyotillo (*Karwinskia humboldtiana*),Texas Lantana (*Lantana urticoides* [*L. horrida*]), Berlandier's fiddlewood (*Citharexylum* b*erlandieri*), Spanish dagger (*Yucca treculeana*), few-flower climbing-dalea (*Dalea scandens* var. *paucifolia)*, goatbush (*Castela erecta* [*C. texana*]), cow-itch vine (*Cissus incisa* [*C. trifoliata*]), old-man's beard (*Clematis drummondii*), threadvine (*Cynanchum barbigerum*), hierba del soldado (*Waltheria indica*), Tamaulipan mistflower (*Tamaulipa azurea*), Lozano's false Indian mallow (*Allowissadula lozanii*), Cuban germander (*Teucrium cubense*), tropical sage (*Salvia coccinea*), guineagrass, big sacaton (*Sporobolus wrightii*), and smutgrass. Approximately 208 acres of this vegetation community occur within the Project site and along the access road.

South Texas Loma Grassland/Shrubland

This community is a mix of grassland and shrubland found at low elevations around the base of lomas and typically forms a continuous ring around the loma. Shrub cover is typically greater than 10 percent. This community occurs throughout the Project site and along the access road at the base of lomas. Typical vegetation includes: big sacaton, guineagrass, whiplash pappusgrass, silver bluestem, witchgrass, short-spike windmillgrass, hooded windmillgrass, smutgrass, multi-flower false rhodesgrass (*Trichloris pluriflora*), hierba del soldado, white mistflower (*Fleischmannia incarnata*), blue mistflower (i), false ragweed (*Parthenium hysterophorus*), goldenweed (*Isocoma drummondii*), Tamaulipan mistflower, cow-itch vine, old-man's beard, threadvine, dwarf morning glory (*Evolvulus alsinoides* var. *angustifolius* [*E. alsinoides* var. *hirtcaulis*]), corona del Christo (*Passiflora foetida* var. *gossypiifolia*), honey mesquite, Spanish dagger, Berlandier fiddlewood, Texas lantana, Texas pricklypear, lotebush, lime prickly-ash, granjeno, coma, tasajillo, coyotillo, cenizo (*Leucophyllum frutescens*), and camphor daisy. At lower elevations, the loma grasslands consist of dense monotypic stands of buffelgrass (*Pennisetum ciliare*) or Angleton bluestem (*Dichanthium aristatum*). Approximately 178 acres of this vegetation community occur within the Project site and along the access road.

4.5.1.4 Coastal Mangrove Shrubland

This vegetation community is located in the intertidal zone and is dominated by black mangrove (*Avicennia germinanas*) and saltwort. Approximately 2 acres of coastal mangrove shrubland occur within the Project site; however, this vegetation community would not be affected by construction and operation of the Project.

4.5.1.5 South Texas Tidal Wind Flats

This community has less than five percent vegetative cover and is infrequently inundated with water from high, wind-driven tides. The sparse vegetation, when present, is composed of scattered individuals of species common in salt marshes. Algal flats may also intermittently occur within tidal flats during periods of long-term inundation; however, given their sporadic and intermittent occurrence within the Project site, algal flats are not included as a permanent vegetation community. Approximately 13 acres of South Texas tidal wind flats occur along the northeastern edge of the Project site.

4.5.2 Vegetation Impacts and Mitigation

As summarized in table 4.5.2-1, constructing and operating the Project would temporarily and permanently impact vegetation. Constructing the Project would impact approximately 462 acres of vegetation, of which approximately 409 acres would be permanently affected by the Project.

TABLE 4.5.2-1

Vegetation Communities Affected by Construction and Operation of the Project

Vegetation Community	Construction Impacts (acres) a/	Operation Impacts (acres) b/
Emergent Herbaceous Wetland		
Coastal Salty Flat/Depression	3	1
Salt and Brackish Wetland	40	40
South Texas Saline Lake Grassland	10	10
Grassland / Herbaceous		
Coastal Sea Ox-eye Daisy Flats	52	48
Gulf Coast Salty Prairie	131	98
Scrub-shrub		
South Texas Loma Evergreen Shrubland	130	127
South Texas Loma Grassland/Shrubland	94	85
Tidal Flats		
South Texas Wind Tidal Flats	2	0
Total c/, d/	**462**	**409**

a/ Construction impacts include all areas disturbed during construction.
b/ Operation impacts include those areas that would be maintained during operation of the Project.
c/ Totals do not include impacts on non-vegetated land cover types (e.g., open water, mud flat, and barren areas).
d/ Numbers may not sum due to rounding.

As summarized in the table above, construction would primarily impact Gulf Coast Salty Prairie (131 acres), South Texas Loma Evergreen Shrubland (130 acres), South Texas Loma Grassland/Shrubland (94 acres), and Coastal Sea Ox-eye Daisy Flats (52 acres). Impacts on vegetation in areas not occupied by permanent facilities and located outside of the temporary workspace (borrow area) would be considered temporary because areas would be allowed to revert to pre-construction land covers and would be monitored for successful revegetation per the Annova *Plan* and *Procedures* (see appendix B). However, the duration of these impacts could be either short term or long term depending on pre-disturbance vegetation cover. Impacts are considered short term if, after three growing seasons, the revegetated disturbed areas resemble adjacent undisturbed lands. Temporary impacts would be considered short-term for the majority of the vegetation communities affected since most of the vegetation communities have the potential for revegetation within three growing seasons. Impacts on South Texas Loma Evergreen Shrubland and South Texas Loma Grassland/Shrubland vegetation communities, however, would be considered long term as these vegetation communities would potentially take longer than three growing seasons to resemble adjacent undisturbed lands.

Operation and maintenance of the Project would impact approximately 409 acres of vegetation communities. Operation of the Project would result in permanent loss of vegetation. This would primarily affect South Texas Loma Evergreen Shrubland (127 acres), Gulf Coast Salty

Prairie (98 acres), South Texas Loma Grassland/Shrubland (85 acres), Coastal Sea Ox-eye Daisy Flats (48 acres), and Salt and Brackish Wetland (40 acres) vegetation communities.

In addition to the direct loss of vegetation, temporary and permanent removal of vegetation communities for construction and operation of the Project would result in indirect impacts on wildlife. Impacts of the Project on wildlife are discussed in section 4.6.

At the request of the FWS, Annova has modified the original Project layout to minimize clearing of mature dense thornshrub vegetation (i.e., South Texas Loma Evergreen Shrubland and South Texas Loma Grassland/Shrubland). The current site layout reduces Project impacts on these vegetation communities on the western and eastern boundaries of the Project site. Additionally, Annova would comply with any Project-specific recommendations and mitigation requirements associated with the Section 404 and Section 10 permits issued by the COE, which would be expected to include implementation of compensatory wetland mitigation similar to what Annova has identified in a draft *Compensatory Mitigation Plan*.

4.5.3 Exotic or Invasive Plants and Noxious Weeds

Exotic and invasive plants and noxious weeds can out-compete and displace native plant species, which can also alter the composition and habitat value of the affected areas. During field surveys of the Project site, Annova did not identify any species listed on federal or state noxious weed lists; however, eight exotic (i.e., introduced) species were observed within the Project site. These include Bermudagrass (*Cynodon dactylon*), Kleberg bluestem (*Dichanthium annulatum*), Angleton bluestem (*Dichanthium aristatum*), false ragweed (*Parthenium hysterophorus*), buffelgrass (*Pennisetum ciliare*), silky leaf frog fruit (*Phyla fruticosa* [*P. strigulosa*]), smutgrass (*Sporobolus indicus*), and guineagrass (*Urochloa maxima*). Because none of these eight introduced species are federally or state-listed as noxious weeds, no special control measures are required by federal or Texas noxious weed control regulations. However, the Annova *Plan* and *Procedures* include measures to control noxious weeds, if any are identified.

In accordance with its *Plan* and *Procedures*, Annova would coordinate with the appropriate agencies to prevent any Project-related introduction or spread of invasive plants and noxious weeds and would conduct post-construction monitoring. As part of this monitoring program, Annova would examine disturbed areas for the presence of invasive species. To ensure that construction equipment brought to the Project site would be clean and free of noxious or invasive species, all contractor-owned equipment would be pressure washed in the contractor's equipment yard and inspected to ensure it is clean. Prior to transport to the Project site, equipment would be inspected and, if necessary, re-washed. For equipment that is not contractor owned, a cleaning and inspection program would be implemented at each rental yard to ensure equipment is clean and free of noxious or invasive species prior to transport to the Project site.

4.5.4 Vegetation Communities of Special Concern

Vegetation communities of special concern include ecologically important natural communities, threatened or endangered plant species, or other rare or imperiled plants in need of special protection or minimal disturbance. No state-designated vegetation communities of special concern (including rare, threatened, or endangered plants) occur in the Project area; therefore, construction or operation of the Project would not affect vegetation communities of special concern. However, Loma vegetation communities, including South Texas Loma Evergreen Shrubland and South Texas Loma Grassland/Shrubland communities, do provide habitat for several federal and state-listed threatened and endangered species (see sections 4.6 and 4.7). On the Project site, South Texas Loma Evergreen Shrubland vegetation is found on top of all three lomas and South Texas Loma Grassland/Shrubland is located at the base of lomas. As described in table 4.5.2-1, approximately 224 acres of South Texas Loma Evergreen Shrubland and Grassland/Shrubland vegetation would be affected during construction, of which 212 acres would be permanently lost due to operation of the Project.

In addition to lomas, wetlands can be a source of substantial biodiversity and serve a variety of functions that include providing wildlife habitat, recreational opportunities, flood control, and naturally improving water quality. Wetland communities and open water habitats are addressed in more detail in section 4.4.

4.5.5 Conclusion

Although approximately 409 acres of vegetation communities would be permanently lost, the region contains large quantities of similar vegetation communities. Therefore, we have determined that construction and operation of the Project would not significantly impact vegetation. Annova is also evaluating off-site lands for conservation, either through purchase or conservation easement, to compensate for loss of loma vegetation and wildlife habitat (see section 4.7).

4.6 WILDLIFE AND AQUATIC RESOURCES

The Project area generally includes upland, wetland, and marine habitats, each supporting a variety of terrestrial and aquatic wildlife. Wildlife occurring in the Project area are generally characteristic of the vegetation (described in section 4.5) present. Aquatic wildlife occurring in the BSC or Gulf of Mexico are discussed separately in section 4.6.2. Threatened and endangered species and other protected species are addressed in section 4.7.

4.6.1 Terrestrial Wildlife

In general, the wildlife habitat types present in the Project area include: uplands (herbaceous and scrub-shrub), wetlands, barren/unvegetated, tidal flats, and open water. Typical wildlife occurring within these habitat types are described below.

Upland habitat at the Project site can be further characterized as herbaceous and scrub-shrub. Herbaceous habitat consists of areas dominated by sea ox-eye daisy interspersed in the western half of the Project site, and also salty prairie which is found along the southeastern portion of the Project site and along the proposed access road. Herbaceous habitat supports mammals, reptiles, and birds, including white-tailed deer (*Odocoileus virginianus*), coyote (*Canis latrans*), Eastern gray squirrel (*Sciurus carolinensis*), grasshopper mice (*Onychomys* spp.), Eastern cotton-tail rabbit (*Sylvilagus floridanus*), desert cottontail (*Sylvilagus audubonii*), black-tailed jackrabbit (*Lepus californicus*), least shrew (*Cryptotis parva*), desert shrew (*Notiosorex crawfordi*), and bullsnake (*Pituophis catinefer sayi*).

Scrub/shrub habitats comprise the majority of the Project site and are primarily associated with three distinct lomas: Loma del Potrero Cercado (a large loma system with two distinct peaks), Loma del Divisadero, and the eastern portion of Loma de la Juaja. Lomas are dunes made of wind-blown clay that provide important habitat for protected species such as the ocelot (*Leopardus pardalis*) and jaguarundi (*Herpailurus yagouaroundi cacomitli*) (FWS 2012b), which are further discussed in section 4.7. The lomas, due to their clay substrate and elevation, typically range from 5 to 30 feet above mean high tide and support a specific vegetative cover type, which is described in section 4.5. Wildlife typically associated with scrub/shrub habitat include common raccoon (*Procyon lotor*), white-tailed deer, coyote, bobcat (*Lynx rufus*), collared peccary (*Tayassu tajacu*), Eastern gray squirrel, grasshopper mice, desert cottontail, black-tailed jackrabbit, least shrew, desert shrew, and bullsnake.

Wetland habitats are located along the BSC and also shallow topographic depressions found along the southwest boundary of the Project site and along portions of the Access Road. Wetland habitats typically support diverse ecosystems that provide nutrients, cover, shelter, and water for a variety of terrestrial and aquatic wildlife, including waterfowl, wading birds, raptors, mammals, reptiles, and amphibians. Wildlife typically associated with wetlands include white-tailed deer, grasshopper mice, Eastern cottontail rabbit, least shrew, Rio Grande lesser siren (*Siren intermedia texana*), barred tiger-salamander (*Ambystoma tigrinum mavortium*), black-spotted newt (*Notophthalmus meridionalis*), and red-eared slider (*Trachemys scripta elegans*).

In addition to the upland and wetland habitats, the Project site also contains barren/unvegetated land and tidal/wind flats. Barren areas on the Project site is restricted to areas along the toe of slopes of lomas where vegetation is lacking due to soil movement and active erosion. Tidal flats are frequently inundated for extended periods by tidal fluctuations. In addition to tidal fluctuations, vessel wakes from the BSC cause these areas to be frequently inundated or "washover" areas. At the Project site, tidal flats occur along portions of the waterfront of the BSC. Wind tidal flats are mostly free of vegetation (less than 5 percent cover) and infrequently inundated with water from high, wind-driven tides. These areas are located along the northeastern edge of the Project site and are associated with South Bay. Typical wildlife associated with these habitats include small mammals, reptiles, amphibians, and birds such as least shrew, and Rio Grande lesser siren.

Open water comprises the portions of the BSC that extend into the Project site. Typical wildlife associated with open water habitat include several bird species such as common loon (*Gavia immer*), brown pelican (*Pelecanus occidentalis*), and laughing gull (*Larus atricilla*), and marine mammals and fishes as discussed below in section 4.6.2.

Wildlife species that have been observed within the Project vicinity include: bobcat, coyote, striped skunk (*Mephitis mephitis*), common raccoon, Virginia opossum (*Didelphis virginiana*), nine-banded armadillo (*Dasypus novemcinctus*), white-tailed deer, nilgai antelope (*Boselaphus tragocamelus*), collared peccary, feral pig (*Sus scrofa*), Eastern cottontail rabbit, black-tailed jackrabbit, southern plains woodrat (*Neotoma micropus*), Mexican ground squirrel (*Spermophilus mexicanus*), American badger (*Taxidea taxus*), long-tailed weasel (*Mustela frenata*), and domesticated cats (*Felis catus*), horses (*Equus caballus*), cows (*Bos taurus*), and goats (*Capra hircus*). Certain wildlife species, such as white-tailed deer and feral pigs have recreational value for hunters. Horses, cows, and goats that have been observed in the vicinity of the Project site may be considered commercially important species.

4.6.1.1 Impacts and Mitigation

As described in table 4.5.2-1 (see section 4.5), constructing the Project would affect about 491 acres of upland and wetland habitat and about 80 acres of open water habitat. Operating the Project would result in the permanent loss of about 412 acres of habitat.

Impacts on wildlife resulting from construction of the Project would include displacement, increased stress, and could lead to increased rates of injury and mortality. Vegetation clearing and loss of habitat would reduce suitable cover, nesting, and foraging opportunities available for wildlife. More mobile wildlife, such as birds and mammals, may relocate to similar adjacent habitats when construction activities commence. This displacement and relocation would result in "edge effects"; increased population densities, resulting in increased inter- and intra-specific competition and reduced reproductive success of individuals.

Construction and operation of the Project would result in increased noise, lighting, and human activity that could disturb wildlife in the area. Increased noise and nighttime lighting may cause temporary displacement of terrestrial wildlife. See sections 4.11.2.3 and 4.11.2.4 for detailed discussion of noise that would be generated during construction and operation, respectively. However, there is abundant habitat available in the vicinity of the Project for wildlife displaced temporarily and permanently by construction and operation of the Project. Increased project-related traffic would result in higher rates of stress, injury, and mortality experienced by wildlife. Smaller, less mobile wildlife such as reptiles and amphibians could experience increased rates of injury and mortality (e.g., crushed by heavy equipment or falling into open excavations) during construction and potentially during operation. In accordance with TPWD recommendations, Annova would cover any excavations or trenches that must be left unfilled at the end of the work day, have escape ramps placed in them (made from boards or soil), or would fence off the trench or excavation area with an exclusion fence. Annova would inspect any excavations or trenches left open overnight the following morning for the presence of wildlife.

Construction activities would also result in temporary, localized air emissions that would last for the duration of the construction period. Emissions from construction would not result in the violation of any applicable ambient air quality standards. Impacts on wildlife species due to air emissions during construction and operation of the site are expected to be minimal. Additional information on air quality is provided in section 4.11.

Operating the Project would permanently remove wildlife habitat. In addition, the boundary fence would permanently displace larger wildlife from entering the facility; however, many reptiles, small mammals, and birds would continue to use habitat within the boundary fence right-of-way. Although construction would permanently remove wildlife habitat, ample undisturbed habitat is available in the vicinity of the Project site. In addition, Annova would maintain a wildlife corridor on the west side of the Project site, where existing dense thornshrub and other habitats would be avoided and preserved for use by various wildlife species. A barrier wall located between the site and along the wildlife corridor would reduce light and noise impacts on wildlife using the corridor. Some habitat within the fenced boundaries would only be temporarily disturbed and vegetation would be allowed to revert to pre-existing land covers after construction. Fencing and wildlife crossings along the access road and establishment of speed limits is expected to reduce the possibility of vehicle collisions.

Temporary workspaces would be disturbed during construction, then planted with native grasses in the goal of restoring a grassland/herbaceous wildlife habitat. Annova would implement the applicable BMPs from the TPWD Wildlife Habitat Assessment Program, which includes the *TPWD Guidelines for Revegetation of Disturbed Landscapes* (TPWD 2016d). As a result, any habitats within the fenced boundaries that would be temporarily disturbed would be converted to herbaceous habitat during Project operation.

Annova has proposed measures that would minimize the effects of light on visual resources, off-site areas, and contrast with the night sky. The proposed lighting design and practices to minimize light emitted from the Project include the following:

- installing lighting only where needed (motion sensors or timers would be incorporated where use at night is intermittent);
- shielding bulbs and directing light downward;
- installing lamps with warmer colors and minimum blue light;
- minimize lighting on the access road to that required for safety reasons;
- whenever possible place lights so they do not shine directly towards adjacent undisturbed habitats or the beach; and
- avoiding flaring of gas at night whenever feasible.

Annova would incorporate this information into a *Facility Lighting Plan* for use during Project operation. The FWS has commented that Annova should also evaluate methods to minimize the effects of light on wildlife during construction. Because construction would occur over a period of four years, we agree. Because Annova has not yet developed its *Facility Lighting Plan*, **we recommend that**:

- **Prior to construction, Annova should file with the Secretary, for review and written approval by the Director of OEP, its *Facility Lighting Plan* for operation of the LNG terminal. In addition, Annova should include in its *Facility Lighting Plan* measures to reduce the effects of light during construction and commissioning of the Project.**

4.6.1.2 Unique and Sensitive Wildlife

Unique or sensitive wildlife resources are present in the vicinity of the Project and are discussed below. Species protected under the ESA are discussed in section 4.7.

Migratory Birds

Migratory bird species nest in the United States and Canada during the summer months and then migrate south to the tropical regions of Mexico, Central and South America, and the Caribbean for the non-breeding season. Some species migrate from breeding areas in the north to the Gulf Coast for the non-breeding season. Migratory birds are protected under the Migratory Bird Treaty Act (MBTA), which prohibits the take or killing of individual migratory birds, their eggs and chicks, and active nests. The MBTA provides that it is unlawful to pursue, hunt, take, capture, kill, possess, sell, purchase, barter, import, export, or transport any migratory bird, or any part, nest, or egg of any such bird. Executive Order 13186 (January 2001) directs federal agencies to consider the effects of agency actions on migratory birds and determine where unintentional take is likely to have a measurable negative effect on migratory bird populations, and to avoid or minimize adverse impacts on migratory birds through enhanced collaboration with the FWS. Executive Order 13186 states that emphasis should be placed on species of concern, priority habitats, and key risk factors, and that particular focus should be given to addressing population-level impacts.

On March 30, 2011, the FWS and the Commission entered into a Memorandum of Understanding (MOU) that focuses on avoiding or minimizing adverse impacts on migratory birds and strengthening migratory bird conservation through enhanced collaboration between the two agencies. This voluntary MOU does not waive legal requirements under the MBTA, BGEPA, ESA, Federal Power Act, NGA, or any other statute and does not authorize the take of migratory birds.

Consistent with EO 13186 which emphasizes a focus on species of concern and priority habitats, the Project would be located within the North American Bird Conservation Initiative - Bird Conservation Region 37 – Gulf Coastal Prairie (FWS 2015d). Appendix D identifies the Birds of Conservation Concern known to occur in Cameron County and also includes species that have nesting ranges within the county. Nineteen species of birds of conservation concerns have the potential to nest within the Project site from approximately February to September (Cornell Lab of Ornithology 2015; FWS 2015d).

Migratory birds follow broad routes called flyways between breeding grounds and wintering grounds. South Texas and the Gulf of Mexico are part of the North American Central Migratory Flyway, an important pathway for migratory birds, with many coastal and marine species using the coastlines of Louisiana and Texas during migration (FWS 2012c; BOEM 2011).

Colonial waterbirds, a subset of migratory birds, include a large variety of bird species that share two common characteristics: 1) they tend to gather in large assemblies, called colonies or rookeries, during the nesting season; and 2) they obtain all or most of their food from the water (FWS 2002).[7] No colonial waterbird rookeries have been identified within the Project site.

Impacts and Mitigation

A variety of migratory birds including birds of conservation concern and waterfowl use or could use the habitats affected by the Project. These birds use these habitats for foraging, resting (stopover), sheltering, breeding, and nesting. These habitats and the impacts on them resulting from constructing and operating the Project were addressed previously. As described previously, constructing the Project would require the temporary removal of habitat that may be used by migratory birds, much of which would be permanently removed for operation. Behavior changes including nest abandonment combined with the loss and/or conversion of wildlife habitats as well as direct impacts from construction could increase the amount of stress, injury, and mortality experienced by migratory birds. In addition, increased noise and construction-related activity could deter birds from nesting and, therefore, potentially decrease fertility. Migratory birds using the Project area for foraging or roosting activities could be disrupted if they are disturbed while engaging in these activities. The temporary and permanent loss of migratory bird habitat and the general disruption to bird behavior created by the use of construction equipment could result in the displacement of migratory birds. Displacement and avoidance could impact bird migration, nesting, foraging, and mating behaviors.

Many migratory birds use natural light from the sun, moon, and stars for navigation, and artificial lighting can suppress natural light sources, which could have unknown effects on birds at the population level. Fatalities to avian species due to artificial light are well documented, with avian fatalities associated with attraction to light sources, especially in low light, fog, and when there is a low cloud ceiling (Orr et al. 2013). In addition, migratory birds are often attracted to artificial lighting on large land-based facilities, and this light can disrupt migration patterns and cause the birds to veer off course. A 2008 study showed that the strongest bird attraction response is to white light, which seems to interfere with visual orientation (Poot et al. 2008). Attraction to artificial lighting could impact migratory birds if they collide with lighting structures or elevated structures at the Project site.

The FAA requires that structures exceeding 200 feet be marked and/or lighted (FAA 2016). The FAA conducted a study that evaluated obstruction lighting arrangements to better understand how migratory birds are negatively affected by obstruction lights and to identify lighting

[7] Colonial waterbirds demonstrate nest fidelity, meaning they return to the same rookery year after year. Rookeries are typically in marshes or near the shores of ponds or streams. Although some colonial waterbirds (e.g., least terns) will nest in developed areas, many waterbirds (e.g., great blue heron and great egrets) are wary of human activity.

techniques to reduce avian fatalities (Patterson 2012). Annova is not proposing any structures over 200 feet.

To minimize potential impacts on migratory bird nesting, the FWS recommends that vegetation clearing activities be conducted outside the nesting season or between September 1 and February 28 of each year in this area. In addition, several species that may occur in the Project area are ground-nesting species; therefore, the FWS recommends that ground-disturbing activities also be conducted outside the migratory bird nesting season. Annova would attempt to limit clearing on the Project site to between September 1 through and February 28 to avoid impacts on migratory bird nesting. If construction during the nesting season cannot be avoided, Annova would follow the FWS recommendation to have a biologist trained in bird identification available to survey the work area to identify and avoid active nests prior to and during the clearing activity. If nests are found, a buffer around the active nest would be established until the birds fledge. Upon fledging, construction activities would resume within the buffer.

Concerning the other FWS recommendations, Annova would implement the FWS' recommendation that the construction cranes have the boom down when not in use and at night, in order to minimize impacts on migratory birds, especially during inclement weather or during conditions of limited visibility, and during bird migration. Because the MBTA is under the jurisdiction of the FWS, **we recommend that:**

- **<u>Prior to construction</u>, Annova should consult with the FWS to develop a Project-specific *Migratory Bird Plan* that includes measures to avoid and minimize impacts on migratory birds, including details from the *Facility Lighting Plan* that are intended to reduce impacts on wildlife and birds. Annova should file the *Migratory Bird Plan* and evidence of consultation with the FWS with the Secretary.**

To address potential impacts related to construction and operation lighting, Annova would ensure that facility lighting meets the required codes for safety, security, and egress and would include design measures and practices that would reduce off-site light impacts and light impacts on the nighttime sky (see above) that would limit nuisance light and reduce potential impact on migratory birds. Section 4.8 provides additional information on mitigation measures for lighting to reduce visual impacts. As previously indicated, because Annova has not yet developed a plan that identifies guidelines for lighting during operation of the LNG terminal, we recommend that Annova file its *Facility Lighting Plan* with the Secretary prior to construction, and that Annova include measures to address construction and commissioning in its *Facility Lighting Plan*.

During operation of the terminal, Annova anticipates that the use of warm/cold gas flares would only occur intermittently during planned maintenance, shut-down, and start-up (MSS) events. MSS flaring would typically occur for up to 12 hours each year (i.e., 6 hours for each biannual MSS event) with a worst-case scenario of up to 40 hours during a year when all MSS flaring events could coincide. Flaring from the marine flare stack would occur during the transfer of LNG from the marine terminal to an LNG carrier that arrives with warm inert cargo tanks full of either carbon dioxide or nitrogen. Annova estimates these marine flaring events would occur up to two times per year, with the flaring operating continuously for up to 25 hours per event for an annual total of up to 50 hours per year. Although this occasional flaring could impact some migratory birds if present during the flaring event, we find that occasional flaring during operation would not substantially impact migratory bird populations.

National Wildlife Refuges and Preserves

Two National Wildlife Refuges (NWR), two wildlife preserves, and a wildlife corridor are located within 1.0 mile of the Project site. Impacts on wildlife within these areas are further discussed below.

<u>Laguna Atascosa National Wildlife Refuge</u>

The Laguna Atascosa NWR is a 97,000-acre coastal refuge located north of the Project site across the BSC and SH 48. Established in 1946 as a migratory bird habitat area, the landscape consists of thornscrub, coastal prairie, sand dunes, lomas, and tidal flats. Within the Laguna Atascosa NWR is the Bahia Grande Unit, a 6,500-acre tidal basin connected to the BSC by a pilot channel. The closest portion of the NWR to the Project site is the Bahia Grande Unit which is approximately 0.7 mile northwest from the Project site, and borders along the north side of SH 48. In the 1930s, the Bahia Grande was cut off from the natural tidal flow provided from Laguna Madre by various construction projects. In the early 2000s, a pilot channel was constructed between the Bahia Grande and the BSC to provide a natural tidal flow and restore the basin to its original, natural state. Work continues today on the Bahia Grande restoration, with the next phase of construction involving the widening of the pilot channel between the Bahia Grande and the BSC. Upon completion, it is expected that this expanded pilot channel will allow exchange of more water with the BSC and a more natural tidal flow (FWS 2015b).

The Laguna Atascosa NWR would not have any Projects components constructed within the NWR; however, impacts on the Bahia Grande Unit of the Laguna Atascosa NWR may occur during construction and operation, including disturbance from increased noise, nighttime lighting, and dredging within the BSC.

Construction and operation noise impacts on humans is addressed in section 4.11.2 and summarized here relative to the NWR. Noise impacts on species are addressed in previous sections and in section 4.7. Existing daytime and nighttime sound levels were measured at 4 locations near the Project site, with the closest location to the Bahia Grande Unit being within the site about 0.7 mile from the southwest border of the NWR (Noise Monitoring Location 4 (NML4). Existing sound levels at all locations ranged from 40 to 54 decibels (dBA), with the range at NML4 being 47-54 dBA. During construction, the most prevalent noise-generating equipment and activity is anticipated to be pile driving, although general construction equipment and dredging would also produce sound levels that would be perceptible in the vicinity of the site. Predicted construction sound levels are listed in table 4.11.2-4, which shows that construction sound levels would be less than 55 dBA at any of the four residential areas evaluated, however construction noise would be audible at off-site locations, including within the Bahia Grande Unit of the Laguna Atascosa NWR. This noise impact could continue periodically, depending on the phase of construction, for up to four years. Because the most prevalent noise-generating equipment and activity is anticipated to be pile driving, we have included a recommendation in section 4.11.2.3 to ensure that noise generated from pile driving would not exceed predicted levels.

During operation, noise from the Project is predicted to be less than 50 dBA or less at the edge of the Bahia Grande Unit of the Laguna Atascosa NWR at SH 48, and 45 dBA or less within several hundred feet of SH48 (see figure 4.11.2-2). This change of sound level from the existing sound levels measured in the Project vicinity would be within the range considered barely perceivable to noticeable to humans. Animals have different sensitivity to noise frequencies than humans. The noise impacts may be greater as many species also have a wider hearing frequency range. However, given the distance and unweighted noise levels, impacts from noise within the NWR during operation would be expected to be minor and limited to the area along the SH48 corridor.

Lighting within the Project site would be required during both construction and operation. Impact of lighting is addressed above in section 4.6.1.1, where we have included a recommendation to ensure that Annova's proposed *Facility Lighting Plan* would minimize impact of construction and operation lighting on off-site wildlife habitats. Visual impact on humans from nighttime lighting during Project operation is evaluated in section 4.8.5.2, which includes evaluation from two locations along SH 48 at the edge of the Bahia Grande Unit of the Laguna Atascosa NWR - KOP 8 at a SH 48 pull-off near the Bahia Grande Channel, and KOP 9 at the Jaime J. Zapata Memorial Boat Ramp. Animals may have different sensitivity to nighttime lighting than humans. General impact on animals from Project lighting is discussed above.

Proposed dredging and the potential for impact on Bahia Grande is addressed in section 4.3.2.2. Dredging activities would result in increased turbidity and affect water quality in the BSC, however modeling indicates that water quality impacts on the Bahia Grande from the proposed dredging would be minor.

<u>Lower Rio Grande National Wildlife Refuge</u>

The Lower Rio Grande Valley NWR comprises both FWS-owned and FWS-leased lands. Established in 1979 to protect biodiversity along the Rio Grande, the Lower Rio Grande Valley NWR is a 102,000-acre coastal refuge that borders the Project site and the main access road. The NWR connects lands managed by private landowners, nonprofit organizations, the State of Texas, and two other NWRs (Laguna Atascosa and Santa Ana) along the last 275 river miles of the Rio Grande (FWS 2013a). The management goals in the Comprehensive Conservation Plan for the Lower Rio Grande Valley NWR include protecting biological diversity and wildlife and habitat management; water rights, water quality, and wetlands; cultural resources; and public use, recreation, and wildlife interpretation and education (FWS 1999).

Impacts on the portion of the Lower Rio Grande Valley NWR that is south of the Project site would occur during construction and operation, including disturbance from increased noise and nighttime lighting. During construction, the most prevalent noise-generating equipment and activity is anticipated to be pile driving, although general construction equipment and dredging would also produce sound levels that would be perceptible in the vicinity of the site. The noise impact could continue periodically, depending on the phase of construction, for up to four years. Because the most prevalent noise-generating equipment and activity is anticipated to be pile driving, we have included a recommendation in section 4.11.2.3 to ensure that noise generated from pile driving would not be greater than predicted.

During operation, noise from the Project is predicted to be less than 40 dBA at the edge of the portion of the Lower Rio Grande Valley NWR that lies south of the Project site (see figure 4.11.2-2). As indicated previously, animals have different sensitivity to noise frequencies than humans. The noise impacts may be greater as many species also have a wider hearing frequency range. However, the sound level would be at or below the measured existing sound levels in the vicinity of the NWR, therefore impact on the NWR from noise during operation would be expected to be minor.

Lighting within the Project site would be required during both construction and operation. Impact of lighting is addressed above in section 4.6.1.1, where we have included a recommendation to ensure that Annova's proposed *Facility Lighting Plan* would minimize impact of construction and operation lighting on off-site wildlife habitats.

Loma Ecological Preserve

The Project site was formerly managed by the FWS on behalf of the BND as part of mitigation for a canceled project. Under COE Permit 13942 issued to the BND in 1982 (COE 1982), an area associated with the Loma del Potrero Cercado was set aside as mitigation for a project to deepen the BSC and facilitate construction of multipurpose docks at the deepwater turning basin. Under COE Permit 13942, mitigation of impacts from the deepwater project included setting aside 4,837 acres as a loma ecological preserve, which now includes the Project site. The BND and the FWS entered into a lease for management of the preserve; however, the BND did not implement the project to deepen the BSC and the permit expired in 1987. After consulting with the FWS, Annova modified the site layout to minimize potential impacts on mature dense thornshrub vegetation and to maintain a wildlife corridor on the western boundary of the site for potential wildlife movement through the area. The modified layout requires an additional area of the loma ecological preserve. To facilitate preservation of the wildlife corridor, the FWS agreed to terminate their lease for this additional area upon construction of the Project.

South Bay Coastal Preserve

South Bay Coastal Preserve, a Texas Gulf Ecological Management Site, is located adjacent to the Boca Chica Tract, approximately 3 miles from the Project site. The TPWD currently leases the preserve from the Texas General Land Office. The lands adjacent to the South Bay Coastal Preserve are privately, locally, state, or federally owned or administered. The preserve was originally held by the BND, but the area was transferred to the Texas General Land Office in February of 1986 and was subsequently leased to the TPWD (TPWD 1989). The preserve contains the southernmost bay in Texas and comprises approximately 3,500 surface acres of water. Habitats within the bay are characterized primarily by emergent and submergent vegetation and extensive algal flats. The area is used more frequently for recreation activities such as hunting and fishing and is the location of extensive commercial oyster landings. Potential impacts on the South Bay Coastal Preserve would generally be similar, but less than, those described above for the Boca Chica Tract of the Lower Rio Grande Valley NWR because the South Bay Coastal Preserve is a greater distance from the Project site, which would reduce both noise and light impacts.

South Texas Coastal Corridor

The Project site is located within a region considered by the FWS as being particularly important to the travel and dispersal of the endangered ocelot. Within the region, the FWS has developed a strategic habitat conservation plan, referred to as the South Texas Coastal Corridor that has a goal of creating a wildlife corridor connecting the Laguna Atascosa NWR and Lower Rio Grande Valley NWR (FWS 2015b). The FWS holds a conservation easement directly south of the Laguna Atascosa NWR, between SH 48 and the BSC. This easement is 1,000 feet wide and 2,900 feet long and is considered a wildlife corridor for the endangered ocelot. The corridor connects the Laguna Atascosa NWR to the BSC via a wildlife tunnel that passes under SH 48.

The FWS has identified as a focus for purchasing properties or obtaining easements within Cameron County to establish the South Texas Coastal Corridor. The FWS's goal for the acquisition of properties and easements within this corridor is to eventually connect the main Laguna Atascosa NWR tracts, the Bahia Grande Unit of the Laguna Atascosa NWR, Lower Rio Grande Valley NWR units, and the Boca Chica tract, resulting in a contiguous conservation landscape (National Fish and Wildlife Foundation [NFWF] 2015). This conservation landscape, in turn, is linked to more than 2 million acres of private ranchland located north of the Laguna Atascosa NWR with the 1.3-million-acre Rio Bravo Protected Area, managed by the National Commission on Natural Protected Areas (known by its Spanish acronym CONANP) in coastal Mexico (NFWF 2015).

As previously discussed, Annova would maintain a wildlife corridor on the west side of the Project site, where existing dense thornshrub and other habitats would be avoided and preserved. Annova would protect the wildlife corridor with a conservation easement for the life of the Project. In addition, Annova would install a barrier wall along the southwest edge of the site between the LNG terminal facilities and the wildlife corridor to reduce light and noise impacts on wildlife. Section 4.7 provides additional information on the ocelot and other protected species that would be impacted as a result of habitat loss and fragmentation.

Pollinator Habitat

Pollinator species, including bats, bees, hummingbirds, butterflies, wasps, moths, and flies, require the pollen and/or nectar of plants for food. About 80 percent of plant species need to be pollinated; however, there is currently no specific FWS management of pollinator habitat (FWS 2016a). The decrease in suitable plant cover has led to concern over the state of pollinator species. A total of 30 native pollinators (bees, butterflies, and moths) have been designated by the TPWD as Species of Greatest Conservation Need in Texas; as such, the TPWD has developed the *Texas Monarch and Native Pollinator Conservation Plan*, which outlines plans to conserve habitat, educate the public, and conduct research on these species (TPWD 2016e).

According to the FWS (2012), the lower Rio Grande Valley is home to more than 300 butterfly species. Common butterfly species include the large orange sulphur butterfly (*Phoebis agarithe*), queen butterfly (*Danaus gilippus*), giant swallowtail butterfly (*Papilio cresphontes*), Mexican bluewing butterfly (*Myscelia ethusa*), and monarch butterfly (*Danaus plexippus*).

The monarch butterfly has gained recent attention due to extensive habitat loss and degradation throughout its migratory ranges (FWS 2015e). A public comment was received regarding potential impacts on monarch butterflies that could result from Project activities. Texas is an important state in monarch butterfly migration because it is situated between the species' principal breeding grounds to the north and its overwintering areas in Mexico (TPWD 2015a). Monarch butterflies pass through Texas in both a fall and spring migration, and the Project site is located within the coastal migratory range of this species. The FWS issued a notice that it planned to conduct an ESA status review of the monarch butterfly to determine whether the species should be proposed for federal listing (79 FR 78775-78778). The results of the ESA status review are not yet publicly available.

Additionally, as described in the June 20, 2014, Presidential Memorandum, "Creating a Federal Strategy to Promote the Health of Honey Bees and Other Pollinators", "there has been a significant loss of pollinators, including honey bees, native bees, birds, bats, and butterflies, from the environment." The memorandum states that "given the breadth, severity, and persistence of pollinator losses, it is critical to expand Federal efforts and take new steps to reverse pollinator losses and help restore populations to healthy levels." In response to the Presidential memorandum, the federal Pollinator Health Task Force published a National Strategy to Promote the Health of Honey Bees and Other Pollinators in May 2015. This strategy established a process to increase and improve pollinator habitat. Constructing the Project would temporarily and permanently impact pollinator habitat (vegetation). The temporary loss of this habitat would increase the rates of stress, injury, and mortality experienced by butterflies, honey bees and other pollinators.

Milkweed (*Asclepias* spp.) is the primary plant species monarch butterflies use for foraging and for reproduction; therefore, impacts and range-wide loss of this plant species has had a potential population effect on monarch butterflies. Vegetation surveys performed in fall 2014 and spring 2015 indicated that no milkweed species were present within the Project site; therefore, construction and operation of the Project is not anticipated to impact the primary habitat for the monarch butterfly.

4.6.1.3 Conclusion for Terrestrial Wildlife

Based on the anticipated impacts on wildlife and the proximity of diverse and ample habitat outside the Project site, and Annova's proposal to implement TPWD avoidance and minimization measures, implement the above-listed design measures to minimize impact from facility lighting during operation, and develop and implement a *Facility Lighting Plan*, we conclude that impacts on terrestrial wildlife and wildlife habitat would be minor.

4.6.2 Marine Resources

Marine habitats in the Project area are described in section 4.3. The BSC and associated wetlands are the principal marine habitats within the footprint of the proposed Project where marine species could be affected by the Project. The Gulf of Mexico is also included in this analysis as marine species in the northern Gulf of Mexico would be exposed to LNG ship traffic.

4.6.2.1 Existing Marine Resources

Marine Mammals

Under the Marine Mammal Protection Act (MMPA; 16 USC 1361 et seq.), NOAA Fisheries is responsible for protection of whales, porpoises, and dolphins and FWS is responsible for manatees. Three marine mammal species known to occur in the Gulf of Mexico are federally listed as endangered, one species is threatened, and one is proposed endangered under the ESA. All marine mammals in the northern Gulf of Mexico are included in table 4.6.2-1; ESA-protected species are discussed further in section 4.7.1.

TABLE 4.6.2-1

Gulf of Mexico Marine Mammal Summary with Likelihood of Occurrence in Brownsville Ship Channel

Common Name	Species Name	Status	Potential Occurrence in Brownsville Ship Channel
Sei Whale	*Balaenoptera borealis*	ESA Endangered	Unlikely / rare
Fin Whale	*Balaenoptera physalus*	ESA Endangered	Unlikely / rare
Sperm Whale	*Physeter microcephalus*	ESA Endangered	Unlikely
Gulf of Mexico Bryde's Whale	*Balaenoptera edeni*	MMPA / Proposed Endangered	Unlikely
West Indian Manatee, Florida subspecies	*Trichechus manatus latirostris*	ESA Threatened	Unlikely / rare
Humpback Whale	*Megaptera novaeangliae*	MMPA	Unlikely / rare
Pygmy Sperm Whale	*Kogia breviceps*	MMPA	Unlikely / rare
Dwarf Sperm Whale	*Kogia simus*	MMPA	Unlikely / rare
Cuvier's Beaked Whale	*Ziphius cavirostris*	MMPA	Unlikely / rare
Blainville's Beaked Whale	*Mesoplodon densirostris*	MMPA	Unlikely / rare
Gervais' Beaked Whale	*Mesoplodon europaeus*	MMPA	Unlikely / rare
Melon-headed Whale	*Peponocephala electra*	MMPA	Unlikely / rare
Pygmy Killer Whale	*Feresa attenuata*	MMPA	Unlikely / rare
False Killer Whale	*Pseudorca crassidens*	MMPA	Unlikely / rare
Killer Whale	*Orcinus orca*	MMPA	Unlikely / rare
Short-finned Pilot Whale	*Globicephala macrorhynchus*	MMPA	Unlikely / rare
Rough-toothed Dolphin	*Steno bredanensis*	MMPA	Unlikely / rare
Fraser's Dolphin	*Lagenodelphis hosei*	MMPA	Unlikely / rare
Bottlenose Dolphin (multiple stocks)	*Tursiops truncatus*	MMPA	Common
Risso's Dolphin	*Grampus griseus*	MMPA	Unlikely / rare
Atlantic Spotted Dolphin	*Stenella frontalis*	MMPA	Common
Pantropical Spotted Dolphin	*Stenella attenuata*	MMPA	Unlikely / rare
Striped Dolphin	*Stenella coeruleoalba*	MMPA	Unlikely / rare
Spinner Dolphin	*Stenella longirostris*	MMPA	Unlikely / rare
Clymene Dolphin	*Stenella clymene*	MMPA	Unlikely / rare

Key: ESA = Endangered Species; MMPA = Marine Mammal Protection Act

A number of marine mammals are known to occur in the Gulf of Mexico; however, only two species are considered regularly occurring in the Gulf of Mexico near the Project site—the Atlantic spotted dolphin (*Stenella frontalis*) and the bottlenose dolphin (*Tursiops truncatus;* multiple stocks). It is unlikely but remotely possible that the sperm whale or Bryde's whale would be encountered in the Gulf of Mexico near the Project site, especially in the LNG carrier transit zone. The sperm whale is listed under the ESA; the Gulf of Mexico Distinct Population Segment of Bryde's whale is proposed endangered (81 FR 88639); these two ESA species are addressed in section 4.7.1.

<u>Atlantic Spotted Dolphin</u>

The Atlantic spotted dolphin occurs throughout the warm temperate, subtropical, and tropical waters of the Atlantic Ocean (NOAA Fisheries 2015a). It ranges across the U.S. East Coast from the Gulf of Mexico to Cape Cod, Massachusetts; the Azores; and Canary Islands to Gabon and Brazil. Its distribution may be affected by warm currents such as the Gulf Stream. In the waters of the northern Gulf of Mexico, this species is usually observed within the shelf waters from about 30 to 650 feet (10 to 200 meters) deep to the continental slope in waters around 1600 feet (500 meters) deep (Waring et al. 2015). The Atlantic spotted dolphin typically occurs in groups of up to 50 individuals, but groups of up to 200 animals have been observed.

Bottlenose Dolphin

The bottlenose dolphin occurs in oceanic waters worldwide, ranging from latitudes of 45°N to 45°S. The Gulf of Mexico population is managed as several separate stocks (Waring et al. 2010). Coastal populations migrate into bays, estuaries and river mouths, while offshore populations remain in open waters along the continental shelf (NOAA Fisheries 2015b). The coastal stocks are reported throughout shallower nearshore waters up to 66 feet deep (around 56 miles from shore) in the northern Gulf of Mexico (Waring et al. 2015).

Fisheries Resources

Fisheries resources include managed fish and invertebrates, species of concern, and federally designated EFH. Fisheries resources in the State of Texas are managed by the FWS, NOAA Fisheries, and the TPWD. Fish and invertebrate communities in the Project area include species common throughout South Texas estuaries. Table 4.6.2-2 lists the species indicated as common in the BSC by the TPWD and local fishing reports. TCEQ has designated the BSC as a warmwater fishery that supports aquatic life, recreational uses, and general use (TAC Title 30, Part 1, Chapter 307). The BSC is the only state-named, non-wetland, waterbody at the Project site. The South Bay Coastal Preserve is located within the South Laguna Madre watershed approximately 2 miles from the Project site; while the Lower Laguna Madre is located approximately 4 miles from the Project site (see section 4.3 for details regarding waterbodies).

Seagrass beds function as nursery habitat for commercially important fishes and crustaceans. Figure 4.3.2-3 in section 4.3 shows the locations of seagrass beds in the vicinity of the Project site. The large open water channel of the BSC supports little submerged vegetation, and seagrasses are not expected to occur there.

The BSC is likely used by fish species predominantly in their adult life stage. Nearby estuarine habitat (e.g., seagrass, oysters, soft bottom) and associated wetlands (such as South Bay and Bahia Grande) provide habitat for early life stages of species including, but not limited to, those listed in table 4.6.2-2. These estuarine habitats act as spawning, nursery, and feeding grounds and are important for sea turtle development, as well as populations of fish and shellfish (EPA 1999). An estimated 90 to 95 percent of all commercially and recreationally important fish and invertebrate species inhabit estuaries at some point in their life cycle (Texas Aquatic Science 2015).

Six fish listed by NOAA Fisheries as species of concern may occur in the Project vicinity and nearshore Gulf of Mexico. These include species for which there are conservation concerns regarding population status, but insufficient information is available to indicate a need to list the species as threatened or endangered: Alabama shad (*Alosa alabamae*), dusky shark (*Carcharhinus obscurus*), sand tiger shark (*Carcharias taurus*), Warsaw grouper (*Epinephelus nigritus*), speckled hind (*Epinephelus drummondhayi*), and opossum pipefish (*Microphis brachyurus lineatus*) (NOAA Fisheries 2012). The habitats within the Project area do not provide resources to meet critical life needs of any of these fish species of concern.

TABLE 4.6.2-2	
Common Fish and Invertebrate Species within the Project Area	
Fish	
Pinfish (*Lagodon rhomboides*)	Lane snapper (*Lutjanus synagris*)
Snook (*Centropomus undecimalis*)	Black drum (*Pogonias cromis*)
Sheepshead (*Archosargus probactocephalus*)	Gulf flounder (*Paralichthys albiguttata*)
Red drum (*Sciaenops ocellatus*)	Speckled trout (*Cynoscion nebulosus*)
Mangrove snapper (*Lutjanus griseus*)	Gag grouper (*Mycteroperca microlepis*)
Southern flounder (Paralichthys lethostigma)	Gafftopsail catfish (*Bagre marinus*)
Pigfish (*Orthopristis chrysoptera*)	Hardhead catfish (*Ariopsis felis*)
Greater amberjack (*Seriola dumerili*)	Atlantic cutlassfish (*Trichiurus lepturus*)
Red snapper (*Lutjanus campechanus*)	Atlantic croaker (*Micropogonias undulates*)
Vermilion snapper (*Rhomboplites aurorubens*)	Striped mullet (*Mugil cephalus*)
Ladyfish (*Elops saurus*)	Spotted sea trout (*Cynoscion nebulosus*)
Florida pompano (*Trachinotus carolinus*)	Cobia (*Rachycentron canadum*)
Crevalle jack (*Caranx hippos*)	American eel (*Anguilla rostrata*)
Tripletail (*Lobotes surinamensis*)	
Invertebrates	
Blue crab (Callinectes sapidus)	Lightening whelk (*Busycon perversum*)
Stone crab (*Menippe adina*)	Brown shrimp (*Farfantepenaeus aztecus*)
Fiddler crab (*Uca rapax*)	White shrimp (*Litopenaeus setiferous*)
Eastern oyster (*Crassostrea virginica*)	Pink shrimp (*Farfantepenaeus duorarum*)

Sources: TPWD 2002, 2016e; Texas Weekend Angler 2016; Chron 2010

Managed Fisheries and Essential Fish Habitat

The MSA defines EFH as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity” (16 USC §1802 [10]) and promotes the protection of EFH in the review of projects conducted under federal permits, licenses, or other authorities that affect, or have the potential to affect, such habitat. EFH has been designated for several groups of federally managed fishes in the Gulf of Mexico, including coastal migratory pelagic resources, reef fish, shrimp, and red drum, all of which have designated EFH within and near the Project site (GMFMC 2007; NOAA Fisheries 2015c). Waters to the north and east of the Project site are classified as EFH for coastal migratory pelagic species, reef fish, shrimp, and red drum.

Three species in the Project area are included in the coastal migratory pelagics FMP: king mackerel (*Scomberomorus cavalla)*, Spanish mackerel (*Scomberomorus maculates*), and cobia (*Rachycentron canadum*). EFH for coastal migratory pelagics comprises all the estuarine, nearshore, and offshore areas of the Gulf of Mexico out to the 100-fathom depth contour, including the BSC (GMFMC 2004). An EFH Assessment, included as appendix F, provides a detailed analysis of impacts on EFH for managed fish species, including species and life stages for which EFH occurs within and adjacent to the Project site.

4.6.2.2 Impacts and Mitigation: Marine Resources

Constructing and operating the Project would temporarily and permanently affect marine resources within the BSC and potentially affect marine resources in the Gulf of Mexico. As described below; excavation, dredging, vessel traffic, water withdrawals and discharges, equipment noise, run off, pile driving, and lighting would all affect marine resources.

Excavation, Dredging, and Dredge Disposal

The marine facilities would be developed along the BSC at the Project site through a combination of excavation and dredging as described in section 2.6.2. Excavation would occur in two stages: a terrestrial excavation followed by a marine excavation (dredging activities) to remove the remaining material below the water surface. The marine facilities would be dredged using a hydraulic cutter suction dredge. Excavation and dredging would increase runoff and the suspension of sediment, which would affect marine fish and invertebrates by decreasing visibility and causing respiratory stress.

The effects of dredging on fish and invertebrates are a function of suspended sediment concentration, duration of exposure, species, and life stage (Newcombe and Jensen 1996). An increase in turbidity due to sediment suspension would reduce light penetration locally and a corresponding reduction in the primary production of aquatic plants, algae, and phytoplankton. As a result, there may also be lower dissolved oxygen concentrations, causing a displacement of motile organisms or stress and reduction in numbers of sessile benthic organisms (LUMCON 2016; COE 2012). Increased turbidity could also temporarily reduce predation efficiency. Extended periods of elevated turbidities have been shown to reduce feeding rates by up to 20 percent and to reduce the efficiency of the foraging process (Utne-Palm 2001; Gardner 1981). Increased turbidity would limit feeding within the construction area, but prey would still be accessible in nearby unaffected areas. During periods of increased turbidity, fish and mobile invertebrates may move away/avoid the project vicinity (Nightingale and Simenstad 2001).

As mentioned above, increases in turbidity can also affect the level of dissolved oxygen. Microorganisms, in response to the release of nutrients from disturbed sediments could increase their rate of reproduction. Microorganism blooms can be followed by population crashes, which lead to localized depletion of dissolved oxygen. Because light is not transmitted as easily in turbid water, phytoplankton may be less able to photosynthesize and produce oxygen that would restore the desired dissolved oxygen concentration.

An increase in turbidity would most likely have the greatest direct effects to eggs and larval stages (Robertson et al. 2006). Because these life stages are more sensitive to such stresses and are unable to move from the affected area, they are more susceptible to impacts than juveniles and adults. Excess sediment in the water column could be fatal to larval or post-larval shrimp if dredging occurs during peak abundance in early spring or summer. Construction dredging is expected to take at least 8 months, making it likely to overlap with the presence of larval and post-larval shrimp.

Impacts from dredging would be minimized with the use of BMPs to contain the turbidity plume (see section 4.3). The maintenance dredging would mirror the maintenance dredging of the BSC currently conducted by the COE. During maintenance dredging there may be an increase in turbidity in the BSC; however, BMPs would be implemented to meet water quality criteria identified in the 401 Water Quality Certification at the edge of the work zone, resulting in localized effects. Construction-related turbidity may cause greater stress to marine species than the short-term increases in turbidity typically associated with storms in the BSC.

Dredging would also permanently remove the soft bottom habitat of the BSC within the footprint of the dredged area, causing a loss of habitat. Some bottom dwelling (demersal) species such as mollusks, crustaceans, and shrimp (if present) may be entrained (and likely injured or killed) during dredging activities. Larger, more mobile, species (e.g., blue crab) may be temporarily displaced (Nightingale and Simenstad 2001). Although dredging activities would affect species occupying the soft bottom habitat in the immediate Project area, effects on marine resources in the Gulf of Mexico would be negligible.

Direct impacts from dredging on macroinvertebrates may include localized disruption of activities, removal, turnover, burying, and crushing, all of which would increase the rates of stress, injury, and mortality experienced by these species. As most benthic infauna live on or within the upper 6 inches of the sediment surface, it is expected that removal of sediment and burial from settling of sediments resulting from increased turbidity would result in some loss of these organisms. Germano et al. (1994) found that benthic communities recover to an equilibrium community within approximately 6 months to 1 year after a physical disturbance. Other studies indicate recovery to this stage in 2 years or less (Murray and Saffert 1999; Rhoads et al. 1978). Many physical and biological factors affect the recolonization process, with one of these being the texture of the disturbed sediment. Any change in the texture of the material after the activity is completed may result in changes in the community that was present before activities took place. Additionally, overturned, deeper sediments may be hypoxic, resulting in longer periods to re-establishment of former communities. Direct disturbance-related effects on benthos from the proposed Project would be long term but mostly localized within the dredging footprint. Sedimentation could indirectly affect some organisms downstream of the dredged area, as discussed in section 4.3. Benthic species are likely to recolonize the dredged area but would be disturbed by maintenance dredging at 2-year intervals. As such, the Project is expected to result in long-term localized impacts on benthic marine species.

The potential for direct and indirect adverse effects of dredging on a given species of invertebrate or fish would depend on its life history, habitat use, distribution, and abundance. However, short-term impacts on older life-stages (juvenile and adult) of both pelagic and demersal fish would be limited to temporary displacement during dredging activities. Because Annova is proposing placement of dredged material in the adjacent DMPA 5A on BND property, no in-water effects are expected.

Hydrostatic Testing

As described in section 2.6.3, the LNG storage tanks would be hydrostatically tested with surface water to ensure their integrity prior to placing them into service. Hydrostatic test water withdrawals could entrain and impinge fish eggs and juvenile fish near the intake structures in the BSC. Entrainment and impingement could cause injury of mortality of organisms. In accordance with its Project-specific *Procedures* (see appendix B), Annova would screen intake hoses to limit the entrainment of aquatic organisms during water withdrawal. Annova would place screened intake structures at the lowest possible elevation to reduce the impingement of biological organisms and debris on intake screens. With the implementation of these measures, impacts on aquatic resources as a result of water intake would be temporary and negligible.

When hydrostatic testing is complete, Annova would return the test water to the BSC. In accordance with the EPA's Hydrostatic Test Water Discharge Permit and the Railroad

Commission of Texas' permit requirements, the water would be tested for total suspended solids, oil and grease, and pH, and treated (if test results indicate that the water would not meet requirements) prior to being discharged to the BSC. Discharge of hydrostatic test water may cause localized, short-term turbidity in the BSC; however, potential impacts on aquatic resources would be localized, temporary, and negligible and would be minimized through the use of energy-dissipating devices installed at water discharge points.

Vessel Traffic

Increased traffic within the BSC and Gulf of Mexico due to LNG carrier transit to and from the LNG terminal site could result in vessel strikes. Vessel strikes would increase the rates of injury and mortality experienced by marine species. However, LNG carriers are generally slower and generate more noise than typical large vessels, allowing marine mammals, sea turtles, and fishes to more readily avoid collisions with them than with faster marine vessels.

To minimize the potential for vessel strikes, Annova would provide LNG carrier captains with the NOAA Fisheries–issued document entitled *Vessel Strike Avoidance Measures and Reporting for Mariners*, which outlines collision avoidance measures. Based on the relatively small increase in shipping activity relative to the total shipping traffic occurring in the Gulf of Mexico, and because Annova would provide LNG carrier captains with NOAA Fisheries' recommended strike avoidance measures, the potential for the Project to result in increased vessel strikes to marine mammals or sea turtles is unlikely to occur (discountable).

Ballast Water Discharge

LNG carriers, like other large vessels withdraw and discharge water into and out of onboard ballast tanks to provide additional draft and improve navigational performance. During loading, LNG carriers would discharge ballast water into the BSC. Discharge of large volumes of ballast water can cause changes to the quality of receiving waters by affecting salinity, dissolved oxygen, temperature, and pH (see section 4.3). In addition, nonindigenous species transported in ballast water may be introduced to receiving waters during discharge.

As described in section 4.3, ballast discharged into the BSC would have little to no effect on the BSC's salinity regime. Additionally, marine species likely to occur within the project vicinity are highly adapted to salinity variations, and any short-term increases from ballast discharge would be well within their tolerance range. Therefore, we have determined that changes in salinity from ballast water discharges would be temporary and negligible.

As discussed in section 4.3, depending on the oxygen levels present in both the ballast and ambient water at the time of discharge, aquatic resources in the vicinity of the discharge point could be exposed to dissolved oxygen levels considered unhealthy for aquatic life. Marine species typical of warmer latitudes such as the BSC are generally habituated to fluctuations in dissolved oxygen (Engle et al. 1999). The adaptability of resident species within the BSC to natural variation in oxygen levels would minimize the impacts associated with low dissolved oxygen on mobile species. Bivalves are not able to be relocated when oxygen levels drop. Instead, they simply close their valves and wait for more favorable conditions to return. Impacts on aquatic species within the BSC from changes in dissolved oxygen are expected to be minor and temporary in nature.

Depending on the time of year, ballast water discharges would likely be several degrees cooler that ambient temperatures in the BSC. The pH of the ballast water would reflect conditions where open ocean exchange occurred. The volume of ballast water discharge is small relative to the BSC. The expected differential between ballast water discharge and the BSC is not large enough to cause a change in pH or temperature that would significantly impact aquatic organisms. Impacts of temperature and pH in ballast water discharge on existing marine organisms in the BSC would be temporary and negligible.

Invasive Species

Ballast water management is specified in the National Invasive Species Act of 1996 and international standards adopted in 2004 to minimize the release of aquatic species that were transported from other location in ballast water. If species that are not native to the BSC become established and outcompete native species, the ecosystem in the BSC could be disrupted, leading to declines in native species that are important to recreational or commercial fisheries or have other societal values. However, since the Port of Brownville has been in operation for more than 80 years including for international trade, the makeup of native aquatic species within the BSC has likely been altered over the years by ballast water exchange that occurred prior to ballast water regulation.

To minimize and avoid impacts on marine resources resulting from the introduction of invasive species, the Coast Guard would require all LNG carriers calling on the terminal to adhere to all applicable ballast water management rules and regulations. Additionally, LNG carriers would be required to adhere to all applicable U.S. laws, regulations, and policy documents related to ballast water including the following:

- the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (NANPCA) established a broad federal program "to prevent introduction of and to control the spread of introduced aquatic nuisance species." The FWS, Coast Guard, EPA, COE, and NOAA Fisheries all were assigned responsibilities.
- the NISA reauthorized and amended the NANPCA because "Nonindigenous invasive species have become established throughout the waters of the U.S. and are causing economic and ecological degradation to the affected near shore regions." The Secretary of Transportation was charged with developing national guidelines to prevent import of invasive species from ballast water of commercial vessels, primarily through mid-ocean ballast water exchange, unless the exchange threatens the safety or stability of the vessel, its crew, or its passengers.
- the NISA, amended in 2005 and again in 2007, established a mandatory National Ballast Water Management Program. The primary requirements established under NAISA are: 1) all ships operating in U.S. waters are required to have on board an Aquatic Invasive Species Management Plan; 2) the Coast Guard was made responsible for the development of standards for mid-ocean ballast water exchange and ballast water treatment for vessels operating outside of the EEZ; and 3) implementing the BMPs and available technology related to ballast water treatment.

- the National Ballast Water Management Program, originally established by NANPCA and further amended by the National Invasive Species Act of 1996 (NISA and NAISA, made the ballast water management program mandatory, including ballast water exchange, with reporting to the Coast Guard.
- the Shipboard Technology Evaluation Program is a program authorized under the Coast Guard Ballast Water Management Program and designed to facilitate the development of "effective ballast water treatment technologies, through experimental systems, thus creating more options for vessel owners seeking alternatives to ballast water exchange."
- the Navigation and Vessel Inspection Circular 07-04, Change 1, a program developed by the Coast Guard for the management and enforcement of ballast water discharge into U.S. ports and harbors.
- Vessels Carrying Oil, Noxious Liquid Substances, Garbage, Municipal or Commercial Waste, and Ballast Water, implementing regulations for the Act to Prevent of Pollution from Ships of 1980, which applies to all U.S.-flagged ships anywhere in the world and to all foreign-flagged vessels operating in navigable waters of the U.S. or while at port under U.S. jurisdiction.

Cooling Water Intake and Discharge

All ships use water to cool their boilers. The cooling water would be withdrawn along the vessel transit routes while in route to the Project, and from the BSC marine facility while loading LNG cargo. Depending upon engine type, LNG carriers would use between 5.5 and 11.7 million gallons of water for engine cooling while at the LNG terminal. Intake of water can result in the entrainment of aquatic resources. Early life stages of fish and invertebrates (ichthyoplankton) would be most susceptible to entrainment. Quantitative data for the structure and density of the ichthyoplankton community within the BSC are unavailable; however, we would expect the species composition to be largely composed of the same species identified in table 4.6.2-2. As a proxy for the density, we refer to sampling data collected within the Calcasieu River near Carlyss, Calcasieu Parish, Louisiana. In that sampling, fish species had a larval density of 522.2 individuals per 1,000 cubic meters and the shrimp larval density was 91.5 individuals per 1,000 cubic meters. Using these estimated densities and estimated range of cooling water use, between 10,900 and 23,100 larval fish, and between 1,900 and 4,100 larval shrimp could be entrained by each LNG carrier while at the Project. At full capacity, Annova would receive a maximum of 80 LNG carriers per year, which would affect between 872,000 and 1.8 million larval fish and 152,000 and 328,000 larval shrimp per year by cooling water intake. It is important to realize that, due to the high natural mortality rates in the first year of ichthyoplankton (greater than 90 percent), an incremental loss would not significantly impact the health of the adult fish population. The impact on ichthyoplankton from cooling water uptake would be permanent (for the life of the facility), but we conclude these impacts would not be significant.

Water used for engine cooling would be discharged at a temperature between 2.7°F and 7.2°F warmer than the ambient water temperature (Caterpillar 2007, 2011, 2012). Using the most conservative estimates (assuming the highest ambient temperature generally found within the BSC [86°F], the greatest change in water temperature [7.2°F], and the largest volume of water [11.7 million gallons]), the discharged cooling water temperature would be 95.5°F. Fish and invertebrates within the immediate vicinity of the LNG carrier could be temporarily affected by this increase in temperature; however, many of the species present are mobile and would be expected to relocate to more suitable conditions during discharges. Given the volume of cooling water discharged relative to the total volume of water within the BSC, and the expectation that mobile species would temporarily leave the area of increased temperature, we have determined that impacts on marine and aquatic resources would be short-term and minor.

Increased Noise Levels

The effects of sound on marine fish species are pathological, physiological, and behavioral. Pathological effects include lethal and sub-lethal physical damage; physiological effects include primary and secondary stress responses; and behavioral effects include changes in exhibited behaviors. Project-related acoustic stressors include pile driving and dredging during construction and LNG carrier engines during operation.

Pile Driving

Construction of the marine facilities would require installation of pilings using land-based and in-water equipment, as described in section 2.6.2. Pile-driving activities could result in temporary increases in underwater noise levels in the BSC. During land-based pile driving the earth would act as a sound buffer, thereby reducing the noise reaching the BSC. Consequently, effects on species in the BSC from land-based pile driving would be minimal. Any pile-driving activities conducted in the marine environment may have minor sedimentation effects to marine species, similar to those described above with respect to dredging.

Pathological effects reported in several studies indicate that sounds of 90 to 140 decibels (dB) above the hearing threshold of a fish may potentially injure the inner ear of the fish (Hastings et al. 1996; Enger 1981). Since many fish use their swim bladders for buoyancy, they are susceptible to rapid expansion/decompression due to peak pressure waves from underwater noises (Hastings and Popper 2005). The Fisheries Hydroacoustic Working Group (consisting of federal and state transportation and rescue agencies, underwater acoustics experts, fish biologists, and transportation specialists) was formed in 2004 to gather all available information on the effects of sound on fish. An agreement was established with this multi-agency group on underwater noise effects criteria for fish for in-water projects. The underwater noise interim threshold criteria for fish injury from a single pile strike during impact pile-driving occurs at a sound pressure level of 206 dB peak pressure within a circle centered at the location of the driven pile out to a distance of approximately 13 feet (Fisheries Hydroacoustic Working Group 2008).

A physiological effect of sound may include generalized stress (Wysocki et al. 2006). Some studies indicate that behavioral responses at construction sites, including site avoidance, may be as strongly tied to visual stimuli as to underwater sound (Huijbers et al. 2012; Guthrie and Muntz 1993; Feist et al. 1992). The majority of research on this topic involves studies of the physiological effect of impact pile-driving on fish due to changes in water pressure. Fish with swim bladders would be more vulnerable to such pressure changes, which can cause capillaries to rupture or the swim bladder to rapidly expand and contract (California Department of Transportation 2001; ICF Jones & Stokes and Illingworth and Rodkin, Inc. 2009). Therefore, it is likely that fish would alter their normal behavior, displaying a startle response during the initial stages of pile driving, and then avoid the Project site during pile-driving activities.

Behavioral reactions to underwater noise include moving out of the way, moving to deeper depths, or altering schooling behavior. The levels at which fish react are somewhat variable, depending on circumstances and species.

It is anticipated that some fish would avoid the area because of levels of sound when the hammer is operating. However, as pile driving would be a short-term, temporary action performed only during construction, the occurrence of these species within the BSC over the long term is not likely to change significantly. Pile driving is expected to take no more than five days. Additionally, the area of disturbance would be small and similar habitat surrounds the Project site; therefore, the energy expended by fish to avoid the Project area would be minimal. Disturbance of fish close to an individual pile or within the immediate Project area would be short-term and is not expected to result in population-level effects. Annova would protect fish and marine wildlife from noise associated with dredging and pile driving through use of thresholds established for marine wildlife by the Fisheries Hydroacoustic Working Group. Annova would minimize impacts from in-water noise by installing noise bubble curtains and conducting on-site monitoring in consultation with NOAA Fisheries.

Dredging and LNG Carrier Traffic

Engine-noise produced by dredges and LNG carriers would result in temporary increases in underwater noise levels near the vessels (see additional discussion in section 4.11.2.4). The noise typically emitted by an operating dredge is below 1 kHz (Todd et al. 2014). Noise generated by LNG carriers is generally omni-directional, emitting from all sides of the vessel (Whale and Dolphin Conservation Society 2004), but is greatest on the sides of the ship and weakest on the bow and stern of the ship. Impacts on marine and aquatic species due to increased noise levels of vessels would vary by species; however, the species within the BSC and LNG carrier routes are likely accustomed to regular fluctuations in noise levels from ongoing industrial and commercial shipping activities in the BSC and vessel transit routes. Additionally, as described above, many of the species present within the BSC and LNG carrier transit routes are mobile and would be able to move out of noisy areas that would startle or stress any species present. Due to the existing industrial and shipping activities within the BSC and LNG carrier transit routes and the mobility of resident species, we have determined impacts on aquatic species from engine-noise produced by dredges, and LNG carriers during operation, would be intermittent and minor.

Spills

Annova developed a Project-specific *Plan* and *Procedures* (see appendix B) based, respectively, on our *Plan* (FERC 2013a) and *Procedures* (FERC 2013b). The Annova *Plan* and *Procedures* include pollution control measures and BMPs that would help to control erosion, sedimentation, and pollutants in runoff from the site (including stormwater runoff and spills).

Annova would obtain an NPDES General Permit for Construction Storm Water Discharge from the EPA prior to any site disturbance and an NPDES Industrial Waste Water Discharge Permit for facility discharges of stormwater from an oily water separator, stormwater ponds, and on-site packaged sanitary wastewater treatment pond. Annova would follow the SWPPP required as part of the EPA NPDES General Permit for Construction Storm Water Discharge, as well as the SPCC Plan for construction to prevent and respond to spills. Adherence to the Annova *Plan* and

Procedures would reduce the potential for spills or impacts on the waterway; therefore, impacts on fisheries due to stormwater discharge are expected to be negligible.

Lighting

Ichthyoplankton, juvenile fish, and species of small fish may be attracted to lighting during construction and operation. However, no subsurface lighting is planned for the LNG facilities. Lighting impacts would be primarily associated with aggregation of planktonic organisms, with possible increased feeding in the local area by larger species. Potential impacts from lighting would be reduced by Annova's use of measures designed to reduce nuisance lighting, and development and implementation of a *Facility Lighting Plan* for operation of the LNG terminal. At the request of the FWS we are also recommending that the *Facility Lighting Plan* also address construction and commissioning. Overall, with the use of Annova's proposed measures to reduce nuisance lighting, and implementation of a Project-specific *Facility Lighting Plan*, no significant impacts on ichthyoplankton or fisheries resources are expected from lighting at the Project site. Additional information on lighting is provided in section 4.8.4.

4.6.2.3 Conclusion for Marine Resources

Construction of the Project would result in minor effects on aquatic resources due to temporary degradation of water quality and direct mortality of some immobile individuals during dredging. Further, noise from pile-driving would result in temporary and minor impacts on fish. In addition, spills of hazardous materials could affect water quality and affect aquatic organisms during construction and operations; however, implementation of measures in Annova's SPCC Plans and Project-specific *Plan* and *Procedures* would minimize potential effects. During operation, the Project would have minor effects on aquatic resources due to maintenance dredging and increased vessel traffic. Permanent effects on aquatic habitat would occur where open water would be converted to commercial/industrial land within the BSC; however, the permanent reduction in aquatic habitat within the Project area is not expected to result in significant adverse effects on marine resources.

4.7 SPECIAL STATUS SPECIES

Special status species are those species for which state or federal agencies afford an additional level of protection by law, regulation, or policy. Included in this category are federally listed and federally proposed species that are protected under the ESA; species that are currently candidates for federal listing under the ESA; state-listed threatened or endangered species; and species otherwise granted special status at the state or federal level.

Federal agencies are required by Section 7 of the ESA to ensure that any actions authorized, funded, or carried out by the agency do not jeopardize the continued existence of a federally listed threatened or endangered species, or result in the destruction or adverse modification of designated critical habitat of a federally listed species. As the lead federal agency, the FERC is required to coordinate with the FWS and NOAA Fisheries to determine whether federally listed threatened or endangered species or designated critical habitat are found in the vicinity of the Project, and to determine potential effects on those species or critical habitats.

For actions involving major construction activities with the potential to affected ESA-listed species or designated critical habitat, the lead federal agency must prepare a BA and submit it to the FWS and NOAA Fisheries. If the action would adversely affect a listed species, the federal agency must also submit a request for formal consultation. In response, the FWS and NOAA Fisheries would issue a Biological Opinion as to whether or not the federal action would likely jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. The FERC is currently preparing a BA for the Annova Project, which will be submitted to the FWS and NOAA Fisheries.

To assist in compliance with Section 7 of the ESA, Annova, acting as the FERC's non-federal representative for the Annova LNG Project, coordinated with the FWS' Texas Coastal Ecological Services Field Office and with NOAA Fisheries regarding the Project. In addition, Annova also coordinated with the TPWD and requested a review of information contained within the TPWD's Texas Natural Diversity Database (TXNDD) regarding species and habitats potentially affected by construction and operation of the Project. Based on this information and a review of publicly available information, agency correspondence, and field surveys, 64 federally and/or state-listed threatened and endangered, or candidate species may occur in Cameron County. Federally and state-listed species known to occur or potentially occurring in the vicinity of the Project are identified in tables 4.7.1-1 and 4.7.2-1, respectively.

Under the MMPA, NOAA Fisheries is responsible for the protection of all whales, porpoises, and dolphins, while the FWS is responsible for manatees. Federal responsibilities include providing overview and advice to regulatory agencies on all federal actions that might affect marine mammals. The ESA-protected marine mammals known to occur in the northern Gulf of Mexico are addressed herein. Other marine mammals are addressed in section 4.6.2.1.

4.7.1 Federally Listed Threatened and Endangered Species

Based on information obtained from the FWS and NOAA Fisheries, 21 federally listed, proposed, or candidate threatened and endangered species may occur within Cameron County. Of these, two listed plant species do not have the potential to occur in the vicinity of the Project and are not discussed further in this EIS. The remaining 18 species include marine mammals, terrestrial mammals, birds, and sea turtles. Within Cameron County, critical habitat has been designated for the loggerhead sea turtle in the offshore marine area transited by LNG carriers and for the wintering piping plover in the onshore Project area.

TABLE 4.7.1-1

Federally Listed and Candidate Species Known to Occur or Potentially Occurring in Cameron County, Texas

Listed Species					
Common Name	Scientific Name	Listing Status	Jurisdiction	Project Component	Preliminary Impact Determination a/
Mammals					
Blue whale	*Balaenoptera musculus*	Endangered	NOAA Fisheries	Marine facilities	NLAA
Fin whale	*Balaenoptera physalus*	Endangered	NOAA Fisheries	Marine facilities	NLAA
Sei whale	*Balaenoptera borealis*	Endangered	NOAA Fisheries	Marine facilities	NLAA
Sperm whale	*Physeter macrocephalus*	Endangered	NOAA Fisheries	Marine facilities	NLAA
Gulf of Mexico Bryde's whale	*Balaenoptera edeni*	Proposed Endangered	NOAA Fisheries	Marine facilities	NLAA
West Indian manatee	*Trichechus manatus*	Threatened	FWS	Marine facilities	NLAA
Ocelot	*Leopardus pardalis*	Endangered	FWS	LNG facilities and access road	LAA
Gulf Coast jaguarundi	*Herpailurus yagouaroundi cacomitli*	Endangered	FWS	LNG facilities and access road	LAA
Birds					
Northern aplomado falcon	*Falco femoralis septentrionalis*	Endangered	FWS	LNG facilities and access road	NLAA
Piping plover	*Charadrius melodus*	Threatened	FWS	LNG facilities and access road	NLAA
Red-crowned parrot	*Amazonia viridigenalis*	Candidate	FWS	LNG facilities and access road	Would not contribute to a trend toward federal listing
Red knot	*Calidris canutus rufa*	Threatened	FWS	LNG facilities and access road	NLAA
Whooping crane	*Grus Americana*	Endangered	FWS	LNG facilities and access road	NLAA
Eastern black rail	*Laterallus jamaicensis jamaicensis*	Proposed Threatened	FWS	LNG facilities and access road	NLAA
Reptiles					
Green sea turtle	*Chelonia mydas*	Threatened	FWS; NOAA Fisheries	Marine facilities	NLAA
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered	FWS; NOAA Fisheries	Marine facilities	NLAA
Loggerhead sea turtle	*Caretta caretta*	Threatened	FWS; NOAA Fisheries	Marine facilities	NLAA
Hawksbill sea turtle	*Eretmochelys imbricata*	Endangered	FWS; NOAA Fisheries	Marine facilities	NLAA
Leatherback sea turtle	*Dermochelys coriacea*	Endangered	FWS; NOAA Fisheries	Marine facilities	NLAA

TABLE 4.7.1-1 (continued)					
Federally Listed and Candidate Species Potentially Occurring in Cameron County, Texas					
Listed Species					
Common Name	Scientific Name	Listing Status	Jurisdiction	Project Component	Preliminary Impact Determination [a]
Flowering Plants					
South Texas ambrosia	*Ambrosia cheiranthifolia*	Endangered	FWS	No evidence of occurrence	NE
Texas ayenia	*Ayenia limitaris*	Endangered	FWS	No evidence of occurrence	NE

a/ Preliminary impact determinations: NLAA = may affect but is not likely to adversely affect; LAA = likely to adversely affect; NE = no effect because the species is not expected to occur in the Project vicinity

4.7.1.1 Marine Mammals

Whales

The blue whale occurs in all oceans of the world. It inhabits sub-polar to sub-tropical oceans and rarely occurs in the Gulf of Mexico off the coast of Texas. The only two records of a blue whale in the Gulf of Mexico are for strandings: one near Sabine Pass, Louisiana, in 1926 and one near Freeport, Texas, in 1940 (Texas Tech University 1997). Both identifications have been questioned. The current North Atlantic population of 100 to 1,500 individuals represents a small portion of the worldwide population of 11,000 to 12,000 blue whales.

The fin whale occurs in deep offshore waters of all major oceans (NOAA Fisheries 2011b) but is rarely encountered in the Gulf of Mexico. A young individual was stranded on the beach at Gilchrist in Chambers County on February 21, 1951 (Texas Tech University 1997). This highly migratory species forages in high latitudes during spring and summer and migrates to temperate waters for mating and calving during fall and winter.

The sei whale is a medium-sized baleen whale occurring primarily in offshore waters from the Gulf of Mexico and Caribbean Sea northward to Nova Scotia and Newfoundland. This migratory species tends to occur in groups of two to five individuals. No occurrences of sei whales have been reported in the waters off Texas (Schmidly 2004).

The sperm whale typically inhabits waters about 2,000 feet (600 meters) or greater in depth, and is uncommon in waters less than 1,000 feet (300 meters) deep (NOAA Fisheries 2011b). The sperm whale occurs in all oceans between approximately 60 degrees north and 60 degrees south latitudes. This species is the most abundant whale in the Gulf of Mexico, and sightings in Texas near the coast are relatively common (Texas Tech University 1997). The sperm whale is encountered most often at depths of 655 feet or greater, along submarine canyons on the edge of the continental shelf. Threats to this species in the Gulf of Mexico include entanglement in longline fishing gear and vessel strikes. However, serious injuries or mortalities of sperm whales were reported in the northern Gulf of Mexico during the most recent stock assessment period (2009–2013) (NOAA Fisheries 2016a).

The Gulf of Mexico Bryde's whale was determined to be a genetically distinct subspecies of the Bryde's whale and proposed for listing as endangered in December 2016 (81 FR 88639-88656). It is the only baleen whale that occurs in the Gulf of Mexico year-round. Based on sightings, the De Soto Canyon area in the northeastern Gulf of Mexico has been identified as a biologically important area for the Bryde's whale. This subspecies is most often reported in the De Soto Canyon area along the continental shelf break between about 300 and 1,000 feet in depth. While the Gulf of Mexico Bryde's whale may occur in other portions of the Gulf of Mexico, its distribution and abundance are not known (81 FR 88639-88656).

<u>Impacts and Mitigation: Whales</u>

Although no whale species are expected to venture into the relatively shallow waters of the BSC, individual whales occurring in the Gulf of Mexico may be subjected to strikes by LNG carriers transiting to and from the Project. The Coast Guard LOR indicated that a maximum of 80 LNG carriers per year would visit the Project, depending on vessel size. LNG carriers operating within the U.S. EEZ in the Gulf of Mexico are generally slower and generate more noise than typical large vessels and would therefore be more readily avoided by these mobile species. The probability of any whale encountering an LNG carrier in the open Gulf is low because (1) whales are generally able to detect and avoid large vessels and (2) NOAA Fisheries and the Coast Guard provide educational materials to vessel operators to increase awareness of whales in sensitive areas. An increase in LNG carrier traffic as a result of the Project (see section 4.9.10) would increase the potential for risk of strikes; however, we conclude based on the frequency of both whale occurrences and shipping traffic that this increase would be minimal Vessel strikes would be mitigated and minimized by vessel operators watching for and avoiding strikes, as described in NOAA Fisheries' most recent *Vessel Strike Avoidance Measures and Reporting for Mariners* (revised February 2008).

Based on the relatively small increase in shipping activity when compared to the total shipping traffic in the Gulf of Mexico, and because Annova would provide LNG carrier captains with NOAA Fisheries' recommended strike avoidance measures, the potential for the Project to result in increased vessel strikes to any whale species is minimal. Therefore, we have determined that constructing and operating the Project *may affect, but is not likely to adversely affect* whale species.

West Indian Manatee

The West Indian manatee includes two distinct subspecies: the Florida manatee (*Trichechus manatus latirostris*) and the Antillean manatee (*Trichechus manatus manatus*). This species was previously listed as endangered, but was downlisted to threatened status on May 5, 2017, based on significant improvements in its population and habitat conditions (82 FR 16668 16668-16704).

The manatee is a rotund, slow-moving herbivorous marine mammal that reaches up to about 13 feet in length. It ranges throughout the southeastern United States in nearshore coastal marine, brackish, and freshwater habitats. The Florida manatee occurs in very shallow water (about 6 to 13 feet deep) close to shore where it forages on seagrasses (FWS 2013b and 2007). Manatees often congregate near natural springs, power plants, or other industrial sites that discharge warm water in Florida during the winter. During the warmer months, the Florida manatee may range as far north as Massachusetts and as far west as Texas; however, occurrences outside of the primary range are irregular (FWS 2013b and 2007). The manatee is rare in Texas, but has been sighted in Corpus Christi Bay, Laguna Madre, Cow Bayou near Sabine Lake, Copano Bay, along Bolivar Peninsula, and at the mouth of the Rio Grande (Texas Tech University 1997).

Impacts and Mitigation: Manatee

The occurrence of the manatee in the Project area is considered possible but unlikely. Sightings of manatees in the BSC are very rare and typically involve only a single animal that does not remain long in the vicinity. To address the possibility of a transient manatee, Annova would provide recognition and orientation training on the manatee to all personnel associated with the Project. Posters and other information would provide assistance in identification of manatees and would instruct personnel not to feed or otherwise engage the manatees. Given the rare occurrence of the manatee in the BSC and the conservation measures described above, we have determined that constructing and operating the Project *may affect, but is not likely to adversely affect* this species.

4.7.1.2 Terrestrial Mammals

The ocelot (*Leopardus pardalis)* and Gulf Coast jaguarundi *(Herpailurus yagouaroundi cacomitli)* could occur in the Project area. Suitable habitat is present in the Project area for both of these species. No critical habitat has been designated by the FWS for the ocelot or jaguarundi.

Annova conducted a camera-trapping survey for ocelot and jaguarundi on BND and private land in the Project vicinity from January 2016 through January 2017. The objective of the survey was to augment the existing database of ocelot/jaguarundi observations in the survey area, which could provide information on the current ocelot/jaguarundi use of the potential habitats in the survey area. Over the course of the survey, 121 camera trap sets were installed in the survey area and operated for over 40,000 trap-nights. No ocelots or jaguarundis were observed during the camera-trapping survey.

Ocelot

The ocelot is federally listed as endangered. This species is a medium-sized, spotted cat about 30 to 41 inches in length and weighing from 14 to 30 pounds (Campbell 2003). Its pelage is grayish or buffy and is heavily marked with black spots, small rings, blotches, and short bars (Schmidly 2004). The ocelot has a long tail that is ringed or marked with dark bars on the upper surface, parallel stripes running down the nape of the neck, and a shorter pelage (Campbell 2003; Schmidly 2004). Ocelots are primarily nocturnal and solitary, normally beginning their activity at dusk when they begin their nightly hunt for rodents, rabbits, and other small mammals, as well as birds, snakes, and lizards (Schmidly 2004; Tewes and Hughes 2001). Ocelots prefer dense thornshrub and rocky areas (FWS 1990a) and require large unbroken blocks of habitat for movement. During denning season, which is mid-April through December (Laack et al. 2005), ocelots give birth to and care for one to two kittens that are unable to travel for a period of time without being moved by the adult female.

Historically, dense thornshrub habitat preferred by ocelots occurred throughout south Texas, but in the 20th century ocelot habitat was reduced to less than one percent of its former distribution by agricultural, suburban, and urban development (Tewes and Everett 1986; Grassman 2006). Fragmentation and loss of dense brush habitat, combined with vehicle road mortalities, are the greatest threats to ocelot persistence in south Texas (Haines et al. 2005; FWS 2013d).

Two verified breeding ocelot populations occur in the United States, one in Cameron County, Texas, at the Laguna Atascosa NWR and one in Willacy County, Texas, on private ranches (Tewes 2017). The Laguna Atascosa NWR population is the closest resident subpopulation to the Project area and is located approximately 11 miles north of the Project. However, in 1998 a dispersing male ocelot was captured, radio-collared, and tracked in dense thornscrub on lomas in and around the Project area. Based on tracking, this ocelot eventually travelled north to the Laguna Atascosa NWR. Ocelots have previously been documented in and around the Project area. The current size and distribution of loma thornshrub in the vicinity of the Project site may support transient or resident ocelots, although surveys have only documented the one transient individual.

The Project is located within a region considered by the FWS as being an important component of the coastal ocelot corridor connecting Texas and Mexico. This corridor is referred to by the FWS as the South Texas Coastal Corridor. The FWS believes that this corridor is essential for the movement and the genetic viability of the ocelot. Additional information on the coastal wildlife corridor is provided in the BA.

Gulf Coast Jaguarundi

The Gulf Coast jaguarundi is federally listed as endangered throughout its range, which was historically limited to the Lower Rio Grande Valley in southern Texas in the United States and eastern Mexico in the States of Coahuila, Nuevo Leon, Tamaulipas, San Luis Potosi, and Veracruz (FWS 2013c). Only a small portion of the Gulf Coast jaguarundi's range and habitat occur in the United States. The last confirmed sighting of Gulf Coast jaguarundi within the United States was in April 1986, when a roadkill specimen was collected 2 miles east of Brownsville, Texas, and positively identified as a jaguarundi (FWS 2013c). Numerous unconfirmed sightings have been reported since then, including some sightings with unidentifiable photographs, but no United States reports since April 1986 have been confirmed as jaguarundi. Known jaguarundis closest to the United States border are found approximately 95 miles southwest in Nuevo Leon, Mexico. There are no documented occurrences of jaguarundi within the Project area.

The Gulf Coast jaguarundi uses dense, thorny shrublands or woodlands and bunchgrass pastures adjacent to dense brush or woody cover. Caso (2013) found that radio-collared jaguarundis spent up to 40 percent of their time in tall, dense grass habitats, but habitat analysis indicates that the preferred habitat is natural undisturbed forest. Primary known threats to the Gulf Coast jaguarundi are habitat destruction and degradation, habitat fragmentation due to agriculture and urbanization and, to some extent, human disturbance including border security activities. Mortality from collisions with vehicles is also a threat. Competition with bobcats may be a limiting factor in the northern portion of the jaguarundi's range (Sanchez-Cordero et al. 2008). Increases in temperature and decreases in precipitation resulting from climate change are also believed to affect Gulf Coast jaguarundi populations by altering their preferred habitat (FWS 1990b).

Impacts and Mitigation: Terrestrial Mammals

Constructing and operating the Project would result in the loss of suitable ocelot and jaguarundi habitat, which could affect their movement resulting in avoidance and displacement. The Project would result in the permanent loss of 127 acres of Loma Evergreen Shrubland, which is considered preferred habitat for ocelots and jaguarundis. Because this habitat is part of the South Texas Coastal Corridor identified by the FWS, this habitat loss could decrease the effectiveness of this habitat linkage (resulting in habitat fragmentation) and affect the ability of ocelots to use this area as a potential travel corridor. To address this impact and as discussed further below, Annova designed the Project layout to include an undisturbed wildlife corridor on the Project's western boundary.

Increased human disturbance could discourage ocelot and jaguarundi use of the Project area, although use of the site by jaguarundi is expected to be minimal to none based on the absence of a known population in South Texas. Construction and operation activities would increase noise levels in the Project area. These noise impacts, especially impulsive noise such as pile driving, would affect use by ocelots and jaguarundis, if present.

Artificial lighting would disrupt ocelot and jaguarundi dispersal movements (Beier 2005). Project-related vehicle traffic would increase wildlife collision potential. Vehicle collisions are the leading cause of death of ocelots in Texas. Vehicle collisions from Project traffic could affect jaguarundis, although the possibility is considered minimal given the absence of a known population of jaguarundis in South Texas. Construction of fencing and wildlife crossings along the access road and the establishment of speed limits is expected to further reduce the possibility of vehicle collisions.

To avoid direct impacts on the ocelot and jaguarondi during construction, clearing of dense thornshrub communities and adjacent shrub communities that are present on the lomas within the Project site would be conducted outside the denning season (i.e., from January to mid-April). Alternatively, if clearing could not be conducted during this timeframe, a survey would be conducted for at least a month immediately preceding clearing and biologists would monitor the clearing to ensure that these species are not impacted.

In coordination with the FWS, Annova identified the following conservation measures that would minimize Project impacts on the ocelot and jaguarundi.

- **Conservation of Off-Site Lands.** Annova is evaluating lands for purchase or conservation easement in the Project region to aid in ocelot conservation. Annova would transfer the land to the FWS, or provide funding for conservation lands that may benefit ocelots and jaguarundis.
- **Preservation of a Wildlife Corridor.** Annova modified its initial design for the Project to accommodate a wildlife corridor on the west side of the Project site, where existing dense thornshrub and other habitats would be preserved. Annova is proposing to protect the wildlife corridor with a conservation easement for the life of the Project. Annova would install a barrier wall along the southwest edge of the site between the LNG terminal facilities and the wildlife corridor to reduce light and noise impacts on wildlife. The barrier wall would consist of posts drilled into the ground and approximately 25-foot-tall concrete panels between the posts, and would include three-inch-high cut outs spaced along the base of the wall to allow for stormwater drainage.
- **Time Extension of Existing Redhead Ridge Conservation Easement.** Annova is working with the BND to extend the duration of a BND-owned conservation easement located on the north side of the BSC (Puerta de Trancas Loma). This conservation easement consists of a 1,000-foot-wide easement encompassing three

tracts of land extending from the SH 48 southerly right-of-way line to the BSC. The conservation easement was established in 2004 in association with the Texas Department of Transportation's proposed improvements to SH 48 and is adjacent to a wildlife crossing bridge under SH 48. Currently, the conservation easement is scheduled to expire in September 2023. If approved by the BND, Annova is proposing to extend the conservation easement for the life of the Project in order to connect the proposed wildlife corridor on the west side of the Project site to additional conservation lands further north.

Annova would continue to consult with the FWS regarding potential impacts on the ocelot and jaguarondi. The FWS stated that it will be working with Annova on details for the design of the access road, including number of wildlife crossings, dimensions of size of openings, and fencing on both sides of the wildlife crossings to keep cats and other wildlife off the road.

The past documented occurrences of ocelots in and around the Project site are limited and distant enough in time to provide little support that the species is likely to be encountered. Suitable habitat is present within the Project site; however, the site would likely only be used by transient individuals, possibly from the known ocelot subpopulation in Laguna Atascosa NWR. However, Annova has agreed to establish a wildlife corridor along the southwest boundary of the Project site that may be utilized in the event transient individuals attempt to traverse the site. In light all of these considerations we have consulted closely with the FWS regarding an appropriate determination of effect and conclude that constructing and operating Project *may affect, and is likely to adversely affect the ocelot*.

The current size and distribution of loma thornshrub in and around the Project site, and within the larger region, may support jaguarundis if they still exist in Texas, and the FWS typically treats the jaguarundi in a similar manner to the ocelot; therefore, we have determined that the constructing and operating the Project *may affect, and is likely to adversely affect* the jaguarundi.

4.7.1.3 Birds

The listed northern aplomado falcon, piping plover, and red knot, the candidate red-crowned parrot, and the proposed Eastern black rail are known to occur or potentially occur in Cameron County (table 4.7.1-1). Suitable habitat is present in the Project area for all of the federally listed and candidate bird species with the exception of the red-crowned parrot. The FWS has also identified designated critical habitat for the wintering piping plover in the Project area.

Northern Aplomado Falcon

The northern aplomado falcon *(Falco femoralis septentrionalis)* is federally listed as endangered. This species is a medium-sized falcon that ranges in length from 15 to 18 inches and in wingspan from 32 to 36 inches (Campbell 2003). Although it is difficult to precisely determine former abundance of the species in the U.S., most observers in the latter half of the 19th century described northern aplomado falcons as fairly common (FWS 1990c). Dramatic decreases of the U.S. population of northern aplomado falcons occurred between 1890 and 1910 (Oberholser 1974). Reintroduction of the northern aplomado falcon into the U.S. began in the mid-1980s at the Laguna Atascosa NWR in south Texas. In conjunction with the FWS, the Peregrine Fund has raised and released northern aplomado falcons at the Laguna Atascosa NWR and other sites in Texas and

New Mexico, with more than 1,500 captive-bred northern aplomado falcons released through the Northern Aplomado Falcon Restoration Project (Peregrine Fund 2012). Today, the U.S. population consists of two nesting subpopulations located along the Gulf Coast in South Texas.

The northern aplomado falcon hunts prey individually, in pairs, and in family groups (Burnham et al. 2002). Small birds and insects are common prey items pursued in flight, though pursuit is readily continued on foot through trees, brush, or dense grass (FWS 1990c).

Northern aplomado falcons do not construct their own nests but appropriate stick platforms built by other raptors and corvids (Campbell 2003). In south Texas, nests have been found in Spanish dagger (*Yucca treculeana*), honey mesquite (*Prosopis glandulosa*), Texas ebony (*Ebenopsis ebano*), and on artificial structures such as electric transmission poles. Surveys have also found northern aplomado falcons nesting on the ground (Burnham et al. 2002). Aplomado falcons usually lay two to three brown speckled eggs, and both parents provide incubation (Campbell 2003).

Aplomado falcons are year-round residents in the Project area. The northern aplomado falcon nesting season (egg-laying through fledging) in the Project vicinity could extend from March through August. Northern aplomado falcons are known to use the Project site, although no nests have been recorded. However, nests have been recorded within one mile of the Project (FWS 2014b; Peregrine Fund 2015).

A safe harbor program was initiated in 1996 that provides landowners, including the BND, a safe harbor (i.e., permission to cause incidental take of the northern aplomado falcon at the Project site, so long as the level of incidental take does not cause the Action Area's environmental baseline for the northern aplomado falcon to fall below conditions existing at the time BND became a sub-permittee). The Permit defines the environmental baseline for the northern aplomado falcon as the pair of northern aplomado falcons that was bred in captivity and that nested in the Brownsville area in 1995. As no northern aplomado falcon nests existed within the Project site at the time BND became a sub-permittee under the Permit, any incidental take associated with the Project would be covered under the Safe Harbor Agreement.

Impacts and Mitigation: Northern Aplomado Falcon

Approximately 186 acres of potentially suitable habitat for listed bird species would be affected by construction and 147 acres would be affected by operation of the Project. Land clearing could adversely impact northern aplomado falcons, which rely on larger plants to perch and nest, such as yuccas. Human disturbance could cause northern aplomado falcons to be flushed and displaced and may interrupt foraging and roosting. Northern aplomado falcons would likely avoid areas where active construction and operation activities are occurring.

Construction and operation activities will increase noise levels in the Action Area (see section 4.11). Birds demonstrate startle effects when exposed to a sound pressure level (SPL) of 108 dBA (Burger 1981). Noise levels exceeding that level are not expected during construction or operation of the Project (see tables 4.11.2-4 and 4.11.2-7 in section 4.11). High-noise events may cause birds to avoid the Project area, and if present, would be flushed, both of which could affect bird behavior including feeding, preening, and caring for their young (NoiseQuest 2015).

Although Project lighting could cause northern aplomado falcons to be disoriented and collide with buildings or other structures at the Project site, lighting is expected to have a minimal effect on northern aplomado falcons as this species is not nocturnal or migratory. Annova would evaluate lighting schemes to reduce potential lighting effects. Furthermore, whenever possible, lights would be placed so they do not shine directly towards adjacent undisturbed habitats or the beach, and lighting would be extinguished upon completion of work in an area.

An increase in vehicle traffic may result in a corresponding increase in avian mortality. Some fencing would be incorporated along the access road as part of the design for wildlife crossings, and the FWS has recommended that design of the fencing take into account the potential to serve as perches for aplomado falcons and whether this would be a potential hazard. However, given the commonplace nature of fencing, we conclude that fencing could serve as a perch, but any resulting risk would not be substantial. Direct mortality from collisions with vehicles or construction equipment may occur, though the potential for collisions with vehicles and equipment is expected to be low for aplomado falcons.

To minimize potential effects on the northern aplomado falcon, when possible, clearing of vegetation would be scheduled from September through February, outside the nesting season for northern aplomado falcons. If vegetation clearing is conducted during the nesting season (March through August), then Annova would conduct a nest survey prior to the clearing. If an active northern aplomado nest is found on the Project site, Annova, in coordination with the BND, would notify the Peregrine Fund and allow them to survey for nests/offspring in the Project area in order to relocate nests out of the Project area prior to habitat removal. Annova would also follow the FWS recommendation to have a biologist trained in bird identification available to survey the work area to identify and avoid active nests prior to and during clearing or ground-disturbing activities.

Although northern aplomado falcons have been documented in and near the Project site, no nests have been documented at the Project site. This species is highly mobile and typically departs at the approach of humans. In addition, Annova would implement measures, including minimization of impacts on suitable nesting habitat as well as clearing outside the nesting season or otherwise conducting nest surveys prior to construction. Therefore, we have determined that constructing and operating the Project *may affect, but is not likely to adversely affect the northern aplomado falcon*.

Piping Plover and Red Knot

<u>Piping Plover</u>

The piping plover *(Charadrius melodus)* is federally listed as threatened. This species is a small shorebird about 7 inches in length with a wingspan of approximately 15 inches (Campbell 2003). In Texas, habitat preferred by piping plovers includes mud, sand, or algal flats and mainland or barrier island beaches, all of which are areas that are periodically covered with water and then exposed either by tides or wind (Campbell 2003).

Piping plovers spend 3 to 4 months of the year on their breeding grounds in the northern United States and Canada and the remainder of the year on their wintering grounds. One of their primary wintering areas is the Texas coast, which is estimated to winter more than 35 percent of the known piping plover population (Campbell 2003). These plovers arrive in Texas between late

July and late October and depart for their breeding grounds between early March and mid-May (Oberholser 1974).

Piping plovers usually disperse to feed and are typically observed singly or in small flocks foraging or roosting on barrier islands and mainland beaches, sand, mud and algal flats, washover passes, salt marshes, and coastal lagoons. A common feeding trait is its habit of run-and-halt foraging wherein the plover sprints along the beach, stops suddenly to inspect the surrounding territory, and then sprints on (Oberholser 1974). Typical prey of the piping plover includes marine worms, flies, beetles, spiders, crustaceans, mollusks, and other small marine animals and their eggs and larvae (Campbell 2003).

Habitat in the Project area (which includes the Coastal Salt and Brackish High Tidal Marsh, Coastal Tidal Flat/Washover, and South Texas Wind Tidal Flats[8]) may support foraging, roosting, and sheltering piping plovers. In addition, the sparsely vegetated areas at DMPA 5A may provide suitable wintering habitat. There are no documented occurrences of piping plovers within the Project site; however, this species has been recorded in the Rio Grande Valley.

Piping Plover Critical Habitat

The FWS designated 7,217 acres of the south Texas coast (i.e., Unit TX-1) as wintering piping plover critical habitat (FWS 2000). The boundaries of this unit include wind tidal flats that are infrequently inundated by seasonal wind-driven tides and serve as preferred piping plover habitat. Based on the description of piping plover critical habitat, we have assumed that the Project site includes a portion (13.4 acres) of the designated critical habitat. This is approximately 0.2 percent of the critical habitat included in the 7,217-acre Unit TX-1 and 0.02 percent of the total piping plover critical habitat designated in Texas.

Red Knot

The red knot *(Calidris canutus rufa*) is federally listed as threatened. This species is a long-distance migrant bird with a wingspan of 20 inches. Red knots can fly more than 9,300 miles from south to north every spring and repeat the trip in reverse every autumn (FWS 2015g). Surveys of wintering red knots along the coasts of southern Chile and Argentina and during spring migration in Delaware Bay on the United States coast indicate that a serious population decline occurred in the 2000s. Recent information suggests that red knots may spend more than three-fourths of each year along the Texas coast, occurring from late July or early August to mid-May, from Matagorda Island south to the state of Tamaulipas in Mexico.

The wintering habitat for red knots along the Texas Gulf Coast is similar to piping plover habitat and includes barrier island beaches, exposed tidal flats, washover passes, and mud flats (Port Isabel Economic Development Corporation 2015). Red knots forage on beaches, oyster reefs, and exposed bay bottoms, and roost on high sand flats, reefs, and other sites protected from high tides (FWS 2014c). A study at Laguna Madre found that red knots prefer bay habitats when they are available, and are sensitive to high water levels in bays. In general, red knots are associated with lower sand flat habitats (FWS 2014d).

[8] Note that the Coastal Salt and Brackish High Tidal Marsh occurs in the Project area, but would not be affected by the Project

Red knots depend on favorable habitat, food, and weather conditions within narrow seasonal windows as they move between migration stopovers between wintering and breeding areas. For example, the red knot population decline that occurred in the 2000s has been attributed to reduced food availability from increased harvests of horseshoe crabs, exacerbated by small changes in the timing that the red knots arrived at the Delaware Bay. Horseshoe crab harvests are now managed with explicit goals to stabilize and recover red knot populations.

Habitat in the Project area that may support foraging roosting, and sheltering red knots include Coastal Salt and Brackish High Tidal Marsh, Coastal Tidal Flat/Washover, and South Texas Wind Tidal Flats[9]. In addition, as described above for the piping plover, suitable habitat for red knots may also be present within sparsely vegetated areas at DMPA 5A. There are no documented occurrences of red knots within the Project site; however, this species has been recorded in the Rio Grande Valley region and the Project site includes suitable habitat for red knots.

Impacts and Mitigation: Piping Plover, Red Knot, and Piping Plover Designated Critical Habitat

Excavating the marine berth would permanently remove approximately one acre of suitable piping plover and red knot habitat along the BSC. In addition, dredging activities planned for the DMPA 5A site would modify potentially suitable habitat that currently exists for piping plovers. The Project has been designed to avoid the wind-tidal flats and piping plover designated critical habitat located on the east side of the Project site.

Human disturbance could cause overwintering piping plovers and red knots to be flushed from the area and displaced, and may interrupt foraging and roosting. Because piping plovers and red knots exhibit a high degree of fidelity to wintering areas, it is expected that birds in the vicinity of the Project site would be permanently displaced to nearby areas of suitable habitat. High quality wintering habitat occurs nearby within the Laguna Atascosa NWR and Designated Critical Habitat Unit TX-1.

As discussed for northern aplomado falcons, noise levels during construction and operation of the Project are not expected to reach a level where birds would demonstrate startle effects. However, high-noise events may cause birds to engage in avoidance behavior, flush or and spend less time engaged in necessary activities like feeding, preening, and caring for their young (NoiseQuest 2015). Construction and operation activities would increase noise levels in the Project area. These noise impacts, especially impulsive noise such as pile driving, would affect use by piping plovers and red knots. However, noise effects are anticipated to be temporary, and once the Project begins operation noise levels would be reduced and piping plovers are expected to return to the area.

As discussed previously, lighting associated with the Project could cause birds to be disoriented and collide with buildings or other structures at the Project site. In addition, birds disoriented by lights can circle structures for extended periods of time, leading to exhaustion and reduced fitness for migration which can lessen migration survival and decrease breeding season productivity (FWS 2017). Piping plovers and red knots could be affected by light from the Project,

[9] Note that the Coastal Salt and Brackish High Tidal Marsh occurs in the Project area, but would not be affected by the Project

particularly if they are migrating through the area at night or roosting in habitats in or adjacent to the Project site. As previously indicated, Annova has stated it would evaluate lighting schemes to reduce effects of light on remaining habitats and minimize lighting on the access road to that required to address safety concerns. Also, whenever possible, lights would be placed so they do not shine directly towards adjacent undisturbed habitats or the beach, and lighting would be extinguished upon completion of work in an area.

Direct mortality from collisions with vehicles or construction equipment may occur. Vehicles would generally be restricted to the access road and roads within the Project site, minimizing the potential for collisions or creating ruts in suitable bird habitat. However, ruts could be created along the BSC beach during construction activities and piping plovers or red knots using ruts to rest would be susceptible to vehicle and/or equipment collisions during construction. Driving is currently allowed in many areas in the Project vicinity on existing access roads and paths, along shorelines, and on mudflats.

As discussed for the northern aplomado falcon, Annova anticipates that the use of gas flares would only occur intermittently. These types of collisions would increase the rates of stress, injury, and mortality experienced by birds. Although this occasional flaring could impact piping plovers and red knots if present during the flaring event, we conclude that occasional flaring during operation would not substantially impact bird populations.

To address concerns regarding piping plovers and red knots, immediately prior to, during, and immediately following construction, Annova would have qualified biologists conduct surveys and monitoring for piping plovers and red knots in and immediately adjacent to the Project site during the months when overwintering piping plovers and red knots are expected to occur in Texas (i.e., from approximately July through May).

Although suitable piping plover and red knot habitat would be permanently affected as a result of the Project, only one acre of habitat would be removed and there is abundant high-quality wintering habitat in the vicinity of the Project site. Therefore, we have determined that constructing and operating the Project *may affect, but is not likely to adversely affect* the piping plover and red knot. As noted above, the Project has been designed to avoid impacts on the wind-tidal flats and designated critical habitat located on the east side of the Project site. Therefore, we have determined that constructing and operating the Project *would not significantly destroy or adversely modify* piping plover critical habitat.

Red-crowned Parrot

The red-crowned parrot (*Amazona viridigenalis*) is a candidate for federal listing under the ESA. The parrot is green with a striking red forehead. It has a blue post-ocular stripe that extends down the sides of its neck, a red speculum, and dark blue primaries. The outer-tail feathers have yellow tips. Females and immature parrots have less red on the crown. Red-crowned parrots are nonmigratory, but are apparently nomadic during the winter (nonbreeding) season when large flocks range widely to forage.

The red-crowned parrot is endemic to northeastern Mexico. Several introduced populations occur in urban areas of the United States, including the Lower Rio Grande Valley. However, evidence suggests populations in the Lower Rio Grande Valley consist, at least partly, of naturally occurring populations. The red-crowned parrot generally occurs in lush areas in arid lowlands and foothills, particularly tropical deciduous forest, gallery forests, evergreen floodplain forest, Tamaulipan thornscrub, and semi-open areas. In the Lower Rio Grande Valley, red-crowned parrots occur primarily in urban areas. Although little information on urban habitat use specific to the Lower Rio Grande Valley is available, in cities where the species is introduced, red-crowned parrots reportedly prefer areas with large trees such as palms that provide both food and nesting sites (76[194] FR 62016-62034).

The red-crowned parrot usually forages in the crowns of trees, but will occasionally feed on low-lying bushes (76[194] FR 62016-62034). Foraging appears to be opportunistic and its diet includes a variety of seeds and fruits, and also buds and flowers. Red-crowned parrots nest in pre-existing tree cavities, including those created by other birds and those resulting from tree decay. Nesting occurs between March and August, and clutch size ranges from two to five eggs.

<u>Impacts and Mitigation: Red-crowned Parrot</u>

There are no documented occurrences of red-crowned parrots within the Project site (TPWD 2015b); however, there are numerous recorded sightings in the vicinity of the Project. The closest documented recent sighting occurred approximately 2.3 miles west of the Project site near San Martin Lake, north of the BSC (eBird 2015). The Project site does not contain tropical deciduous forests and palm habitats that the parrot usually prefers. However, due to the foraging habits of the red-crowned parrot, this species may occasionally occur within the thornscrub or semi-open areas within Project site, although no suitable nesting habitat is present. If red-crowned parrots are present at the Project site, they would likely relocate to nearby suitable habitat; therefore, we have concluded that constructing and operating the Project *would not contribute to a trend toward federal listing* of the red-crowned parrot.

Whooping Crane

The federally endangered whooping crane has three wild populations, including the Aransas-Wood Buffalo National Park population, which is the only remaining self-sustaining wild population. This population breeds at and near the Wood Buffalo National Park in Canada and winters in coastal marshes at the Aransas NWR on the southern coast of Texas near Rockport (FWS 2018a). Migrations to the Aransas NWR begin in mid-September, arriving around November, and leave the NWR in late March or early April. Wintering habitat includes estuarine marshes, shallow bays, and tidal flats. Whooping cranes may also spend time feeding in croplands during migration. Whooping Cranes eat invertebrates, small vertebrates, and plant material found in shallow water. The biggest threats to the species are power lines, illegal hunting, and habitat loss (TPWD 2018).

The Aransas NWR is more than 80 miles northeast of the proposed Project, which coincides with the closest area of whooping crane critical habitat. Although the species is generally noted as potentially occurring only in counties north of the Project site, FWS staff have observed (multi-year sightings) this species near the proposed Rio Grande LNG Terminal site, located directly northeast of the Annova Project site, indicating a potential expansion of the species' range (FWS 2016b).

Habitat within the Project area that may provide suitable wintering habitat for whooping cranes include Coastal Salt and Brackish High Tidal Marsh, Coastal Tidal Flat/Washover, South Texas Wind Tidal Flats, Coastal Salty Flat/Depression, Salt and Brackish Wetland, and South Texas Saline Grassland.[10]

Impacts and Mitigation: Whooping Crane

If whooping cranes were present, the birds would be temporarily displaced to nearby habitat. Operation of the Project would result in the permanent conversion of potentially suitable habitat to developed land that whooping cranes would likely avoid in favor of quieter, undisturbed habitat in the adjacent lands. An estimated 51 acres of suitable whooping crane habitat would be permanently removed by the Project.

Although suitable wintering whooping crane habitat would be permanently affected by the Project, there is abundant high-quality habitat in the vicinity of the Project site. Therefore, we have determined that constructing and operating the Project *may affect, but is not likely to adversely affect* the whooping crane.

Eastern Black Rail

The eastern black rail (*Laterallus jamaicensis jamaicensis*) is proposed for listing as threatened under the ESA. No critical habitat is proposed. The eastern black rail is a small, marsh bird that is one of four subspecies of black rail, and is broadly distributed, living in salt and freshwater marshes in portions of the U.S., Central America, and South America. Partially migratory, the eastern subspecies winters in the southern part of its breeding range (FWS 2018b).

Along portions of the Gulf Coast, eastern black rails can be found in higher elevation wetland zones with some shrubby vegetation. Impounded and unimpounded intermediate marshes (marshes closer to high elevation areas) also provide habitat for the subspecies. Inland coastal prairies and associated wetlands may also provide habitat for the bird but are largely uninvestigated.

There is less information for eastern black rail habitat in the winter range, but wintering habitat is presumably similar to breeding habitat since some sites in the southern portion of the breeding range are occupied year-round. Little is known about eastern black rails during migration, including migratory stopover habitat, but individuals seem to appear more frequently in wet prairies, wet meadows, or hay fields during migration than during the breeding and wintering seasons (FWS 2018b).

Numerous conservation challenges exist for the eastern black rail, including alteration of habitat by fire suppression, invasive species, sea-level rise, and human modifications. Changing temperatures also have affected the natural hydrology of wetlands and have contributed to mangrove encroachment into salt marsh habitat.

The eastern black rail is known to occur in coastal Cameron County which is considered year-round habitat for the species, and it is considered to potentially occur within interior portions

[10] Note that the Coastal Salt and Brackish High Tidal Marsh occurs in the Project area, but would not be affected by the Project.

of Cameron County (FWS 2018b). Habitat in the Project area that may support eastern black rails year-round include Coastal Salt and Brackish High Tidal Marsh. There are no documented occurrences of eastern black rails within the Project site, however, the Project site includes suitable habitat for eastern black rails.

<u>Impacts and Mitigation: Eastern Black Rail</u>

Approximately 50.8 acres of suitable eastern black rail habitat would be permanently removed as a result of the Project, with another 2.2 acres temporarily affected. Human disturbance during construction and operation could also cause eastern black rail in immediately adjacent areas to be flushed from the area and displaced. As discussed for northern aplomado falcons, noise levels during construction and operation of the Project are not expected to reach a level where birds would demonstrate startle effects. However, high-noise events may cause birds to engage in escape or avoidance behavior, flush or expend energy that may affect survival or growth, or spend less time engaged in necessary activities like feeding, preening, and caring for their young (NoiseQuest 2015). These noise impacts, especially impulsive noise such as pile driving, would affect use by eastern black rails; however, this effect is anticipated to be temporary lasting only during active construction, and once the Project begins operation noise levels would be reduced.

As discussed previously, lighting associated with the Project could cause birds to be disoriented and collide with buildings or other structures at the Project site. In addition, birds disoriented by lights can circle structures for extended periods of time, leading to exhaustion and reduced fitness for migration which can lessen migration survival and decrease breeding season productivity (FWS 2017). Eastern black rails could be affected by light from the Project, particularly if migrating through the area at night or roosting in habitats in or adjacent to the Project site. As previously indicated, Annova has proposed measures to reduce nuisance lighting and has stated it would evaluate lighting schemes to reduce effects of light on adjacent undisturbed habitats and minimize lighting on the access road to that required to address safety concerns.

Direct mortality from collisions with vehicles or construction equipment may occur; however, the potential for collisions with vehicles and equipment is expected to be low for eastern black rails. Vehicles would generally be restricted to the access road and roads within the Project site, minimizing the potential for collisions. There is also potential that eastern black rails could collide with the flare stack structures or the flares. As discussed for the northern aplomado falcon, Annova anticipates that the use of gas flares would only occur intermittently. These types of collisions would increase the rates of stress, injury, and mortality experienced by birds. Although this occasional flaring could impact eastern black rail if present during the flaring event, we find that occasional flaring during operation would not substantially impact bird populations.

Although suitable eastern black rail habitat would be permanently affected as a result of the Project, there is abundant estuarine marsh habitat that would remain undisturbed in the vicinity of the Project site. Therefore, we have determined that constructing and operating the Project would result in no effect on this species.

4.7.1.4 Sea Turtles

Sea turtles are long-lived reptiles that occur throughout the world's tropical, subtropical, and temperate seas. Five species of sea turtles are known to occur in the vicinity of the Project and are listed as threatened or endangered under the ESA. Although distribution, habitat utilization, and behavior vary among species, there are similarities among these five species of sea turtles. Females generally return to their natal beaches to nest. Hatchlings immediately enter the ocean, where they spend up to several years near the surface in the open ocean. After this phase, most sea turtles occupy shallow marine environments, including coral reefs and coastal areas rich in prey, although some may remain in the open sea environment or move between the two habitats. Common threats to sea turtles include poaching, entanglement in fishing gear, and degradation of nesting beaches and coastal foraging habitat.

Green Sea Turtle

The green sea turtle inhabits shallow waters with an abundance of marine algae and seagrasses. It is most common in lagoons, bays, inlets, shoals, and estuaries, but also occurs on coral reefs and rocky outcrops near feeding areas. The green turtle eats marine plants, mollusks, sponges, crustaceans, and jellyfish (NOAA Fisheries 2016b).

The north Atlantic distinct population segment (DPS) of the green sea turtle, which includes individuals in the Gulf of Mexico, is listed as federally threatened. Small numbers of green sea turtles occur in Matagorda Bay, Aransas Bay, and the lower Laguna Madre. The southern coast of Texas provides year-round foraging areas for juvenile and sub-adult green sea turtles (Anderson et al. 2013). The abundance of foraging green sea turtles on the Texas coast has been increasing since 1991 (Metz and Landrey 2013). This species may occur in the BSC year-round, particularly as a transit corridor between seagrass beds and other foraging sites. The green sea turtle is known to nest on the coast of the southeastern United States, but not along the Gulf of Mexico near the Project site.

Kemp's Ridley Sea Turtle

The Kemp's ridley is the smallest and most endangered sea turtle (NOAA Fisheries et al. 2011). The Kemp's ridley has one of the smallest ranges of all marine turtles, occurring primarily in the coastal waters of the Gulf of Mexico, from the Yucatán peninsula to South Florida. Its distribution is most concentrated in the Gulf of Mexico, with year-round occurrence throughout the Gulf and southern Atlantic coasts of Florida, and seasonal occurrence along the Atlantic coast as far north as Nova Scotia, Canada (NOAA Fisheries and FWS 2015). This turtle occurs in warm-temperate to subtropical sounds, bays, estuaries, tidal passes, shipping channels, and beachfront waters where it forages on blue crab and other invertebrate prey (Seney and Musick 2005). Nearshore waters off Louisiana and Texas provide foraging habitat for juveniles of this species (Landry et al. 2005); adult females have also been observed in the northwestern Gulf of Mexico during internesting periods (Seney and Landry 2011). The Kemp's ridley turtle is expected to enter the BSC and vicinity to forage on blue crabs and other typical prey (NOAA Fisheries 2015e, 2004; COE 2003). The primary nesting beaches for the Kemp's ridley turtle are in Mexico; however, several beaches in Texas, Alabama, and Florida have reported small numbers of Kemp's ridleys (fewer than 10 nests per year), with Padre Island National Seashore supporting the largest U.S. nesting aggregation (NOAA Fisheries et al. 2011).

Loggerhead Sea Turtle

The loggerhead sea turtle is reported in bays, estuaries, and lagoons and on continental shelves in temperate, subtropical, and tropical waters. The Northwest Atlantic Ocean DPS of the loggerhead sea turtle, which includes the GOM, is listed as threatened under the ESA. The greatest threats to the loggerhead are coastal development, commercial fisheries, and pollution.

Female loggerhead sea turtles nest on open, sandy beaches above the high tide mark and seaward of well-developed dunes, predominantly on steeply sloped beaches with gradually sloped offshore approaches. Most Atlantic nesting sites are on the east coast of Florida; some nests are reported in Georgia, the Carolinas, and on the Gulf Coast of Florida (NOAA Fisheries 2016c; COE 2003). Nesting occurs throughout the summer. Loggerhead hatchlings enter the sea and often associate with floating *Sargassum* for three to five years. Subadults are more common in near-shore and estuarine habitats, while adults are distributed among diverse habitats both near and offshore. Young loggerheads forage on gastropods, crustaceans, and *Sargassum*. Adults feed on benthic organisms but also take jellyfish from surface waters.

The loggerhead is the most abundant sea turtle in Texas waters, especially in shallow, inner continental shelf waters. It is present in Texas year-round, but is reported most frequently during the spring when Portuguese man-of-war jellyfish are abundant (COE 2003). Most loggerhead sightings in the northern Gulf of Mexico are near jettied passes and in open water.

Loggerhead Sea Turtle Critical Habitat

On July 10, 2014, NOAA Fisheries designated 38 occupied marine areas within the range of the Northwest Atlantic Ocean DPS of loggerhead sea turtles as critical habitat (NOAA Fisheries 2014; 79 FR 39857-39912).

The physical or biological feature of loggerhead *Sargassum* habitat is described as developmental and foraging habitat for young loggerheads where surface waters form accumulations of floating material, especially *Sargassum*. The following primary constituent elements support this habitat:

1. convergence zones, surface-water downwelling areas, the margins of major boundary currents (Gulf Stream), and other locations where there are concentrated components of the *Sargassum* community in water temperatures suitable for the optimal growth of *Sargassum* and inhabitance of loggerheads;

2. *Sargassum* in concentrations that support adequate prey abundance and cover;

3. available prey and other material associated with *Sargassum* habitat including, but not limited to, plants and cyanobacteria and animals native to the *Sargassum* community such as hydroids and copepods; and

4. Sufficient water depth and proximity to available currents to ensure offshore transport (out of the surf zone), and foraging and cover requirements by *Sargassum* for post-hatchling loggerheads, i.e., >30 feet in depth.

No loggerhead critical habitat occurs in the Project area, but LNG carriers are likely to transit through *Sargassum* that is designated as critical habitat in offshore Gulf of Mexico waters.

Atlantic Hawksbill Sea Turtle

The hawksbill sea turtle occurs on coastal reefs and in bays, rocky areas, estuaries, and lagoons at depths up to 70 feet. Hatchlings are often associated with masses of floating marine algae while juveniles, subadults, and adults are more common on coral reefs. Typical prey items include sponges, mollusks, sea urchins, seagrasses, and algae. Adults in the Atlantic/Gulf of Mexico population transition to foraging almost exclusively on sponges as they mature. All populations of the hawksbill sea turtle are listed as endangered.

Female hawksbills come ashore to nest on undisturbed, deep sand beaches. Preferred beaches may range from high-energy to small pocket beaches bounded by crevices of cliff walls with woody vegetation near the waterline (NOAA Fisheries 2016d; COE 2003). The Atlantic population nests along the Yucatan Peninsula, the U.S. Virgin Islands, Puerto Rico, and the Florida Keys. Post-hatchlings and juveniles are reported in Texas and Florida, primarily in areas with stone jetties and other hard surfaces where sponges are attached (NOAA Fisheries 2016d).

Leatherback Sea Turtle

The leatherback sea turtle spends most its life in pelagic waters and undergoes extensive migrations across entire ocean basins; however, individuals may enter coastal waters to forage and reproduce. Although the leatherback populations in the Caribbean and Atlantic Ocean (including the Gulf of Mexico) are generally stable or increasing, this species is listed as endangered throughout its range (NOAA Fisheries 2016e).

In the southeastern United States, the leatherback nests on beaches on the Florida Atlantic coast, the U.S. Virgin Islands, and in Puerto Rico (FWS 2012e). It prefers sandy beaches with a deepwater approach for nesting (NOAA Fisheries 2016e; COE 2003). Although the leatherback sea turtle has been reported in Corpus Christi Bay, this species is rare along the Texas coast. No nests have been recorded in Texas in more than 60 years (NOAA Fisheries 2016e; COE 2003).

Impacts and Mitigation: Sea Turtles

No adult or hatchling sea turtles are likely to occur in the onshore portion of the Project site because beaches in the vicinity are not suitable for nesting. Juvenile, sub-adult, and adult loggerhead, green, hawksbill, and Kemp's ridley sea turtles are likely to occur in the BSC and vicinity. Leatherback sea turtles are less likely to occur in the Project area.

<u>Vessel Strikes</u>

Increased vessel traffic within the BSC and Gulf of Mexico would increase the potential for turtle strikes. Sea turtles are vulnerable to vessel strikes while traveling, foraging, and resting on or near the water surface. A sea turtle could be injured or killed by a direct collision with a vessel (NOAA Fisheries and FWS 2013a, b; 2015).

LNG carriers operating within the U.S. EEZ in the Gulf of Mexico are generally slower and generate more noise than typical large vessels, and would therefore be more readily avoided by these species. Sea turtles typically move away from vessels approaching at slower speeds, but avoidance behavior decreases as vessel speed increases (Hazel et al. 2007). To help reduce the risk of strikes or other potential disturbances associated with the presence of LNG carriers, Annova would adopt the NOAA Fisheries *Vessel Strike Avoidance Measures and Reporting for Mariners* (revised February 2008).

Acoustic Stressors: Vessels and Pile Driving

Construction-related noise including vessel noise and pile driving, could adversely affect sea turtles. Cues preceding the commencement of the noise event (such as vessel presence and movement) may result in some sea turtles departing the immediate area even before active sound sources begin transmitting.

The proposed duration and frequency of LNG carrier movement in the Project area would be so low as to represent an insignificant effect of vessel noise on sea turtles. Noise from LNG carriers is not expected to cause behavioral responses to sea turtles. The NOAA Fisheries has indicated that sea turtles and other protected animals experience vessel activity from the time they are young and although it is not known if they become habituated to the noise, individuals are able to function somewhat normally when exposed to vessel noise (NOAA Fisheries 2013). Disturbances from vessel noise would be short term and similar to the existing baseline noise levels in the marine environment. Pile-driving noise sources vary by type of pile (steel, wood, or concrete) and type of driving (impulse or vibratory) (see section 2.6 for a description of the proposed pile driving). Pile driving would create an impulsive source (pulsed noises) audible both within and above the water. Standard ESA protections would be in place, including having observers check for animals in the immediate vicinity and pausing activities until the animals leave the area. Disturbances from pile driving would be short term (approximately five days) and localized.

Sedimentation

Dredging may adversely affect water quality during construction of the marine facilities. Dredging activities could temporarily disrupt potential foraging grounds for turtles. Dredging effects would be temporary and local in nature because dredging would be confined to the proposed turning basin, access channel, and marine berth. Disposal of the dredged material would cause a local, temporary increase in turbidity, but effects on sea turtles would be discountable.

The green, Kemp's ridley, loggerhead, and Atlantic hawksbill sea turtle are likely to occur in the vicinity of the Project (particularly in the transit path of LNG carriers). Although these individual sea turtles species are likely to enter the BSC and could be exposed to stressors associated with construction and operation of the Project, the use of mechanical and hydraulic dredges are expected to minimize adverse effects on sea turtles and not result in any take of protected species (Hanson et al. 2004; GMFMC 2010). The leatherback sea turtle is so uncommon in the northern Gulf of Mexico that effects to it are discountable. Therefore, we have determined that constructing and operating the Project *may affect but is not likely to adversely affect* any sea turtle species listed in table 4.7.1-1.

Determination of Effect on Loggerhead Sea Turtle Critical Habitat

LNG carriers transiting to and from the Project may pass through and disrupt the *Sargassum*. However, this traffic is not anticipated to scatter *Sargassum* mats to the point of affecting the functionality of the loggerhead critical habitat primary constituent elements.

Therefore, we have determined that constructing and operating the Project *would not significantly destroy or adversely modify* loggerhead sea turtle critical habitat.

4.7.1.5 Plants

Two federally listed endangered plant species, South Texas ambrosia (*Ambrosia cheiranthifolia*) and Texas ayenia (*Ayenia limitaris*), have the potential to occur within the Project area. However, there are no documented occurrences of South Texas ambrosia within the Project site or within Cameron County (TPWD 2015b), and the closest known population of Texas ayenia is located approximately 30 miles to the northwest of the Project site (FWS 2010a; TPWD 2015b). Although suitable habitat for both of these species is present within the Project site, neither of these species were observed during presence/absence surveys conducted within the Project site in 2015. Because listed plant species were not observed within the Project site and are not expected to occur in the area affected by the Project, we have determined that constructing and operating the Project would have *no effect* on federally listed plant species.

4.7.2 State-Listed Threatened and Endangered Species

The TPWD has designated protected species under state law and prohibits the take, possession, transportation, or sale of any of the animal species designated by state law as endangered or threatened without the issuance of a permit. Texas laws and regulations prohibit commerce in threatened and endangered plants and the collection of listed plant species from public land without a permit issued by the TPWD. Listing and recovery of endangered species in Texas is coordinated by the TPWD Wildlife Division.

The TPWD database indicates that 54 state-listed species occur in Cameron County (table 4.7.2-1; TPWD 2016f). Of these, 12 species are also federally protected and were addressed above. The smalltooth sawfish is not discussed because no suitable habitat occurs in the Project area. Potentially suitable habitat is present in the Project area for 45 of the state-listed species.

TABLE 4.7.2-1

State-Protected Species and Habitat Potentially Occurring Within the Project Area

Species	State Status	Habitat Description	Potential for Occurrence a/	Project Component
Mammals				
West Indian manatee (Trichechus manatus)	E b/	Gulf and bay system near aquatic vegetation.	Suitable habitat is present within the Project site.	Marine facilities
Coue's rice rat (*Oryzomys couesi*)	T	Cattail-bulrush marsh with a shallower zone of aquatic grasses near the shoreline. Shade trees around the shoreline are important features. Found in both saltwater and freshwater and grassy areas near water.	Suitable habitat is present within the Project site.	LNG facilities access road
Jaguar (*Panthera onca*)	E	Dense chaparral.	Suitable habitat is not present within the Project site.	none
Jaguarundi (*Herpailurus yagouaroundi*)	E b/	Thick brushlands near water.	Yes – FWS and TWPD reported this species may occur within the Project vicinity.	LNG facilities access road
Ocelot (*Leopardus pardalis*)	E b/	Dense chaparral thickets; mesquite-thorn scrub and live oak mottes; often avoids open loma areas.	Yes – FWS and TWPD reported this species may occur within the Project vicinity.	LNG facilities access road

TABLE 4.7.2-1 (continued) **State-Protected Species and Habitat Potentially Occurring Within the Project Area**				
Species	State Status	Habitat Description	Potential for Occurrence a/	Project Component
Southern yellow bat (*Lasiurus ega*)	T	Associated with trees such as palm trees, which provide the species with daytime roosts.	Suitable habitat is present within the Project site.	LNG facilities access road
White-nosed coati (*Nasua narica*)	T	Woodlands, riparian corridors, and canyons.	Suitable habitat is present within the Project site.	LNG facilities access road
Birds				
Northern aplomado falcon (*Falco femoralis septentrionalis*)	E b/	Palm and oak savannahs, various desert grassland associations, and open pine woodlands with open terrain and low ground cover.	Suitable habitat is present within the Project site.	LNG facilities access road
Piping plover (*Charadrius melodus*)	T b/	Coastal beaches, sandflats, barrier islands, gently sloped foredunes, sparsely vegetated dunes, and washover areas cut into or between dunes.	Suitable habitat is present within the Project site.	LNG facilities Marine facilities
Zone-tailed hawk (*Buteo albonotatus*)	T	Arid open country, including open deciduous or pine-oak woodland, mesa or mountain country, often near watercourses and wooded canyons and tree-lined rivers along middle-slopes of desert mountains.	Suitable habitat is present within the Project site.	LNG facilities access road
Texas Botteri's sparrow (*Peucaea botterii texana*)	T	Grassland and short-grass plains with scattered bushes or shrubs, sagebrush, mesquite, or yucca; nests on ground with low grass clumps.	Suitable habitat is present within the Project site.	LNG facilities access road
White-tailed hawk (*Buteo albicaudatus*)	T	Near the coast on prairies, cordgrass flats, and scrub-live oak; further inland on prairies, mesquite and oak savannas, and mixed savanna-chaparral.	Suitable habitat is present within the Project site.	LNG facilities access road
Gray hawk (*Buteo nitidus*)	T	Mature riparian woodlands and nearby semi-arid mesquite and scrub grasslands; breeding range formerly extended north to southernmost Rio Grande floodplain of Texas.	Suitable habitat is present within the Project site.	LNG facilities access road
Northern beardless-tyrannulet (*Camptostoma imberbe*)	T	Mesquite woodlands; near Rio Grande, frequents cottonwood, willow, elm, and great leadtree.	Suitable habitat is present within the Project site.	LNG facilities access road
Reddish egret (*Egretta rufescens*)	T	Brackish marshes and shallow salt ponds and tidal flats; nests on ground or in trees or bushes, on dry coastal islands in brushy thickets of yucca and prickly pear.	Suitable habitat is present within the Project site.	LNG facilities access road Marine facilities
Cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*)	T	Riparian trees, brush, palm, and mesquite thickets; also roosts in small caves during the day and recesses on slopes of low hills.	Suitable habitat is present within the Project site.	LNG facilities access road
Rose-throated becard (*Pachyramphus aglaiae*)	T	Riparian trees, woodlands, open forest, scrub, and mangroves.	Suitable habitat is present within the Project site.	LNG facilities access road Marine facilities
Tropical parula (*Setophaga pitiayumi*)	T	Live-oak woodlands with high densities of epiphytes; mixed deciduous riparian forests adjacent to Rio Grande.	Suitable habitat is present within the Project site.	LNG facilities access road
White-faced ibis (*Plegadis chihi*)	T	Mainly shallow marshes with emergent vegetation, flooded shoals and mangrove swamps, mudflats, and along rivers, lakes, and reservoirs.	Suitable habitat is present within the Project site.	LNG facilities access road Marine facilities

TABLE 4.7.2-1 (continued) **State-Protected Species and Habitat Potentially Occurring Within the Project Area**				
Species	State Status	Habitat Description	Potential for Occurrence a/	Project Component
Common black-hawk (*Buteogallus anthracinus*)	T	Cottonwood-lined rivers and streams; willow tree groves in lower Rio Grande floodplains; formerly bred in south Texas.	Suitable habitat is present within the Project site.	LNG facilities access road Marine facilities
Eskimo curlew (*Numenius borealis*)	E	Grasslands, pastures, plowed fields, and occasionally marshes and mudflats.	Suitable habitat is present within the Project site.	LNG facilities access road Marine facilities
American peregrine falcon (*Falco peregrinus anatum*)	T	Nests in tall cliff eyries; sometimes found in urban areas along coastal and barrier islands; sometimes make stopovers at edges of lake shores, coastlines, and barrier islands.	Suitable habitat is present within the Project site.	LNG facilities access road Marine facilities
Peregrine falcon (*Falco peregrinus*)	T	Most often found in open areas and cliffs and almost always near water.	Suitable habitat is present within the Project site.	LNG facilities access road Marine facilities
Sooty tern (*Sterna fuscata*)	T	Generally found above flood tides and flat, sparsely vegetated, and fairly open habitats but will nest under vegetation or shrubs if aerial predation pressure exists.	Suitable habitat is present within the Project site.	LNG facilities access road Marine facilities
Wood stork (*Mycteria americana)*	T	Forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water. Usually roosts communally in tall snags, sometimes in association with other wading birds (e.g., active heronries). Breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas. Formerly nested in Texas, but no breeding records since 1960.	Suitable habitat is present within the Project site.	LNG facilities access road Marine facilities
Reptiles				
Atlantic hawksbill sea turtle (*Eretmochelys imbricata*)	E b/	Gulf and bay systems, warm shallow waters in rocky marine environments (such as coral reefs and jetties).	Yes – TPWD confirmed sea turtles may occur within the vicinity of the Project site.	Marine facilities
Green sea turtle (*Chelonia mydas*)	T b/	Gulf and bay systems; shallow-water seagrass beds; open water between feeding and nesting areas; barrier island beaches.	Yes – TPWD confirmed sea turtles may occur within the vicinity of the Project site.	Marine facilities
Kemp's ridley sea turtle (*Lepidochelys kempii*)	E b/	Gulf and bay systems; adults typically found in shallow waters of the Gulf of Mexico.	Yes – TPWD confirmed sea turtles may occur within the vicinity of the Project site.	Marine facilities
Leatherback sea turtle (*Dermochelys coriacea*)	E b/	Gulf and bay system; this species has the widest range of any open-water reptile.	Yes – TPWD confirmed sea turtles may occur within the vicinity of the Project site.	Marine facilities
Loggerhead sea turtle (*Caretta caretta*)	T b/	Juveniles are typically in Gulf and bay systems; adults more pelagic.	Yes – TPWD confirmed sea turtles may occur within the vicinity of the Project site.	Marine facilities
Black-striped snake (*Coniophanes imperialis*)	T	Found in extreme South Texas in semi-arid coastal plains with warm, moist micro-habitats and sandy soils.	Yes – TPWD confirmed suitable habitat is present within the Project site.	LNG facilities access road
Northern cat-eyed snake (*Leptodeira septentrionalis septentrionalis*)	T	Gulf Coastal Plain south of the Nueces River; thorn brush woodlands; dense thickets bordering ponds and streams; semi-arboreal.	Yes – TPWD confirmed suitable habitat is present within the Project site.	LNG facilities access road Marine facilities
Speckled racer (*Drymobius margaritiferus*)	T	Dense thickets near water; Texas palm groves, riparian woodlands; areas with a lot of vegetation litter on the ground.	Yes – TPWD confirmed suitable habitat is present within the Project site.	LNG facilities access road Marine facilities

TABLE 4.7.2-1 (continued)				
State-Protected Species and Habitat Potentially Occurring Within the Project Area				
Species	State Status	Habitat Description	Potential for Occurrence a/	Project Component
Texas horned lizard (*Phrynosoma cornutum*)	T	Open, arid and semi-arid regions with sparse vegetation, including grass, cacti, scattered brush, and scrubby trees; soil varies from sandy to rocky; hides under rocks or burrows into soil and enters rodent burrows.	Suitable habitat is present within the Project site.	LNG facilities access road
Texas indigo snake (*Drymarchon melanurus erebennus*)	T	Thornbush-chaparral woodlands in south Texas, dense riparian corridors; suburban and irrigated croplands; rodent burrows.	Yes – TPWD confirmed suitable habitat is present within the Project site.	LNG facilities access road
Texas scarlet snake (*Cemophora coccinea lineri*)	T	Mixed hardwood scrub on sandy soils.	Suitable habitat is present within the Project site.	LNG facilities access road Marine facilities
Texas tortoise (*Gopherus berlandieri*)	T	Open brush with a grass understory; open grass and bare ground are avoided; when inactive, the species occupies shallow depressions at the bases of bushes or cacti, sometimes in underground burrows or under objects.	Suitable habitat is present within the Project site.	LNG facilities access road
Amphibians				
Sheep frog (*Hypopachus variolosus)*	T	Predominantly grassland and savanna; moist sites in arid areas.	Yes – TPWD confirmed suitable habitat is present within the Project site.	LNG facilities access road
White-lipped frog (*Leptodactylus fragilis*)	T	Grasslands, cultivated fields, roadside ditches, under rocks, or in burrows under clumps of grass.	Yes – TPWD confirmed suitable habitat is present within the Project site.	LNG facilities access road
Black-spotted newt (*Notophthalmus meridionalis*)	T	Wet or sometimes wet areas (e.g., arroyos, canals, ditches, or shallow depressions).	Yes – TPWD confirmed suitable habitat is present within the Project site.	LNG facilities access road
South Texas siren (large form *Siren* spp.)	T	Wet or sometimes wet areas (e.g., arroyos, canals, ditches, or shallow depressions); requires some moisture.	Yes – TPWD confirmed suitable habitat is present within the Project site.	LNG facilities Access Road
Mexican treefrog (*Smilisca baudinii*)	T	Subtropical region of extreme southern Texas.	Yes – TPWD confirmed suitable habitat is present within the Project site.	LNG facilities access road
Fish				
Rio Grande silvery minnow (*Hybognathus amarus*)	E	Historically found in Rio Grande and Pecos River systems and canals; pools and backwaters of medium to large streams with low or moderate gradients in mud, sand, or gravel bottom.	Suitable habitat is not present within the Project site.	none
Smalltooth sawfish (*Pristis pectinata*)	E b/	Young are found close to shore in muddy and sandy bottoms, sheltered bays, shallow banks, and in estuaries or river mouths.	Suitable habitat is not present within the Project site.	none
Mexican goby (*Ctenogobius claytonia*)	T	Southern coastal area; brackish and freshwater coastal streams.	Suitable habitat is present within the Project site.	Marine facilities
River goby (*Awaous banana*)	T	Prefers fresh, clear, flowing, oxygenated streams; occasionally taken in brackish turbid waters	Suitable habitat is not present within the Project site.	none
Opossum pipefish (*Microphis brachyurus*)	T	Brooding adults found in fresh or low-salinity waters; young move or are carried into more saline waters after birth; southern coastal areas.	Suitable habitat is not present within the Project site.	none
Mollusks				
Salina mucket (*Potamilus metnecktayi*)	T	Lotic waters; often submerged in soft sediments along river banks.	Suitable habitat is not present within the Project site.	none

TABLE 4.7.2-1 (continued)

State-Protected Species and Habitat Potentially Occurring Within the Project Area

Species	State Status	Habitat Description	Potential for Occurrence a/	Project Component
Texas hornshell (*Popenaias popeii*)	T	Both ends of narrow shallow runs over bedrock in areas where small-grained materials collect in crevices, along river banks, and at the base of boulders.	Suitable habitat is not present within the Project site.	none
Mexican fawnsfoot mussel (*Truncilla cognate*)	T	Endemic to the central Rio Grande drainage in Laredo, TX; habitat preferences are unknown	Suitable habitat is not present within the Project site.	none
Plants				
South Texas ambrosia (*Ambrosia cheiranthifolia*)	E b/	Grasslands and mesquite-dominated shrublands on various soils ranging from heavy clays to lighter textured sandy loams; in modified unplowed sites like railroads and highway rights-of-way, cemeteries, mowed fields, and erosional areas along small creeks.	Suitable habitat is present within the Project site.	LNG facilities access road
Star cactus (*Astrophytum asterias*)	E	Gravelly clays or loams; on gentle slopes and flats in sparsely vegetated openings between shrub thickets within mesquite grasslands or mesquite-blackbrush thorn shrublands.	Suitable habitat is not present within the Project site.	none
Texas ayenia (*Ayenia limitaris*)	E b/	Subtropical thorn woodland or tall shrubland on loamy soils of the Rio Grande delta. Known site soils include well-drained, calcareous, sandy clay loam and neutral to moderately alkaline fine sandy loam.	Suitable habitat is present within the Project site.	LNG facilities access road

Sources: ICUN 2015; FWS 2015d; TPWD 2016f

a/ Based on discussion with TPWD, review of literature, and presence of suitable habitat.
b/ Also federally listed. See section 4.7.1 and table 4.7.1-1.
Key:
E = Texas state-listed as endangered
T = Texas state-listed as threatened
BGEPA = Bald and Golden Eagle Protection Act

4.7.2.1 Terrestrial Mammals

There are four state-only-listed terrestrial mammals listed in Cameron County (TPWD 2016f); the Coue's rice rat (*Oryzomys couesi*), southern yellow bat (*Lasiurus ega*), white-nosed coati (*Nasua narica*) and the jaguar. The jaguar (*Panthera onca*) is believed to be extirpated, and suitable habitat for the jaguar is not present within the Project site; therefore, this species is not discussed further. The remaining five state-listed terrestrial mammals have the potential to occur in the Project area. The Coue's rice rat prefers cattail-bulrush marshes and aquatic, grassy zones near resacas. The southern yellow bat prefers habitat associated with trees such as palm trees, which provide the species with daytime roosting sites. The white-nosed coati prefers woodlands, riparian corridors, and canyons and is most likely a transient from Mexico. Based on these habitat preferences, the potential for occurrence of these species is minimal (TPWD 2016f).

Constructing the Project would permanently remove potential habitat for terrestrial mammals, causing resident wildlife to relocate; however, ample similar habitat is available in the vicinity of the Project site. Also, to reduce impacts on wildlife habitat, Annova would implement the applicable BMPs from the TPWD Wildlife Habitat Assessment Program, which includes the *TPWD Guidelines for Revegetation of Disturbed Landscapes* (TPWD 2016d).

Short-term impacts, such as increased noise and activity and nighttime construction lighting, could cause temporary displacement of state-protected species, and long-term effects would result from permanent habitat removal. Noise and vibration from construction activities would be minimized by ensuring that all construction equipment have mufflers that meet current noise regulations. Annova would minimize the effects of lighting by implementing lighting schemes that minimize effects of light on surrounding habitats as well as minimize lighting on the access road to the extent feasible.

Based on the implementation of Annova's proposed design plans and avoidance, minimization, and mitigation measures, potential impacts on Coue's rice rat, southern yellow bat, and white-nosed coati are expected to be minor.

4.7.2.2 Birds

Eighteen state-listed threatened or endangered bird species have the potential to occur in the Project area (table 4.7.2-1).

Constructing and operating the Project would impact habitat that may be used by state-protected bird species. State listed bird species may use the Project site for foraging or roosting and could be displaced from the Project site, likely relocating to a location nearby with available suitable habitat. In addition, birds may fly over the Project site during migratory flights. Seven of the state- listed bird species have potential to nest at the site, including the northern aplomado falcon, white-tailed hawk, reddish egret, tropical parula, Texas botteri's sparrow, cactus ferruginous pygmy-owl, and sooty tern.

Vegetation temporarily affected would be allowed to revert to pre-existing conditions or the areas would be planted with native grasses. Those bird species that nest within the Project site would be affected by the permanent removal of habitat and would be temporarily impacted by increased noise levels and activity. Construction would be scheduled to avoid the nesting season of protected species (approximately March-September), where possible. If construction during nesting seasons cannot be avoided, Annova would follow the TPWD and FWS recommendation to have a biologist trained to identify the species potentially affected available to survey the areas for construction to identify and avoid nests. Based on these species characteristics and the potential impacts on them, we conclude that these impacts would be minor.

4.7.2.3 Reptiles and Amphibians

Twelve state-listed reptiles and five state-listed amphibians have potential to occur in the Project area (table 4.7.2-1).

Terrestrial and Freshwater Reptiles

Suitable habitat for seven state-listed threatened terrestrial and freshwater reptile species occurs in the Project area. The Texas horned lizard (*Phrynosoma cornutum*), Texas indigo snake (*Drymarchon melanurus erebennus*), and Texas tortoise (*Gopherus berlandieri*) have been observed on the Project site. During the late fall and winter, reptiles become less active or completely inactive by hibernating a few inches underground or occupying burrows or similar cavities. Many reptiles, including the state-listed Texas horned lizard and Texas tortoise, and the rare keeled earless lizard, become more active during the spring mating season (TPWD 2015b).

According to the TPWD, lomas in the Project area provide suitable habitat for the Texas tortoise. The TPWD believes that the lomas located within the Project site are large enough to support significant Texas tortoise populations. The TPWD recommends reviewing information regarding appropriate surveying methodology for estimating tortoise populations and having a biological monitor onsite during ground disturbing activities.

The northern cat-eyed snake (*Leptodeira septentrionalis septentrionalis*), black-striped snake (*Coniophanes imperialis*), and speckled racer (*Drymobius margaritiferus*) may occur in thick plant litter or debris piles, especially near waterbodies. The Texas indigo snake is typically found in riparian corridors or near waterbodies. However, due to its large size and metabolism, the Texas indigo snake has a large home range in which it hunts for food and therefore may be encountered in other types of habitats (TPWD 2015b).

Reptiles could be subject to direct impacts (i.e., crushing by heavy equipment, falling into open excavations) during construction and potentially during operation. Annova has stated it would comply with TPWD recommendations, including any excavations or trenches that must be left unfilled at the end of the work day would either be covered, have escape ramps placed in them (made from boards or soil), or fenced off with an exclusion fence. Any excavations or trenches left open overnight would be inspected the following morning for wildlife; if any state-listed species are trapped, they would be removed by personnel permitted by the TPWD to handle listed species. The TPWD recommends that major ground-disturbing activities such as constructing new access roads be conducted before October, when reptiles become inactive (October through March) and could be utilizing burrows in areas subject to disturbance. In addition, the TPWD recommends that Annova schedule construction activities involving clearing, grading, or bulldozing to occur outside the spring mating season for state-listed reptiles including the Texas horned lizard and Texas tortoise. We have included a recommendation below in section 4.7.3 that Annova continue to consult with TPWD regarding implementation of these recommendations.

As described above, temporarily disturbed areas would be restored to pre-existing conditions or planted with native grasses. Annova would also implement applicable BMPs from the TPWD Wildlife Habitat Assessment Program (TPWD 2016d), which includes Texas tortoise BMPs and guidelines for revegetation of disturbed landscapes. Avoidance and minimization measures may include having a qualified biologist(s) on site to monitor clearing of vegetation and filling of wetlands.

Through implementation of the measures described above, we conclude that impacts on state listed terrestrial and freshwater reptiles would be minor.

Amphibians

Suitable habitat for five state-listed threatened species occurs in the Project area (table 4.7.2-1). Black-spotted newts (*Notophthalmus meridionalis*) and South Texas sirens (large form *Siren* spp.) occur in temporary ponds, ditches, resacas, or streams. Freshwater ponds may also provide potentially suitable habitat for newts and sirens. The Mexican treefrog (*Smilisca baudinii*), sheep frog (*Hypopachus variolosus)*, and white-lipped frog (*Leptodactylus fragilis*) are tropical frog species found only in South Texas. The Mexican tree frog typically occurs near mouths of rivers or in wooded areas near streams and resacas; they may also occur in suburban areas where lawns are watered regularly and contain trees. The sheep frog may occur in tropical thorn scrub, woodlands, and pastures with short grass. The white-lipped frog favors grassy areas next to ponds and in ditches in agricultural areas. These species are nocturnal but will seek shelter in burrows or under dead vegetation during the day. They all breed explosively following rainfall events throughout the year. Ponded waterbodies on the Project site may provide suitable habitat for these species (TPWD 2015b).

Through implementation of Project design and impact minimization measures, we conclude that impacts on state listed amphibians would be minor.

4.7.2.4 Fish

Five fish species listed under the Texas ESA may occur in Cameron County. Suitable habitat exists at the Project site for the Mexican goby (*Ctenogobius claytonia*), although this species has not been documented in the BSC (Hendrickson and Cohen 2015). The Mexican goby occurs in a restricted range from the BSC south to Mexico in estuarine and freshwater coastal streams. No suitable habitat exists on the Project site for the other four state-listed fish species (i.e., the river goby, Rio Grande silvery minnow, smalltooth sawfish, or opossum pipefish; see table 4.7.2-1).

Through implementation of Annova's proposed design plans and avoidance, minimization, and mitigation measures, we conclude that impacts on the state listed Mexican goby fish would be minor. The proposed Project would have no effect on the river goby, Rio Grande silvery minnow, smalltooth sawfish, or opossum pipefish because no suitable habitat for these species exists at the Project site.

4.7.2.5 Mollusks

No suitable habitat for any of the three state-listed mollusks found in Cameron County exists at the Project site, according to TPWD (2016d). The Mexican fawnsfoot mussel occurs only in a small portion of the Rio Grande near Laredo, Texas. The Salina mucket prefers the banks of flowing rivers. The Texas hornshell occurs in shallow flowing runs over bedrock with small-grained substrates. Annova's proposed design plans would have no effect on state listed mollusks because no suitable habitat for these species exists at the Project site.

4.7.2.6 Plants

Four plant species listed under the Texas ESA may occur in Cameron County. Suitable habitat is not present within the Project site for the one state listed species that is not also federally listed (i.e., the star cactus; see table 4.7.2-1). Annova's proposed Project would have no effect on state listed plants because no suitable habitat for these species exists at the Project site.

4.7.2.7 Significant Natural Communities and Rare Species

In addition to state-protected species, TPWD tracks special features, natural communities, species of concern (SOC), and species of greatest conservation need (SGCN) in the TXNDD, and actively promotes their conservation. SOC and SGCN are also referred to as rare species by the

TPWD. Twenty-one plant species are considered SOC/SGCN in Cameron County and can be found on the Annotated County List of Rare Species (TPWD 2016f). The majority of these plants are found adjacent to lomas or other unique habitats found in extreme south Texas and, potentially, on the Project site. However, none of these 21 plant species were observed during field surveys of the Project site. A SOC/SGCN identified during consultation with the TPWD is the Texas Ebony-Snake-eyes Series vegetation community, which occurs in the lower Rio Grande Valley and is associated with lomas in the South Bay area. The Texas Ebony-Snake-eyes Shrubland vegetation community does not occur within the Project site; however, black mangrove shrubland (another SOC/SGCN) does occur adjacent to the Project site but not within the area that would be directly affected by construction or operation (see section 4.5).

Another example of a SOC/SGCN is the keeled earless lizard (*Holbrookia propinqua*), which has the potential to occur within the Project site. This small lizard typically prefers loose, sandy habitats and can be found on sand dunes and barrier beaches within its range (Conant and Collins 1998). Along with most other reptiles, the keeled earless lizard becomes less active or completely inactive, hibernating during the winter months 6 to 12 inches underground or occupying burrows or similar small cavities. As discussed above, potential impacts on reptiles would include direct impacts (i.e., crushing by heavy equipment, falling into open excavations) during construction and potentially during operation. The avoidance and minimization measures described in section 4.7.2.4 for reptiles would also benefit the keeled earless lizard and other SOC/SGCN.

4.7.3 Conclusions and Recommendations

A variety of measures have been proposed by Annova that would minimize impacts on federally and state-listed species including implementation of conservation measures, SPCC Plan, and providing LNG carrier captains with a NOAA-issued guidance document that outlines collision avoidance measures to be implemented in order to minimize impacts on marine mammals and sea turtles. Annova has also identified an off-site mitigation area that would mitigation for the loss of wetland habitat within the site, which would include habitat for some federally listed species. However, because consultations with the FWS and NOAA Fisheries are ongoing, **we recommend that:**

- **Annova <u>should not begin construction activities until:</u>**
  - **a. the FERC staff receives comments from the FWS and NOAA Fisheries regarding the proposed action;**
  - **b. the FERC staff completes Section 7 ESA consultation with the FWS and NOAA Fisheries; and**
  - **c. Annova has received written notification from the Director of OEP that construction or use of mitigation may begin.**

4.8 LAND USE, RECREATION, AND VISUAL RESOURCES

4.8.1 Land Use

The Project site is primarily located on a 731-acre property adjacent to the BSC on land owned by the BND. The property, located at approximate mile marker 8.2 on the BSC, has direct access to the Gulf of Mexico via the Brazos Santiago Pass. The property would be obtained through a long-term lease with the BND. The Project site is located in unincorporated Cameron County in an unzoned area. Presently undeveloped, the Project site is designated for heavy industrial development by the BND (BND 2014).

Affected land use cover was identified based on interpretation of recent aerial photographs and United States Geological Survey (USGS) National Land Cover Database land cover data layers. The Project site would affect six land use cover types, which are defined by the USGS as follows:

- Estuarine Emergent Marsh Wetlands – Areas where perennial herbaceous vegetation accounts for greater than 80 percent of vegetative cover and the soil or substrate is periodically saturated with or covered by water.
- Grassland/Herbaceous – Areas dominated by graminoid or herbaceous vegetation, generally greater than 80 percent of total vegetation.
- Shrub/Scrub – Areas dominated by shrubs less than 5 meters tall with shrub canopy typically greater than 20 percent of total vegetation. This class includes true shrubs, young trees in an early successional stage, and trees stunted due to environmental conditions.
- Barren Land – Areas where vegetation generally accounts for less than 15 percent of total cover. Barren areas within the Project area consist of tidal flats and dredge disposal areas.
- Open Water – Areas of open water, generally with less than 25 percent cover of vegetation or soil.

Construction and operation of the Project would primarily affect shrub/scrub and grassland/herbaceous land cover types (table 4.8.1-1). There are no agricultural areas, specialty crops, mines, quarries, landfills, known hazardous waste sites, or any other known special land uses located on or in the vicinity of the Project site.

TABLE 4.8.1-1 **Land Cover Types Affected by Construction and Operation**		
Land Cover Type	Construction Impacts (acres) a/	Operation Impacts (acres) b/
Estuarine Emergent Wetlands	53	51
Tidal Flat	3	1
Grassland/Herbaceous	183	146
Shrub/Scrub	224	211
Barren	5	2
Open Water	23	1
Total c/,d/	**491**	**412**

a/ Construction impacts include all areas that would be disturbed during construction of the Project.
b/ Operation impacts consist of those areas that would be maintained during operation of the Project.
c/ Does not include 59 acres of open water within the BSC that would be affected by dredging for the turning basin.
d/ Does not include 704 acres of land within DMPA5A.

Annova has indicated that it anticipates all fill material would be excavated from a borrow area within the Project site. Following construction, the borrow area would be stabilized and restored to native, non-maintained Gulf Coast Salty Prairie land cover in accordance with the TPWD's *Ecological Mapping System of Texas* using seed mixes approved by the Natural Resources Conservation Service. Land cover in this area that is not currently Gulf Coast Salty Prairie would be permanently converted to Gulf Coast Salty Prairie. The boundary fence would temporarily disturb the existing herbaceous land cover. After construction, the land along the boundary fence and the area along the outer edge of the limit of disturbance would be stabilized and allowed to revert to native salt prairie.

The remaining areas disturbed by the Project would either contain permanent facilities or be permanently maintained as either concrete or gravel, or in an herbaceous state. Following the completion of construction, the site would shift from undeveloped to industrial land use.

Construction and operation of the Project would disturb about 53 acres of coastal wetlands and about 3 acres of tidal flats (see table 4.8.1-1 and section 4.4). Annova sited the Project facilities to avoid impacts on coastal wetlands to the extent practicable. Annova would submit all necessary permits, including those needed for water appropriation and discharge.

4.8.2 Landowner and Easement Requirements

Annova signed a real estate lease option agreement with the BND for the 731-acre Project site; subject to compliance with the terms of the real estate lease option agreement, Annova may exercise the option and enter into the ground lease with the Port at any time. Annova proposes to use an existing unpaved site access road for construction and incorporate a portion of the road into the permanent site access road, a portion of which crosses the Lower Rio Grande Valley NWR (see section 2.1.8 and figure 2.1.8-1). Use of the proposed access road would require an appropriateness determination and a compatibility determination from the FWS. Annova has stated it is in discussion with the FWS regarding the appropriateness determination. Alternative access road locations are evaluated in section 3.5.

4.8.3 Existing and Planned Residences and Commercial Developments

The nearest residence to the Project site is located approximately 2.7 miles to the south-southeast on County Road 199, off of SH 4 (Boca Chica Boulevard) (see figure 4.9.9-1). The next closest residential developments are located from approximately 4.7 miles to 5.1 miles northeast of the Project site and include areas in Port Isabel, Laguna Heights, and Long Island. No existing buildings are located within 50 feet of the Project site.

No residential areas or subdivisions are planned for development within 0.25 mile of the Project site (Sepulveda 2015). The closest area zoned for residential use by the City of Brownsville is located more than 9 miles southwest of the Project site (City of Brownsville 2015).

There is one planned commercial development located within 0.25 mile of the Project site: Rio Grande LNG, LLC is proposing to build a natural gas liquefaction facility and LNG export terminal on the north side of the BSC. Rio Grande LNG, LLC filed an application to site and operate an LNG terminal for export on May 5, 2016. In addition, Texas LNG Brownsville, LLC is proposing to construct an LNG facility on the north side of the BSC, approximately 2 miles northeast of the Project site. Texas LNG Brownsville, LLC filed an application to site and operate an LNG terminal for export on March 31, 2016.

The Project site is approximately 6.3 miles west-northwest of the proposed Space Exploration Technologies Corporation (SpaceX) vertical launch area. The proposed control center facilities for the launch area would be approximately 4 miles from the Project site. According to the FEIS prepared by the FAA for the SpaceX Texas Launch Site in May 2014, up to 12 launches per year may occur, as well as pre-flight activities such as mission rehearsals and static fire engine tests. According to the SpaceX FEIS, all launch trajectories would be eastward, over the Gulf of Mexico (FAA 2014).

As part of the licensing and permitting process, SpaceX is required to implement a plan that defines the process for restricting public access and securing land and water areas in the vicinity of the vertical launch area (the closure area) on the day of a launch operation. The Project site would be located within the proposed SpaceX closure area, which would include areas along SH 4, on Boca Chica Beach, and offshore areas, as well as the entire Lower Rio Grande Valley NWR and the Palmito Ranch Battlefield NHL (figure 4.8.3-1). SpaceX proposes to limit public access at two pre-defined checkpoints on SH 4 (figure 4.8.3-1).

The first checkpoint would be located on SH 4, just west of the existing U.S. Customs and Border Protection checkpoint (approximately 14 to 16 miles west of the Gulf of Mexico), and west of the Project site (FAA 2014). This first checkpoint would be a soft checkpoint. SpaceX, government, and emergency personnel and anyone with property beyond (east of) the checkpoint would be allowed to pass, but the general public would be denied access. The second checkpoint would be a hard checkpoint, just west of the control center area. No one would be permitted to pass this checkpoint during launch operations (FAA 2014). According to the FAA (2014), SpaceX-related closures would last up to 15 hours on a launch day, with 6 hours being the typical closure time for a nominal launch. Annova would coordinate with SpaceX and applicable agencies to arrange for efficient movement of workers through the planned FAA soft checkpoint west of the Project access road on SH 4 (figure 4.8.3-1).

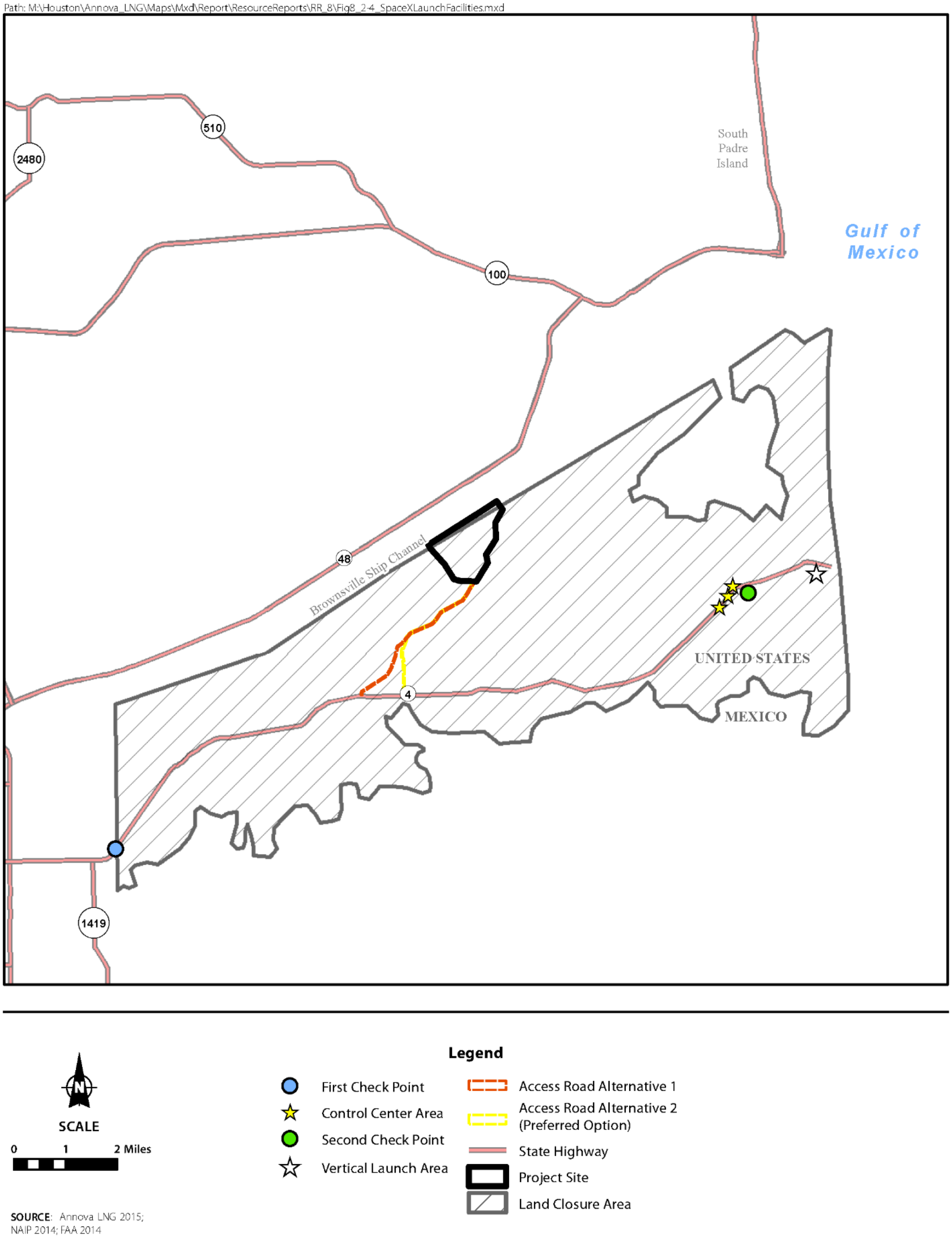


Figure 4.8.3-1 Proposed SpaceX Launch Facilities

Construction of the Project would not conflict with any zoning laws or future plans of the BND or Cameron County. Construction and operation of the Project is not expected to affect existing or planned residential or commercial land uses. Construction and operation of the Project are also not expected to restrict land use on adjacent properties or displace any residences or businesses.

4.8.4 Recreation and Special Interest Areas

4.8.4.1 Public and Conservation Lands

The Project site was formerly managed by the FWS on behalf of the BND as part of mitigation for a project that was canceled. The canceled project would have deepened the BSC and facilitated construction of multipurpose docks at the deepwater turning basin. Under COE Permit 13942 issued to the BND in 1982 (COE 1982), mitigation for the project included setting aside 4,837 acres as a loma ecological preserve (lomas are low, rounded mounds of wind-blown clay; see sections 4.1 and 4.5 for more details). The BND and the FWS entered into a lease for management of the preserve, which included the proposed Project site. However, as noted above, the BND did not implement the project to deepen the BSC and the permit expired in 1987.

After consulting with the FWS, Annova modified its initial site layout to reduce potential impacts on mature dense thornshrub vegetation and maintain a wildlife corridor on the site's western boundary. The modified layout required that the Project site be altered to include an additional area of the loma ecological preserve. The FWS has agreed to terminate their lease for this additional area if the Project is approved; however, the FWS would continue to retain their lease at this time.

There are no lands on the Project site that are administered by federal, other state (other than the BND), or local agencies, or private conservation agencies. However, a portion of the proposed access road would cross the Lower Rio Grande Valley NWR, and the proposed dredged material placement area (DMPA 5A) is on lands controlled by the COE. Public and conservation lands in the vicinity of the Project site include the Laguna Atascosa NWR, Lower Rio Grande Valley NWR, South Bay Coastal Preserve, Palmito Ranch Battlefield NHL site, and Palo Alto Battlefield National Historical Park (including the Resaca de la Palma Battlefield). These areas and potential impacts from Project construction and operation are discussed below.

4.8.4.2 Existing Recreational Resources

The lands surrounding the Project site are largely undeveloped providing a variety of outdoor recreational activities. Fishing and bird/wildlife watching are the main recreational activities in the vicinity of the Project site. Recreational fishing and bird/wildlife watching are discussed separately below. In addition to dispersed recreation activities, there are also designated recreation sites and facilities located in the Project vicinity (figure 4.8.4-1). These designated areas include the five public and conservation land areas identified above: the Laguna Atascosa NWR, Lower Rio Grande Valley NWR, South Bay Coastal Preserve, the Palmito Ranch Battlefield NHL site, and the Palo Alto Battlefield National Historical Park, as well as the Jaime J. Zapata Memorial Boat Ramp Fishing Pier and Kayak Launch Area, the Padre Island National Seashore, South Padre Island, and Brazos Island State Park. These areas are discussed below.

During construction and operation of the Project, residents and tourists using recreational sites in the Project area may be aware of construction and operation activities and increased traffic. People using recreational sites may experience increased levels of dust, noise, and traffic, as well as visual impacts. Construction activities would produce dust primarily during the initial phase of clearing and grading the site. Annova would implement dust control measures as necessary to reduce dust emissions from construction activities (see appendix F and summary in section 4.11.1.4). Recreationists could also experience localized increases in the ambient sound environment, with increases ranging from unnoticeable to intrusive. Potential noise impacts are addressed in section 4.11; visual impacts associated with project construction and operation are discussed below in section 4.8.5.

Laguna Atascosa NWR

The Laguna Atascosa NWR, located across the BSC from the Project site provides recreational opportunities for visitors and residents (figure 4.8.4-1). From north to south, the 97,000-acre Laguna Atascosa NWR extends almost three quarters of the length of Cameron County, and encompasses a portion of South Padre Island across the bay from the Project site. A portion of the NWR is open to the public for wildlife related activities, including wildlife and bird watching, nature trails, hunting, fishing, kayak tours, photography and environmental education (FWS 2016c). The NWR, including the Adolph Thomae Jr. County Park, hosts approximately 350,000 visitors each year, with peak visitation occurring from November through March (FWS and Federal Highway Administration 2017).

All visitor facilities and recreational activities in the Laguna Atascosa NWR, with the exception of fishing, occur in the northern half of the refuge or in the South Padre Island unit. The NWR includes fishing areas on South Padre Island, San Martin Lake in the Bahia Grande, and the Arroyo Colorado. San Martin Lake is accessible from SH 48 via the Jaime J. Zapata Memorial Boat Ramp (figure 4.8.4-1), while the fishing areas in Arroyo Colorado and South Padre Island are further north, more than 5 miles from the Project site (FWS 2016c).

The Bahia Grande is a 6,500-acre tidal basin connected to the BSC by a pilot channel that was constructed in the early 2000s to provide a natural tidal flow and help restore the basin to its original state. The Bahia Grande is shallow and hypersaline, and accessible only by kayak or wading. In addition, a newly funded project, the Bahia Grande Coastal Corridor (BGCC) project, has been initiated. Land acquisition proposed as part of this project would connect over 2 million acres of private ranchland located north of the Laguna Atascosa NWR with the 1.3 million-acre Rio Bravo Protected Area, which is managed by the Commission Nacional De Areas Naturales Protegidas in Mexico (Gulf Coast Ecosystem Restoration Council 2015). All lands currently identified for acquisition are located north of the Bahia Grande. Land acquired as part of the BGCC project would become part of the Laguna Atascosa NWR or Lower Rio Grande Valley NWR.

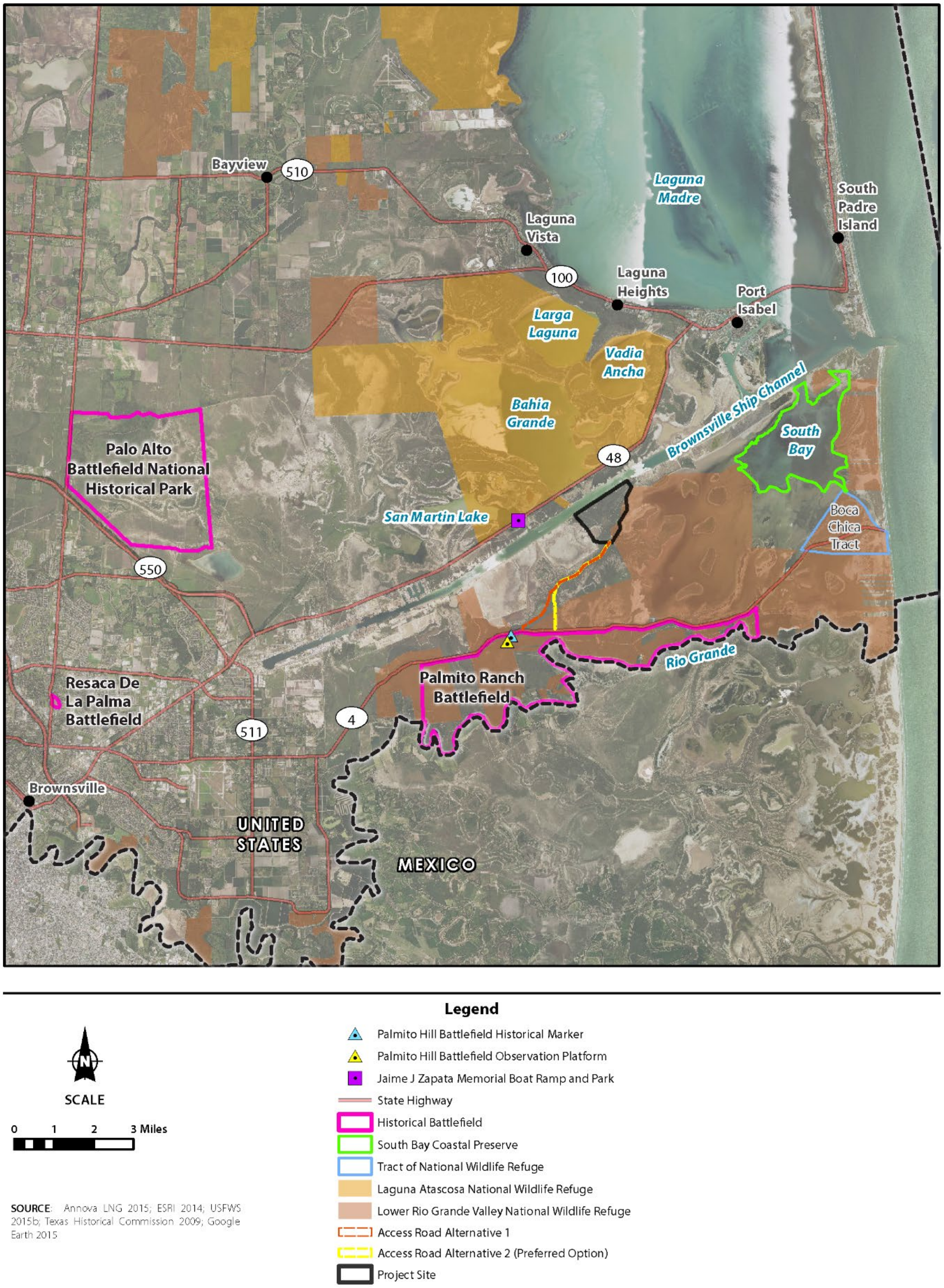


Figure 4.8.4-1 Recreational Resources

The FWS holds a conservation easement directly south of the Laguna Atascosa NWR, between SH 48 and the BSC. Approximately 1,000 feet wide and 2,900 feet long, the easement is maintained as a wildlife corridor for the federally listed, endangered ocelot. The corridor connects the Laguna Atascosa NWR to the BSC via a wildlife tunnel that passes under SH 48.

Construction and operation of the Project would not be expected to affect most visitors to the Laguna Atascosa NWR, because most visitor activities, trails, and facilities are located in the northern half of the refuge or in the South Padre Island unit, away from the Project site. San Martin Lake and Bahia Grande are accessible from SH 48. Project construction and operation would not affect access to these locations, but the Project would likely be visible to anglers and others during some part of their travel to and from San Martin Lake and Bahia Grande. The potential visual impacts of the Project are discussed below in section 4.8.5.

All of the lands identified for acquisition as part of the BGCC project are located along the eastern end of SH 4, north of the Annova Project site, with the closest area approximately 5.4 miles from the Project site. Construction and operation of the proposed Project is, therefore, not expected to conflict with land acquisition plans for the BGCC project.

Lower Rio Grande Valley NWR

Established in 1979 to protect biodiversity along the Rio Grande, the Lower Rio Grande Valley NWR is a 102,000-acre coastal refuge that consists of lands owned and leased by the FWS. The NWR borders the Project site and SH 4 (figure 4.8.4-1). The Lower Rio Grande Valley NWR connects lands managed by private landowners, nonprofit organizations, the State of Texas, and two other NWRs (Laguna Atascosa and Santa Ana) along the last 275 river miles of the Rio Grande. Not all of the refuge property is contiguous or near the Rio Grande itself (figure 4.8.4-1). Visitor activities at the Lower Rio Grande Valley NWR include wildlife watching and hunting.

The Boca Chica Tract is the closest wildlife watching area in the NWR to the Project site (figure 4.8.4-1). Located at the eastern end of SH 4, the Boca Chica Tract is considered a typical coastal environment with beach front, saline flats, mangrove marshes, shallow bays, and lomas. This area connects habitats along the Gulf Coast to the Rio Grande and allows wildlife to travel unimpeded. Other recreational activities within the tract include beach activities, hiking, and birdwatching.

The Lower Rio Grande Valley NWR does not have any trails or visitor facilities in close proximity to the Project site. The Boca Chica Tract, located across South Bay from the Project site, is approximately 4.5 miles east of the Project site. Visitors to the tract and the beach, which fronts onto Laguna Madre, away from the Project site, are not expected to be affected by Project construction or operation. The Project may, however, be visible to visitors during some part of their travel to and from the NWR. The potential visual impacts of the Project are discussed below in section 4.8.5.

South Bay Coastal Preserve

The South Bay Coastal Preserve is a Texas Gulf Ecological Management Site that encompasses the southernmost bay in Texas, near Port Isabel, east of the Project site (figure 4.8.4-1). Bordered to the north by the BSC and associated spoil banks, the bay includes approximately

3,500 surface acres, and is bordered to the south by the riparian edge of the Rio Grande, and by Brazos Island to the east. Boaters and anglers use the South Bay Coastal Preserve on an occasional and seasonal basis for fishing and to a lesser extent waterfowl hunting. The bay also supports commercial oyster landings (TPWD 2016a). The TPWD presently leases the preserve from the Texas General Lands Office.

Construction and operation of the Project could delay recreational boaters attempting to access South Bay along the BSC. Vessel traffic in the BSC would temporarily increase during Project construction with transport of construction equipment, materials, and prefabricated modules to the Project site expected to require an estimated 24 to 36 barge trips per year (less than one trip per week). Impacts on recreational boaters attempting to access South Bay during Project construction are expected to be minimal and would end following the completion of construction.

During Project operation, a maximum of 80 LNG carriers per year would transit the BSC to the Project. Visitors to the South Bay Coastal Preserve presently experience visual and other impacts from large, ocean-going commercial vessels, which call at the Port of Brownsville at an average rate of six per week, or 312 per year (BND 2016). The increase in traffic associated with Project operation, from an average of 2 to 6 vessels per month, could potentially result in additional delays, but is not expected to substantially affect visitation to the South Bay Coastal Preserve.

Palmito Ranch Battlefield National Historic Landmark, Palo Alto Battlefield National Historical Park, and Resaca de la Palma Battlefield

Three historic battlefield sites are located in the general vicinity of the Project site: the Palmito Ranch Battlefield NHL; the Palo Alto Battlefield National Historical Park; and the Resaca de la Palma Battlefield.

The Palmito Ranch Battlefield NHL is the closest of these sites to the Project site (figure 4.8.4-1). Identified as the location of the last major land battle of the American Civil War, the Palmito Ranch Battlefield NHL consists of more than 5,400 acres protected under the NHPA (NPS 2010). The Palmito Ranch Battlefield NHL historic marker, noting the location of the battlefield, is located on SH 4, approximately 3.3 miles southwest of the Project site and approximately 0.25 mile from the intersection of SH 4 and the main access road to the Project site. Facilities at the Palmito Ranch Battlefield NHL include an observation platform that provides views over the area where the historic battle took place. The site is open to visitors for off-trail hiking, bird/wildlife watching, and other forms of recreation.

The Palo Alto Battlefield NHL, located approximately 12 miles west of the Project site, preserves the grounds of the May 8, 1846 Battle of Palo Alto, which was the first conflict in a 2-year-long war that defined the present boundary of the State of Texas. The NPS has acquired about one-third of the designated area, with private landowners still controlling about 2,000 acres of the battlefield. The Palo Alto Battlefield site was re-designated as a National Historic Park in 2009 and expanded to include the Resaca de la Palma Battlefield. The Resaca de la Palma Battlefield is a separate, 34-acre battlefield site located in Brownsville, approximately 5 miles south of the main Palo Alto Battlefield site, and approximately 14 miles southwest of the Project site.

Land in the vicinity of the Project is generally undeveloped and natural, with the exception of dredged material placement areas adjacent to the site on the east and west borders. The surrounding area is generally flat to very gently rolling, and consists mainly of shallow waterbodies, mudflats, and marshes. Because the landscape is generally flat and open, tall structures are often visible from far distances in the region. Visual simulations were created from key observation points (KOPs) located in proximity to the battlefields to represent views of visitors to the battlefields. The overall visual effect of the Project at the Palmito Ranch Battlefield NHL and the Palo Alto Battlefield site KOPs ranged from no effect or negligible in some areas to moderate or moderately high in other areas, due to varying degrees of distance, partial screening, and foreground vegetation. The potential visual impacts of the Project are discussed below in section 4.8.5.

Traffic in the vicinity of Palo Alto Battlefield National Historic Park and Palmito Ranch Battlefield NHL would temporarily increase during Project construction. Traffic increases from workers commuting during the morning peak hour would occur before the Battlefield sites open and would not be expected to affect visitors to the Battlefield sites. Cultural heritage tourists who leave the battlefield sites during the afternoon peak hour may experience longer trips than average. This potential impact would be short-term and vary depending on the number of construction workers employed at any one time. Increases in traffic during Project construction are not expected to deter people from visiting Palo Alto Battlefield National Historic Park or Palmito Ranch Battlefield NHL.

Annova estimated potential noise impacts at noise-sensitive areas, including an interior location within Palmito Ranch Battlefield NHL (modeled as Noise Sensitive Area 4 [NSA4]). Given their distance from the Project site, the Palo Alto and Resaca de la Palma Battlefields were not considered noise sensitive areas. Based on typical human reactions to changes in sound level, predicted changes in sound level caused by Project construction were estimated to be "very noticeable" at NSA4. Very noticeable is the third category on a five-level scale ranging from "unnoticed" to "tolerable" to "very objectionable" to "intolerable." Some visitors to the battlefield may consider this change in sound level intrusive. Typical human reactions to the estimated Project operation-related increases in sound level were considered "unnoticed" to "tolerable." These potential impacts are discussed further in section 4.11.

Jaime J. Zapata Memorial Boat Ramp Fishing Pier and Kayak Launch Area

Accessed via Highway 48, the Jaime J. Zapata Memorial Boat Ramp Fishing Pier and Kayak Launch Area is located along a short channel connecting the BSC to San Martin Lake, approximately 1.5 miles west of the Project site (figure 4.8.4-1). Site facilities include a public boat ramp, two picnic pavilions, a lighted fishing pier, and a kayak launch ramp. The site offers fisherman, boaters, bird watchers, kayakers, and others easy access to San Martin Lake and the BSC (Cameron County Parks and Recreation 2016; Texas General Land Office 2015). Other public boat ramps in the Project vicinity are located at Port Isabel and South Padre Island, approximately 5 miles and 7 miles northeast of the Project site, respectively. Potential impacts on this facility are discussed below in the Recreational Fishing subsection.

Padre Island National Seashore

The Padre Island National Seashore separates the Gulf of Mexico from the Laguna Madre, and protects 70 miles of coastline, dunes, prairies, and tidal flats (NPS 2016a). The longest stretch of undeveloped barrier island in the world, the National Seashore extends north from near the Mansfield Channel in north Willacy County, and is located approximately 40 miles from the Project site at its closest point. Recreation opportunities at the Padre Island National Seashore include beachcombing, bicycling, birding, camping, fishing, hunting, picnicking, swimming and windsurfing (NPS 2016a). Construction and operation of the Project would not be expected to affect visitors to the Padre Island National Seashore based on its location and distance from the Project site.

South Padre Island

South Padre Island is a major tourist destination known nationally for its beaches, and is heavily developed with hotels/motels, retail shops, and entertainment venues. The closest public beach to the Project site (Isla Blanca Beach) is located on the southern tip of the island, approximately 7.2 miles northeast of the Project site. Several charter boats on the bay side of South Padre Island offer daytime and sunset cruises, and dolphin watching excursions in the Lower Laguna Madre. Many charter boats also offer “sea life” tours that involve trawling for sea organisms and providing educational commentary about different species and habitats.

Charter boats could bring visitors to within viewing distance of the Project site, but this impact is expected to be minimal because the Project site is located 8.7 miles inland along the BSC, and few charter cruises and sea life viewing tours take visitors inside the BSC. Another type of marine tour offered by charter boat companies is a cruise through the BSC that features the maritime industrial activities at the Port of Brownsville and along the channel, including international cargo ships, decommissioned naval vessels, and shipworks. The Project is not expected to affect these charter trips.

Comments received during public scoping identified three recreation sites on South Padre Island that could be potentially affected by the Project: Schlitterbahn Waterpark and Resort; Isla Blanca Beach; and the Boy Scout camp at Dolphin Cove. Located approximately 7 miles northeast of the Project site, Schlitterbahn Waterpark and Resort offers indoor and outdoor waterpark facilities, river features, swimming pools, and beach access, as well as resort accommodation and various dining options. Isla Blanca Beach is a public recreational beach located along the east side of the southern tip of South Padre Island, approximately 7.2 miles northeast of the Project site. The Boy Scout camp at Dolphin Cove, located on the south end of South Padre Island, is approximately 6.7 miles northeast of the Project site. Approximately 2.5 acres in size, the Boy Scout camp site includes tent sites, restrooms, staff quarters, first aid station/commissary space, parking areas, trails, recreation facilities, beach and shore areas, and other natural areas.

Construction and operation of the Project would not be expected to affect visitors to the Schlitterbahn Waterpark and Resort, based on its distance from the Project site and location on South Padre Island. The majority of structures and areas within the waterpark and resort are unlikely to have views of the Project due to intervening structures and vegetation, but the Project may be visible from some locations in the parking lot on the west side of the facility and from some of the taller waterpark and resort structures. The potential visual impacts of the Project are discussed below in section 4.8.5.

Construction and operation would not affect beachgoers visiting South Padre Island and Isla Blanca Beach because the beaches are on the ocean side of the island, facing away from the Port of Brownsville and the Project site. Further, the Project is unlikely to be visible from the beach due to intervening terrain, vegetation, buildings, and other structures.

Visitors to the Boy Scout camp at Dolphin Cove are also unlikely to be affected by construction and operation of the Project. The Project would, however, likely be visible from portions of the Boy Scout camp at Dolphin Cove, primarily along the camp's west side, including the tent camping area, nearby beaches and shoreline areas, and trails. The potential visual impacts of the Project are discussed below in section 4.8.5.

Brazos Island State Park

Brazos Island State Park is not identified as a state park by the TPWD (2017), but online review suggests that the south portion of Brazos Island, which borders the South Bay Coastal Preserve to the east, is commonly referred to as a state park or recreation area. Located from 5 to 7 miles east of the Project site, the area identified as a park or recreation area generally appears to extend north from SH 4 toward the mouth of the BSC. There are no established roads in this area, but SH 4 provides access from the south. Public use tends to be concentrated along the beach strand north of SH 4, with uses including camping, driving on the beach, fishing, surfing, swimming, and nature study.

Construction and operation would not affect access to Brazos Island State Park. The beach is on the ocean side of the island, facing away from the Port of Brownsville and the Project site, and the Project is unlikely to be visible from this area due to the foredunes extending along the inland side of the beach. The Project would, however, likely be visible from some inland locations, as discussed below in section 4.8.5.

Recreational Fishing

Recreational fishing is an important outdoor activity in the vicinity of the Project site. According to the TPWD, residents and visitors spent an estimated total of 41,100 hours participating in guided fishing trips and another 461,700 hours participating in private boat fishing trips in the estuarine waters of Cameron and Willacy counties during the 2013-2014 fishing season (Ferguson 2015). The top public boat ramps in the general Project vicinity are Port Mansfield and Arroyo (both in Willacy County), followed by the Jaime J. Zapata Memorial Boat Ramp Fishing Pier and Kayak Launch Area. South Padre Island and Port Isabel are also popular recreational fishing launch sites but are mainly occupied by private marinas rather than public boat ramps (Ferguson 2015). Boaters and anglers use the South Bay Coastal Preserve on an occasional and seasonal basis for fishing; with the exceptions of Port Mansfield and Arroyo, these areas are shown on figure 4.8.4-1. Port Mansfield and Arroyo are located farther north outside the area captured in the figure.

Fishing also occurs in the BSC via vessels or from shore, and the Project site has historically been used as an informal fishing location, boat launch, and BSC access point for anglers. According to the FWS, following a request from the U.S. Border Patrol, a permanent gate with a lock was recently installed to block public access to the Project site via the existing access road from SH 4. Access is currently limited to the FWS, U.S. Border Patrol, and the Port of Brownsville.

Construction and operation of the Project would not permanently affect access to the majority of regional fishing locations in the waters in the vicinity of the Project site, including the estuarine waters of Cameron and Willacy counties and the offshore Gulf of Mexico. Project construction may temporarily affect access to recreational fishing and boating activities along the BSC, including the Jaime J. Zapata Memorial Boat Ramp Fishing Pier and Kayak Launch Area. Access to some destinations may be delayed due to dredging activities and the movement of barges delivering large equipment to the material offloading facility. Annova anticipates that the Coast Guard would provide notices to boaters to avoid this area when these activities occur.

During Project operation, LNG carriers navigating to and from the Project site, may impact recreational anglers who transit recreational fishing boats through the BSC, especially those who use the Jaime J. Zapata Memorial Boat Ramp and Launch Area. These anglers may experience delays during times when the LNG carriers are navigating the waterway. Depending on their location, anglers fishing from boats within the BSC may be required to relocate temporarily for safety reasons while an LNG carrier is navigating to or from the marine berth at the Project site. It is expected that LNG carriers would have a moving security zone during transit through the BSC per Coast Guard regulations at 33 CFR 165.805(a)(2). As a safety and security precaution, typically no vessels are allowed to meet, cross, or overtake LNG carriers in transit or otherwise enter the security zone without the express permission of the Coast Guard. During Project operation a maximum of 80 LNG carriers per year would transit the BSC to the Project. Large, ocean-going vessels presently call at the Port of Brownsville at an average rate of six per week, or 312 per year (BND 2016). The increase in traffic associated with Project operation, from an average of 2 to 6 vessels per month, could potentially result in additional delays, but is not expected to substantially affect recreational fishing in the ship channel. The occurrence and extent of fishing vessel delays would depend on vessel orientation and direction of travel. Small vessels traveling ahead of or behind an LNG carrier in the same direction would not experience measurable delays as long as they remain outside the LNG carrier safety zone. Smaller vessels heading in the opposite direction to a LNG carrier could experience delays of a few minutes to 1.5 hours, depending on the position of the smaller vessel relative to the LNG carrier. These potential impacts are discussed further in section 4.9.10.2 of this EIS.

Birding

The Lower Rio Grande Valley (Cameron, Hidalgo, Willacy, and Starr counties) has been identified as the number two birdwatching destination in North America (Mathis and Matisoff 2004). Within the Valley, the World Birding Center, a network of nine birding sites stretching from South Padre Island in the east to Roma in Starr County in the west, is a major destination for birdwatchers visiting the region. The South Padre Island Birding and Nature Park is the closest World Birding Center site to the Project site, located about 9.5 miles to the east. Other relatively close World Birding Center sites are located further away in Brownsville and Harlingen (World Birding Center 2010). Project construction and operation are not expected to affect the experience of visitors to the World Birding Center sites.

Texas established a formal birding trail, called the Great Texas Coastal Birding Trail, in 1996 (American Birding Association 2015). The "trail" is actually 43 separate hiking and driving trails that include 308 birding sites that covers an area extending over 500 miles from end to end. The closest segment of this trail is the Boca Chica Loop, which consists of a grouping of five birding locations. One of these locations, "LTC 039" (the 39th birding site in the Lower Texas Coast portion of the Great Texas Coastal Birding Trail), is located on the south side of Bahia Grande approximately 0.6 mile from the Project site and accessed by a parking pull-off on the north side of SH 48. Construction and operation of the Project would not affect access to this site, but visitors to the site may be aware of construction activities, with temporary increases in dust, noise, and traffic, as well as visual impacts. These types of potential impacts are discussed in section 4.8.4.2. Furthermore, construction activities may result in disturbances to avian species, which could reduce the number of birds found at this site (see section 4.6).

4.8.5 Visual Resources

Visual resources refer to the composite of basic terrain features, geologic features, hydrologic features, vegetation patterns, and anthropogenic features that influence the visual appeal of an area as perceived by viewers. In general, impacts on visual resources result from changes in landscape character and scenic quality caused by an action. Visual impacts from the Project may occur during construction, when large equipment, excavation activities, spoil piles, and construction materials are visible to residents and visitors, and during operation to the extent that facilities or portions of facilities and their lighting are visible. The degree of visual impact resulting from the Project would be determined by the general character and quality of the existing landscape, the changes created by the visually prominent features of the proposed facilities, and the response of viewers to those changes.

4.8.5.1 Project Facilities and Visual Description

The land in the vicinity of the Project is largely undeveloped and relatively natural in appearance. The physical character of the area, consists of shallow waterbodies, saline mudflats, marshes, drainages, and ditches, interspersed with lomas (clay or sandy dunes/ridges surrounded by marshes and salt flats). Consequently, the terrain is generally flat to very gently rolling. Vegetative cover in the area consists largely of a mix of emergent herbaceous wetlands, barren lands, grasslands, and shrub-scrub lands, with areas of taller brush and mesquite and other trees. Vegetation within, and immediately adjacent to, the Project site is predominantly low-growing grasses and shrubs, with some mesquite trees and other shrubland plants. This results in generally low visual variety in the landscape.

The Project would be constructed in a relatively undeveloped, rural area. Some occupied residences located near County Road 199, off of SH 4, approximately 2.7 miles south of the site, represent the closest developed land uses. The next closest developed areas are the communities of Laguna Heights and Port Isabel, and Long Island located between 4.7 and 5.1 miles to the northeast. There are no schools or churches within 1 mile of the Project site. Public lands managed for conservation or recreation purposes and areas with special federal or state designations such as natural landmarks, scenic roads, trails, or scenic rivers are typically considered visually sensitive areas. Although the proposed site is not directly adjacent to any such resources, a number of potentially sensitive resources are located nearby (NPS 2010b, 2010c, 2012; U.S. Department of

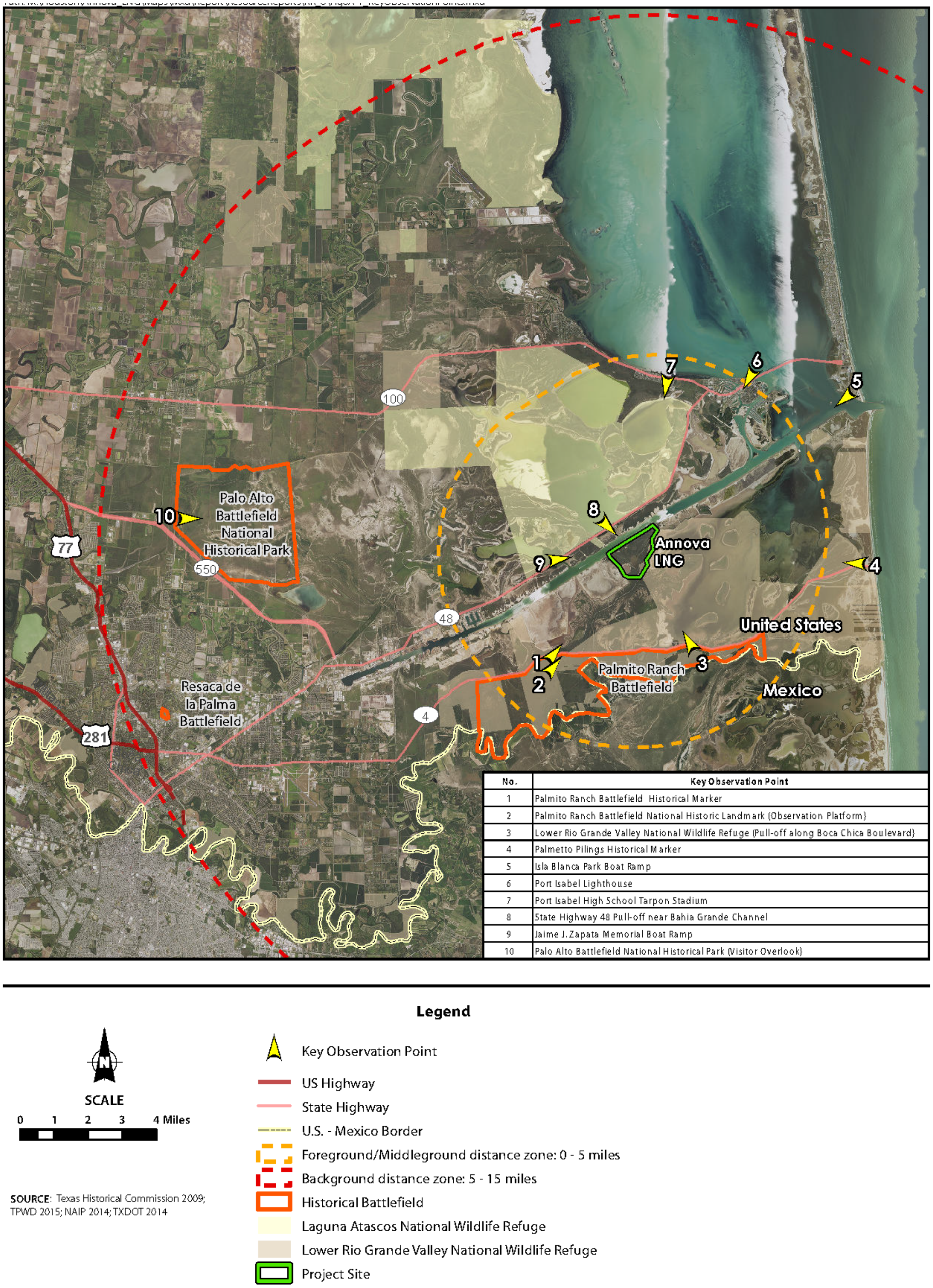
Transportation n.d.). These include the Laguna Atascosa NWR, the Lower Rio Grande Valley NWR, the South Bay Coastal Preserve, and Palmito Ranch Battlefield NHL. Recreational resources in the vicinity include the boat ramps and fishing piers at the Jaime J. Zapata Memorial Boat Ramp Fishing Pier and Kayak Launching Area, and areas within the nearby NWRs.

Both SH 48 and SH 4 are popular routes for visitors and local area residents traveling between the coast and other destinations. Potential viewing locations can occur at numerous informal pull-offs and more formal interpretive wayside exhibits along these highways and smaller roads. In addition, the BSC is utilized as a commercial shipping channel as well as by recreational boaters. Use of the area includes people engaged in wildlife viewing and traveling through the area to visit historic sites, beaches, parks, and other nearby tourist destinations. Although not designated as a scenic byway by the FHA, SH 48 between the city of Brownsville and Highway 100 passes through an extensive area of tidal flats and lomas, where birders regularly view shorebirds, water birds, and other wildlife (TPWD n.d.).

Sensitive viewers in this area include recreational and residential users, both traveling to and from coastal destinations and using nearby recreation areas. As this area is part of the Great Texas Coastal Birding Trail, it attracts birders and others interested in wildlife viewing. Additionally, the Lower Texas Coast Texas 48 Scenic Drive birding trail includes the portion of SH 48 that parallels the BSC north of the Project site. Viewer sensitivity throughout the Project area is generally high due to the large number of people traveling in the area for recreation and leisure.

4.8.5.2 Visual Impact Analysis

Annova prepared a *Visual Impact Assessment* (VIA) for the Project that applied selected procedures of the BLM's *Visual Resource Management (VRM) System* (1984). Specifically, the Project VIA incorporates the VRM contrast-rating procedure in the process used to evaluate visual impacts. In summary, the VIA identified 10 KOPs as reference locations for impact assessment. The analysis documented existing visual conditions for each KOP and assessed visual impacts by determining the amount of visual contrast the Project would introduce into the landscape and the expected response of viewers to those changes. The contrast rating for each KOP was based on a photo simulation of the with-Project condition at that KOP. The contrast ratings were combined with an assessment of visual sensitivity (i.e., a measure of viewer exposure to changes in the landscape and viewer sensitivity to those changes) to determine the level of visual impact at each KOP. The KOPs selected for this VIA are specific locations at representative visually sensitive areas, including historical battlefields in the region, two NWRs in the immediate area, other areas used for recreation and wildlife viewing, key travel routes, and other public gathering areas. KOP locations are provided in figure 4.8.5-1 and KOP simulations are provided in appendix E. Visual sensitivity in the Project area is generally considered to be high because it can be assumed that a large proportion of the viewers in the area are there for recreation and leisure activities.



No.	Key Observation Point
1	Palmito Ranch Battlefield Historical Marker
2	Palmito Ranch Battlefield National Historic Landmark (Observation Platform)
3	Lower Rio Grande Valley National Wildlife Refuge (Pull-off along Boca Chica Boulevard)
4	Palmetto Pilings Historical Marker
5	Isla Blanca Park Boat Ramp
6	Port Isabel Lighthouse
7	Port Isabel High School Tarpon Stadium
8	State Highway 48 Pull-off near Bahia Grande Channel
9	Jaime J. Zapata Memorial Boat Ramp
10	Palo Alto Battlefield National Historical Park (Visitor Overlook)

Figure 4.8.5-1 Key Observation Points

Annova also prepared visual simulations of the Project's active flaring system (i.e., simulations from the KOPs when flaring events are occurring). Among these were simulations depicting both day- and night-time conditions, corresponding to previous KOP Project simulations. Flaring events are planned to have a low frequency of occurrence, and nighttime flaring events are not currently planned but could occur if needed. Simulations included both warm/cold flaring events and marine flaring events. Phast modeling software was used to estimate the flame's dimensions (height, width, and angle), depending on gas composition, wind direction, and other factors. This information was used to generate the graphical representation of the flame's shape for the simulations. Annova modeled possible worst-case non-emergency scenarios of flare events for each KOP where flares could be visible.

The NPS expressed concerns regarding potential visual impact on NHLs, National Historic Parks, and the Padre Island National Seashore. To address this, Annova prepared simulations to evaluate visual effects on these resources identified by the NPS. A simulation was prepared for the Palo Alto Battlefield National Historical Park, located approximately 12 miles west of the Project, to assess visibility and visual impacts on historical areas at this background viewing distance. The landscape in this view is predominantly natural in appearance and Project components would not be concealed by vegetation. An additional simulation for this view was prepared using a 55-millimeter (mm) digital lens setting (a 50-mm lens setting is used to approximate the human view for the standard KOP analysis) at the request of the NPS. Additionally, a night view was simulated for a KOP at the boat ramp on South Padre Island, to address NPS concerns about potential night sky pollution from the Project. Flaring events were also simulated with these conditions.

The most prominent visual features at the Project site would be two domed, cylindrical LNG storage tanks, each 186 feet in height from the finished grade to the top of the dome. Additional vertical structures at the Project site would include a 160-foot-high flare stack and three gas-fired heaters. The flare stacks would be visible when in use in both day and night conditions. When flaring is not occurring, the coloration of the tall flare stack (160 feet elevation) would cause it to blend in with the surrounding landscape. Furthermore, the galvanized steel of the LNG trains, pipes, and pipe rack would be treated to minimize glare.

Annova has included proposed lighting design measures to minimize contrast with the night sky in the landscape. The lighting design and practices to minimize light emitted from the Project include the following:

- installing lighting only where needed (motion sensors or timers would be incorporated where use at night is intermittent);
- shielding bulbs and directing light downward;
- installing lamps with warmer colors and minimum blue light;
- preferentially selecting energy-efficient lamps and fixtures; and
- avoiding flaring of gas at night whenever feasible.

The visual simulations prepared for the Project incorporate these color and lighting mitigation measures in the depiction of the Project facilities. Use of these mitigation measures is reflected in the contrast ratings developed for the KOPs, applying the procedure from the BLM visual resource methodology, and resulted in reduced ratings of overall visual impacts on the surrounding landscape.

The following discussion summarizes the existing visual conditions, simulations and contrast ratings, viewer characteristics, and visual impact ratings for the respective KOPs.

KOP 1. Palmito Ranch Battlefield Historical Marker (3.1 miles southwest from the Project site)

KOP 1 is located at the historical marker for the Palmito Ranch Battlefield NHL along SH 4 (Boca Chica Boulevard). The federal Department of the Interior designated the Palmito Ranch Battlefield as an NHL in 1997, to commemorate the last major land battle of the Civil War. The landmark designation applies to an area of nearly 6,000 acres that extends south from SH 4 to the Rio Grande and east-west for approximately 5 miles (NPS 2010a). The area includes a mixture of private lands and federal lands within the Lower Rio Grande Valley NWR. The historical marker wayside provides a location for people to view the landscape within the battlefield and read the interpretive information about the battle (See also the related discussion for KOP 2).

KOP 1 provides a view to the northeast toward the Project site, which is approximately 3.1 miles from KOP 1, and is located in the foreground/middleground distance zone. Figure E-1a (in appendix E) shows the existing view and a visual simulation of this view with the Project from this location. Although views to the north of the highway are largely screened by vegetation in the immediate foreground, the straight horizon line of the coastal mudflats and marshes is partially visible through openings in the vegetation. The wayside was primarily developed to provide an expansive view to the south that includes part of the battlefield area, which is the opposite direction of the Project. The brown historical marker sign is the only vertical structure in the view. Due to the largely natural appearance of the existing landscape and relative lack of development in this view and other views from this section of SH 4, the visual integrity of the landscape surrounding KOP 1 is relatively high. Nevertheless, as shown in figure E-1a (in appendix E), the specific view toward the Project at KOP 1 is dominated by the dark paved highway, gravel wayside area, and highway signs. Although Annova's VIA did not apply the scenic quality rating component of the BLM's VRM methodology, the existing scenic quality at KOP 1 would appropriately be considered as "low" because of the expanses of flat marshes and low vegetated hills provide little visual variety and interest among the elements of form, line, color, and texture.

Figure E-1a (in appendix E) includes a visual simulation for a daytime view to the northeast, from KOP 1. The Project facilities would be evident in this view due to gaps in the vegetation screening at this location. The vertical lines and varied forms of the Project facilities would be silhouetted against the sky. The introduction of new, large, and varied industrial facilities in this largely undeveloped and natural area would be visible to an observer at this location and could attract the attention of viewers. Because of the viewing distance and dominating influence of the highway and the presence of foreground vegetation, however, these changes would not begin to dominate the landscape. Annova's VIA rated the contrast of the Project within the view of the distant landscape as moderate. The BLM (1986) guidance for a moderate contrast rating indicates that the "element contrast begins to attract attention and begins to dominate the characteristic landscape." The guidance for a weak contrast rating is that the "contrast can be seen but does not attract attention." Based on the conditions depicted in the simulation, the contrast created by the Project facilities would not begin to dominate the landscape and the overall contrast rating for KOP 1 is weak. A weak contrast rating is based on the viewing distance, the existing contrast associated with the highway, and partial screening by the vegetation in the immediate foreground.

During operations, it is anticipated that periodic flare events would occur. To assess the visual impacts of flare events, Annova modeled worst-case, non-emergency marine flare events (figure E-1b in Appendix E) and warm/cold flare events (figure E-1c in Appendix E) during daytime hours for KOP 1. Due to distance and partial screening of vegetation, there is very little noticeable additional visual impacts from these scenarios.

The viewer sensitivity at this location is likely a mixture of moderate and high sensitivity. Moderate sensitivity would apply to travelers on SH 4 who continue past KOP 1 without stopping at the historical marker. Travelers who do stop at the marker presumably are interested in battlefield views and interpretive information, and would likely have a high sensitivity to visual change. Given the relatively low existing scenic quality, a weak contrast rating, and moderate to high viewer sensitivity, the potential visual impact of the Project as seen from KOP 1 would be moderate.

KOP 2. Palmito Ranch Battlefield National Historic Landmark – Observation Platform (3.4 miles southwest from the Project)

KOP 2 is located at an observation platform for the Palmito Ranch Battlefield NHL, off Palmito Hill Road, south of Boca Chica Boulevard (SH 4). The NHL is within the Lower Rio Grande Valley NWR, established in 1979 and owned by the FWS. The management goals in the Comprehensive Conservation Plan for the Lower Rio Grande Valley NWR include protecting biological diversity and wildlife and habitat management; water rights, water quality, and wetlands; cultural resources; and public use, recreation, and wildlife interpretation and education (FWS 1999). The NHL is located along the south side of Boca Chica Boulevard (SH 4) and is within five miles of the Project (see figure 4.8.5-1). The observation platform was constructed in 2014, as a partnership with the Texas Historical commission, FWS, and the NWR, within the battlefield area, with interpretive signs, parking area, and monument. This platform and parking area provide a location for people to view the landscape from the battlefield area and read interpretive information about the battle.

KOP 2 provides a view to the northeast toward the Project site, which is approximately 3.4 miles away and located in the foreground/middleground distance zone. Figure E-2 (in appendix E) shows the existing view and a visual simulation of this view with the Project from this location. The existing view from the platform is enclosed by foreground vegetation and is dominated by the constructed features (i.e., a metal fence, concrete walkway, and stone interpretive monument) and dense, green, low and medium height vegetation in the immediate foreground. Views of the landscape to the northeast are blocked by vegetation, although expansive views of the battlefield area are present to the east, west, and south of the viewing platform. Due to the largely natural appearance of the existing landscape, and the lack of intrusive development in this view, the visual integrity of the landscape surrounding KOP 2 is relatively high. Although Annova's VIA did not apply the scenic quality rating component of the BLM's VRM methodology, the existing scenic quality at KOP 2 would appropriately be considered as "low" because of the dominance of vegetation, and low vegetated terrain that provide little visual variety and interest among the elements of form, line, color, and texture.

Figure E-2 (in appendix E) includes a visual simulation for a daytime view to the northeast from KOP 2. The simulation indicates that the dense vegetation enclosing the view to the north would fully screen views toward the Project site and the facilities would not be visible from this KOP (consequently, no additional simulations of flare events were prepared). This means that construction and operation of the Project, including flaring events, would not result in any visual contrast or visual impact from this location, and there would be no reduction in visual integrity and scenic quality from this KOP. However, other areas along Boca Chica Boulevard, such as where it borders the Palmito Ranch Battlefield NHL, would have unscreened views to the north, which would likely result in some Project visibility along the portion of Boca Chica Boulevard that borders the NHL (see KOP 3).

KOP 3. Lower Rio Grande Valley National Wildlife Refuge – Pull-off along Boca Chica Boulevard (2.4 miles southeast from the Project)

KOP 3 is located at a pull-off along Boca Chica Boulevard (SH 4) within the Boca Chica Unit of the Lower Rio Grande Valley NWR (see KOP 2). The area is very secluded and characterized as a typical coastal environment, interspersed with miles of beach front, saline flats, mangrove marshes, shallow bays, and lomas (FWS 2012a). Primary recreational activities within the tract include beach activities, hiking, and birdwatching. The KOP is also located on the northern boundary of the Palmito Ranch Battlefield NHL and therefore also represents views from a portion of this historic area (see KOPs 1 and 2 for additional information on the NHL).

KOP 3 provides a view to the north towards the Project site, which is approximately 2.4 miles from KOP 3 and is located in the foreground/middle ground distance zone. Figure E-3a (in appendix E) shows the existing view and a visual simulation of this view of the Project from this location. The existing view is dominated by the dense, green, medium height vegetation along the edge of the pull-off in the immediate foreground and bright sky and low clouds. The straight, level horizon line of the coastal mudflats and marshes is visible beyond the vegetation. An area of shallow, open water is also visible. Although a portion of the sandy pull-off is visible, there are no structures or other development in the view. Due to the largely natural appearance of the existing landscape and relative lack of development in this view and other views from this section of SH 4, the visual integrity of the landscape surrounding KOP 3 is relatively high. Although Annova's VIA did not apply the scenic quality rating component of the BLM's VRM methodology, the existing scenic quality at KOP 3 would appropriately be considered as "low" or possibly "moderate." The expanses of flat marshes and low vegetated hills provide little visual variety and interest among the elements of form, line, color, and texture; however, the water element is a significant feature that adds interest to the landscape.

Figure E-3a (in appendix E) includes a visual simulation for a daytime view to the north-northwest from KOP 3. The simulation indicates that the Project facilities would be clearly visible from this viewpoint silhouetted against the sky above the vegetation in the foreground. Clearing of vegetation at the Project site would alter the form, line, and color of the vegetation at this site, although that likely would not be noticeable from KOP 3 because of the viewing distance. The introduction of new, large, and varied industrial facilities in this largely undeveloped and natural-appearing area would be noticeable to an observer at this location and could attract the attention of viewers. Annova's VIA rated the contrast of the Project within the view of the distant landscape as moderate to moderately strong. The BLM (1986) guidance for a moderate rating indicates that the "element contrast begins to attract attention and begins to dominate the characteristic landscape." The guidance for a strong contrast is that the "element contrast demands attention, will not be overlooked, and is dominant in the landscape." Based on the conditions depicted in the simulation, the contrast created by the Project would be likely to attract attention and potentially begin to dominate the view, but would not demand attention nor dominate the view, resulting in an overall contrast of moderate. A moderate contrast rating is based on viewing distance and dominant presence of, and partial screening of the view by, vegetation in the immediate foreground.

During operations, it is anticipated that periodic flare events would occur. To assess the visual impacts of flare events, Annova modeled worst-case, non-emergency marine flare events (figure E-3b in appendix E) and warm/cold flare events (figure E-3c in appendix E) during daytime hours for KOP 3. The visual impact from the flaring events is noticeable but reduced by distance and other visual features, such as the road reflectors, in the foreground. The light from the flare stacks would be noticeable to a casual observer but would not demand attention in the view.

The visual sensitivity at this location is likely moderate to moderately high. Moderate sensitivity would apply to travelers on SH 4 who continue past KOP 3 without stopping at the pull-off to view the landscape. Higher sensitivity would likely apply to travelers who stop to look at the view or hope to see wildlife using the refuge. Views of the NHL from this KOP largely face away from the Project and focus to the south, or inward to the core interpretive area of the battlefield. Given the low to moderate scenic quality, moderate to high viewer sensitivity, and moderate contrast rating, the potential visual impact of the Project as seen from KOP 3 would be moderate.

KOP 4. Palmetto Pilings Historic Marker (approximately 5.9 miles east from the Project)

KOP 4 is located at the Palmetto Pilings Historical Marker wayside along Boca Chica Boulevard (SH 4), near the eastern edge of the Boca Chica Unit of the Las Palomas Wildlife Management Area (WMA). The pilings, seen from the historical marker, are the remains of the railroad crossing of the Boca Chica inlet to White's Ranch on the Rio Grande, constructed between 1864 and 1865 for transport of military supplies (THC 2017b). The Las Palomas WMA was established to preserve habitat associated with white-winged doves. It is contiguous with the Boca Chica Unit, and the Lower Rio Grande Valley NWR. Boca Chica Beach borders the unit on the east.

KOP 4 provides a view west to the Project site, which is approximately 5.9 miles from KOP 4 in the background distance zone. Figure E-4a (in appendix E) shows the existing view and a visual simulation of this view of the Project from this location. The existing view includes expanses of low-growing light and medium green vegetation extending to the nearly level horizon. There are some areas of light tan, barren mudflat interspersed with vegetation in the foreground, and some clusters of taller, dark green vegetation, including a few palm trees, line portions of the horizon in the distance. The light gray, stone historical marker and portions of the dark paved roadway and gravel pull-off are prominent in the immediate foreground. A line of short wood posts strung with cable extends across the view in the foreground and several taller structures associated with residences and agricultural operations are visible along the horizon in the background. Although the light colors of the residential and agricultural structures are somewhat noticeable, they are not dominant elements in the view because of their distance and low profiles. The wood posts are noticeable in the view but are not dominant. The predominance of natural features and the small number of structures in this view and other views from along SH 4 provide relatively high visual integrity for this portion of the highway. The existing scenic quality at KOP 4 would appropriately be considered as "low" or possibly "moderate." The expanses of flat marshes and low vegetated hills provide little visual variety and interest, although the presence of features with historical context provides some degree of added interest to the view.

Figure E-4a (in appendix E) includes a visual simulation for a daytime view at this location. This view is looking west toward the Project site. The simulation indicates that the Project would be visible in the background from this viewpoint. The visible Project components from this viewpoint would primarily include the two LNG storage tanks and flare stacks. Because of the viewing distance and color similarity with the existing vegetation, the Project facilities would not be prominent. The presence of the new facilities may attract some attention from people stopping to visit the historical marker and surrounding landscape, but the Project would not begin to dominate the view. A weak contrast rating is appropriate based on the viewing distance, the existing contrast associated with the highway, and the presence of vertical elements in the foreground/middle ground and background distances.

During operations, it is anticipated that periodic flare events would occur. To assess the visual impacts of flare events, Annova modeled worst-case, non-emergency marine flare events (figure E-4b in appendix E) and warm/cold flare events (figure E-4c in Appendix E) during daytime hours for KOP 4. The visual impact from the flaring events is noticeable but largely reduced by distance and other visual features, such as the road reflectors, in the foreground. The light from the flare stacks, particularly for the warm/cold flare, would be noticeable to a casual observer but would not demand attention in the view.

The viewer sensitivity at this location is moderate to moderately high. Moderate sensitivity would apply to travelers on SH 4 who continue past KOP 4 without stopping at the wayside to view the landscape and historical marker. Higher sensitivity would apply to travelers who stop to look at the view or wildlife using the refuge or those viewing the historical interpretive area. Given the low to moderate scenic quality and weak contrast introduced by the Project, the Project would have a low to moderate potential visual impact from this location.

KOP 5. Isla Blanca Park Boat Ramp (6.7 miles northeast from the Project)

KOP 5 is located at the Isla Blanca Park Boat Ramp, which is located near the southern end of South Padre Island. Isla Blanca Park is administered by Cameron County Parks and Recreation. The boat ramp is located within the park, and is near an extensive recreational vehicle park, marina, and other facilities. The Park includes over a mile of beachfront on the Gulf of Mexico. The boat launch is on the landward side of the southern end of South Padre Island, providing an entry point for boaters.

KOP 5 provides a view to the southwest toward the Project site, which is approximately 6.7 miles from KOP 5 and located in the background distance zone. Figure E-5a (in appendix E) shows the existing view and a visual simulation of this view with the Project from this location during the daytime. The most prominent element of the existing daytime view is the expanse of deep blue water stretching from the shore in the immediate foreground almost to the horizon in the background. The immediate foreground includes a portion of disturbed ground with some sparse grass and various small structures (e.g., a wooden kiosk, a metal trash can, short wood posts with signs, a wood bench, a small concrete dock, a short rock jetty, and other signs). A tall, marine navigation structure protrudes from the water in the foreground and, silhouetted against the broad, light blue-gray sky, is a prominent element in this view. Several buoys, including two bright orange ones, are also visible in the water. In the distance, along the generally level horizon, are areas of low landforms with some low vegetation on the left side of the view and more distant development with numerous low-profile structures on the right side of the view. The tall structure visible on the right side of the view, likely an offshore oil platform, is a dominant element silhouetted against the sky on the horizon. A tall communication tower, also in the right side of the view, extends high above the horizon, but its thin frame and light gray color is not readily noticeable or a dominant feature in the view. The combination of marine structures and the broad expanse of open water give this view moderately high visual coherence and integrity and moderately high scenic quality.

Figures E-5a and E-5d (in appendix E) include visual simulations for daytime and nighttime views, respectively, from this location to the southwest from KOP 5. The Project facilities would be visible in both daytime and nighttime views due to unobstructed views of the horizon as a result of open water and flat terrain between the KOP and the Project. The majority of the Project facilities would be visible from this viewpoint, silhouetted against the sky above the water. From this view, the clearing of vegetation at the Project site would not be noticeable due to the distance from the Project site. The new facilities would be visible and could attract some attention from viewers at this location. Because of the viewing distance and existing contrast from other industrial structures visible in the distance, as well as the presence of various structures in the foreground, however, these facilities would not begin to dominate the landscape. Annova's VIA rated the contrast of the Project within the view of the distant landscape as weak to moderate. Based on the conditions depicted in the simulation, the contrast rating for KOP 5 is weak.

The nighttime view and simulation at KOP 5 (Figure E-5d in appendix E) show ambient and direct lighting both in the background and foreground viewing distances. The Project would be silhouetted against the night sky above the horizon from this location. Project elements might appear faintly noticeable during certain atmospheric and lighting conditions, such as around dusk or dawn or with bright moonlight. However, other elements in the immediate foreground and silhouetted above the horizon in the background of this view are more dominant. Lights associated with the Project would increase the number of lights and lighted elements in this area. However, these new lights and lighted elements would not add substantially to the amount of light and number of lighted elements visible along the horizon, and the contrast would be weak.

During operations, it is anticipated that periodic flare events would occur. To assess the visual impacts of flare events, Annova modeled daytime worst-case, non-emergency marine flare events and warm/cold flare events (figures E-5b and E-5c, respectively, in appendix E) and nighttime worst-case scenario marine flare events and warm/cold flare events (figures E-5e and 5f, respectively, in appendix E) for KOP 5. The visual impact from the daytime flaring event and the marine nighttime flare event is difficult to detect in the simulations, and minimally visible for the nighttime warm/cold flare event (figure E-5f). The minimal contrast between the flare and the bright daytime sky and distance from the viewer result in minimal, if any, additional daytime impact from the flare events. The presence of multiple lights along the horizon and distance from the viewer result in minimal nighttime visual impacts from flare events, with a slight elevated impact from the warm/cold flares over the lower profile marine flare stacks.

The viewer sensitivity at this location is considered high, as it represents a recreational area on South Padre Island. This public park and boat launch area is used regularly by a variety of visitors and local residents for recreational and leisure activities that include boating, fishing, and wildlife watching. The Project facilities silhouetted against the sky above the horizon would attract some attention but would not be a dominant element in views from this area during the day. At night, the Project would introduce new lights and lighted elements along the horizon line in the distance; however, Project structures and lighting against the horizon would not substantially reduce the visual integrity or scenic quality of nighttime views from this location. Although we do not know the typical orientation of observations from this KOP, recreational viewers would likely focus on the landscape to the east, which contains the beaches and ocean, rather than to the southwest in the direction of the BSC and the Project. For these reasons, construction and operation of the Project would have low visual impact at this location during both day- and night-time conditions.

KOP 6. Port Isabel Lighthouse (5.1 miles northeast from the Project)

KOP 6 is located at the observation deck of the Port Isabel Lighthouse in Port Isabel. The lighthouse is operated by the City of Port Isabel and is the only lighthouse originally constructed along this coastal area that is open to the public. Area visitors and local residents come to this historic lighthouse for recreational and leisure activities that include learning about the history of the area and viewing the surrounding landscape.

KOP 6 provides a view to the southwest toward the Project site, which is approximately 5.1 miles from KOP 6, and is located in the background distance zone. Figure E-6a (in appendix E) shows the existing view and a visual simulation of this view with the Project from this location. The existing view is dominated by expansive urban development interspersed with dark vegetation and several prominent port, infrastructure, and industrial facilities. This is a modified landscape, with only the very distant background zone representing natural scenic conditions. The eye is immediately drawn to the drill platform to the left of the view, as well as other commercial and industrial developments. The existing scenic quality at KOP 6 would appropriately be considered as “low” due to extensive development that lacks historical context and limited extent of natural features.

Figure E-6a (in appendix E) includes a visual simulation for a daytime view to the southwest, from KOP 6. This represents the view from the Port Isabel Lighthouse observation deck. From this location, the Project would be visible as silhouetted above the flat horizon. Changes to the Project site from grading and vegetation removal are unlikely to be visible due to the distance to the Project. While the vertical Project elements would contrast with the horizon line, the fairly dark and subdued “covert green” color of the facilities would help them recede and blend with surrounding landscape elements. In the distant background view, the Project would introduce new industrial elements to the horizon in a portion of the view without any other breaks in the horizon line. Annova’s VIA rated the contrast of the Project within the view of the distant landscape as moderate. Based on the conditions depicted in the simulation, the contrast created by the Project facilities would be subordinate to the existing contrast associated with other vertical background elements, and dominance of urban and industrial features in the foreground/ middleground distance zones and would not begin to dominate the landscape. Therefore, the appropriate contrast rating for KOP 6 is weak.

To assess the visual impacts of flare events, Annova modeled worst-case, non-emergency marine flare events (figure E-6b in appendix E) and warm/cold flare events (figure E-6c in appendix E) during daytime hours for KOP 6. The visual impact from the marine flaring event is reduced due to distance and lower profile; however, the warm/cold flare event would be visible and attract the attention of the casual observer. The addition of the flare would increase the visual impact of the Project during the periodic active flaring as it provides novel visual content to the view and would draw attention to the rest of the Project components.

Viewer sensitivity for this KOP is moderately high because of the unique opportunity provided by this viewing location and the use of KOP 6 for recreation. Overall, the Project would introduce a small number of new structures that are industrial in character; however, numerous other industrial structures are also visible in this view of a highly urbanized landscape. Given the relatively low existing scenic quality, a weak contrast rating, and moderately high viewer sensitivity, the potential visual impact as seen from KOP 6 would be low to moderate.

KOP 7. Port Isabel High School Tarpon Stadium (4 miles north from the Project)

KOP 7 is in the upper level of the elevated seating at the Port Isabel High School Tarpon Stadium in Port Isabel, and provides a view looking south toward the Project site. The stadium is used for activities such as school sports and other events, which occur at night as well as during the day. Viewers at KOP 7 are typically focused on the athletic fields or the track in the stadium, which is in the opposite direction of the view south toward the Project.

The Project site is approximately 4.0 miles from KOP 7 and is located in the distant foreground/middleground zone. Figure E-7a (in appendix E) shows the existing view and a visual simulation of this view with the Project from this location. The existing view includes the strong uninterrupted horizontal feature created by the low, vegetated terrain on the horizon line, accentuated by the narrow band of medium green vegetation between the much lighter colored water and sky. The foreground/middleground area is occupied by the expanse of dark green trees, blue-gray open water, bands of low landforms covered with light and medium green vegetation, and narrow bands of tan barren areas along shorelines. Structures (such as school buildings, vertical utility structures, fences, athletic field elements) and school buses are dominant elements in the immediate foreground. Several other large structures are faintly visible in the distance on the right side of the view protruding above the horizon. Because they are distant, these structures appear small in scale and very light gray in color and are subordinate and barely noticeable in the overall view. Although Annova's VIA did not apply the scenic quality rating component of the BLM's VRM methodology, the existing scenic quality at KOP 7 would appropriately be considered as "moderate" because of the low level of variation in horizontal forms, but presence of expansive water view from this location. Overall, the expanse and variety of natural features give this view moderate visual integrity and scenic quality.

Figure E-7a (in appendix E) also provides a visual simulation for a daytime view to the south from KOP 7. The Project facilities would be visible due to the lack of any screening vegetation or structures from this location. The vertical lines and varied forms of the Project facilities would be visible in the distant middleground and silhouetted above the flat horizon. Changes to the Project site from grading and vegetation removal would likely be unnoticeable due to the distance. The introduction of new, large, and varied industrial facilities to the nearly unbroken horizon line would be noticeable to the casual observer at this location and could attract the attention of viewers. Because of the viewing distance and dominating influence of existing contrast created by structures and other development elements in the foreground, however, Project facilities would not dominate the landscape. Annova's VIA rated the contrast of the Project within the view of the distant landscape as moderately strong, based primarily on its prominent forms and lines silhouetted above the horizon and the relative lack of other structures readily noticeable along or protruding above the horizon. Based on the BLM (1986) guidance for moderate and strong contrast ratings and the conditions depicted in the simulation, the contrast created by the Project facilities would not dominate the landscape and the appropriate contrast rating for KOP 7 is moderate.

To assess the visual impacts of flare events, Annova modeled worst-case, non-emergency marine flare events (figure E-7b in appendix E) and warm/cold flare events (figure E-7c in appendix E) during daytime hours for KOP 4. The daytime visual impact from the flaring events is largely indistinguishable in the distance from the other Project impacts. Distance, bright daytime sky, and haze along the horizon as well as presence of multiple vertical structures adjacent to, and partially obscuring the view of, the Project reduce the additional visual contrast and impact from the daytime flare events.

Viewer sensitivity at this location is likely a mix of low and moderate. Low sensitivity is due to the focus of users at this location being toward athletic fields in the stadium and away from the Project, while moderate sensitivity could apply to viewers who are interested in viewing the landscape from this elevated location. Overall, the Project would introduce new structures that appear industrial in character, where no other large industrial structures are easily noticeable in this view. Because of the moderate contrast introduced by the Project and low to moderate viewer sensitivity, construction and operation of the Project would have a low to moderate potential visual impact from this location.

KOP 8. State Highway 48 Pull-off near Bahia Grande Channel (0.6 mile northwest from the Project)

KOP 8 is located at a pull-off along SH 48 bordering the Laguna Atascosa NWR near the Bahia Grande Channel. North of this location is the Bahai Grande Wetland Mitigation Site, within the NWR. The approximately 10,000-acre mitigation site consists generally of the inundation areas for Bahia Grande, Laguna Larga, Little Laguna Madre, and the channels connecting these shallow bays to each other and the BSC (NOAA Fisheries 2016f; FWS 2003). Restoration of the Bahia Grande Wetland Mitigation Site began in 2005 with the reintroduction of water from the BSC. While land access to the site is limited to two highway pull-offs (one off of SH 100 and this one off of SH 48), guided seasonal bird walks are provided by the refuge staff from the pull-off where KOP 8 is located.

KOP 8 provides a view looking southeast toward the Project site, which is approximately 0.6 mile from KOP 8 and in the near foreground/middleground distance zone. Figures E-8a, E-8b, and E-8e (in appendix E) show the existing daytime and nighttime views and visual simulations of these views with the Project from this location, respectively. The view is dominated by the expanse of varied green, low-growing vegetation extending from the pull-off to the nearly level horizon. Barren mudflats are interspersed with the vegetation in the foreground, and much of the horizon is lined with taller, dark green vegetation. No existing structures are visible in the view shown by the existing conditions in figures E-8a, E-8b, and E-8d (in appendix E). No exposed lights, lighted elements, reflected lights, or noticeable ambient light in the atmosphere are visible in the existing nighttime view due to the lack of development in the area. Due to the predominance of natural features and lack of any encroaching structures in this view, the visual integrity for KOP 8 is high. The scenic quality of this view is low or possibly moderate, however, because there is little variety of plant forms and color, and a lack of noticeable relief, water, or other landscape features that may provide interest.

Figures E-8a and E-8e (in appendix E) include simulations of the Project for daytime and nighttime views, respectively. Figure E-8b (in appendix E) includes a simulation of the Project with daytime views with an LNG carrier at dock. Due to low ground elevations, changes on the Project site from grading and vegetation removal might appear somewhat noticeable from this viewpoint. The simulations indicate that because of the open landscape and lack of tall, screening vegetation, much of the Project facilities would be visible from this location. The geometric, angular, and rounded forms of the tall structures, primarily the LNG storage tanks, liquefaction trains, and flare stacks, would be noticeable elements silhouetted against the sky above the flat horizon. The straight vertical and horizontal lines of the structures would contrast with the strong horizontal lines and forms of the vegetation and mudflats and the irregular rounded lines and forms of the mounded shrubs in the foreground and vegetation lining the horizon in the distance. These components of the Project silhouetted above the horizon would be dominant and strongly noticeable elements in the landscape that would likely attract the attention of viewers. Nighttime simulations show that the Project would introduce new lighting features as vertical elements both illuminated and silhouetted against the sky, which would dominate the view and demand viewer attention. The contrast created by the Project would be strong due to the close viewing distance to it, the strong forms and large scale of the Project facilities, and the lack of existing contrast from other vertical features or other industrial elements in the landscape.

During operations, it is anticipated that periodic flare events would occur. To assess the visual impacts of flare events, Annova modeled daytime worst-case, non-emergency marine flare events and warm/cold flare events (figures E-8c and E-8d, respectively, in appendix E) and nighttime worst-case scenario marine flare events and warm/cold flare events (figures E-8f and 8g, respectively, in appendix E) for KOP 8. Flare events would be visible and demand attention from the casual viewer. Contrast would be moderate to strong as the flares would add a novel element into the landscape. Nighttime flare events, although anticipated to be rare, would contribute additional visual contrast with the night sky, providing novel visual input that adds additional contrast with the industrial lighting and calls further attention to the Project structures.

Overall, the Project would change the character of the view from this KOP from natural to industrial and reduce the scenic quality from low-moderate to low. The addition of the intermittent and regular presence of the LNG carriers to the view would increase the already strong contrast of the views. The Project would introduce new lighting and lighted elements into an otherwise dark environment. The form and line of large structures silhouetted above the horizon and the addition of new lights and lighted elements would produce strong contrasts that would substantially reduce the scenic quality of nighttime views from this KOP.

The viewer sensitivity level at this location is likely a mixture of moderate and high. Moderate sensitivity would apply to travelers on SH 48 who continue past KOP 8 without stopping at the pull-off. For travelers interested in stopping along the highway, this pull-off near the Bahia Grande Channel is one of only a few places available along this stretch of highway to safely pull off the highway to observe wildlife and the surrounding landscape. This KOP is also representative of views experienced by people who frequent the general area to fish and boat along the BSC to the south. Given the low or low-moderate existing scenic quality, moderate and high viewer sensitivity, and a strong contrast rating, the potential visual impact of the Project as seen from KOP 8 would be moderately high.

KOP 9. Jaime J. Zapata Memorial Boat Ramp (1.4 miles west from Project)

KOP 9 provides a view looking east toward the Project site from the Jaime J. Zapata Memorial Boat Ramp located on the south side of SH 48 and north of the ship channel. The Laguna Atascosa NWR is located immediately to the north across the highway from the boat ramp area. The boat ramp is managed by Cameron County Parks & Recreation Department. This public boat launch and nearby areas are used regularly by a variety of visitors and local residents for recreational and leisure activities that include boating, fishing, and wildlife watching. The state highway is frequently traveled by people for purposes of recreation, leisure, and exploring nearby historical areas, wildlife refuges, and natural areas.

KOP 9 provides a view to the east toward the Project site, which is approximately 1.4 miles from this KOP, and is located in the foreground/middleground distance zone. Figures E-9a, E-9b, and E-9e (in appendix E) show the existing daytime and nighttime views and visual simulations of this view with the Project from this location. The boat ramp location provides an expansive view of the nearby waterway, beaches, and marshlands. The existing view from the KOP shows the parking area and associated facilities, open water, and exposed gravel and sandy shoreline areas in the immediate foreground. Exposed shoreline and barren areas with low, undulating dunes, or lomas, mostly covered with dense, dark green vegetation, extend to the horizon. Structures in the foreground include multiple light posts, trash receptacles, shelters, and signs. There is a distinct horizon line forming an undulating, horizontal edge between the sky and the vegetation along the flat landscapes and lomas. The light standards in the immediate foreground are prominent vertical elements protruding well above the horizon and are silhouetted against the blue sky. The expanse of gray-blue water, exposed shoreline, and vegetated lomas are prominent natural features in the view, although there is relatively little visual variety among these elements. The structures associated with the parking area in the immediate foreground are encroaching elements that attract viewers' attention and tend to reduce the visual coherence and integrity of this view. As a result, the existing scenic quality is appropriately considered moderate.

Figures E-9a, E-9b, and E-9e (in appendix E) include visual simulations for daytime and nighttime views to the east, from KOP 9. Additionally, figure E-9b includes a simulation of the LNG carrier at dock with the Project from this location. The daytime simulations indicate that the

Project would be visible in the foreground/middleground distance zone, silhouetted against the sky, with vertical Project elements contrasting with the horizon and low rolling forms of vegetation and lomas. Although the silhouetted forms and straight vertical lines would be prominent, the Project's overall contrast would be moderate due to the existing contrast created by forms and lines of elements associated with the parking area in the immediate foreground. In addition, the fairly dark green color of the Project structures would blend, to a degree, with the surrounding colors in the landscape (see figure E-9a in appendix E). Although the Project would be co-dominant with the structures of the parking area, the Project contrast would be greater as viewed from nearby points without the parking area in the immediate foreground; in such cases, the Project might appear highly noticeable to viewers and dominate the view, and the contrast could conceivably be moderately strong. The intermittent and periodic presence of LNG carriers with their angular, geometric forms, varied lines, and often contrasting colors would slightly increase the contrast in views (see figure E-9a in appendix E). The nighttime simulation suggests that the Project would be slightly visible at night from KOP 9, introducing industrial elements into the horizon landscape. The vertical illuminated structures, however, would be subordinate to the dominant boat ramp lighting at this KOP. The street lights, in the immediate foreground of this view would appear more dominant, and the Project contrast would remain moderate. However, visitors sitting at the beach would have unobstructed views of the Project.

To assess the visual impacts of flare events, Annova modeled daytime worst-case, non-emergency marine flare events and warm/cold flare events (figures E-9c and E-9d, respectively, in appendix E) and nighttime worst-case scenario marine flare events and warm/cold flare events (figures E-9f and 9g, respectively, in appendix E) for KOP 5. The flares would be visible to the casual observer in all simulated conditions. The daytime impacts are reduced due to distance and presence of multiple vertical and light-colored structures present in the view. The novel form of the flame may still attract additional attention to the Project but would not demand attention. The warm/cold flare event is more likely to attract attention of the casual observer, due to being located in an area of the view without additional distractions from the flat horizon line. The nighttime impacts would be moderated by the dominating presence of streetlamps in the view. Distance would further reduce additional impacts; however, the presence of the flares in the relative dark background between the foreground structures would draw attention to the presence of the Project.

Viewer sensitivity at this location is likely moderate to high. Users of the boat launch may immediately leave the area and not be affected by the surroundings, while people using this location to access the surrounding wetlands for activities such as bird-watching or fishing would have more unobstructed views and would be sensitive to the intrusion of industrial features. Based on low existing scenic quality, moderate contrast moderate to high viewer sensitivity, construction and operation of the Project would result in moderate potential visual impact on the daytime view from KOP 9.

KOP 10. Palo Alto Battlefield National Historical Park – Visitor Overlook (12.4 miles west from the Project)

KOP 10 is situated at the interpretive outlook at the visitor center for the Palo Alto Battlefield National Historical Park located north of Brownsville. This is the only National Park dedicated to the U.S.–Mexican War, and the Park includes interpretive services documenting the entire conflict, its origins, and aftermath.

KOP 10 provides a view looking east toward the Project site, which is approximately 12.4 miles from KOP 10, and is in the background distance zone. Figures E-10a and E-10b (in appendix E) show the existing view and a visual simulation of this view of the Project from this location. The view includes interpretive signs and a railing at the overlook with low vegetation extending to the nearly level horizon dominating the existing view. The vegetation exhibits a variety of textures and shades of green with some areas of yellow and brown intermixed. A few tall, vertical, pale-gray industrial structures are faintly visible, silhouetted against the sky, along the horizon. The visitor center overlook focuses viewers' attention toward the historic battlefield and provides important information about the history of the site and the surrounding area. The visitor center is also the start of short walking paths and the Brownsville Historic Battlefield Hike and Bike Trail. Due to the largely natural appearance of the existing landscape, with few structures affecting the condition of the view, the visual integrity is high. The scenic quality of this view is low, however, based on the low diversity of landforms and lack of waterbodies or other features of interest.

Figures E-10a and E-10b (in appendix E) include a visual simulation of the Project for a daytime view to the northeast from KOP 10. Figure E-10b provides a more focused view towards the Project, as requested by the NPS. Changes to the Project site from grading and vegetation removal would appear unnoticeable from this KOP due to distance. From this KOP, the geometric forms and straight vertical and horizontal lines of the Project's structures would be barely visible along the landscape's horizon, contrasting slightly against the horizontal form and sky. From this KOP, existing industrial structures that are visible as light gray forms silhouetted against the sky in several locations would appear taller, but more noticeable than the Project. Because of the distance, the small scale, and the green color of the structures that would blend with the surrounding colors in the landscape, the contrast created by the Project would be weak at most. No nighttime simulations were requested for this KOP. Although the lighted elements of the Project would likely be visible from this location at night, visitors to the Park are not likely to utilize the battlefield viewing areas during the night.

To assess the visual impacts of flare events, Annova modeled worst-case, non-emergency marine flare events (figure E-10c in appendix E) and warm/cold flare events (figure E-10d in appendix E) during daytime hours for KOP 10. The daytime visual impact from the flaring events is largely indistinguishable in the distance from the other Project impacts. Distance, bright daytime sky, and vegetation along the horizon as well as the presence of multiple vertical structures of the Project would reduce any additional visual contrast and impact from the daytime flare events.

Viewer sensitivity from this KOP would be high because the overlook focuses recreational visitors' attention toward the historic battlefield and provides important information about the history of this site and the surrounding area. Therefore, viewers would be sensitive to changes in the landscape that would detract from the historical characteristics of the view. From this KOP, the Project would appear subordinate in the broader landscape and would be unlikely to attract viewers' attention. Construction and operation of the Project would result in a low potential impact on the view from KOP 10.

In general, Annova's Visual Impact Assessment showed that visual impacts can potentially occur at all KOPs and ranged from low to moderate at most locations. However, the visual impacts at KOP 8 at the State Highway 48 pull-off near Bahia Grande Channel would be moderately high at this one isolated location. In considering the totality of these impacts, we conclude that visual impacts from the Project would only be of moderate impact and not be significant.

4.8.6 Coastal Zone Management

The CZMA calls for the "effective management, beneficial use, protection, and development" of the nation's coastal zone and promotes active state involvement in achieving those goals. As a means to reach those goals, the CZMA requires participating states to develop management programs that demonstrate how those states will meet their obligations and responsibilities in managing their coastal areas.

The Project would be located within the Texas coastal zone boundary. The Combined Coastal Management Program and FEIS for the State of Texas identifies 16 Coastal Natural Resource Areas. The Project area contains four of these areas: coastal wetlands, special hazard areas, tidal sand or mud flats, and waters under tidal influence. The federal CZMA requires a federal consistency review for actions taken or authorized by federal or state agencies that may affect an approved state coastal zone. For oil and gas projects within the Texas coastal zone boundary, the RRC administers the CZMA and is the lead state agency that performs federal consistency reviews for such facilities.

Annova submitted a request to the RRC on July 21, 2016, for a determination of consistency with the Texas Coastal Management Program. On August 30, 2017, Annova submitted a supplemental filing to their July 21, 2016 request. This supplemental filing updated text previously filed with the RRC to reflect changes to the Project design and impacts on waters of the U.S. A determination from the RRC that the Project is consistent with the Texas Coastal Zone Management Plan must be received before we could issue a notice to proceed with constructing the Project. Annova has not yet obtained this authorization, therefore, **we recommend that:**

- **<u>Prior to construction</u>, Annova should file with the Secretary a determination from the Texas Coastal Coordination Advisory Committee that the Project is consistent with the laws and regulations of the state's Coastal Zone Management Program.**

The FERC would not approve construction until all federal authorizations, including a consistency determination with the CZMA, have been granted.

4.8.7 Conclusion

Construction and operation of the Project would permanently convert about 412 acres of undeveloped land along the BSC to an industrial use but would not conflict with any zoning laws or future plans of the BND or Cameron County. Construction and operation of the Project would not be expected to affect existing or planned residential or commercial land uses and would not be expected to restrict land use on adjacent properties or displace any residences or businesses. The Project site was formally part of a wildlife preserve managed by the FWS under a lease agreement with the BND, however that lease has expired and there are currently no public lands directly affected by the site. The proposed access road would cross a portion of the Lower Rio Grande Valley NWR which would require an appropriateness determination and a compatibility determination from the FWS, for which a decision has not been made.

Based on our analysis, Project construction and operation would not result in significant impacts on current land use, visual impacts, and recreation.

4.9 SOCIOECONOMICS

The new facilities for the Project would be located entirely within Cameron County, Texas. Cameron County is part of the Brownsville-Harlingen-Raymondville Consolidated Statistical Area, which also includes Willacy County to the north. These two counties form the primary socioeconomic impact area for this analysis. Cities and towns in the vicinity of the Project include Brownsville, Cameron Park, Los Fresnos, Port Isabel, Laguna Heights, Laguna Vista, Long Island, and South Padre Island.

Cameron County is located in the southeast corner of the Lower Rio Grande Valley. The Lower Rio Grande Valley includes Cameron, Hidalgo, Willacy, and Starr Counties, which lie along the South Texas border, separated by the Rio Grande River from the Mexican state of Tamaulipas. These four counties along with the neighboring Mexican cities of Matamoros, Reynosa, and Rio Bravo have a total combined population of approximately 2.7 million (Brownsville Economic Development Council 2015).

4.9.1 Population

Cameron and Willacy Counties had estimated populations of 420,392 and 21,903 in 2014, respectively (see table 4.9.1-1). The population in both counties increased between 2010 and 2014 at a slower rate than the state of Texas as a whole, with Willacy County actually losing population over this period. The population in Cameron County increased at a slightly faster rate than the statewide average from 2000 to 2010, with Willacy County growing at about half the statewide average. Population is projected to increase statewide and in both counties over the next two decades (Texas State Data Center 2014). Projected increases as a percentage of existing population in both counties are expected to be larger than the statewide average increase (see table 4.9.1-1).

TABLE 4.9.1-1

Population by County and State

Geographic Area	2014 Population	2014 Population Density (persons/ square mile)	Population Change (Percent)		Projected Population Change (Percent)	
			2000 to 2010	2010 to 2014	2010 to 2020	2020 to 2030
Cameron County	420,392	471.9	21.2%	3.5%	14.3%	13.8%
Willacy County	21,903	37.1	10.2%	-1.0%	12.0%	10.5%
State of Texas	26,956,958	103.2	20.6%	7.2%	8.3%	6.4%

Sources: Texas State Data Center 2014; U.S. Census Bureau 2000, 2016a

Cameron County is more densely populated than Willacy County and the state of Texas, with almost 5 times as many people per square mile than the state average (table 4.9.1-1). This primarily reflects the presence of the cities of Brownsville and Harlingen, which combined, had a total estimated population of 248,960 in 2014 (U.S. Census Bureau 2016a).

The city of Brownsville is the closest large city to the Project, with an estimated 2014 population of 183,046 (U.S. Census Bureau 2016a). Other nearby municipalities include Los Fresnos, South Padre Island, La Feria, and San Benito, with respective estimated 2014 populations of 6,447, 2,889, 7,308, and 24,506 (U.S. Census Bureau 2016a).

The Rio Grande Valley is also home to a large seasonal winter population, with retirees temporarily relocating to the region from their homes mainly in the Midwest and Canada. An estimated 53,000 households temporarily relocated to the region between November 1, 2013, and March 31, 2014 (the 2013-2014 season), the majority of which own a seasonal residence, mainly mobile homes or recreational vehicles (RVs) (The University of Texas-Pan American 2014).

Project construction would result in a short-term increase in population in the Project area. Construction is expected to be completed over a 48-month period, with an average of 700 workers employed on-site during this period. A total of 1,200 workers would be employed during peak construction, which is expected to last 6 months starting mid-way through the second year.

The duration of each worker's employment would vary depending on individual skillsets and Project needs, with workers moving in and out of the Project as it advances through construction. A management team would likely be employed for the duration of construction, with the remainder of the workers hired during construction likely employed for shorter periods. Very few, if any, of the non-local workers employed during the construction phase of the Project are expected to permanently relocate to the Project area or be accompanied by their families.

An average of 253 non-local workers (36 percent) are expected to be employed to perform the specialized jobs needed to complete the Project, while the remaining 447 workers (64 percent) are expected to be local hires from Cameron County, with a much smaller share potentially residing in Willacy County. During peak construction, up to 780 non-local workers (65 percent of the total labor force) may temporarily relocate to the region. The temporary relocation of non-local workers during average and peak construction conditions would be equivalent to 0.1 percent and 0.2 percent of the existing population in Cameron County. These potential impacts on the regional population are expected to be short-term and minor.

Operation and maintenance of the Project is expected to require approximately 165 personnel when fully operating. Annova anticipates that approximately 110 of these positions would be filled by non-local workers who would permanently relocate to the area. The relocation of approximately 110 workers and their families to the Project area is not expected to have a noticeable effect on the population in the area, based on the existing population sizes.

4.9.2 Economy and Employment

A summary of economic information for 2014 is presented in table 4.9.2-1. The statewide annual unemployment rate in Texas (5.1 percent) was lower than the U.S. average (6.2 percent) in 2014. Annual unemployment rates in Cameron and Willacy Counties were 8.3 percent and 12.3 percent, respectively, which is noticeably higher than the state and national averages (table 4.9.2-1).

Statewide per capita income in 2014 in Texas ($45,699) was similar to the national per capita ($46,409). Per capita income in Cameron and Willacy Counties was equivalent to just 55 percent and 56 percent of the state per capita in 2014, respectively, with per capita incomes of $25,211 and $25,480 (table 4.9.2-1). Based on 2014 data by U.S. Bureau of Economic Analysis (2015a), the top three economic sectors in the U.S. by employment were: government and government services; health care and social assistance; and retail trade. These sectors were also the major employers statewide in Texas, as well as Cameron and Willacy Counties (table 4.9.2-1).

TABLE 4.9.2-1

Economic Characteristics, 2014

State/County	Civilian Labor Force a/	Unemploy-ment Rate (Percent) a/	Per Capita Income a/	Percent of State/US Per Capita b/	Top Economic Sectors by Employment c/
Texas	**13,112,000**	**5.1**	**$45,669**	**99%**	**Government (12.4%), Retail Trade (9.7%), Health Care (9.5%)**
Cameron	167,645	8.3	$25,211	55%	Health Care (19.9%), Government (16.8%), Retail Trade (11.7%)
Willacy	7,250	12.3	$25,480	56%	Government (20.0%), Retail Trade (8.8%), Health Care (8.3%)
United States	**155,922,000**	**6.2**	**$46,049**	**100%**	**Government (12.9%), Health Care (11.2%), Retail Trade (10.1%)**

a/ Civilian labor force, unemployment rate, and per capita income are annual average figures for 2014.

b/ County per capita income is shown as a percent of the corresponding state average; the state figure is shown as a percent of the national average.

c/ Top industries by employment are identified from annual data compiled for 2014 by the U.S. Bureau of Economic Analysis. The full names of the identified sectors are: government and government services; health care and social assistance; and retail trade. Percentages indicate the share of total employment that each sector accounts for.

Source: U.S. Bureau of Economic Analysis 2015a, 2015b, U.S. Bureau of Labor Statistics 2015a, 2015b

Ernst & Young (2015) prepared an economic impact analysis of the Project on behalf of Annova. Annova estimated that it would spend $3 billion to construct the Project, of which an estimated $1.5 billion would be spent on construction of the Project and shared infrastructure in Texas, with $1.5 billion spent elsewhere. Project expenditures in Cameron County would include as estimated $130 million on construction materials. Materials expected to be purchased locally may include concrete, sand, gravel/rock, lumber, erosion and sediment control devices (e.g., silt fences, erosion control blankets, seeding, mulch), personal protective equipment, welding consumables (gases, rods, etc.), and other miscellaneous items and services.

Project expenditures would generate economic activity and support employment and income elsewhere in the state and local economy through the multiplier effect, as initial changes in demand "ripple" through the local economy and support indirect and induced impacts. Indirect and induced impacts are defined as follows:

- *Indirect* impacts are generated by the expenditures on goods and services by suppliers to the construction project. Indirect effects are often referred to as "supply-chain" impacts because they involve interactions among businesses.
- *Induced* impacts are generated by the spending of households associated either directly or indirectly with the project. Workers employed during construction, for example, use their income to purchase groceries and other household goods and services. Workers at businesses that supply the facility during construction or operation do the same. Induced effects are sometimes referred to as "consumption-driven" impacts.

Ernst & Young (2015) developed estimates of total (direct, indirect, and induced) economic impact for Cameron County and the State of Texas. These estimates were developed using separate IMPLAN models for each geographic area and were based on projected spending. Statewide, construction of the Project was estimated to support 2,753 total jobs, $1.1 billion in labor income, and $3.9 billion in economic output (table 4.9.2-2). The average annual wage of workers hired directly to support construction of the Project was estimated to be the equivalent of $77,220, or $6,435 per month. In Cameron County, the Project was estimated to support 2,011 total jobs, $688.2 million in total labor income, and $3.0 billion in associated economic output. (Ernst & Young 2015). These estimates are one-time economic impacts that would be generated during the 48-month construction period.

TABLE 4.9.2-2

Estimated One-Time Economic Impacts of Project Construction

Type of Impact	Average Employment	Labor Income ($ million)	Output ($ million)
Texas Statewide Impacts			
Direct	675	$323.8	$1,545.5
Indirect	1,132	$591.2	$1,795.9
Induced	946	$183.5	$527.5
Total a/	**2,753**	**$1,098.5**	**$3,868.9**
Cameron County Impacts			
Direct	447	$245.3	$1,423.3
Indirect	993	$368.7	$1,373.7
Induced	571	$74.1	$228.5
Total a/	**2,011**	**$688.2**	**$3,025.5**

a/ Columns may not sum due to rounding

Source: Ernst & Young 2015

Ernst & Young (2015) also developed estimates of annual economic impacts associated with operation and maintenance of the Project. Operation and maintenance of the Project would require 165 personnel once all six liquefaction trains are fully operating, as indicated in table 4.9.2-3. This direct employment would generate approximately $17.3 million in annual labor income in Cameron County, with an estimated average salary per worker of $105,000, including benefits (Ernst & Young 2015). Operations and maintenance was estimated to support 446 total (direct, indirect, and induced) jobs in Cameron County, $30.8 million in total labor income and $522 million in economic output. Statewide, the Project was estimated to support 2,855 total jobs, $334.3 million in labor income, and $1.2 billion in economic output annually.

TABLE 4.9.2-3

Estimated Annual Economic Impacts of Project Operation

Type of Impact	Average Employment	Labor Income ($ million)	Output ($ million)
Texas Statewide Impacts			
Direct	165	$17.3	$463.6
Indirect	1,185	$244.2	$478.0
Induced	1,504	$72.7	$208.9
Total a/	**2,855**	**$334.3**	**$1,150.6**
Cameron County Impacts			
Direct	165	$17.3	$463.6
Indirect	106	$7.8	$40.9
Induced	175	$5.7	$17.5
Total a/	**446**	**$30.8**	**$522.0**

a/ Columns may not sum due to rounding.

Source: Ernst & Young 2015

4.9.2.1 Ports

The Port of Brownsville handled an estimated 9.1 million tons of cargo in 2015, the highest amount in the last 10 years (Port of Brownsville 2016). Commodities moving through the Port included steel, aluminum, lumber, minerals, gasoline, diesel, and windmill components. More than 230 companies were located in the BND in 2012 (Martin Associates/John C. Martin Associates, LLC [Martin Associates] 2012). According to a study by Martin Associates (2012), activity at the Port of Brownsville contributed an estimated $926.7 million to the regional economy in 2011, with direct employment of 4,393 jobs and total (direct, indirect, and induced) employment of 11,230 jobs in the region.

The Port of Port Isabel is located approximately 3 miles west of the Brazos-Santiago Pass and is primarily accessed from the BSC. Due to the location of the entrance to Port Isabel, the Port of Brownsville commercial vessel traffic data recorded by the harbor master includes data for Port Isabel (Bearden 2015). The Port of Port Isabel has five business and industry lessees, including an offshore pipe manufacturer, a freezer food packing operation, federal administrative buildings, and seven shrimp boats; and handled approximately 13,000 tons of cargo in 2014 (Bearden 2015).

Construction of the Project is expected to indirectly support jobs and industries associated with the Port of Brownsville, with a portion of the indirect employment and labor income supported during construction expected to occur with suppliers and support vessel companies who regularly do business with port industries and are equipped to serve the needs of the Project during construction (Ernst & Young 2015). The Port of Port Isabel is less likely to be affected by Project construction due to its much smaller size.

Annova would lease the Project site from the BND. Lease payments and property taxes paid to the Brownsville Navigation District would generate revenues during the Project's operation. As with the Project's construction, a portion of the indirect employment and labor income estimated to be generated by the Project would occur with suppliers and transportation related companies who regularly do business at the Port of Brownsville and are equipped to serve the needs of the Project during operation (Ernst & Young 2015). The Port of Port Isabel may also be positively affected by operation of the Project, but the majority of Project impacts on local area ports would be expected to be on the Port of Brownsville.

4.9.2.2 Recreation and Tourism

Recreation and tourism contribute to state and local economies. Visitors generate local revenue and support employment and income through spending on accommodations, food, local transportation and gas, arts, entertainment, recreation, and other retail purchases. In 2014, travelers spent an estimated $70.6 billion in Texas, including $804 million in Cameron County and $26 million in Willacy County (table 4.9.2-4). In 2014, Cameron County ranked 11th out of 254 Texas counties in terms of total annual visitor spending (Dean Runyan Associates 2015).

Travel-related employment accounted for about 3.9 percent of total employment in Texas, 4.5 percent in Cameron County, and 2.4 percent in Willacy County. These estimates developed by Dean Runyan Associates (2015) include business, as well as leisure travel, and do not distinguish between the two. However, separate studies found that leisure travel accounted for 94 percent of travel to and within Cameron County measured in visitor days, and 73.3 percent of all travel to and within Texas (D.K. Shifflet & Associates, Ltd. 2015a, 2015b).

TABLE 4.9.2-4

Tourism-Related Economic Impacts by County and State

Geographic Area	Travel Spending ($ million)	Employment (Jobs		Earnings ($ million)	
		Travel	Travel as a % of Total	Travel	Travel as a % of Total
Cameron County	$803.5	8,480	4.5%	$186.3	2.9%
Willacy County	$26.4	150	2.4%	$3.7	1.6%
Texas	$70,594.0	629,700	3.9%	$21,781.0	2.3%

Source: Dean Runyan Associates 2015

Primary attractions in the region include beach and waterfront usage, visiting national and state parks, wildlife viewing, and other outdoor sports, including fishing, biking, and sailing (D.K. Shifflet & Associates 2015). Nature tourism in the region includes birding, with the Lower Rio Grande Valley (Cameron, Hidalgo, Willacy, and Starr Counties) identified as the number two birdwatching destination in North America (Mathis and Matisoff 2004). Nature tourism in the Valley supported an estimated 6,613 total (direct, indirect, and induced) jobs and $163 million in total labor income in 2011 (Texas A&M University 2012). The majority of the visitors surveyed as part of this study were most likely birders, as data were collected at seven locations, five of which were designated birdwatching sites, with additional survey data collected at a birding festival in Harlingen (Texas A&M University 2012).

Existing recreational resources in the vicinity of the Project site are discussed in section 4.8 of this EIS. Recreational resources include birding sites, such as the World Birding Center and part of the Great Texas Birding Trail; recreational fishing locations, such as the Jaime J. Zapata Memorial Boat Ramp Fishing Pier and Kayak Launch Area; the Laguna Atascosa NWR and Lower Rio Grande Valley NWRs; the South Bay Coastal Preserve; the Padre Island National Seashore; and three historic battlefields (see section 4.8).

In addition, South Padre Island, a major tourist destination known nationally for its beaches, is heavily developed with hotels/motels, retail shops, and entertainment venues. Tourism and tourism-related industries are the main economic activities on the island, with more than a million visitors annually, and total estimated visitor spending of $360 million in 2014 (Aaron Economic Consulting 2015). As discussed in section 4.8, Project construction and operation would not affect beachgoers visiting South Padre Island because the beaches are on the ocean side of the island, facing away from the Port of Brownsville and the Project site.

The City of South Padre Island and the COE work together to use dredged sand from the Brazos-Santiago Pass to nourish the South Padre Island beaches (Trevino 2016). Dredging in the BSC conducted for the Project is not expected to displace any sand that would otherwise be used for South Padre Island beach nourishment (i.e., the Project would not interfere with existing sources of sand used for beach nourishment). Annova has indicated that it is evaluating the potential for beneficial use of dredged and excavated material (Black & Veatch 2016f).

Impacts on recreational resources and use during Project construction and operation are discussed in section 4.8. Project-related impacts from construction and operation are generally expected to be short-term and site-specific, and are not expected to affect regional tourism patterns or the overall level of visitation to the region.

4.9.2.3 Commercial Fishing

Commercial fishing near the Project mainly takes place in the Gulf of Mexico, with some fishing also taking place in estuarine waters, and a few shrimp boats that trawl in the BSC for marketable bait shrimp. The Ports of Brownsville and Port Isabel together were the 12th largest port in the Gulf of Mexico by landing weight in 2014 and the second largest based on value. A total of 12.1 million pounds were landed in 2014, with a landed value of $84.2 million (in 2014 dollars) (National Ocean Economics Program 2016a). The main catch landed at the Ports of Brownsville and Port Isabel is shrimp, almost all of which is caught offshore in the Gulf of Mexico. Shrimp boats are prohibited from fishing in many of the area's estuarine waters to protect seagrasses and because few areas are deep enough for trawling (Ferguson 2015). Landed weight at the Ports of Brownsville and Port Isabel fluctuates from year-to-year, but has generally declined since 2009, with the largest decrease occurring from 2013 to 2014, with a drop of 8.6 million pounds (from 20.7 million pounds to 12.1 million) (National Ocean Economics Program 2016b).

The commercial fishing that does occur in the estuarine waters of Cameron and Willacy Counties are dominated by bait fisheries, with a small black drum (*Pogonias cromis*) commercial fishery also present (Fisher 2015). The bait fisheries are almost exclusively shrimp, with most shrimping occurring in and around the Intracoastal Waterway where the water is deep enough for the gear to deploy (Fisher 2017). In 2013, the total commercial fish catch in estuarine waters of Cameron and Willacy Counties weighed approximately 0.7 million pounds, accounting for about 3 percent of the total catch of 20.7 million pounds landed at the Ports of Brownsville and Port Isabel that year (Fisher 2015).

The total shrimping fleet operating out of the Ports of Brownsville and Port Isabel has decreased from a high of around 350 vessels in the 1990s to approximately 160 vessels in the late 2000s (Nelsen 2008). The majority of the shrimping fleet in the Project area docks along the BSC, primarily in the Port of Brownsville Fishing Harbor. A recent survey conducted by the Port of Brownsville identified a total of 127 shrimp vessels operating out of the Port of Brownsville Fishing Harbor (Rosenbaum 2016). Approximately 50 shrimp boats dock in marinas in or near Port Isabel (Bearden 2015).

Dredging activities during Project construction would temporarily affect those shrimpers who operate adjacent to the Project site. Annova estimates that in-water dredging would require approximately 176 working days. Temporarily displaced shrimpers would be able to trawl elsewhere in the BSC or nearby Gulf of Mexico. Access to the portion of the BSC adjacent to the Project site would be restored following the completion of dredging, subject to any security measures in place while LNG carriers are present. Construction barge traffic is not expected to affect the passage of shrimp boats or other commercial fishing vessels through the BSC.

Commercial fishermen who dock along the BSC may experience delays when LNG carriers are making ports of call at the Project site. The presence of an LNG carrier could delay commercial fishing vessels leaving or returning to the docks at the Port of Brownsville Fishing Harbor. In addition, for safety reasons, the few shrimp boats that trawl for bait shrimp in the BSC may be required to delay or postpone shrimping activities when an LNG carrier is moving through the fairway due to the moving safety zone located around the LNG carriers (see section 4.9.10.2). Annova estimates that on average, 2-6 LNG carriers per month would visit the Project once fully operational, up to a maximum of 80 visits per year. Potential impacts on fishery resources are discussed in section 4.6 of this EIS.

4.9.3 Property Values

The Project is not expected to affect surrounding residential or commercial property values. Presently undeveloped, the Project site is located entirely on property owned by the Brownsville Navigation District and designated for industrial use. Factors expected to influence the potential for a facility to impact property values include the presence of similar industrial or commercial uses and the distance to the potentially affected properties. Visual impacts, noise, traffic congestion, and odors have been identified as conditions with the potential to affect property values (Yellow Wood Associates 2004). Industrial and similar developments have been found to affect property values within an approximate 2-mile radius (Yellow Wood Associates 2004).

Land in the vicinity of the Project is generally undeveloped and natural, with the exception of dredged material placement areas adjacent to the site on the east and west borders. The surrounding area is generally flat to very gently rolling, and consists mainly of shallow waterbodies, mudflats, and marshes. Because the landscape is generally flat and open, tall structures are often visible from far distances in the region (see section 4.8.4). While these factors suggest the potential for impacts on residential property values, the closest residences to the Project site boundary are located more than 2 miles from the Project, with the nearest residences located approximately 2.3 miles to the south, on County Road 199, off of SH 4. These residences are separated from the Project site by the Lower Rio Grande Valley NWR. The next closest residential developments are located from about 4.7 to 5.1 miles northeast of the Project site and include Port Isabel, Laguna Heights, and Long Island. As noted in section 4.8.2, no residential areas or subdivisions are planned for development within a 0.25-mile radius of the site, and the closest area zoned for residential use by the City of Brownsville is located more than 9 miles southwest of the Project site. As a result, the Project is not expected to affect residential property values.

The only planned commercial development located within 0.25 mile of the Project site is another potential LNG facility and export terminal proposed by Rio Grande LNG, LLC, and located on the north side of the BSC. A third potential LNG facility, proposed by Texas LNG Brownsville, LLC, would also be located on the north side of the ship channel, approximately 2 miles northeast of the Project site. Development of the proposed Annova facility is not expected to affect the value of these properties or potential developments, or the value of other surrounding commercial property owned by the BND.

4.9.4 Construction Payroll and Material Purchases

Annova plans to invest approximately $3 billion to construct the Project and develop the surrounding infrastructure, with in-state construction costs expected to total $1.546 billion (Ernst & Young 2015). The Project would have an estimated statewide total construction payroll of approximately $323.8 million over the 48-month construction period. As noted in section 4.9.2, an estimated $130 million would be spent on construction materials within Cameron County.

Once construction is complete, the Project would generate an estimated annual payroll of $17.3 million during operation. Ernst & Young (2015) estimate that operation of the Project would involve $446 million in annual expenditures, with $330 million of these purchasers from Texas suppliers. The majority of these in-state purchases are expected to be for utilities ($152 million) and pipeline transportation ($150 million).

4.9.5 Tax Revenues

Revenues and expenditures for fiscal year (FY) 2015 are presented for Cameron County in table 4.9.5-1. Taxes were the main source of revenue in Cameron County, followed by Intergovernmental revenue, accounting for 53 percent and 25 percent of total revenues, respectively. Total assessed values for real property and personal property in Cameron County in FY 2015 were $14.346 billion and $2.217 billion, respectively, for a combined total of about $16.5 billion. The property tax rate was $0.399291 per $100 assessed taxable valuation, and the total property tax levy was $66.1 million (Cameron County 2016).

The Project site is owned by the BND, a political subdivision of the State of Texas. Property taxes for BND properties are billed and collected by Cameron County for a fee and remitted to the BND. Annova would lease the Project site from the BND, with property taxes charged against improvements on Port of Brownsville property and the value of the leasehold. Improvements on BND land are not subject to city property taxes (BND 2015b).

TABLE 4.9.5-1

Revenues and Expenditures in Cameron County for FY 2015

Category	Revenues/Expenditures ($ million)
Taxes	$65.4
Licenses, Permits, Charges, Fees, and Fines	$20.1
Intergovernmental Revenue	$30.9
Other Revenue	$6.8
Total Revenue	**$123.2**
General Government	$18.5
Public Safety	$68.8
Highways and Streets/Public Works	$11.7
Health and Welfare	$19.1
Other Expenditures	$18.6
Total Expenditures	**$136.8**

Sources: Cameron County 2016

Construction of the Project would generate an estimated $192 million in state and local taxes, with approximately 60 percent of this total paid directly by Annova (Ernst & Young 2015). This total estimate ($192 million) also includes estimated state and local taxes that would result from economic activity supported elsewhere in the state economy (indirect and induced effects), with indirect and induced activity estimated to generate $50.1 million and $15.6 million of the total, respectively (Ernst & Young 2015).

The facility would be located in an unincorporated part of Cameron County that is not subject to local sales taxes. As a result, purchases of construction materials and facility equipment would not generate local sales tax revenues for the county. However, according to Ernst & Young (2015), Project construction would still generate approximately $17 million in local taxes for Cameron County, with the majority of this total expected to be generated by taxes on indirect ($11.5 million) and induced ($2.3 million) economic activity.

Operation of the Project would also generate state and local tax revenues, with total (direct, indirect, and induced) economic activity supported by Project operation estimated to generate an estimated $13.5 million and $47.8 million in annual state and local tax revenues, respectively (table 4.9.5-2). These estimates include approximately $34.2 million in state and local tax revenues that would be generated in local jurisdictions in Cameron County, including the Cameron County government, City of Brownsville, and the BND. Direct property tax payments to the Brownsville Navigation District are expected to account for 77 percent ($24.2 million) of the estimated payments to local jurisdictions in Cameron County (Ernst & Young 2015).

Annova had initially explored the option of obtaining property tax abatement agreements from the Point Isabel Independent School District (ISD) and Cameron County; however, the Point Isabel ISD did not approve an abatement agreement for the Project (Chapa 2015). Annova discontinued exploring a property tax abatement with Cameron County. As a result, no tax abatements would apply to the Project.

TABLE 4.9.5-2

Estimated Annual State and Local Tax Revenues by Tax Type

	Estimated Annual Tax Revenues ($000) a/			
Tax Type	Direct	Indirect	Induced	Total
State Taxes				
Sales and Excise Tax	$587	$8,269	$2,463	$11,319
Texas Margin Tax	–	$1,016	$302	$1,318
Other State Taxes	$44	$624	$186	$854
Total State Taxes	***$631***	***$9,909***	***$2,951***	***$13,491***
Local Taxes				
Property Taxes	$33,681	$8,861	$2,639	$45,181
Other Local Taxes	$78	$1,941	$578	$2,597
Total Statewide Local Taxes	***$33,759***	***$10,802***	***$3,217***	***$47,778***
Total State and Local Taxes	**$34,390**	**$20,711**	**$6,168**	**$61,269**

a/ Tax estimates are based on estimated total (direct, indirect, and induced) economic activity supported by operation of the Project.

Source: Ernst & Young 2015

4.9.6 Housing

Available housing is summarized by geographic area in table 4.9.6-1 using estimates for 2014, as prepared by the U.S. Census Bureau (2016b, 2016c). The Census Bureau defines a housing unit as a house, apartment, mobile home or trailer, group of rooms, or single room occupied or intended to be occupied as separate living quarters. The rental vacancy rate in

Cameron County was higher than the state average, with almost 5,000 housing units available for rent, approximately 1,300 of which were located in the city of Brownsville (table 4.9.6-1).

TABLE 4.9.6-1

Housing

Geographic Area	Housing Units 2014				Hotels and Motels 2015		
	Total Housing Units	Rental Vacancy Rate	Units Available for Rent	For Seasonal, Recreational, or Occasional Use a/	Number of Facilities	Number of Rooms	Number of RV and Mobile Home Parks 2015 b/
Texas	**10,187,189**	**8.5**	**318,661**	**241,679**	**4,771**	**415,485**	**na**
Cameron County	144,180	11.0	4,943	10,736	103	6,911	110
Willacy County	7,073	8.1	98	605	6	198	4
City of Brownsville	55,618	6.3	1,283	1,706	36	1,649	25

na = not available

a/ Housing units for seasonal, recreational, or occasional use are generally considered to be vacation homes. They are not included in the estimated number of housing units available for rent.

b/ RV and mobile home parks are counted together because most parks have a mix of both.

Sources: Marchex, Inc. 2015, Source Strategies 2016b, The Winter Texas Connection 2015, U.S. Census Bureau 2016b, 2016c

Data on hotels and motels are also presented in table 4.9.6-1. Almost 7,000 hotel rooms are located in Cameron County, approximately 1,650 of which are located in the city of Brownsville. More than half of the hotel rooms in Cameron County are located in South Padre Island. The supply and availability of hotel and motel rooms varies seasonally. Viewed by quarter, 5-year average hotel occupancy rates in Cameron County (2011 to 2015) ranged from 41.2 percent in the fourth quarter to 61.7 percent in the third quarter, with the estimated number of rooms typically unoccupied and available for rent ranging from approximately 2,900 (third quarter) to about 3,375 (fourth quarter), with an annual average of 3,200 available rooms (Source Strategies 2016a). In Brownsville, 5-year average hotel occupancy rates (2011 to 2015) ranged from 53.6 percent (fourth quarter) to 65.0 percent (third quarter), with the estimated number of rooms typically unoccupied and available for rent ranging from approximately 560 (third quarter) to about 720 (fourth quarter), with an annual average of approximately 680 available rooms (Source Strategies 2016a).

Temporary accommodation is also available in the form of RV and mobile home parks in the Project vicinity. Comprehensive data are not available for these types of resources, but information compiled by Annova indicates that an estimated 110 RV and mobile home parks are located in Cameron County, with 25 of these parks located in Brownsville (table 4.9.6-1). According to a study of Winter Texans by the University of Texas-Pan American (2014), the average RV and mobile home park in the Rio Grande Valley region has approximately 193 sites, with RV sites comprising an average of 61 percent or 118 of these sites, and 62.1 percent of all RV sites occupied by Winter Texans during the winter months. In the absence of comprehensive data, these estimates may be used to approximate the number of RV sites potentially available in Cameron County. Based on the average number of sites, the RV share of these sites, and the portion occupied by Winter Texans, RV and Mobile Home parks in Cameron County include an estimated 13,000 RV sites, with Winter Texans occupying more than 8,000 of these sites during the winter months, leaving almost 5,000 sites available for other users.

The temporary relocation of non-local workers to the Project area during construction would likely result in an increase in demand for temporary housing. An average of 253 non-local workers are expected to be employed for the duration of the Project, with up to 780 non-local workers expected during peak construction. Review of available temporary housing resources suggests that almost 5,000 housing units were available for rent in Cameron County, including approximately 1,300 in the city of Brownsville. An estimated annual average of 3,200 hotel rooms are usually unoccupied in Cameron County, including an estimated 680 units in Brownsville, with several thousand RV sites also likely to be available. This suggests that sufficient temporary housing resources likely exist within daily commuting distance of the Project site, and the temporary relocation of non-local workers is unlikely to displace tourists or other seasonal visitors.

Operation and maintenance of the Project is expected to require approximately 165 personnel once all six liquefaction trains are fully operating. Annova anticipates that approximately 110 of these positions would be filled by non-local workers who would permanently relocate to the area. The relocation of approximately 110 workers and their families to the Project area is not expected to affect the supply of regional housing resources.

4.9.7 Removal of Agricultural, Pasture, or Timberland from Production

Construction and operation of the Project would not require the removal of agricultural land, pasture, or timberland from production; therefore, no adverse impacts on these resources would occur.

4.9.8 Public Services

4.9.8.1 Public Safety

Cameron County is divided into 10 "fire zones," each of which is under the responsibility of a fire department. Unincorporated areas of the county are included in these zones so that no area of the county is outside a fire department's area of responsibility. The Project site is located in Zone 1 (Brownsville) and the Brownsville Fire Department is responsible for dispatching first responders to a fire or related emergency in the area. Cameron County has a total of 12 fire departments and 29 fire stations (table 4.9.8-1). Brownsville and Harlingen have multiple fire stations, commensurate with their geographic size and population, staffed primarily by career firefighters. Willacy County is served by six fire departments, each consisting of one fire station and, in the case of Santa Monica, one fire truck with on-call firefighters (Gutierrez 2015).

TABLE 4.9.8-1

Public Safety Services: Fire Departments and Law Enforcement Agencies

Geographic Area	Fire Departments	Fire Stations	Municipal and County Law Enforcement Agencies a/
Cameron County	12	29	11
Willacy County	6	7	2
Total	**18**	**36**	**13**

a/ Does not include university or port-affiliated police departments, or other private enforcement agencies.
Sources: FireDepartment.Net 2015a, 2015b; Gutierrez 2015; USA Cops 2015a, 2015b; Cameron County 2009

Cameron County has a total of 11 county and municipal law enforcement agencies; another two agencies are located in Willacy County (table 4.9.8-1). Both counties have a county sheriff department, with local offices in cities and towns. Raymondville is the only city in Willacy County with a municipal police department. The Willacy County Sheriff's Department is responsible for the remainder of the county.

Construction of the Project facilities could result in increased demand for emergency services due to the temporary relocation of non-local workers and family members to local communities during construction. However, given the short-term nature of most of the construction jobs and the relatively small temporary increase in population, the temporary influx of non-local workers is not expected to affect the levels of service provided by existing law enforcement and fire protection personnel.

Annova would work directly with local law enforcement, fire departments, and emergency medical services to coordinate for effective emergency response at the Project site (medical services are discussed further in section 4.9.8.2). Police personnel may also be called upon to assist in traffic control, but these impacts would be short-term and minor.

Annova does not anticipate the need for additional local emergency services and facilities during normal Project operations. The potential relocation of approximately 110 workers and their families to the Project area would have a negligible impact on the population in the area and demand for services. Project facilities would include independent fire protection systems, with water from the BSC used for the firewater supply and distribution system. Annova has initiated consultation with the Texas Department of Public Safety and the BND, and would continue to consult with the appropriate authorities to ensure that fire protection and other safety systems meet all applicable codes and standards. Public safety is discussed further in section 4.12.

4.9.8.2 Medical Facilities

Sixteen hospitals and medical centers provide emergency and generalized care in Cameron County. The closest major hospitals to the Project site are Valley Regional Medical Center and Valley Baptist Medical Center Brownsville, both located within the city limits of Brownsville. Both hospitals provide comprehensive medical services and are designated Advanced Level III Trauma Centers by the Texas Department of Health, providing emergency coverage 24 hours a day (Valley Baptist Medical Center 2015; Valley Regional Medical Center 2015). Willacy County has one hospital, with additional medical services provided by walk-in health care clinics (Marchex, Inc. 2015).

Construction of the Project is not expected to have significant adverse impacts on local and regional medical facilities and services. Temporary relocation of non-local workers and families during construction, and the permanent relocation of some during operation, is not expected to affect existing levels of health care and medical services. Annova would work directly with local law enforcement, fire departments, and emergency medical services to coordinate for effective emergency response in the event of an incident during the Project's construction or operation.

4.9.8.3 Schools

The Project site is located in the Point Isabel ISD. Schools in this ISD are located in and near the town of Port Isabel north of the BSC. Port Isabel Junior High and High School are the closest schools, located approximately 4.0 miles to the north-northeast of the Project site. The closest schools in the neighboring Brownsville ISD are located about 10 miles southwest of the Project site. Table 4.9.8-2 identifies all of the public ISDs in Cameron and Willacy Counties, along with the number of schools and estimated number of students by ISD. As shown in table 4.9.8-2, approximately 103,200 students were enrolled in 147 schools in Cameron County for the 2013-2014 school year, with a further 4,500 students enrolled in 14 schools in Willacy County.

Few of the non-local workers temporarily relocating to the Project area would be expected to be accompanied by their families, therefore the temporary workforce would not be expected to affect existing average student/teacher ratios. During operation, assuming an average family size of 3.3 consisting of 1.3 school-aged children, the potential relocation of approximately 110 workers and their families to the Project area would add approximately 144 students to area schools.[11] This addition would be equivalent to approximately 0.3 percent of current enrollment in the Brownsville ISD and 0.1 percent of total enrollment in Cameron County. The potential addition of these students would have a minor impact on existing student/teacher ratios.

TABLE 4.9.8-2

Public School Inventory in the Project Area

School District	Total Schools	Total Students
Cameron County		
Brownsville ISD	58	49,314
Harlingen CISD	30	18,745
La Feria ISD	7	3,597
Los Fresnos CISD	14	10,523
Point Isabel ISD	4	2,637
Rio Hondo ISD	4	2,168
San Benito CISD	19	11,010
Santa Maria ISD	3	727
Santa Rosa ISD	3	1,170
South Texas ISD	5	3,353
Cameron County Total	**147**	**103,244**
Willacy County		
Lyford CISD	3	1,586
Lasara ISD	3	487
Raymondville ISD	5	2,154
San Perlita ISD	3	276
Willacy County Total	**14**	**4,503**

CISD = Consolidated Independent School District
ISD = Independent School District
Source: Texas Education Agency 2015

11 According to the 2010 Census, the average family size in Texas is 3.31 (U.S. Census Bureau 2010).

4.9.8.4 Public Utilities

The Brownsville Municipal Solid Waste Landfill serves Brownsville and surrounding areas and is located approximately 8.5 miles southwest of the Project site. The landfill has approximately 38 years of waste disposal capacity remaining (City of Brownsville Public Works 2016). The landfill accepts household waste, construction waste, and certain special wastes.

The Brownsville Public Utilities Board, a municipally owned utility, provides electrical, water, and wastewater services to at least 46,000 customers in and around the City of Brownsville, including the BND (Brownsville Public Utilities Board 2016). The Brownsville Public Utilities Board's potable water infrastructure includes three water treatment plants with a combined rated capacity that exceeds the peak demand of its current customer base (Brownsville Public Utilities Board 2013). The American Electric Power Service Corporation (AEP) and STEC also provide electricity in the Brownsville area. STEC provides wholesale electric power to member cooperatives in South Texas, including the Magic Valley Electric Cooperative, which has over 4,800 miles of power lines and more than 90,000 members. Annova would be a retail customer of the Magic Valley Electric Cooperative. Texas Gas Service provides local natural gas distribution services in the Brownsville area.

The temporary relocation of construction workers and their families to the Project area is not expected to affect the service capacities of the local public utilities that serve the Project area. Construction-related solid waste would be disposed of at the Brownsville Municipal Solid Waste Landfill. As stated above, the landfill has approximately 38 years of waste disposal capacity remaining, and it is expected to be able to accommodate the addition of Project construction-related solid waste. Potable water would be provided by the BND, which obtains water from the Brownsville Public Utilities Board. Estimated Project water requirements during construction and operation would be equivalent to approximately 0.34 percent and 0.07 percent of the Brownsville Public Utilities Board's rated capacity for potable water (40 million gallons per day), respectively. Temporary wastewater services would be provided during construction, with Annova renting temporary sanitary facilities through a third party to serve the construction crew on-site. Following construction, wastewater services would be provided by the Brownsville Public Utilities Board.

The potential relocation of approximately 110 workers and their families to the Project area during operation would not be expected to affect the service capacities of local public utilities.

4.9.9 Environmental Justice

For projects with major aboveground facilities, FERC regulations (18 CFR 380.12(g)(1)) direct us to consider the impacts on human health or the environment of the local populations, including impacts that would be disproportionately high and adverse for minority and low-income populations. The EPA's Environmental Justice Policies (which are directed, in part, by Executive Order 12898: Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations) focus on enhancing opportunities for residents to participate in decision making. The EPA (2011) states that Environmental Justice involves meaningful involvement so that: "(1) potentially affected community residents have an appropriate opportunity to participate in decisions about a proposed activity that would affect their environment and/or health; (2) the public's contributions can influence the regulatory agency's decision; (3) the concerns of all participants involved would be considered in the decision-making process; and (4) the decision-makers seek out and facilitate the involvement of those potentially affected." CEQ also has called on federal agencies to actively scrutinize a number of important issues with respect to environmental justice (CEQ 1997a).

As part of our NEPA review, we have evaluated potential environmental justice impacts related to the Project taking into account the following:

- the potential presence of minority and/or low-income communities;
- the potential for high and adverse human health or environmental effects to disproportionately affect identified minority and/or low-income populations; and
- public participation strategies, including community or tribal participation in the NEPA process (CEQ 1997a).

4.9.9.1 Minority and Low-Income Communities

Guidelines provided by the CEQ (1997) and EPA (1998) indicate that a minority community may be defined as one where the minority population comprises more than 50 percent of the total population or comprises a meaningfully greater share of total population than the share in the general population. Minority communities consist of individuals who are members of non-White population groups. Minority population groups include the following: Hispanic; African American/Black; Asian; American Indian and Alaska Native; Native Hawaiian and Other Pacific Islander; and Some Other Race (see table 4.9.9-1). Minority communities may consist of a group of individuals living in geographic proximity to one another, or a geographically dispersed set of individuals who experience common conditions of environmental effect. Further, a minority population exists if there is "more than one minority group present and the minority percentage, as calculated by aggregating all minority persons, meets one of the above-stated thresholds" (CEQ 1997).

The CEQ and EPA guidelines suggest low-income populations should be identified based on annual statistical poverty thresholds established by the U.S. Census Bureau. Low-income communities may consist of individuals living in geographic proximity to one another, or a geographically dispersed set of individuals who would be similarly affected by the proposed action or program. The U.S. Census Bureau defines a poverty area as a census tract or other area where at least 20 percent of residents are below the poverty line (U.S. Census Bureau 2016d).

Large populated geographic areas may have the effect of "masking" or "diluting" the presence of minority and/or low-income populations (CEQ 1997; EPA 1998). Therefore, we reviewed data at the census block group level.[12] Two census block groups are located within 1 mile of the Project site: Block Group 2, Census Tract 127 and Block Group 1, Census Tract 142 (see figure 4.9.9-1), both of which are potential environmental justice populations because the total minority population exceeds 50 percent and more than 20 percent of households are below the poverty level (table 4.9.9-1). It may be noted that this is also the case with Census Tracts 127 and 142, as well as with Cameron County as whole (table 4.9.9-1).

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12 A census block group is a statistical subdivision of a census tract, generally defined to contain between 600 and 3,000 people and 240 and 1,200 housing units.

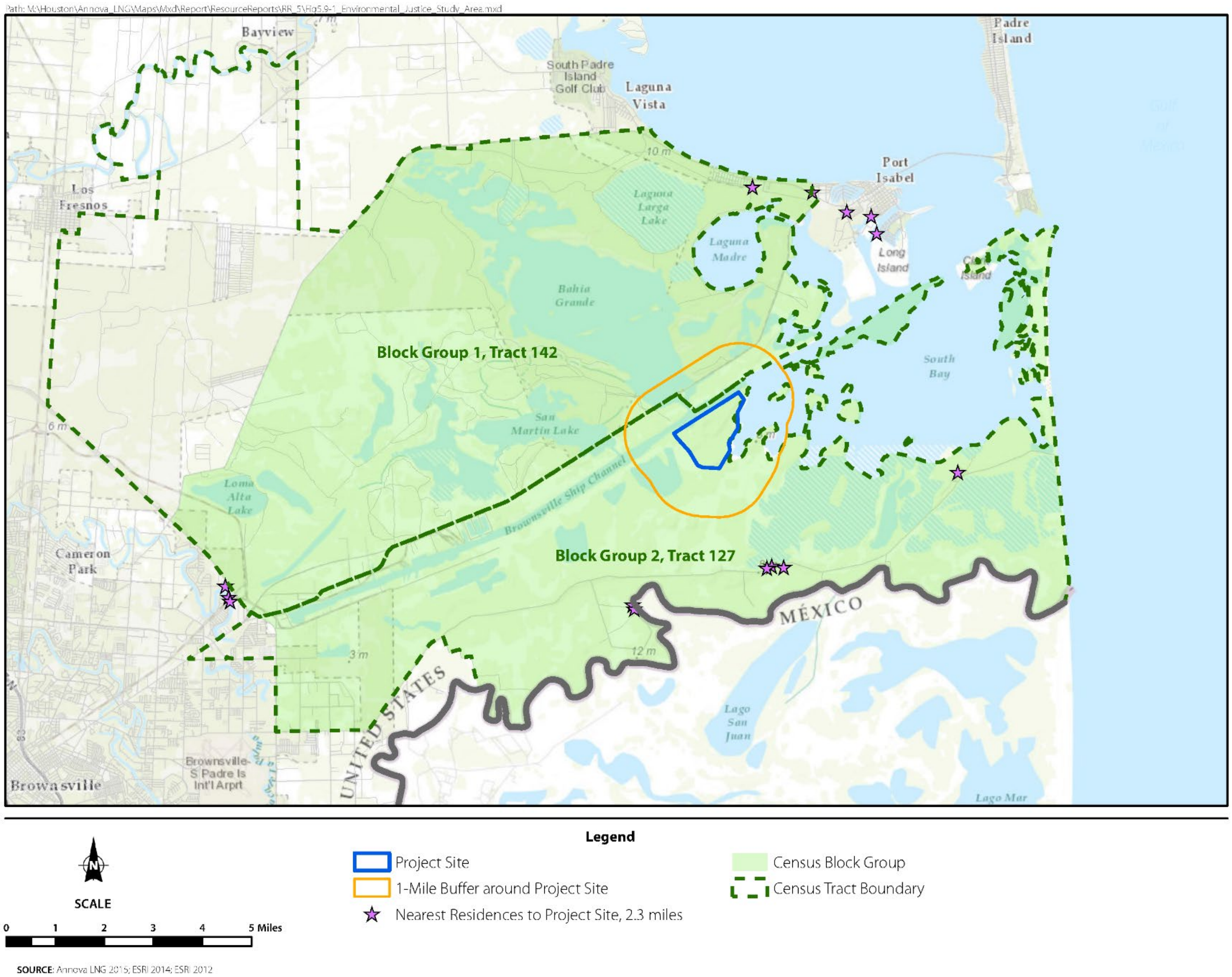

Figure 4.9.9-1 Environmental Justice Study Area

TABLE 4.9.9-1 **Race and Ethnicity and Poverty by Geographic Area, 2014**							
		Percent of Total					
Geographic Area	Total Population	White a/	Hispanic Origin	African American/ Black a/	Other Race a/, b/	Total Minority Population	Below Poverty Level
Texas	26,092,033	44%	38%	12%	6%	55%	16%
Cameron County	415,103	10%	88%	0%	1%	90%	31%
Census Tract 127	5,544	7%	93%	0%	0%	93%	37%
Census Tract 142	5,258	9%	91%	0%	0%	91%	39%
Block Group 2, Census Tract 127	801	28%	72%	0%	0%	72%	31%
Block Group 1, Census Tract 142	3,806	2%	98%	0%	0%	98%	43%

Numbers may not sum due to rounding.

a/ Non-Hispanic only. The federal government considers race and Hispanic/Latino origin to be two separate and distinct concepts. People identifying Hispanic or Latino origin may be of any race. The data summarized in this table present Hispanic/Latino as a separate category.

b/ The "Other Race" category presented here includes census respondents identifying as "Asian," "American Indian and Alaska Native," "Native Hawaiian and Other Pacific Islander," "Some Other Race," and "Two or more races."

Source: U.S. Census Bureau 2016e, 2016f

4.9.9.2 Disproportionate Human Health or Environmental Effects

Construction and operation of the Project would not be expected to have high and adverse human health or environmental effects on any nearby communities. The Project site is entirely located on property owned by the BND and designated for industrial use. The closest residences to the Project site boundary are located approximately 2.3 miles to the south, on County Road 199, off of SH 4. These residences are separated from the Project site by the Lower Rio Grande Valley NWR. The next closest residential developments are located from about 4.7 miles to 5.1 miles northeast of the Project site and include Port Isabel, Laguna Heights, and Long Island. Review of the EPA's Environmental Justice Screening and Mapping Tool (EJSCREEN) confirmed that there are no residents within 1 mile of the Annova site.

Elsewhere in this document, we identify impacts on environmental resources that potentially may have a direct or indirect effect on the local population, including air quality and noise (see section 4.11), water resources (see section 4.3), and hazardous materials (see section 4.2). Impacts during construction would be temporary and localized and are not expected to be high. In addition, Annova would implement a series of measures to minimize these types of potential impacts.

4.9.9.3 Public Participation

All public documents, notices, and meetings were made readily available to the public during FERC's review of the Project. Public outreach activities by Annova have included meetings with interested individuals, local associations, community leaders, public groups, and other non-governmental associations. In addition, Annova held a community open house on April 21, 2015, at the Brownsville Event Center, with English- and Spanish-speaking representatives of the Project available to hold one-on-one discussions with meeting attendees and address questions.

Annova used a variety of communication and advertisement methods to notify all potentially affected residents and property owners of the open house, including direct mailing, advertisements in the English- and Spanish-language press, radio advertisements on Spanish-language radio, and targeted online advertisements.

Annova also used the FERC's pre-filing process (see section 1.3 of this EIS). One of the major goals of this process is to increase public awareness and encourage public input regarding every aspect of the project before a formal application is filed with the FERC. FERC staff participated in the April 21, 2015, community open house in Brownsville (discussed above), and also held a public scoping meeting in Port Isabel, Texas on August 11, 2015. Interested parties have had, and will be given, opportunities to participate in the NEPA review process. To date, this has included the opportunity to participate in the public scoping meetings within the Project area to identify concerns and issues that should be covered in the EIS, and the opportunity to submit written comments about the Project to the FERC. Stakeholders will have the opportunity to review this draft EIS, participate in public meetings, and provide comments directly to the FERC staff in person or in writing.

4.9.9.4 Conclusion

Although the demographics indicate that potential environmental justice communities are present within the census blocks near the Project site, there is no evidence that these communities would be disproportionately affected by the Project or that impacts on these communities would appreciably exceed impacts on the general population. It is not anticipated that the Project would cause significant adverse health or environmental harm to any community with a disproportionate number of minority or low-income populations. We conclude that the Project would not have disproportionate adverse effects on minority and low-income residents in the area.

4.9.10 Transportation and Traffic

4.9.10.1 Land Transportation

Roadway Traffic

SH 48 (Padre Island Highway) is the major principal arterial roadway in the Project vicinity. SH 48 extends east from Brownsville and Interstate 69E (I-69E) passing north of the Project site and the BSC to intersect with SH 100 just west of Port Isabel. Average annual daily traffic (AADT) volumes on SH 48 in 2013 ranged from 15,100 to 29,660 (table 4.9.10-1). AADT volumes represent the total volume of traffic passing a point or segment of a highway facility in both directions for 1 year divided by the number of days in the year.

A network of state and local roads and port facilities would provide access to the site. Workers commuting and trucks delivering materials to the Project site would use the existing road network during construction and operation, with SH 4 (Boca Chica Boulevard) providing main access to the site. AADT volumes on Boca Chica Boulevard in 2013 ranged from a high of 38,980 near I-69E to 285 near the Project site (table 4.9.10-1).

TABLE 4.9.10-1

Major Existing Roadways Near the Project Site

Street Name	Functional Class	Typical Section	Posted Speed (mph)	AADT
SH 48/SH 4 (Boca Chica Boulevard) a/	Principal Arterial (west of FM 511), Minor Arterial (between FM 511 and FM 1419), and Major Collector (east of FM 1419)	Five-lane to two-lane undivided	40-55	285 (near the project site)–38,980 (near I - 69E)
SH 48 (S. Padre Island Highway)	Principal Arterial	Five-lane to four-lane divided	45-55	15,100–29,660
FM 511 (Indiana Avenue)	Principal Arterial	Two-lane frontage road (north of SH 48) to two-lane undivided	55	8,130–9,410
FM 802 (Ruben Torres Boulevard)	Principal Arterial	Five-lane with two-way left-turn lane	45	6,480–19,300
FM 3248 (Dr Hugh Emerson Road)	Principal Arterial	Five-lane with two-way left-turn lane	45	6,070–19,840
FM 1847 (Paredes Line Road)	Principal Arterial	Five-lane with two-way left-turn	45	11,640
SH Toll 550	Principal Arterial – Limited Access Toll Route	Four-lane divided	65	NA

a/ The initial stretch of Boca Chica Boulevard extending east from I-69E is SH 48; Boca Chica Boulevard subsequently becomes SH 4 and SH 48 trends northeast and becomes S. Padre Island Highway.

AADT = Average Annual Daily Traffic obtained from Texas Department of Transportation are for 2013, and rounded to the nearest 10; FM = Farm to Market; NA = Not Available; SH = State Highway

Source: Traffic Impact Group, LLC 2015

Annova commissioned a study of potential land transportation impacts that evaluated how construction and operation of the Project would likely affect traffic volumes, circulation patterns, and levels of service (LOS) on roadways within the Project area (Traffic Impact Group, LLC [Traffic Impact Group] 2015). The analysis was based on existing conditions in 2015, with peak construction assumed to occur in 2019, and normal operations taking place in 2022. The analysis also employed the following assumptions:

- a background growth factor of 1.0 percent (based on discussions with Texas Department of Transportation [TxDOT] and Cameron County) was used to account for regional growth in traffic volumes;
- a distribution of trips that reflects existing traffic patterns, engineering judgment, and discussion with TxDOT and Cameron County;
- a peak workforce of 1,000 construction workers, 200 support and management staff, a carpooling rate of 20 percent, and staggered shifts during construction to reduce impacts; and
- an operations workforce of 165 employees in three shifts, including 75 workers in the day shift, 50 workers in a swing shift, and 40 workers in the night shift.

On June 30 and July 1, 2015, existing traffic volumes were measured at 11 key intersections (figure 4.9.10-1) during the morning and evening peak hours, analyzing road and intersection capacities, and identifying the LOS for each intersection under existing conditions, peak construction conditions, and normal operational conditions. The preliminary analysis indicated that the addition of 1,000 Project-related vehicles during morning and evening peak hours would cause failing conditions at the intersections nearest to the Project access road. In order to address this issue, the analysis assumed that construction shifts would be staggered, with half the workforce (500 vehicles) arriving and departing during peak hours, and subsequently recommended that half of the employees (500 trips) work from 6:30 a.m. to 5:00 p.m., with the remaining half (500 trips) working from 7:30 a.m. to 6:00 p.m. Operation shifts were also assumed to be staggered in this analysis, resulting in a total of 115 vehicles entering (75 trips) and exiting (40 trips) the site during the morning peak hour, with the same overall number (115 vehicles) entering (40 trips) and exiting (75 trips) in the evening peak hour.

The traffic impact analysis assessed potential changes to intersection LOS based on the addition of Project construction and operation worker trips to existing trips. LOS refers to how traffic operates in intersections using six levels of service ranging from A to F, with A representing the best conditions, and F representing the worst. Conditions that could result in an intersection operating at LOS E or worse are considered an adverse impact. Overall LOS ratings for existing conditions, peak construction, and normal Project operations are summarized for each key intersection in table 4.9.10-2. Intersections 5, 6, 7, 8, 9, and 11 (as identified in table 4.9.10-2) would not experience any change in peak hour LOS during construction or operations. Intersection 10 would experience temporary reductions in LOS but would function at acceptable conditions and would not require improvements (table 4.9.10-2).

The results of the analysis (Traffic Impact Group 2015) may be summarized for the other four study intersections (1 through 4) as follows. Potential mitigation measures identified as part of this analysis are discussed below and summarized in table 4.9.10-3.

- Intersection 1 is the intersection of the Project site access road with SH 4 (Boca Chica Highway). The Boca Chica Highway in this location is a two-lane undivided roadway with an AADT of approximately 200 vehicles per day. The intersection is expected to operate at an acceptable LOS during Project construction and operation, but improvements were recommended as a result of the analysis to meet TxDOT Roadway Design Manual guidelines (table 4.9.10-3 describes the recommended improvements).

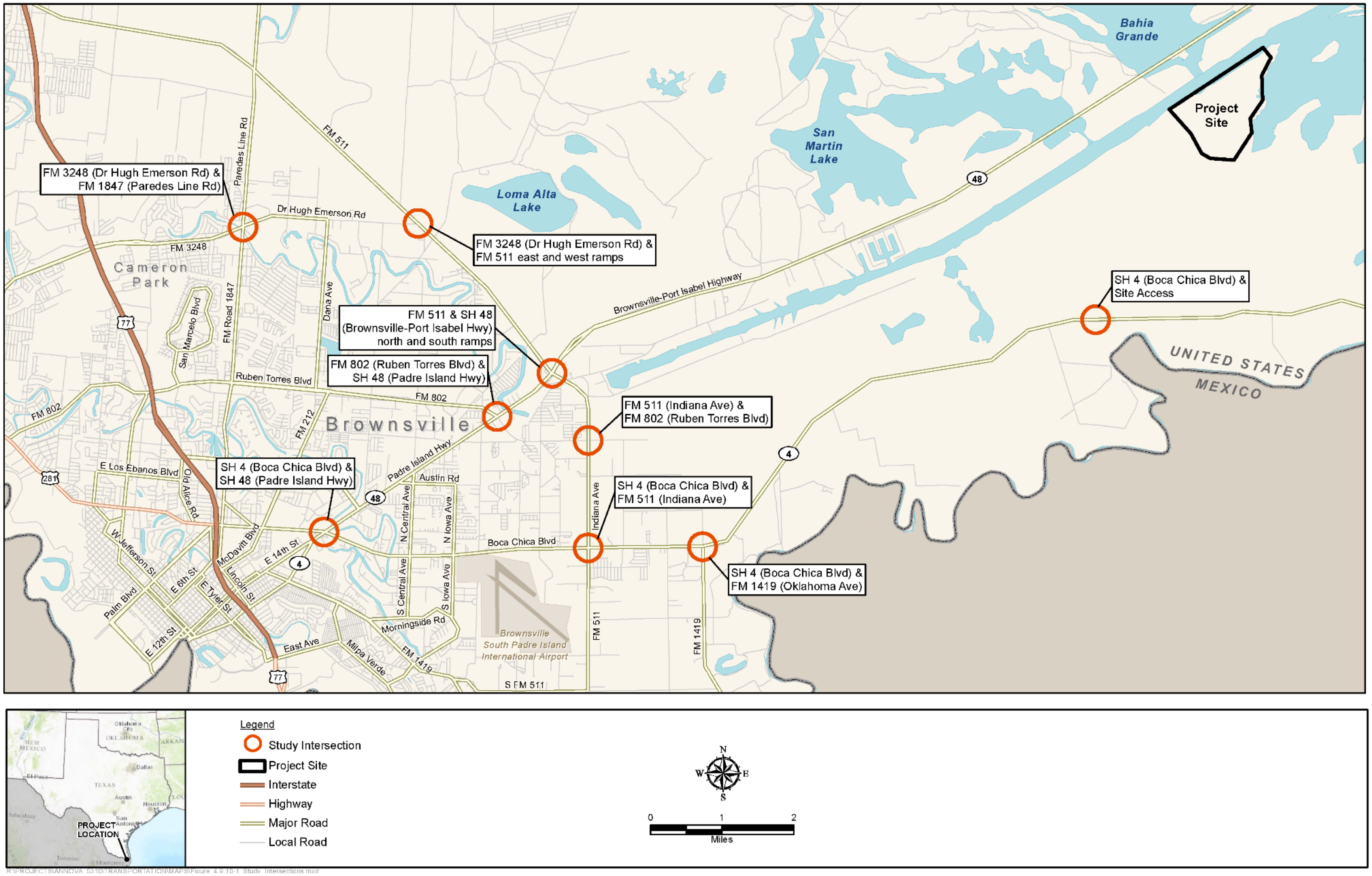

Figure 4.9.10-1 Traffic Impact Study Intersections Map

TABLE 4.9.10-2

Measured and Calculated Overall Levels of Service at Intersections During Construction and Operation

Street Name		Levels of Service a/ 2015 Existing a.m./p.m.	2019 Peak Construction a.m./p.m.	2022 Normal Operation a.m./p.m.
1 (A) Project Site Access and SH 4 (Boca Chica Boulevard)		NA	NA	NA
2 (B) SH 4 (Boca Chica Boulevard) and FM 1419 (Oklahoma Avenue)	EB	A/A	A/A	A/A
	WB	A/A	A/A	A/A
	NB	B/B	D/E	C/C
	SB	B/B	E/E	C/C
3 (C) SH 4 (Boca Chica Boulevard) and FM 511 (Indiana Avenue)		C/C	E/C	C/C
4 (D) SH 4/48 (Boca Chica Boulevard) and SH 48 (S Padre Island Highway)/ SH 4 (East 14th Street)		D/E	E/E	E/E
5 (E) FM 511 (Indiana Avenue) and FM 802 (Ruben Torres Boulevard)		B/B	B/B	B/B
6 (F) FM 802 (Ruben Torres Boulevard) and SH 48 (S Padre Island Highway)		C/C	C/C	C/C
7 (G) FM 511 (Indiana Avenue) and SH 48 (Brownsville-Port Isabel Highway) South Ramp		A/B	A/B	A/B
8 (H) FM 511 (Indiana Avenue) and SH 48 (Brownsville-Port Isabel Highway) North Ramp		A/A	A/A	A/A
9 (I) FM 3248 (Dr Hugh Emerson Road) and FM 511 Northbound		A/A	A/A	A/A
10 (J) FM 3248 (Dr Hugh Emerson Road) and FM 511 Southbound		A/A	B/A	B/A
11 (K) FM 3248 (Dr Hugh Emerson Road/Alton Gloor Boulevard) and FM 1847 (Paredes Line Road)		C/C	C/C	C/C

a/ Levels of Service refers to how traffic operates in intersections using six levels of service ranging from A to F, with A representing the best conditions, and F representing the worst.

Key:
EB = Eastbound
FM = Farm-to-Market Road
NA = Not applicable
NB = north bound
SB = southbound
SH = State Highway
WB = Westbound
Source: Traffic Impact Group 2015

- Intersection 2 – SH 4 (Boca Chica Boulevard) and FM 1419 (Oklahoma Avenue) – is an unsignalized intersection with stop sign control for northbound and southbound traffic. The eastbound and westbound approaches have a left-turn lane, and a shared through-right lane. The northbound and southbound approaches both consist of a single lane. During peak construction, the northbound and southbound approaches to this intersection would be expected to see LOS D or LOS E in both peak hours (table 4.9.10-2).

  These reductions in LOS would be temporary, with the intersection expected to function at acceptable levels (LOS C) following construction during normal operations (table 4.9.10-2). Further, the study found that despite this drop in LOS during peak construction, the intersection would not be expected to meet traffic volumes that would warrant signalized control. Based on these expected conditions, the study did not recommend improvements for this intersection.

- Intersection 3 – SH 4 (Boca Chica Boulevard) and FM 511 (Indiana Avenue) – is a signalized intersection with protected-permitted phasing for eastbound and westbound left-turns, and split phasing for northbound and southbound. During peak construction, this intersection would see LOS E for the southbound left-turn movement in the morning peak hour, with significant backups (table 4.9.10-2). The study indicated that this impact could be mitigated by changing the existing timing and phasing plan for the intersection (see table 4.9.10-3).

- Intersection 4 – SH 4/SH 48 (Boca Chica Boulevard) and SH 48 (S Padre Island Highway)/SH 4 (E 14th Street) – is signalized with protected phasing for all left turn movements. All approaches consist of two left-turn lanes, two through lanes, and a channelized right-turn lane with yield control (Traffic Impact Group 2015). The study found that this intersection currently sees LOS D overall in the morning peak hour and LOS E overall in the afternoon peak hour, with some movements experiencing delays ranging into LOS F.

  During peak construction, the intersection would see LOS E overall in both peak hours. This would also be the case for normal operating conditions (2022), indicating continued congestion and delays. The study noted that signal timing optimization may improve existing and future traffic flows at this intersection. The analysis also recommended that the Project avoid using Boca Chica Boulevard as a truck route, and instead use SH Toll 550 as the preferred truck route to and from the north (table 4.9.10-3).

TABLE 4.9.10-3

Potential Mitigation Measures for Construction-Related Traffic as Identified in Annova's Traffic Impact Analysis

Intersection a/	Mitigation Measures
1. (A). Project Site Access Road and SH 4 (Boca Chica Boulevard)	– Construct an eastbound left-turn lane with a storage length of 100 feet, a deceleration length of 510 feet, and a taper length of 100 feet. – Construct a westbound right-turn acceleration lane with an acceleration length of 930 feet and a taper length of 250 feet.
3. (C). SH 4 (Boca Chica Boulevard) and FM 511 (Indiana Avenue)	– Revise northbound and southbound timing from split phasing to protected-permitted phasing.
4. (D). SH 48/4 (Boca Chica Blvd) and SH 48 (S Padre Island Hwy)/SH 4 (E 14th Street)	– Based on existing traffic congestion, this intersection may benefit from signal timing optimization. – Avoid SH 48/4 (Boca Chica Boulevard) as a truck route. Use SH Toll 550 as the preferred truck route for routes to/from the north.

Source: Traffic Impact Group (2015)

a/ Intersection numbers 1, 3, and 4 correspond with those shown in table 4.9.10-2.

Annova proposes to transport construction workers to and from the construction site from a centralized location via passenger buses. Depending on the location of the centralized site, the use of buses would reduce the potential impacts assessed in the Traffic Impact Analysis as summarized above. The use of buses would reduce the number of commuter vehicles considered in the analysis and the corresponding impacts at the U.S. Border Patrol (Border Patrol) checkpoint (see below) and one or more intersections assessed in the Traffic Impact Analysis, such as

Intersection 1 (Project Site Access Road and SH 4 [Boca Chica Boulevard]) and Intersection 2 (SH 4 [Boca Chica Boulevard] and FM 1419 [Oklahoma Avenue]) (see above).

Border Patrol

The Border Patrol operates a checkpoint on SH 4 (Boca Chica Boulevard), west of the proposed access road to the Project site. The checkpoint requires vehicles to stop and show photo identification. Vehicles traveling to and from the Project site would pass through this checkpoint, with significant potential delays anticipated during construction. The checkpoint consists of a trailer and is not equipped to handle the estimated amount of peak construction traffic (Traffic Impact Group 2015). Annova would coordinate with the Border Patrol to establish procedures for workers to move through border security checkpoints during facility construction and operation.

Annova also proposes to transport construction workers to and from the construction site from an off-site centralized location via passenger buses. Support and management staff would drive their vehicles directly to the Project site. Use of an off-site centralized location and passenger buses would reduce the number of individual vehicles passing through the Border Patrol checkpoint. Consultation with the United States Border Patrol indicated that U.S. citizenship checks could be performed at this centralized location as craftsmen board the bus, which would allow the buses to move through the checkpoint without stopping, further reducing delays at the checkpoint. Depending on the stage of construction, six to eight, 40- to 44-passenger buses would transport construction workers to and from the Project site. Annova has not yet identified the off-site centralized location that would be used for working parking. Therefore, **we recommend that:**

- **<u>Prior to the end of the draft EIS comment period</u>, Annova should file the specific location(s) of any off-site centralized parking sites that would be used for the construction work force. For each location, Annova should identify: the existing environment and land use at those locations; an evaluation of potential impacts that would result from use as an off-site parking and staging facility; and a description of how the use of these sites would mitigate the impacts at Intersections 1-4, identified in the Traffic Impact Group 2015 report.**

Heavy Trucks

Annova and their transportation consultant have identified three general delivery truck routes, and routes from four local concrete plants in Brownsville and San Benito that could supply the Project during construction (Traffic Impact Group 2015). The three identified truck routes are the Port Isabel Truck Route, the North Truck Route, and the Alternate North Truck Route (figure 4.9.10-2), which was developed following discussion with TxDOT and Cameron County staff. Based on this analysis, Annova's transportation consultant identified the Alternate North Truck Route as the recommended truck route to and from the north, and indicated that overheight or overweight trucks would be required to the follow the North Truck Route (Traffic Impact Group 2015). Analysis of potential routes from the four identified concrete plants found that some detours would be necessary from the initially identified routes for overheight or overweight trucks. Many of the roads near the Project site are designated as truck routes and designed to withstand heavier vehicles.

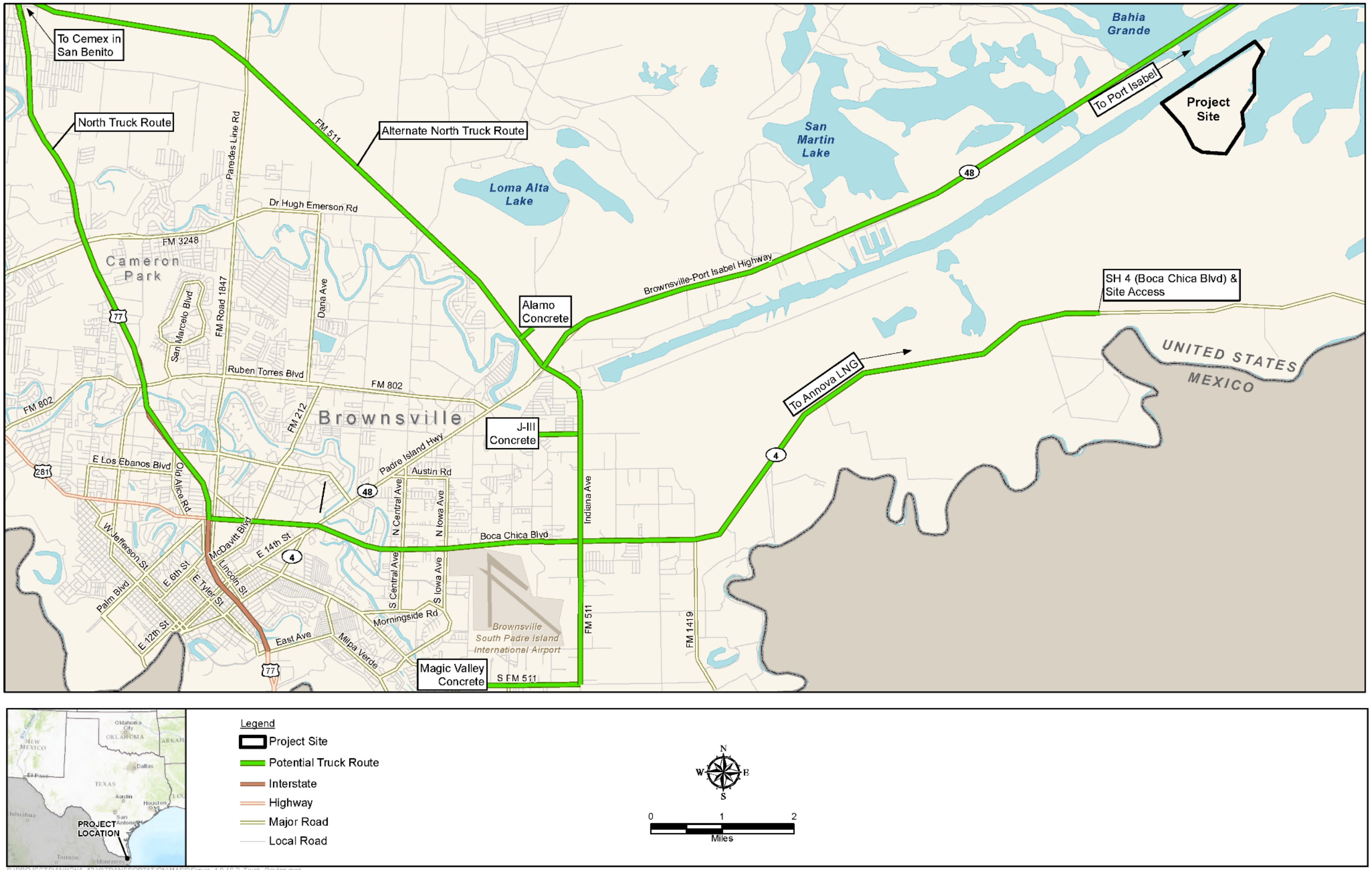

Figure 4.9.10-2 Potential Truck Routes During Construction

Tourism and Recreation

Traffic in proximity to Palo Alto Battlefield National Historic Park and Palmito Ranch Battlefield NHL would temporarily increase during the Project's construction. Traffic increases from workers commuting during the morning peak hour would occur before the Battlefield sites open and would not be expected to affect visitors to the Battlefield sites. Cultural heritage tourists who leave the battlefield sites during the afternoon peak hour may experience longer trips than average. This potential impact would be highest during peak construction, becoming less pronounced during less intensive construction periods, and stopping once construction is complete. Increases in traffic during Project construction are not expected to deter people from visiting Palo Alto Battlefield National Historic Park or Palmito Ranch Battlefield NHL.

4.9.10.2 Marine Transportation

The majority of commercial vessels that transit the BSC call at the Port of Brownsville. Commercial vessel calls are identified by type of vessel in table 4.9.10-4. Vessel counts include commercial vessels that called at Port Isabel, which represented a very small share of the overall total (Bearden 2015). Data are presented as annual averages over a three-year period from 2012 to 2014. These totals do not include commercial fishing vessels or recreational boats.

TABLE 4.9.10-4

Average Annual Commercial Vessel Calls at the Port of Brownsville, 2012 to 2014

Type of Vessel	Average Calls (2012-2014)	Average Trips per Week	Percent of Total
River Vessels			
River Barges	652	12.5	62%
Tugs	93	1.8	9%
Subtotal	**745**	**14.3**	**70%**
Ocean-going Vessels			
Cargo Vessels	108	2.1	10%
Ocean Barge	80	1.5	8%
Tankers	78	1.5	7%
Scrap Vessels/Barges	25	0.5	2%
Container/Bulk/Cargo	7	0.1	1%
Government	7	0.1	1%
Deck Barge	4	0.1	<1%
Drilling Rig	3	0.1	<1%
Subtotal	**312**	**6**	**30%**
Grand Total	**1,057**	**20.3**	**100%**

Numbers may not sum due to rounding.
Source: BND 2016

Average annual volumes of waterborne cargo transported through the Port of Brownsville for the period 2012 to 2014 are identified in table 4.9.10-5. Almost half (45 percent) of all waterborne cargo that moved through the Port came in from international ports via ocean-going vessels ("deep sea in").

TABLE 4.9.10-5 **Average Annual Volume of Waterborne Cargo Transported via the Port of Brownsville, by Direction of Vessel Movement, 2012 to 2014**		
Direction	Annual Average (metric tons)	Percent
Coastwise In	1,144,112	20%
Coastwise Out	526,323	9%
Deep Sea In	2,572,341	45%
Deep Sea Out	242,979	4%
Intracoastal In	675,040	12%
Intracoastal Out	541,793	10%
Total Waterborne Cargo	**5,702,586**	**100%**

Source: BND 2016

An average annual total of 745 river vessels and 312 ocean-going vessels called at the port from 2012 to 2014, approximately 14.3 river vessels and 6 ocean-going vessels a week (table 4.9.10-4). Of the large, ocean-going vessel class, cargo vessels were the most frequent visitors (35 percent of the total), followed by ocean barges (26 percent), and tankers (25 percent) (table 4.9.10-4). Other ocean-going vessels entering the BSC include government vessels, scrap vessels, and drilling rigs (floating objects that must be towed, similar to barges). In almost all cases, a local pilot affiliated with the Brazos Santiago Pilots Association must pilot the ocean-going vessel through the Brazos-Santiago Pass, into the BSC, and ultimately to the Port of Brownsville turning basin or directly to a berth. The channel is effectively one-way because ocean-going commercial vessels generally do not pass each other in opposite direction. Commercial vessel traffic going in and out of the channel is managed by the harbormaster, in coordination with the pilots. A large number of river barges travel through the BSC. Depending on the circumstances, the harbormaster may arrange for a river barge to meet an ocean-going vessel if passing is considered safe (Wilson 2015).

Large vessels provide at least 96 hours' notice to the Coast Guard and harbormaster prior to approaching the BSC. Cargo vessels or tankers entering the channel and beginning to transit toward the Port are highly visible, giving commercial and recreational fishing vessels visual notice to stay at berth or harbor if headed in the opposite direction. The BND advises smaller vessels not to pass ocean-going, commercial vessels, because the amount of water they displace creates strong surge and suction effects to the sides and rear (Duke 2015). However, there are no regulations under ordinary circumstances that restrict small vessels from overtaking and passing an ocean-going vessel, or passing an ocean-going vessel in the opposite direction (Wilson 2015). Typical smaller vessels in the BSC include shrimping and other commercial fishing vessels, recreational motorboats, and kayaks. Once a large vessel passes by, smaller vessels can immediately begin their transits in the opposing direction, and small vessels heading in the same direction as a larger vessel can travel in front of or well behind the larger vessel, usually with little or no delay.

Most local Gulf-shrimping vessels dock at the Port of Brownsville Shrimp Basin (Duke 2015). Bay shrimping vessels primarily dock at Port Isabel, with those that come into the BSC to trawl for bait shrimp generally operating between sunrise and noon (Ferguson 2015; Wilson 2015). A typical Gulf-shrimping vessel exits or enters the BSC a limited number of times per season because shrimp harvesting trips in the Gulf of Mexico generally last for several weeks or more. As a result, the potential for a Gulf-shrimping vessel to interact with a large ocean-going vessel in the BSC is limited to the few times the shrimping vessel enters or exits the channel. If a shrimping vessel waits in the Shrimp Basin for a large, ocean-going vessel to transit the channel, the delay is typically several hours.

On days when multiple vessels are escorted in or out of the channel in sequence, the required coordination and limited number of tugs and pilots serving the Port create breaks, allowing smaller vessels, such as shrimp boats, sufficient time to enter or exit the channel between the transits of large vessels (Duke 2015). In practice, shrimping vessels and other small vessels frequently choose to meet ocean-going vessels and pass them in the BSC. Shrimping vessels, other fishing vessels, and recreational vessels are, however, prevented from passing when a drilling rig is being towed in or out the BSC or a unique vessel like an aircraft carrier is transiting through with a moving security zone (this would also apply to the LNG carriers; see further discussion below).

Vessel traffic in the BSC would temporarily increase during Project construction with transport of construction equipment, materials, and prefabricated modules to the Project site expected to require an estimated 24 to 36 barge trips per year, less than one trip per week. From 2012 to 2014, an annual average of 652 river barges and 80 ocean barges transited the ship channel for a combined total of 732 barge trips (table 4.9.10-4). The estimated 24 to 36 Project-related barge trips would be equivalent to 3.3 percent to 4.9 percent of the average annual total from 2012 to 2014, with minimal impacts on other vessel traffic or recreational fishing vessels anticipated.

During Project operation, approximately 2-6 LNG carriers per month (with a maximum of 80 per year) would transit to the Project. LNG carriers calling at the Project would enter the Santiago Pass from the Brazos Santiago Pass Fairway of the Gulf of Mexico, and then turn into the BSC. The inland navigation route would be about 8.7 miles from the Brazos Santiago Pass Fairway to the Project site. Smaller vessels, including supply vessels, tugboats, and barges, would also call at the Project site, and would be similar in size to many of the vessels currently using the BSC.

To minimize interference with existing BSC vessel traffic, the Project's marine transfer facilities would be recessed into the southern bank of the BSC. The Project berth's size, location, and orientation would ensure safe navigable approach and departure conditions and safe distances from the influence of passing vessels.

LNG carrier transits through the BSC and Brazos-Santiago Pass would be similar to current large vessel transits. Local pilots would board and steer the LNG carriers, and the BSC would function as a one-way channel for all other large vessels during LNG carrier transits. The current notification requirements that apply to large commercial vessels would also apply to all LNG carriers. In addition, LNG carriers calling at the proposed Annova facility would have a Coast Guard-enforced safety/security zone that would impact the transits of other waterway users while the zone is being enforced.

Large ocean-going commercial vessels currently call at the Port of Brownsville at an average rate of six per week, or 312 per year (BND 2016). The addition of approximately two-six LNG carriers per month with 2-hour transits in each direction per carrier is not expected to create adverse impacts on inbound and outbound transits of large vessels, which are already accustomed to queues and early scheduling requirements. Delays to small vessels may occur when an LNG carrier is in transit between the Brazos-Santiago Pass jetty entrance and the Project berth. The occurrence and extent of small vessel delays would depend on vessel orientation and direction of travel. Small vessels traveling ahead or behind an LNG carrier in the same direction would not experience measurable delays as long as they remain outside the LNG carrier safety zone. Smaller vessels heading in the opposite direction to a LNG carrier could experience delays of a few minutes to 1.5 hours, depending on the position of the smaller vessel relative to the LNG carrier.

Estimated potential delays for small vessels when an LNG carrier transits inbound or outbound are summarized in table 4.9.10-6. These estimates are based on vessel simulation modeling of LNG carrier movements between the Project and the Gulf of Mexico conducted by Annova. The estimated hours of delay represent the total hours that portions of the channel would be restricted during an LNG carrier's transit to and from the Project's berth. Actual delays incurred by small vessels would depend on individual vessel positions relative to the LNG carrier. The total estimated annual delay for small vessels ranges from 1.8 to 5.5 percent of daylight hours (table 4.9.10-6). Impacts are based on 80 LNG carrier visits per year (80 inbound transits and 80 outbound transits) and estimated delays of 0.5 hours to 1.5 hours delay per carrier transit.

TABLE 4.9.10-6

Estimated Small Vessel Delay Times During LNG Carrier Transit

LNG Carrier Location a/	Small Vessel Location	Estimated Delay Time per Carrier Transit (hours)		Estimated Total Annual Delay Time (hours) b/		Percent of Daylight Hours per Year
		Carrier Inbound	Carrier Outbound	Carrier Inbound	Carrier Outbound	
Brazos Santiago Pass Jetty	Any Location	0.5 to 1.5	0.5 to 1.5	40 to 120	40 to 120	1.8 to 5.5%

a/ Transit destination is Gulf of Mexico.
b/ Estimated annual delay time is based on 80 LNG carrier visits to the Project per year.

4.9.11 Conclusion

The Project would result in a short-term, moderate increase to the local population during construction, would result in a negligible, long-term increase during operation. Construction and operation would generate local and state tax revenues from sales and payroll taxes, and support some local employment. The Project would not be expected to have high and adverse human health or environmental effects on any nearby communities. During operation, relocation of some families to the area would have a minor impact on existing student/teacher ratios. During construction a moderate impact on local traffic would be expected, however Annova has proposed some measures to minimize that impact. Construction and operation would result in an increase in marine traffic in the area, with minor impacts on large and small vessels using the BSC.

4.10 CULTURAL RESOURCES

Section 106 of the NHPA, as amended, requires the FERC take into account the effects of its undertakings on properties listed in or eligible for listing in the NRHP, and afford the ACHP an opportunity to comment on the undertaking. Annova, as a non-federal party, is assisting the FERC in meeting our obligations under Section 106 by preparing the necessary information, analyses, and recommendations, as authorized by 36 CFR 800.2(a)(3).

Construction and operation of the Project could have the potential to affect historic properties (e.g., cultural resources listed in or eligible for listing in the NRHP). Historic properties include prehistoric or historic archaeological sites, districts, buildings, structures, and objects, as well as locations with traditional value to Native Americans or other groups. Historic properties generally must possess integrity of location, design, setting, materials, workmanship, feeling, and association, and must meet one or more of the criteria specified in 36 CFR 60.4.

4.10.1 Cultural Resource Survey

The direct area of potential effect (APE) for the Project is defined as the boundaries of the 1,132-acre parcel of land upon which the proposed LNG terminal would be constructed as well as the areas that would be temporarily affected by construction of the LNG terminal. The APE also includes the approximately 668-acre LNG lease at Port of Brownsville, the 2.8-mile-long proposed access road (Access Road Alternative 2), and the 263-acre dredge material placement area. The direct APE extends to the maximum depth of disturbance within each of these areas. The indirect APE for the facility is a 0.5-mile area around the boundaries of the Project site, and a 300-foot area on either side of the access roads.

Annova's consultant, Blanton and Associates, Inc.'s (B&A) consulted with the Texas Historical Commission (THC), which serves as the SHPO, regarding the cultural resources survey of the APE. B&A completed a records review and cultural resource survey of the Project. The investigations covered both archaeological and architectural resources. In addition, iLinks Geosolutions, LLC conducted a bathymetric survey and Ecology & Environment, Inc. conducted a visual impact assessment (VIA) under Section 106 of the NHPA.

Regionally significant sites in the general area include the Palmito Ranch Battlefield NHL (which abuts the southern boundary of the APE), the Palo Alto Battlefield NHL (which is located approximately 12 miles west of the Project area), and the Brazos Santiago Depot (which is located at the entrance of the BSC, northeast of the APE). The Palmito Ranch Battlefield NHL, located on the south side of SH 4 at the intersection with the main access road, is the only non-archeological historic-age resource within the 300-foot-radius indirect APE for the Project access road. Based on field investigations, we determined that the Project would have no direct or indirect effect on this historic property.

The Palo Alto Battlefield NHL is outside of the direct and indirect APE; however, the NPS has expressed concern for the landmark (as well as the Palo Alto Battlefield NHL and the Brazos Santiago Depot). The Project would have no direct or indirect effect on this historic property. The Brazos Santiago Depot primarily exists as a submerged historic resource. Like the Palo Alto Battlefield NHL, the site is outside the Project's direct and indirect APE but is a concern for cooperating agencies. We have determined that the Project would have no direct or indirect effect on this historic property.

4.10.1.1 Archaeological Survey

Between April 27 and May 29, 2015, B&A conducted an archaeological survey of the APE. Portions of the APE were not surveyed due to the presence of sensitive thornshrub habitat and historical tidal flats. Conducting archaeological investigations within this area, which includes site 41CF48, requires clearing of vegetation. Archaeological investigations of this area would occur prior to construction (if the Project is approved).

In addition, the proposed dredge material placement area was not surveyed. In a letter dated November 17, 2016, the SHPO concurred that the proposed dredge material placement area was historically tidal flat that is unlikely to contain archaeological resources and no historic properties would be affected by the proposed activities at this location. Annova would consult with the SHPO if it identifies other sites for dredged material placement, including for beneficial use of dredged material.

Archaeological investigations identified four previously recorded archeological sites (41CF49, 41CF50, 41CF87, and 41CF102), four newly recorded sites (41CF219, 41CF220, 41CF221, and 41CF222) and two isolated finds. B&A recommended that those sites investigated within the APE (41CF49, 41CF50, 41CF87, 41CF102, 41CF219, 41CF220, 41CF221, and 41CF222) lack significant research potential and are not eligible for listing in the NRHP.

In a letter dated October 1, 2015, the SHPO concurred that sites 41CF49, 41CF50, 41CF87, 41CF102, 41CF219, 41CF220, 41CF221, and 41CF222 are not eligible for listing in the NRHP. These resources therefore do not warrant further work. The SHPO also recommended that the area around site 41CF48 in the Zone 1 Texas Thornbush Protected Habitat is considered unevaluated due to the inability to survey the area. The SHPO recommended that if this site cannot be avoided the SHPO must be consulted and the area surveyed prior to construction to determine the eligibility of site 41CF48. If the Commission authorizes the Project, Annova would then complete the investigation of site 41CF48 and provide results to the SHPO and FERC prior to the start of construction.

In November 2015, B&A conducted a survey of an additional 71.4 acres added to the APE. No cultural resources were identified. In a letter dated September 13, 2016, the SHPO stated that the Project activities in the additional 71.4 acres would have no effect on archaeological resources.

In addition, 39.1 acres associated with the proposed permanent access road (i.e., Access Road Alternative 2) have been surveyed (Griffith and Sanchez 2017). This part of the APE was subjected to surface and subsurface investigations. The 36 shovel tests conducted ranged between 35 and 65 centimeters in depth. No cultural resources were identified. Further, the southern end of the Access Road Alternative 2 was found to have been significantly disturbed by subsurface utilities in the area closest to the Palmito Ranch Battlefield NHL. Based on results of the survey, Access Road Alternative 2 is believed to have little to no potential for unidentified archaeological resources. It is unclear if the report has been filed with SHPO for concurrence with this finding.

4.10.1.2 Architectural (Non-archaeological) Resources

The APE for architectural (non-archaeological) historic resources was defined in accordance with the SHPO's standards for infrastructure that is less than 200 feet tall. Using these standards, the indirect APE is defined as 0.5 mile from the boundaries of the Annova LNG facility site, and 300 feet on either side of the 3.3-mile-long access road. Annova conducted a non-archaeological resource survey of this APE on May 28, 2015, and June 3, 2015. No previously recorded non-archaeological historic properties were identified within the direct APE. One previously recorded historic resource (the Palmito Ranch Battlefield NHL) was identified within 1 mile of the access road and within the indirect APE. In addition to the Palmito Ranch Battlefield NHL, the NPS has expressed concern for the visual impact of the Project on the Palo Alto Battlefield NHL and the NRHP-listed Brazos Santiago Depot.

Annova consulted with the NPS including staff from the Inter-Mountain Region (IMR) Environmental Quality Division, the IMR Natural Resources Division, the Palo Alto Battlefield NHL and National Historic Park, and members of the Heritage Partnership Program. Annova prepared a VIA to address concerns regarding visual impacts on the Palmito Ranch Battlefield NHL, the Palo Alto Battlefield NHL, and the NRHP-listed Brazos Santiago Depot. The VIA was prepared in accordance with procedures of the BLM's *Visual Resource Management (VRM) System* (1984). FERC requested that Annova also assess the visual effect of the Project under Section 106 of the NHPA for the two NHLs and the Brazos Santiago Depot.

On April 5, 2017 Annova submitted to the SHPO an assessment of the Project's visual effect on the Palmito Ranch Battlefield NHL, the Palo Alto Battlefield NHL, and the Brazos Santiago Depot. The NPS also received a copy of the visual assessment. The study found that while the Project would introduce a new visual component to the setting outside of the NHLs and NRHP-listed properties' boundaries, each property would retain its overall integrity such that each would continue to convey the characteristics and qualities that made it eligible for the NHL and/or NRHP. The SHPO concurred on May 4, 2017 that the Project would have no adverse effect on these properties with regard to potential visual effects. We agree with the SHPO's findings. Annova sent letters to SHPO and NPS again on April 26, 2018 requesting comment on visual effects to historic properties. The SHPO concurred that the Project would have no major visual impact on nearby historic resources or historic properties. We agree with the SHPO's recommendations. On August 22, 2018, NPS notified Annova that the reports are adequate and meet professional standards and that the NPS plans to provide its comments after reviewing the draft EIS. The effects to the viewsheds of all three properties (Palmito Ranch Battlefield NHL, Palo Alto Battlefield NHL, and Brazos Santiago Depot) are discussed below. Additional analysis of the aesthetic impacts is presented in section 4.8.4.

Annova also sent letters to SHPO and NPS on April 26, 2018, regarding auditory effects to the Palmito Ranch Battlefield NHL. The SHPO concurred that the Project would have minimal audible impact on the NHL. We agree with the SHPO's findings. On August 22, 2018, NPS notified Annova that the reports are adequate and meet professional standards and that the NPS plans to provide its comments after reviewing the draft EIS.

Palmito Ranch Battlefield NHL

The Palmito Ranch Battlefield NHL, which is located on the south side of SH 4 at the intersection with the main access road, is the only historic property within the indirect APE for the Project. The NPS and American Battlefield Protection Program have stated that that while the Project would have no direct effect on the Palmito Ranch Battlefield NHL, a potential indirect visual effect is a concern.

The Palmito Ranch Battlefield originally was listed in the NRHP under Criteria A (Events) and D (Information Potential). The battleground is the location of the last engagement of the U.S. Civil War and dates to an event in 1865. The NHL includes a Core Battlefield Area, which is the primary area of interpretation and is the focal point of activities associated with the Civil War event. An observation platform in this location provides visitors with a 360-degree view of the battlefield. The Core Battlefield Area is located along Palmito Hill Road and is approximately 3.6 miles from the Project site.

Information from the analysis of KOPs 1, 2, and 3 in the VIA was used to help determine the potential effects of the Project on the NHL. At KOP 1, a roadside marker 3 miles to the southwest of the Project, vertical components of the Project would be visible within 3 to 5 miles and silhouetted against the sky above a flat horizon. At KOP 2, the Palmito Ranch Battlefield Observation Platform 3.4 miles south of the Project, project components would not be visible due to dense vegetation. If the vegetation were to be removed, the Project would be visible. At KOP 3, the Rio Grande Valley NWR 2.4 miles southeast of the Project and adjacent to the NHL, Project components would also be obscured by vegetation. Although simulations prepared for the VIA did not include the wildlife corridor barrier wall at the southwest edge of the Project site, the proposed 25-foot-high wall would be significantly shorter than other project components that were included in the visual simulations, and the barrier wall would be expected to be obscured by vegetation from KOPs 1, 2, and 3.

Due to the distance of the primary Project components (i.e., built structures), the relationships of open space within the NHL would remain unchanged, along with the topographic and natural features that comprise it. Visible changes, however, would occur in the setting surrounding the property because the Project would be among the limited infrastructure that breaks above the horizon line; it would be visible from within the NHL, especially if vegetation is absent.

The addition of the proposed access road also would add to the presence of the existing infrastructure and detract from the natural appearance of the battlefield at its boundaries. The access road would be built on a raised berm with a paved asphalt and limestone surface. The roadway itself would not be as visible from within the NHL due to the lack of a vertical dimension and the presence of roadside vegetation. During construction of the access road, activity would be more apparent in this location and, once in operation, lighting and signage may be present that would affect the setting of the NHL.

Since the battlefield is large and the presence of vegetation is variable, the addition of the Project, while introducing new elements to the setting, does not diminish the overall quality of it. This is, in part, due to the manner in which one experiences the NHL. Views of the NHL largely face away from the Project and focus inward to the core interpretive area of the battlefield (i.e., the Core Battlefield Area), which is screened in part by existing vegetation.

The Project would not affect the essential features of the Palmito Ranch Battlefield for the period of significance (the Civil War) and its overall integrity would remain intact.

Palo Alto Battlefield NHL

The Palo Alto Battlefield NHL is located approximately 6.3 miles north of Brownsville in Cameron County, and approximately 9.1 miles west of the Project site (measured to the eastern boundary of the NHL). As previously noted, the Palo Alto Battlefield NHL is located outside the established direct and indirect APEs. However, given concerns voiced by cooperating agencies, it is included here.

This battlefield was the site of one of only two important battles fought on American soil during the Mexican War. Its period of significance is from 1800 to 1899 with a specific date of 1846. The property is listed in the NRHP and NHL for its association with an event (Criterion A) significant in our nation's history. The setting of the property has largely remained intact due to the lack of extensive development within its vicinity, and the Palo Alto Battlefield conveys a strong visual sense of the area as it might have appeared during its period of significance and retains its integrity of location, setting, feeling, and association. The Palo Alto Battlefield NHL is managed by the NPS as an historical park and includes an interpretive center, trails, and outlook area.

Information from the analysis of KOP 10 in the VIA was used to help determine the potential effects of the Project on the NHL. At KOP 10, a visitor overlook viewing platform approximately 12.4 miles west of the Project site, project components would be minimally visible just above the horizon. However, changes to the Project site as a result of grading and vegetation removal would not be visible.

No part of the NHL would be physically moved or directly altered. Due to the distance of over 12 miles between site and the primary Project components (i.e., built structures), the relationships of open space within the NHL would remain unchanged, along with the topographic and natural features that comprise it. Visible changes would occur in the setting outside the boundaries of the NHL, as the Project would be among the limited infrastructure that breaks above the horizon line. The Project would appear faintly visible from locations within and at the borders of the NHL. Due to the large size of the battlefield (and its associated historic park) and the variable presence of vegetation, the addition of the Project would not diminish its setting.

The Project would not affect the essential features of the Palo Alto Battlefield for the period of significance (the Mexican War) and its overall integrity would remain intact.

Brazos Santiago Depot

The Brazos Santiago Depot is located approximately 5.5 miles to the east of the Project site. The NRHP-listed historic property is located outside the direct and indirect APEs. However, given concerns voiced by cooperating agencies, it is included here.

The Brazos Santiago Depot is recorded as archaeological site 41CF4. The site consists of the remains of a 19th century historic military depot. It was listed in the NRHP in 1971 for its association with significant national themes of historic commerce, non-aboriginal history, historic military, and historic transportation (Criteria A) as well as the site's potential to yield additional information significant to the nation's history (Criterion D). It is classified as a submerged archaeological site due to the deflation of the land mass upon which it was originally sited.

Information from the analysis of KOP 5 in the VIA was used to help determine the potential effects of the Project on the Brazos Santiago Depot, as an historic property. At KOP 5, the Isla Blanca Park Boat Ramp approximately 6.7 miles east of the Project, some project components would be visible above the flat horizon. However, landform grading and vegetation removal would not likely be visible. In general, the Project would appear subordinate to or co-dominant with other structures within the view.

The historic property is significant for its ability to convey information and to yield data to help address important research questions. The Project would not affect these qualities, as no direct effects would occur. Since the site is primarily submerged, the aboveground setting is not a primary consideration when assessing effects to this site. While the Project may be visible from the location of the Brazos Santiago Depot, the construction and operation of the Project would not affect the site's potential to provide information about its period of significance or to yield information about the past.

4.10.1.3 Geophysical Underwater Survey

The SHPO has identified a shipwreck within the BSC near the Project area, known locally at the *PT Brownsville*. The SHPO indicated in a letter on November 17, 2016, that the wreck is within the APE. However, the letter also states that the wreck is no longer listed in the Automated Wrecks and Obstruction Information System, which suggests it may no longer be present.

Annova commissioned a combined bathymetric, geophysical, and archaeological survey of a 204-acre area within the BSC to provide detailed information about the existing underwater conditions where installation of sheet piles and tubular piles would occur to construct the marine berth and marine transfer facilities. No major magnetic signatures were identified nor were any archaeological sites of cultural significance identified during the bathymetric survey, suggesting the wreck is not in the work area (as noted in the SHPO's November 17, 2016 letter). However, the SHPO also noted there is a possibility that it could still exist. The SHPO requested that the State Marine Archaeologist be contacted in the event the wreck is encountered during construction.

Annova has proposed that if future dredging activity must extend outside the currently identified area, a certified archaeologist with training in historic vessel and artifact recognition as well as the use of navigation survey software would monitor the dredging activities. The monitor would have the authority to halt or alter the location of dredging operations in the event the remains of an historic shipwreck are identified.

4.10.2 Unanticipated Discovery Plan

Annova prepared an *Unanticipated Discovery Plan* (UDP) that would be implemented in the event that cultural resources or human remains are encountered during construction. In a letter dated August 3, 2015, the SHPO concurred with the proposed plan. On November 9, 2016, Annova summited a revised plan in response to comments of FERC staff. We find the revised plan to be acceptable.

4.10.3 Native American Consultation

On March 27, 2015, Annova wrote to the following federally recognized tribes: the Alabama Coushatta Tribe of Texas, the Comanche Nation of Oklahoma, and the Tonkawa Tribe of Oklahoma. Annova also wrote to the Lipan Apache Tribe of Texas and the Tap Pilan Coahuiltecan Nation, both state-recognized tribes. On April 2, 2015, the Comanche Nation of Oklahoma responded and on April 17, 2015, the Tonkawa Tribe of Oklahoma responded. Both tribes emphasized the need for coordination with the SHPO and compliance with the Native American Graves Protection and Repatriation Act. The Tonkawa Tribe of Oklahoma stated they have no historical or cultural interest in the Project. On July 9, 2015, Annova contacted the Lipan Apache Tribe of Texas via telephone and a tribal representative indicated that their ancestors were not culturally affiliated with the prehistoric people of South Texas, but would assist Annova with the compliance protocols associated with the UDP, if needed. Annova submitted the UDP to the Alabama Coushatta Tribe of Texas, the Comanche Nation of Oklahoma, the Lipan Apache Tribe of Texas, and the Tonkawa Tribe of Oklahoma on July 23, 2015. Subsequently, on December 7, 2015, Annova wrote to the Kickapoo Tribe of Oklahoma, to the Kickapoo Traditional Tribe of Texas, and to the American Indians in Texas at the Spanish Colonial Missions. To date, no additional responses have been received from the tribes.

The FERC sent its July 23, 2015 NOI for the Project to the same federally recognized tribes as above, and on August 27, 2015 we wrote letters to the same federally recognized tribes requesting their comments on the Project. No responses have been received to date.

4.10.4 Impacts and Mitigation

Construction and operation of the Project could potentially affect historic properties (i.e., cultural resources listed in or eligible for listing in the NRHP). Direct effects could include destruction or damage to all, or a portion, of an historic property. Indirect effects could include the introduction of visual, atmospheric, or audible elements that affect the setting or character of a historic property.

If NRHP-eligible resources are identified which cannot be avoided the applicants would prepare treatment plans for review and approval by the appropriate parties including the FERC, the SHPOs and Indian tribes. The FERC would afford the ACHP an opportunity to comment in accordance with 36 CFR 800.6. Implementation of a treatment plan would only occur after certification of the project and the FERC provides written notification to proceed.

4.10.5 Conclusions and Recommendation

Compliance with Section 106 of the NHPA has not been completed for the project. Annova has not completed cultural resources surveys of some sensitive shrub habitat to avoid clearing in this area prior to Project authorization, as well as in some historical tidal flat areas, or NRHP eligibility testing of archaeological site 41CF48. Additionally, consultation with the SHPO, Federal Land Managers, Indian tribes and other parties is incomplete.

To ensure that the FERC's responsibilities under the NHPA and its implementing regulations are met, **we recommend that:**

- **Annova should not begin construction of facilities and/or use of staging, storage, or temporary work areas and new or to-be-improved access roads until:**

  a. Annova files with the Secretary:

  (i) remaining cultural resources survey report(s);

  (ii) site evaluation report(s) and avoidance/treatment plan(s), as required; and

  (iii) comments on all cultural resources reports and plans from the Texas State Historic Preservation Office.

  b. the Advisory Council on Historic Preservation is afforded an opportunity to comment if historic properties would be adversely affected; and

  c. the FERC staff reviews and the Director of OEP approves the cultural resources reports and plans, and notifies Annova in writing that treatment plans/mitigation measures (including archaeological data recovery) may be implemented and/or construction may proceed.

  All materials filed with the Commission containing location, character, and ownership information about cultural resources must have the cover and any relevant pages therein clearly labeled in bold lettering: CUI/PRIV "CONTAINS PRIVILEGED INFORMATION - DO NOT RELEASE."

4.11 AIR QUALITY AND NOISE

4.11.1 Air Quality

Air quality would be affected by construction and operation of the Project. Though air emissions would be generated by operation of equipment during construction of the Project facilities, most air emissions associated with the Project would result from the long-term operation of the Project. This section identifies the estimated direct and indirect emissions from the Project and identifies the associated impacts.

Operation of the Project's three medium fired heaters and its thermal oxidizer, as well as some minor contributions from other equipment, would involve the combustion of fossil fuels. Combustion of natural gas would produce criteria air pollutants such as ozone (O_3), carbon monoxide (CO), sulfur dioxide (SO_2), and inhalable particulate matter ($PM_{2.5}$ and PM_{10}). $PM_{2.5}$ includes particles with an aerodynamic diameter less than or equal to 2.5 micrometers, and PM_{10} includes particles with an aerodynamic diameter less than or equal to 10 micrometers. Combustion of fossil fuels also produces volatile organic compounds (VOC), a large group of organic chemicals that have a high vapor pressure at room temperature; and oxides of nitrogen (NO_x). VOCs react with nitrogen oxides, typically on warm summer days, to form ozone. Other byproducts of combustion are greenhouse gases (GHG) and hazardous air pollutants (HAP). HAPs are chemicals known to cause cancer and other serious health impacts.

GHGs produced by fossil-fuel combustion are CO_2, methane (CH_4), and nitrous oxide (N_2O). The status of GHGs as a pollutant is not related to toxicity. GHGs are non-toxic and non-hazardous at normal ambient concentrations. GHG emissions due to human activity are the primary cause of increased levels of all GHG since the industrial age. These elevated levels of GHGs are the primary cause of warming of the global climate system since the 1950s. These existing and future emissions of GHGs, unless significantly curtailed, will cause further warming and changes to the local, regional and global climate systems. Emissions of GHGs are typically expressed in terms of CO_2 equivalents (CO_{2e}).

Other pollutants, not produced by combustion, are fugitive dust and fugitive emissions. Fugitive dust is a mix of $PM_{2.5}$, PM_{10}, and larger particles thrown up by vehicles, earth movement, or wind erosion. Fugitive emissions, in the context of this EIS, would be fugitive emissions of methane from operational pipelines and aboveground facilities.

4.11.1.1 Regional Climate

The Project area climate – humid subtropical – is significantly influenced by its location in the Texas Coastal Zone (i.e., proximity to the Gulf of Mexico). In general, the Port Isabel area has very short, mild winters and long hot summers, although the sea breeze can help moderate peak temperatures. Climate data obtained from NOAA for the period 1981 to 2010 show an annual average temperature of 74°F. Daily average high temperatures range from 68°F during January to 91°F during August. Daily average low temperatures range from 52°F during January to 77°F during July and August. The record minimum and maximum temperatures are 17°F and 103°F, respectively (NOAA 2016). The region experiences relatively high dew point values (about 75°F in summer), resulting in higher relative humidity for the June through September period.

Monthly total rainfall tends to be highest (greater than 2 inches) during the early summer and autumn months. The annual average precipitation amounts to approximately 29 inches, with a monthly maximum of 6.3 inches in September (NOAA 2016). Much of this precipitation comes from thunderstorm activity, although the majority of days that receive precipitation experience light rain. Tropical storms or hurricanes, although uncommon, can also enhance summer and autumn rainfall in this region.

The overall predominant wind pattern for the year in the extreme southern Texas Coastal Zone is southeasterly winds, with northwesterly winds dominating at times in the cooler part of the year, particularly December. The annual average wind speed is approximately 10 mph, with the highest average monthly wind speeds occurring during spring (NOAA 2016). The prevailing southeast wind is further enhanced during spring and early summer by thermal winds which develop when the air over the heated land farther west from the coast is warmer than the air over the relatively cooler waters of the Gulf of Mexico.

4.11.1.2 Existing Air Quality

Ambient Air Quality Standards

The EPA has established National Ambient Air Quality Standards (NAAQS) for six criteria pollutants: SO_2, CO, O_3, nitrogen dioxide (NO_2), PM_{10}, $PM_{2.5}$, and lead. There are two classifications of NAAQS, primary and secondary standards. Primary standards set limits the EPA believes are necessary to protect human health including sensitive populations such as children, the elderly, and asthmatics. Secondary standards are set to protect public welfare from detriments such as reduced visibility and damage to crops, vegetation, animals, and buildings.

Individual state air quality standards cannot be less stringent than the NAAQS. The federal NAAQS for criteria pollutants are the same as the state standards established by the TCEQ in accordance with Section 30 of the TAC, Rule §101.21. The TCEQ has also established 30-minute average property line standards for SO_2 and H_2S in 30 TAC §112. The federal NAAQS and Texas-specific standards (referenced as net ground-level concentrations) are summarized in table 4.11.1-1.

As with any activity that involves combustion of fossil fuels and processing of natural gas, the Project would contribute GHG emissions. The principal GHGs that would be produced by the Project are CO_2, CH_4, and N_2O. Emissions of GHGs are quantified and regulated in units of carbon dioxide equivalents (CO_2e). The GHG CO2e unit of measure takes into account the global warming potential (GWP) of each GHG. The GWP is a ratio relative to CO_2 that is based on the particular GHG's ability to absorb solar radiation as well its residence time within the atmosphere. Based on this definition, CO_2 has a GWP of 1, CH4 has a GWP of 25, and N_2O has a GWP of 298. To obtain the CO_2e quantity, the mass of the particular GHG compound is multiplied by the corresponding GWP, the product of which is the CO_2e for that compound. The CO_2e value for each of the GHG compounds is summed to obtain the total CO_2e GHG emissions.

TABLE 4.11.1-1

Ambient Air Quality Standards

Pollutant	Averaging Period	Primary NAAQS	Secondary NAAQS	Texas NGLC
Ozone (O_3)	8-Hour (2008) a/	0.075 ppm	0.075 ppm	-
Carbon monoxide (CO)	1-Hour b/	35 ppm	-	-
	8-Hour b/	9 ppm	-	-
Nitrogen dioxide (NO_2)	1-hour c/	100 ppb	-	-
	Annual d/	53 ppb	53 ppb	-
$PM_{2.5}$	24-Hour e/	35 μg/m^3	35 μg/m^3	-
	Annual f/	12 μg/m^3	15 μg/m^3	-
PM_{10}	24-Hour g/	150 μg/m^3	150 μg/m^3	-
Lead	3-Month h/	0.15 μg/m^3	0.15 μg/m^3	-
Sulfur dioxide (SO_2)	1-Hour i/, j/	75 ppb	-	-
	3-Hour b/	-	0.5 ppm	-
	30-minute	-	-	0.4 ppm k/
Hydrogen sulfide (H_2S)	30-minute	-	-	0.08/0.12 ppm l/

a/ Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years.
b/ Not to be exceeded more than once per year.
c/ The 98th percentile of daily maximum 1-hour average concentrations, averaged over 3 years.
d/ Annual arithmetic mean.
e/ The 98th percentile of 24-hour concentrations, averaged over 3 years.
f/ Annual arithmetic mean, averaged over 3 years.
g/ Not be exceeded more than once per year on average over 3 years.
h/ Not to be exceeded.
i/ The 99th percentile of daily maximum 1-hour concentrations, averaged over 3 years.
j/ The 24-hr and annual SO_2 NAAQS were revoked in 2010 (75 Federal Register 35520); however, standards remain in effect until one year after an area is designated attainment or nonattainment for the 1-hour standard, except in areas designated nonattainment for the 1971 standard, where the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standard are approved.
k/ Net ground-level concentration not to be exceeded at the property boundary.
l/ Net ground-level concentration of 0.08 ppm not to be exceeded on property normally occupied by people and net ground-level concentration of 0.12 ppm not to be exceeded on property that are not normally occupied by people.

μg/m^3 = micrograms per cubic meter; ppm = parts per million; ppb = parts per billion; NAAQS = National Ambient Air Quality Standards; NGLC = net ground-level concentration; $PM_{2.5/10}$ = particulate matter less than 2.5 or 10 microns in diameter

Air Quality Control Regions and Attainment Status

Air Quality Control Regions (AQCR) are areas established for air quality planning purposes in which implementation plans describe how ambient air quality standards will be achieved and maintained. AQCRs were established by the EPA and local agencies, in accordance with Section 107 of the CAA and its amendments, as a means to implement the CAA and comply with the NAAQS through State Implementation Plans (SIP). The AQCRs are intrastate and interstate regions such as large metropolitan areas where the improvement of the air quality in one portion of the AQCR requires emission reductions throughout the AQCR. The entire Project area is located in the Brownsville Laredo Intrastate AQCR (AQCR 213).

An AQCR, or portion thereof, is designated based on compliance with the NAAQS. There are three AQCR designations: attainment (areas in compliance with the NAAQS); nonattainment (areas not in compliance with the NAAQS); or unclassifiable. AQCRs that were previously designated nonattainment but have since met the requirements to be classified as attainment are classified as maintenance areas. The Brownsville Laredo Intrastate AQCR is designated as better than national standards, as unclassifiable, or as attainment for all criteria pollutants.

Transport of construction materials associated with the Project could occur within the Houston-Galveston-Brazoria (HGB) area, which is a marginal nonattainment area for the 2008 8-hour ozone standard. Construction emissions from the Project occurring within the HGB area would not be expected to result in an exceedance of applicable general conformity thresholds for the HGB area.

Air Quality Monitoring and Existing Air Quality

Air quality monitors are located throughout the state to determine existing levels of various air pollutants. Air quality monitoring data obtained from the EPA AirData and the TCEQ Air Quality Data databases can be used to characterize ambient air quality for regulated criteria pollutants in the vicinity of the Project. Data for 2012 to 2014 for SO_2, CO, NO_2, O_3, PM_{10}, $PM_{2.5}$, and lead from representative Project area monitors are summarized in table 4.11.1-2.

4.11.1.3 Regulatory Requirements for Air Quality

The Project would be potentially subject to a variety of federal and state regulations pertaining to the construction or operation of air emission sources. The TCEQ has the primary jurisdiction over air emissions produced by stationary sources associated with the Project. The TCEQ is delegated by the EPA to implement federal air programs. The following sections summarize the applicability of various state and federal regulations.

Federal Air Quality Requirements

The CAA, 42 USC 7401 et seq., as amended in 1977 and 1990, and 40 CFR Parts 50 through 99 are the basic federal statutes and regulations governing air pollution in the U.S. The following federal requirements have been reviewed for applicability to the Project.

- New Source Review (NSR) / Prevention of Significant Deterioration;
- Title V Operating Permits;
- New Source Performance Standards (NSPS);
- National Emission Standards for Hazardous Air Pollutants (NESHAP);
- Greenhouse Gas Reporting;
- Chemical Accident Prevention Provisions; and
- General Conformity.

New Source Review/Prevention of Significant Deterioration

Separate preconstruction review procedures for major new sources of air pollution (and major modifications of major sources) have been established for projects that are proposed to be built in attainment areas versus nonattainment areas. The preconstruction permit program for new or modified major sources located in attainment areas is called PSD. This review process is intended to keep new air emission sources from causing existing air quality to deteriorate beyond acceptable levels codified in the federal regulations. Construction of major new stationary sources in nonattainment areas must be reviewed in accordance with the nonattainment NSR regulations, which contain stricter thresholds and requirements.

TABLE 4.11.1-2

Existing Ambient Air Concentrations for the Project Area

Pollutant	Averaging Period	Measured Concentration a/	Units	Monitor Information: Air Quality Control Region (AQCR) b/	Location - County	Site ID No.
Sulfur Dioxide (SO_2)	1-hour	5.3	ppb	AQCR 214	Nueces	48-355-0025 (Corpus Christi West)
	3-hour	0.0032	ppm			
	24-hour c/	1.4	ppb			
	Annual c/	0.0003	ppm			
Carbon Monoxide (CO)	1-hour	1.6	ppm	AQCR 213	Cameron	48-061-0006 (Brownsville)
	8-hour	1.0	ppm			
Nitrogen Dioxide (NO_2)	1-hour	19.7	ppb	AQCR 216	Brazoria	48-039-1016 (Lake Jackson)
	Annual	1.8	ppb			
Ozone	8-hour	58.7	ppb	AQCR 213	Cameron	48-061-0006 (Brownsville)
Particulate Matter (PM_{10})	24-hour	50.3 d/	μg/m^3	AQCR 213	Cameron	48-061-0006 e/ (Brownsville)
Particulate Matter ($PM_{2.5}$)	4-hour	24.0	μg/m^3	AQCR 213	Cameron	48-061-2004 f/ (Isla Blanca)
	Annual	10.3	μg/m^3			
Lead (Pb)	Rolling 3-month	0.078 g/	μg/m^3	AQCR 213	Cameron	48-061-0006 (Brownsville)

a/ Measured concentration shown matches the statistic of the NAAQS, as noted in table 4.11.1-1. Three-year averages are derived from 2012 to 2014 data. For CO, value shown is the highest occurring in the 2012 to 2014 period.

b/ AQCRs: AQCR 213: Brownsville-Laredo Intrastate; AQCR 216: Metropolitan Houston-Galveston Intrastate; AQCR 214: Corpus Christi-Victoria Intrastate

c/ The 24-hour and annual SO_2 standards were revoked in 2010. However, these standards remain in effect until one year after an area is designated for the 1-hour SO_2 standard.

d/ Value shown is maximum second highest average from 2010 to 2012 data.

e/ Data for PM_{10} at the Brownsville station is from 2010-2012.

f/ Data for $PM_{2.5}$ at the Isla Blanca station is from 2011-2013.

g/ Three-month rolling averages are not yet available for Pb from AQS Data Mart. In lieu of this value, the highest 24-hour first maximum value for the 2012 to 2014 period is shown.

μg/m^3 = micrograms per cubic meter; ppm = parts per million; ppb = parts per billion

The PSD rule defines a major stationary source as any source with a potential to emit (PTE) 100 tons per year (tpy) or more of any criteria pollutant for source categories listed in 40 CFR §52.21(b)(1)(i) or 250 tpy or more of any criteria pollutant for source categories that are not listed. If a new source is determined to be a major source for any (non-GHG) PSD pollutant, then other remaining criteria pollutants (including GHG) would be subject to PSD review if those pollutants are emitted at rates that exceed the following significant emission thresholds: 100 tpy for CO; 40 tpy each for nitrogen oxides (NO_x), volatile organic compound (VOC), and SO_2; 25 tpy for total suspended particulate; 15 tpy for PM_{10}; 10 tpy for (direct) $PM_{2.5}$; and 75,000 tpy for GHG as CO_2e. Sources that exceed the major source threshold are then subject to a PSD review.

The EPA defined air pollution to include the mix of six long-lived and directly emitted GHGs, finding that the presence of the following GHGs in the atmosphere may endanger public health and welfare through climate change: CO_2, CH_4, N_2O, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. The PSD GHG Tailoring Rule intends to account for facilities that represent an estimated 70 percent of GHG emissions. This rule applies to all industrial sources that are major sources of any NSR-regulated pollutant other than GHGs and emit or have the potential to emit 75,000 tpy or more of CO_2e.

As shown in table 4.11.1-4 (in section 4.11.1.4), the stationary sources associated with the Project would have operating emissions that are less than the PSD major source thresholds for all (non-GHG) pollutants. Although potential emissions of GHG are above the PSD significant emission threshold, the requirements of PSD are not triggered if GHG is the only pollutant above this threshold. Therefore, the Project would not be subject to PSD review.

An additional factor considered in PSD permit review is potential impact on protected Class I areas. Class I areas were designated as pristine natural areas or areas of natural significance and have the lowest increment of permissible deterioration, which precludes development near these areas. Class I areas are given special protection under the PSD program. However, as described in section 4.11.1.6, because the proposed Project site is more than 300 kilometers (186.4 miles) from the nearest Class I area, and because the Project's potential emissions would make it a minor source with respect to PSD, a Class I analysis is not required for the Project.

Title V Operating Permits

Title V of the CAA requires states to establish an air quality operating permit program. The requirements of Title V are outlined in the federal regulations in 40 CFR Part 70 and in state regulations at 30 TAC §122. The operating permits required by these regulations are often referred to as Title V or Part 70 permits.

Major sources (i.e., sources with a PTE greater than a major source threshold level) are required to obtain a Title V operating permit. Title V major source threshold levels are 100 tpy for CO, SO_2, PM_{10}, or $PM_{2.5}$; 10 tpy for an individual HAP; or 25 tpy for any combination of HAPs. The recent Title V GHG Tailoring Rule also requires facilities that have the potential to emit GHGs at a threshold level of 100,000 tpy CO_2e be subject to Title V permitting requirements.

The Project would be subject to the Title V program because the stationary source emissions would exceed the major source thresholds for CO and GHGs. Therefore, Annova would need to apply for and obtain a Title V operating permit.

New Source Performance Standards

NSPS regulations (40 CFR Part 60) establish pollutant emission limits and monitoring, reporting, and recordkeeping for emission sources based on source type and size, and apply to new, modified, or reconstructed sources. The following NSPS requirements are potentially applicable to the specified proposed stationary sources at the Annova LNG terminal.

Subpart Db of 40 CFR Part 60, Standards of Performance for Industrial-Commercial-Institutional Steam Generating Units, applies to steam generating units constructed after June 19, 1984, and that have a maximum heat input capacity of greater than 100 million British thermal units per hour (MMBtu/hr). The three natural gas–fired heaters for the liquefaction trains would each have a maximum heat input rating of 143.6 MMBtu/hr and would be subject to Subpart Db. Gas-fired boilers are subject to a NO_x rate of either 0.20 lb/MMBtu (for boilers with a high heat release rate, defined as a heat input per cubic foot of furnace volume of greater than 70,000 Btu/hr), or 0.10 lb/MMBtu (for boilers with a low heat release rate, defined as a heat input per cubic foot of furnace volume of 70,000 Btu/hr or less). The heaters would use ultra-low NO_x burners to achieve an emission rate of 0.035 lb/MMBtu, in compliance with Subpart Db. The SO_2 and PM emission limits in Subpart Db do not apply to boilers that only burn natural gas.

Subpart Kb of 40 CFR Part 60, Standards of Performance for Volatile Organic Liquid Storage Vessels, applies to storage vessels containing volatile organic liquids depending on construction date, size, vapor pressure, and contents of the storage vessel. Subpart Kb applies to new tanks, unless otherwise exempted, that have a storage capacity between 75 m^3 (19,813 gallons) and 151 m^3 (39,890 gallons) and contain VOCs with a maximum true vapor pressure greater than or equal to 15.0 kilopascals (kPa). Subpart Kb also applies to tanks that have a storage capacity greater than or equal to 151 m^3 and contain VOCs with a maximum true vapor pressure greater than or equal to 3.5 kPa. Pressure tanks are exempt from the requirements of Subpart Kb.

The two LNG storage tanks would have a capacity of 160,000 m^3, which would meet the volume criteria for Subpart Kb. The LNG is considered a volatile organic liquid because a small portion of the LNG would consist of VOCs. The LNG storage tanks would operate at approximately -260°F and the true vapor pressure of the VOC (assumed to be propane) at this temperature is 0.0007 kPa. This would be well below the applicability threshold of 3.5 kPa; therefore, Subpart Kb would not apply to the LNG storage tanks. The condensate storage tank at the Project would have a capacity of 282,000 gallons (1,067 m^3), which is greater than 151 m^3; however, the material stored would have a true vapor pressure of less than 3.5 kPa, and therefore Subpart Kb would not apply. Additionally, there would be three diesel fixed-roof storage tanks located at the Project. The tanks would each have a capacity less than 75 m^3, and therefore would be exempt from Subpart Kb based on size.

Subpart JJJJ of 40 CFR Part 60, Standards of Performance for Stationary Spark Ignition Internal Combustion Engines, applies to spark ignition engines with a maximum engine power greater than 25 hp for which construction commenced by July 12, 2006, and which were manufactured after January 1, 2009. The Project's six natural gas-fired standby generators, each rated at approximately 3 megawatts (MW) of electrical output, would meet these applicability criteria and would therefore subject to the requirements of Subpart JJJJ. In order to demonstrate compliance with the emission limits found in the rule, owners and operators may either operate a manufacturer-certified engine according to manufacturer's operation and maintenance procedures or conduct performance testing. Owners/operators of emergency engines are required to keep records of their hours of operation. Additionally, maintenance records must be kept for all engines.

Subpart IIII of 40 CFR Part 60, Standards of Performance for Stationary Compression Ignition Internal Combustion Engines, applies to diesel-fueled stationary compression ignition internal combustion engines of any size that are constructed, modified, or reconstructed after July 11, 2005. The rule requires manufacturers of these engines to meet emission standards based on engine size, model year, and end use. The rule also requires owners and operators to configure, operate, and maintain the engines according to specifications and instructions provided by the engine manufacturer. These requirements of Subpart IIII would apply to the Project's mission critical diesel electric generator rated at approximately 2.5 MW of electrical output, and to the three diesel firewater pump engines rated at 750 hp each. The record-keeping and reporting requirements would also apply. The mission critical diesel electric generator and the firewater pump engines would normally operate only for testing and maintenance purposes, and would be limited to 100 hours of non-emergency operation per year.

National Emission Standards for Hazardous Air Pollutants

The NESHAP (40 CFR Parts 61 and 63) regulate HAP emissions. Part 61 (promulgated prior to the 1990 Clean Air Act Amendments (CAAA)) regulates HAPs such as asbestos, benzene, beryllium, coke oven emissions, inorganic arsenic, mercury, radionuclides, and vinyl chloride. The 1990 CAAA established a list of 189 HAPs while directing the EPA to publish categories of major sources and area sources of these HAPs, for which emission standards were to be promulgated according to a schedule outlined in the CAAA. These standards, also known as the Maximum Achievable Control Technology (MACT) standards, were promulgated under Part 63. The 1990 CAAA defines a major source of HAPs as any source that has a PTE of 10 tpy for any single HAP or 25 tpy for all HAPs in aggregate. Area sources are stationary sources that do not exceed the thresholds for major source designation. Federal NESHAP requirements are incorporated by reference in 30 TAC §113.55 and §113.00.

The annual PTE for HAP emissions from the stationary sources of the proposed Project would be 5.2 tpy in aggregate (see section 4.11.1.5); therefore, the Project would not be a major source of HAPs but would be classified as an area source of HAPs. Although an LNG liquefaction and export terminal is not one of the source categories regulated under Part 63, NESHAP/MACT standards could still apply for specific types of sources that support facility operations. The NESHAP described in the following paragraphs have been identified as being potentially applicable to specific sources at the Project.

Subpart ZZZZ of 40 CFR Part 63, NESHAP for Stationary Reciprocating Internal Combustion Engines, applies to reciprocating internal combustion engines of all sizes located at major and area sources of HAPs. Therefore, the six natural gas-fired standby generators, the mission critical diesel electric generator, and the three diesel firewater pump engines would all be subject to Subpart ZZZZ. However, as provided under 40 CFR 63.6590(c), the requirements of Subpart ZZZZ are satisfied by meeting the applicable requirements of either 40 CFR Part 60, Subpart IIII, or 40 CFR Part 60, Subpart JJJJ.

Greenhouse Gas Reporting Rule

Subpart W under 40 CFR Part 98, the Mandatory Greenhouse Gas Reporting Rule, requires petroleum and natural gas systems that emit 25,000 metric tons or more of CO_2e per year to report annual emissions of GHG to the EPA. “LNG storage” and “LNG import and export equipment” are industry segments specially included in the source category definition of petroleum and natural gas systems. Equipment subject to reporting includes storage of LNG, regasification of LNG and liquefaction of natural gas.

We required Annova to calculate estimated emissions of GHGs associated with the construction and operation of the Project, including all direct and indirect emission sources. In addition, GHG emissions were converted to total CO_2e emissions based on the global warming potential of each pollutant. The reporting rule does not apply to construction emissions; however, we have included the construction emissions for accounting and disclosure purposes. GHG emissions from operation of the stationary sources of the proposed Project may exceed the 25,000 metric ton threshold and therefore would be subject to the reporting rule. Annova would be required to report actual GHG emissions in accordance with the provisions of 40 CFR Part 98.

Chemical Accident Prevention Provisions

The chemical accident prevention provisions, codified in 40 CFR Part 68, are federal regulations designed to prevent the release of hazardous materials in the event of an accident and minimize potential impacts if a release does occur. The regulations contain a list of substances (including methane, propane, and ethylene) and threshold quantities for determining applicability to stationary sources. If a stationary source stores, handles, or processes one or more substances on this list in a quantity equal to or greater than specified in the regulation, the facility must prepare and submit a risk management plan. A risk management plan is not required to be submitted to the EPA until the chemicals are stored on-site at the facility.

If a facility does not have a listed substance on-site, or the quantity of a listed substance is below the applicability threshold, the facility does not have to prepare a risk management plan. However, if there is any regulated substance or other extremely hazardous substance onsite, the facility still must comply with the requirements of the General Duty Clause in Section 112(r)(1) of the 1990 CAAA. The General Duty Clause is as follows:

> "The owners and operators of stationary sources producing, processing, handling and storing such substances have a general duty to identify hazards which may result from such releases using appropriate hazard assessment techniques, to design and maintain a safe facility, taking such steps as are necessary to prevent releases, and to minimize the consequences of accidental releases which do occur."

Stationary sources are defined in 40 CFR Part 68 as any buildings, structures, equipment, installations, or substance-emitting stationary activities which belong to the same industrial group, that are located on one or more contiguous properties, are under control of the same person (or persons under common control), and are from which an accidental release may occur. The Project would have the capacity to store approximately 331,600,000 pounds of methane as LNG on-site. However, the definition also states that the term "stationary source" does not apply to transportation, including storage incidental to transportation, of any regulated substance or any other extremely hazardous substance. The term "transportation" includes transportation subject to oversight or regulation under 49 CFR Parts 192, 193, or 195. Based on these definitions, the Project, which is subject to 49 CFR Part 193, would not require a risk management plan.

General Conformity

A conformity analysis must be conducted by the lead federal agency if a federal action would result in the generation of emissions that would exceed the conformity threshold levels (*de minimis*) of the pollutants(s) for which an AQCR is in nonattainment. According to Section 176(c)(1) of the CAA (40 CFR §51.853), a federal agency cannot approve or support any activity that does not conform to an approved SIP. Conforming activities or actions should not, through additional air pollutant emissions:

- cause or contribute to new violations of the NAAQS in any area;
- increase the frequency or severity of an existing violation of any NAAQS; or
- delay timely attainment of any NAAQS or interim emission reductions.

General Conformity assessments must be completed when the total direct and indirect emissions of a planned project would equal or exceed the specified pollutant conformity emission thresholds per year in each nonattainment area.

A General Conformity Determination must show that the emissions would conform to the applicable SIP and would not degrade air quality in the nonattainment area. This can be demonstrated through acquisition of emission offsets, SIP revisions, or dispersion modeling. On-site mitigation of emissions (i.e., controls above and beyond what is required by regulation) can also be used to demonstrate conformity. According to 40 CFR §51.853, emissions from sources subject to NSR or PSD requirements are exempt and are deemed to have conformed.

As discussed in section 4.11.1.2, the Project facilities would be located in an area currently designated by EPA as better than national standards, as unclassifiable, or as in attainment for all criteria pollutants. Operating emissions for these facilities would be located entirely within designated unclassifiable/attainment areas for all criteria air pollutants and would be subject to evaluation under the PSD permitting program; therefore, these emissions are not subject to General Conformity regulations.

However, during the construction phase of the Project, barges carrying equipment and materials could potentially travel through nonattainment areas en route to the Project site. Although Annova has not yet determined where equipment deliveries would originate, Annova evaluated a hypothetical scenario to estimate marine vessel construction emissions for barge travel through the HGB ozone nonattainment area, where the Port of Houston is located. Annova estimates a total of 24 to 36 barge deliveries to the Project site per year would be required during construction. This hypothetical scenario assumes that up to 25 barge round trips per year of construction would originate and terminate at the Port of Houston. The construction barge traffic emissions associated with travel in the HGB ozone nonattainment area would be subject to evaluation under General Conformity regulations. The relevant general conformity pollutant thresholds for the HGB ozone nonattainment area are 100 tpy of NO_x and VOC (ozone precursors).

Annova estimated emissions from tug vessels that push the barges using the methodology and emission factors described in EPA's Current Methodologies in Preparing Mobile Source Port-Related Emission Inventories (ICF International 2009). The emissions assumed one tugboat per barge, rated at 2,000 hp with an engine load factor of 0.85, and traveling at an average speed of 5 miles per hour. For the purpose of estimating the distance and duration of travel within the HGB ozone nonattainment area, Annova selected the Barbours Cut container terminal at the Port Authority of Houston as the origin point for barge trips. This results in a one-way travel distance of approximately 80 miles within the HGB ozone nonattainment area, which ends at the Brazoria/Matagorda county boundary.

Annova estimated that the total potential direct and indirect emissions from construction barge travel in the HGB ozone nonattainment area would be 7.6 tpy of NO_x and 0.3 tpy of VOCs. Based on these emissions, a General Conformity Determination is not required for the Project.

Applicable State Air Quality Requirements

In addition to the federal regulations identified above, the TCEQ has its own air quality regulations, codified in 30 TAC. State requirements potentially applicable to the Project include:

- 30 TAC Chapter 101, Subchapter A – *General Rules*.
- 30 TAC Chapter 111 – *Control of Air Pollution from Visible Emissions and Particulate Matter.*
- 30 TAC Chapter 112 – *Control of Air Pollution from Sulfur Compounds*.
- 30 TAC Chapter 113 – *Control of Air Pollution from Toxic Materials*. Chapter 113 incorporates by reference the NESHAP source categories (40 CFR Part 63).
- 30 TAC Chapter 114 – *Control of Air Pollution from Motor Vehicles*.
- 30 TAC Chapter 115 – *Control of Air Pollution from Volatile Organic Compounds*.
- 30 TAC Chapter 116, Subchapter B – *Control of Air Pollution by Permits for New Construction or Modification*.
- 30 TAC Chapter 118 – *Control of Air Pollution Episodes*. 30 TAC Chapter 122 – *Federal Operating Permits*.

4.11.1.4 Construction Emissions and Mitigation

Construction of the Project would result in short-term increases in emissions of some air pollutants due to the use of equipment powered by diesel fuel or gasoline engines and the generation of fugitive dust due to the disturbance of soil and other dust-generating activities. More specifically, the construction activities that would generate air emissions include:

- site preparation (vegetation clearing, trenching, land contouring, foundation preparation, etc.);
- installation of equipment;
- operation of off-road vehicles and trucks during construction;
- operation of marine vessels (e.g., equipment barges) during construction;
- offshore dredging; and
- workers' vehicles used for commuting to and from the construction site (i.e., on-road vehicles).

The emission increases associated with the Project construction activities would have short-term, localized impacts on air quality. These emissions are not subject to the air quality permitting requirements that apply to emissions from operation of stationary sources at the Project. We note that there are no residential or sensitive populations within one mile of the Project site. Nevertheless, the construction-related emission rates are discussed in this section as a means of identifying potential air quality concerns associated with the construction phase of the Project and to assist in developing mitigation.

The amount of fugitive dust for an area under construction would depend on numerous factors, including degree of vehicular traffic; size of area disturbed, amount of exposed soil, soil properties (silt and moisture content); and wind speed. Construction of the Project would also result in fuel combustion emissions from a variety of sources, including off-road sources (e.g., bulldozers, cranes, front-end loaders, pile drivers), on-road sources (e.g., construction worker vehicles), and marine vessels (e.g., tugs, barges).

Site preparation would include grading, cutting of drainage ditches, placement of gravel surfaces (e.g., lay-down areas), and construction of access roads within the Project site boundaries. Site preparation activities would generate fugitive dust from earthmoving and movement of construction equipment over unpaved surfaces and tailpipe emissions from construction equipment and vehicle engines. The construction equipment and vehicles would be powered by internal combustion engines that would generate PM_{10}, $PM_{2.5}$, SO_2, NO_x, VOC, and CO emissions. Site preparation equipment would include bulldozers, front-end loaders, backhoes, excavators, compactors, dump trucks, and other mobile construction equipment.

The construction of the Project would include installation of six liquefaction trains, two LNG storage tanks, LNG carrier berths and LNG transfer lines, major mechanical equipment, and piping and instrumentation, as well as construction of foundations, pipe racks, miscellaneous storage tanks, and buildings. The Project construction equipment would include cranes, forklifts, man lifts, drill rigs, welding machines, air compressors, and generators (for various duties, such as pumping, lighting, etc.), which would result in fuel combustion and fugitive dust emissions.

The LNG storage tanks would include the use of perlite insulation in the space between the outer tank shell and the inner nickel alloy wall. Perlite is a naturally occurring mineral that expands to between 10 and 20 times its original volume when heated, giving it excellent insulating qualities. Because expanded perlite is fragile and can be easily crushed during handling, the perlite material would be trucked to the Project site in unexpanded form, and then expanded onsite, which involves the use of a small natural gas-fired furnace equipped with a wet cyclone to capture particulate emissions. Perlite expansion would occur as each LNG storage tank is constructed.

The Project would include offshore dredging of the LNG carrier berthing area. The emissions generated by these activities would be predominantly combustion emissions from the construction equipment and marine vessel engines. The construction equipment used for the offshore dredging would include a barge-mounted suction dredge. In addition, one tugboat would be used to deliver construction materials by barge through the BSC to the Project site.

Site truck traffic (e.g., supply trucks) and worker commuter vehicles would generate fugitive dust from travel on paved and unpaved surfaces as well as tailpipe emissions. Construction of the Project would require a peak of approximately 1,200 workers, with an average of approximately 700 workers on-site per month during construction. Most of the commuter vehicles would likely burn gasoline, although supply trucks and some worker pickup trucks would burn ultra-low-sulfur diesel fuel.

Fuel combustion emissions from off-road construction equipment were determined using emission factors obtained from the EPA's NONROAD Emission Factor Model, Version 2008a, contained within the EPA Motor Vehicle Emission Simulator (MOVES) 2014 vehicle emission modeling software. Fuel combustion emissions from on-road vehicles were determined using emission factors obtained from MOVES 2014.

Annova would minimize emissions from off-road construction equipment using the following measures:

- implement idling restrictions;
- commit to the use of newer-tier engines when available; and
- install add-on pollution controls on temporary stationary construction equipment.

SO_2 emissions would be further reduced by the use of ultra-low-sulfur diesel. In addition, vehicle emissions would be minimized through compliance with 30 TAC Chapter 114 – Control of Air Pollution from Motor Vehicles. Estimated fugitive dust emissions generated by on-site construction equipment were based on emission factors developed by the *WRAP Fugitive Dust Handbook* (Countess Environmental 2006). The total estimated criteria air pollutant and GHG (as CO_2e) emissions associated with construction-related activities for the Project are summarized in table 4.11.1-3. These totals include fuel combustion emissions as well as fugitive PM emissions. For fuel combustion emissions from non-road and on-road engines, nearly all emitted PM is assumed to be $PM_{2.5}$.

TABLE 4.11.1-3

Total Project Construction Emissions by Year

	Annual Emissions (tpy) a/							
Year	NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2e b/	HAPs
1	23	2.6	40	0.04	293	30	7,802	<0.1
2	172	22	220	0.3	158	25	56,316	<0.1
3	152	17	224	0.25	126	21	44,492	<0.1
4	131	13	202	0.22	65	14	39,619	<0.1
5	50	6	86	0.08	59	8	15,025	<0.1

a/ Includes suction dredge, barge deliveries, and other off-road equipment; Perlite expansion equipment; construction mobile sources, including worker commutes; fugitive dust from general site work and earth moving; and fugitive dust from construction and use of the access road.
b/ CO_2e emissions based on global warming potentials of 1 for CO_2, 25 for CH_4, and 298 for N_2O.
CO = carbon monoxide; CO_2e = carbon dioxide equivalent; HAP = hazardous air pollutant; NO_x = nitrogen oxides; SO_2 = sulfur dioxide; $PM_{2.5/10}$ = particulate matter less than 2.5 or 10 microns in diameter; tpy = ton per year; VOC = volatile organic compound

Fugitive dust accounts for the majority of PM emissions during the construction period for the Project. Annova has developed a *Fugitive Dust Control Plan* to mitigate these emissions (see appendix G). Measures outlined in the plan include the following:

- properly maintain construction equipment and vehicles to minimize particulate matter from exhaust;
- utilize existing public and private roads and existing right-of-way for access during construction wherever possible;
- apply water as needed to all affected unpaved roads, unpaved haul/access roads, and staging areas when in use;
- when appropriate, apply a water/magnesium chloride mixture as needed as a dust suppressant;

- reduce vehicle speeds on all unpaved roads, and unpaved haul and access roads. Speed limits would be set to 20 miles per hour for unpaved roads in all areas, or in accordance with posted public speed limits;
- inspect paved road access points and clean up track-out and/or carry-out areas at paved road access points at a minimum of once every 48 hours;
- gravel pads may be installed adjacent to paved roadways to limit track-out, and clearly established and enforced traffic patterns may be used to route traffic over track-out control devices;
- for bulk transfer operations, spray handling and transfer points with water at least 15 minutes before use;
- cover all haul truck loads or maintain at least 6 inches of freeboard space in each cargo compartment. Ensure that all haul truck cargo compartments are constructed and maintained to minimize spillage and loss of materials, and clean or wash each cargo compartment at the delivery site after removal of the bulk material;
- apply water to active construction areas as needed. Areas should be pre-watered and soils maintained in a stabilized condition where support equipment and vehicles would operate. Water disturbed soils to form a crust; and
- for temporary surfaces during periods of inactivity, restrict vehicular access by means of either fencing or signage, and apply water to comply with the stabilized surface requirements.

As indicated in table 4.11.1-3, there may be localized minor to moderate elevated levels of fugitive dust and tailpipe emissions near construction areas during the 60-month construction period associated with the LNG terminal site. The construction emissions' impact on ambient air quality would vary with time due to the construction schedule, the mobility of the sources, and the variety of emission sources. Fugitive dust and other emissions due to construction activities generally do not pose a significant increase in regional pollutant levels; however, local pollutant levels would increase during the construction period. Considering these factors, we determine that construction of the Project would impact local air quality. However, construction emissions would not have a permanent effect on air quality in the area.

4.11.1.5 Operating Emissions and Mitigation

Operation of the Project would result in air emissions from stationary equipment (e.g., heaters, flares, oxidizers, and emergency generators) and mobile sources (e.g., LNG carriers and tugs). Operational-phase emissions from a variety of sources/equipment would be permanent. These various sources and associated criteria pollutant, GHG, and HAP emission rates are discussed in the following section. The Project would operate up to six natural gas liquefaction trains continuously. Sources of air emissions associated with operation of the Project include:

- three natural gas-fired heaters with a maximum heat input rating of 143.6 MMBtu/hr each;
- one thermal oxidizer to combust waste gas from the gas pretreatment facilities, as well as BOG from the LNG storage and handling equipment;

- warm and cold gas flares (one of each) to combust gas streams during system commissioning, cool-downs, equipment startup, and planned maintenance shutdowns;
- one marine flare to combust gas streams produced during cooldown of LNG carriers that arrive with warm cargo tanks filled with inert gas (estimated to be required for two LNG carriers per year);
- six natural gas–fired standby generator engines each rated at approximately 3 MW electrical output;
- one diesel fuel–fired mission critical electric generator engine rated at approximately 2.5 MW electrical output, to be used in a facility black-start scenario;
- three diesel fuel-fired firewater pump engines each rated at 750 hp;
- one 282,000-gallon vertical, fixed-roof aboveground storage tank for storage of heavy hydrocarbon liquids condensed during the liquefaction process;
- three small fuel oil storage tanks (approximately 600 gallons each) serving the mission critical electric generator and firewater pump engines;
- marine vessel emissions from LNG carriers and tugboats;
- fugitive VOC and GHG emission sources (e.g., valves, flanges, connectors, and marine vessel offloading equipment);
- fugitive GHG emissions from sulfur hexafluoride leakage at electric substation; and
- planned maintenance, startup, and shutdown (MSS) activities.

Emissions of NO_x, VOC, CO, PM_{10}, $PM_{2.5}$, and SO_2 would be generated primarily by the fuel combustion sources. Table 4.11.1-4 provides a summary of the estimated annual operating emissions for criteria air pollutants, GHG (as CO_2e), and HAPs from the Project stationary sources. The estimate of annual emissions is based on the following assumptions:

- continuous operation (8,760 hours per year) for the heaters, the thermal oxidizer, and the flare pilot flames;
- 50 hours per year for marine flare inert ship events; and
- no more than 100 hours of non-emergency operation per year for the electric generators and fire water pumps.

The warm and cold flares would only operate intermittently, and their annual non-pilot flame emissions are included as part of the MSS emission totals.

Annova has prepared a draft Minor Source Construction Permit Application for eventual submittal to TCEQ, in which it has proposed the following emission limits for the Project's stationary sources to satisfy TCEQ's BACT guidelines.

- for the gas-fired heaters: use of low-NOx burners meeting 0.035 pound (lb)/MMBtu; CO limit of 50 parts per million (ppm) corrected to 3 percent oxygen (O_2); use of a continuous emission monitoring system; use of natural gas as the only fuel; and good combustion practices;
- for the thermal oxidizer: use of low-NOx burners meeting 0.06 lb/MMBtu; VOC emissions limited to 99.9 percent destruction and removal efficiency or 10 ppm corrected to 3 percent O_2; use of a sulfur recovery unit to initial performance test; and monitoring of combustion chamber exit temperature;
- for the gas-fired standby generators: NOx limit of 0.5 grams per brake horsepower-hour (g/bhp-hr); CO limit of 1.9 g/bhp-hr; VOC limit of 0.39 g/bhp-hr; use of natural gas as the only fuel; limited hours of operation; good combustion practices; and compliance with NSPS Subpart JJJJ;
- for the mission critical generator and firewater pump engines: use of ultra-low-sulfur diesel fuel; limited hours of operation; good combustion practices; and compliance with NSPS Subpart IIII;
- for the flares: compliance with 40 CFR Part 60.18 for flare tip velocity and waste gas heat content to achieve 99.5 percent control of VOC and H_2S; no flaring of halogenated compounds; use of a flow monitor; and operation of a continuous pilot flame;
- for the condensate tank: capture of vapor emissions for use as supplemental fuel in the gas-fired heaters; and
- for fugitive equipment leaks: compliance with TCEQ's 28M leak detection and repair program to achieve 75 percent control of VOC emissions.

Table 4.11.1-5 provides a summary of the estimated annual operating emissions for criteria air pollutants, GHG (as CO_2e), and HAPs from the mobile sources associated with the Project. The annual mobile source emissions are based on the following assumptions.

- transit emissions for 78 LNG carrier annual round-trips via the BSC;
- Annova has assumed that all LNG carriers would be dual-fuel diesel-electric, firing 95 percent natural gas plus 5 percent diesel;
- hoteling emissions from LNG carriers while moored at the Project's marine transfer facility with their propulsion engines shut off;
- tugboat emissions associated with each LNG carrier trip, including one 6,000-hp tugboat escort for the entire route, and three additional 6,000-hp tugboats to assisting with maneuvering and mooring activities at the Project's marine transfer facility;
- two 800-hp security vessels to escort each LNG carrier along the entire transit route;
- one 800-hp security vessel to patrol the Project docking area (up to 8 hours per day);
- worker commute traffic for approximately 165 full-time employees; and
- on-site traffic and truck deliveries to the Project site.

TABLE 4.11.1-4

Estimated Annual Project Operating Emissions for Onshore Stationary Sources

	Annual Emissions (tpy)													
							HAPs							
Emission Source	NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	Benzene	Ethyl-benzene	Formaldehyde	Hexane	Toluene	Xylene	Total HAPs	CO_2e a/
Medium Fired Heaters (3)	66	11	94	0.1	15	15	0	0	0.15	3.57	0	0	3.7	208,202
Thermal Oxidizer (1)	7	0.38	5.9	83	0.53	0.53	0	0	0.01	0.13	0	0	0.13	137,709
Standby Generators (6)	1.1	0.89	4.3	0.004	0.24	0.24	0.012	0	0.59	0	0.0059	0	0.61	1,237
Mission Critical Diesel Generator	0.2	< 0.01	0.021	< 0.001	< 0.01	< 0.01	0.0002	0	0	0	0.0001	0	0.0003	36
Firewater Pumps (3)	0.5	0.02	0.13	0.001	0.01	0.01	0.0006	0	0.0007	0	0.0002	0.0002	0.0017	100
Warm Gas Flare	0.4	1.6	1.5	< 0.0001	0	0	0	0	0	0	0	0	< 0.0001	360
Cold Gas Flare	0.6	2.6	2.5	< 0.0001	0	0	0	0	0	0	0	0	< 0.0001	599
Marine Flare	6.5	27	26	0.01	0	0	0	0	0	0	0	0	< 0.001	286
Fugitive Emissions b/	0	3.9	0	0	0	0	0	0	0	0.69	0	0	0.69	4,413
Condensate Tank	0	4.2	0	0	0	0	0	0	0	0	0	0	< 0.001	0
Planned MSS c/	0.1	0.5	0.3	< 0.0001	0	0	0	0	0	0	0	0	0	130
Total d/	**82**	**52**	**135**	**83**	**16**	**16**	**0.02**	**0**	**0.75**	**4.38**	**0.01**	**0**	**5.2**	**353,072**
PSD Major Source Threshold e/	250	250	250	250	250	250	N/A	N/A	N/A	N/A	N/A	N/A	N/A	75,000
Subject to PSD Review?	No	No	No	No	No	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No f/

a/ CO_2e emissions based on global warming potentials of 1 for CO_2, 25 for CH_4, and 298 for N_2O.
b/ Includes emissions from the condensate storage tank, diesel storage tanks, and component/equipment leaks. Total includes application of current Texas Commission on Environmental Quality Best Available Control Technology for equipment leaks.
c/ Includes worst-case annual emissions produced during planned maintenance events, and equipment startups and shutdowns associated with planned events that occur at least annually. Per Texas Commission on Environmental Quality, does not include unplanned events. Some maintenance events occur with frequency longer than 1 year. Emissions are produced from flaring.
d/ The heaters and thermal oxidizer would operate continuously (8,760 hours per year). The flares would operate intermittently, except that pilot/purge would operate continuously. The standby generators and firewater pumps would operate only for routine maintenance runs and during emergency situations.
e/ Emissions of other Prevention of Significant Deterioration (PSD)-regulated air pollutants – lead, fluorides, sulfuric acid mist, H_2S, total reduced sulfur, and reduced sulfur compounds – are negligible.
f/ PSD review for GHG emissions is only required if a facility is major for a non-PSD pollutant.

CO = carbon monoxide; CO_2e = carbon dioxide equivalent; HAP = hazardous air pollutant; NO_x = nitrogen oxides; SO_2 = sulfur dioxide; $PM_{2.5/10}$ = particulate matter less than 2.5 or 10 microns in diameter; tpy = ton per year; VOC = volatile organic compound

TABLE 4.11.1-5

Estimated Annual Project Operating Emissions for Mobile Sources

Emission Source	Annual Emissions (tpy)													
							HAPs d/							
	NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	Benzene	Ethyl-benzene	Formaldehyde	Hexane	Toluene	Xylene	Total HAPs	CO_2e a/
LNG Vessels and Tugboats b/, c/	87	8	17	1	4	4	0.0403	0.0040	0.3036	0.0109	0.0063	0.0095	0.6242	7,984
Security Vessel Operations	18	0.48	3	0.01	0.44	0.44	0.0072	0.0007	0.0525	0.0019	0.0011	0.0017	0.1020	1,229
Worker Commuting	0.34	0.07	8.4	0.01	0.01	0.01	0.0027	0.0013	N/A	0.0014	0.0057	0.0047	0.0159	1,185
On-Site Traffic	0.02	< 0.01	0.25	< 0.01	< 0.01	< 0.01	0.0004	0.0002	N/A	0.0002	0.0008	0.0007	0.0023	20
Truck Deliveries	0.23	0.03	0.1	< 0.01	0.01	0.01	0.0001	0.0000	N/A	0.0000	0.0001	0.0001	0.0003	153
Total	**105.6**	**8.6**	**28.8**	**1**	**4.5**	**4.5**	**0.0507**	**0.0062**	**0.3561**	**0.0144**	**0.0140**	**0.0167**	**0.7447**	**10,571**

a/ CO_2e emissions based on global warming potentials of 1 for CO_2, 25 for CH_4, and 298 for N_2O.

b/ Based on 173,000 cubic meter dual-fuel diesel electric LNG carrier, tug boats of 6,700 brake-horsepower. HAPs shown represents largest individual HAP emitted (formaldehyde); other HAP emission rates are an order of magnitude lower.

c/ Based on a 173,000-cubic meter capacity vessel because these produce the largest short-term impacts.

d/ Total HAP includes additional speciated compounds for marine vessels that are not shown in this table.

CO = carbon monoxide; CO_2e = carbon dioxide equivalent; HAP = hazardous air pollutant; NO_x = nitrogen oxides; SO_2 = sulfur dioxide; $PM_{2.5/10}$ = particulate matter less than 2.5 or 10 microns in diameter; tpy = ton per year; VOC = volatile organic compound

Table 4.11.1-6 provides a summary of estimated emissions from MSS activities for the six liquefaction trains. Maintenance would include replacement of dust filters (every 6 months), molecular sieve filters (every 2 to 4 years), dehydrators (every 2 to 4 years), pump seals (every 2 to 4 years), and replacement of propane and isopentane drying beds (every 10 years). Emissions from MSS activities would result from flaring of process gases (primarily methane), which would be sent to the warm flare or the cold flare as appropriate as they are flushed from the equipment undergoing maintenance. It is estimated that worst-case annual MSS emissions would occur every 4 years, when the annual, 2-year, and 4-year maintenance schedules overlap. These worst-case MSS emissions are included in the Project-wide annual emissions shown in table 4.11.1-4 above.

TABLE 4.11.1-6

Estimated Maintenance, Startup, and Shutdown Emissions

Interval	Annual Emissions (tpy)			
	NO_x	VOC	CO	CO_2
Annual	0.002	0.02	0.02	4
Two Years a/	0.005	0.04	0.04	8
Three Years b/	0.05	0.4	0.5	91
Four Years c/	0.1	0.5	0.3	131
Ten Years d/	0.02	0.07	0.05	14

a/ MSS 2-year emissions include annual and 2-year recurring events.
b/ MSS 3-year emissions include annual and 3-year recurring events.
c/ MSS 4-year emissions include annual, 2-year, and 4-year recurring events.
d/ MSS 10-year emissions include annual, 2-year, and 10-year recurring events.
CO = carbon monoxide; CO_2 = carbon dioxide; MSS = maintenance, startup, and shutdown; NOx = nitrogen oxides; tpy = ton per year; VOC = volatile organic compound

4.11.1.6 Operational Impact Assessment

The stationary sources associated with the proposed Project are considered a new minor stationary source, as defined under 30 TAC §116.12, and TCEQ therefore requires that Annova perform state-level air quality dispersion modeling to demonstrate that the Project would not cause or contribute to a violation of any applicable NAAQS, or adversely affect public health or welfare. In addition, we requested that Annova perform modeling that includes both the Project's stationary sources and emissions from the marine vessels that would operate as part of the Project's activities. The methodology and results for these modeling analyses are discussed in the following section.

Overall Modeling Methodology

Annova conducted dispersion modeling using the latest version of the American Meteorological Society/EPA Regulatory Model (AERMOD, Version 15181), in accordance with TCEQ modeling guidance, as well as guidance provided by FERC. Annova submitted a modeling protocol describing the approach for both the TCEQ and the FERC modeling analyses. AERMOD was run in the regulatory default mode for all pollutants. Total ambient impacts were calculated by adding modeled facility impacts on existing air pollutant background concentrations. Receptors were placed along the proposed fence line, and in a grid extending out to 50 kilometers (31 miles) from the center of the Project site. Separate analyses were conducted including only the Project stationary sources and including both the stationary sources and mobile source emissions from one LNG carrier docked at the loading berth with one tugboat on stand-by near the LNG carrier.

Because the Project would be a minor source with respect to PSD, and because the nearest Class I area is more than 300 kilometers (186.4 miles) away, no evaluation of impacts on Class I areas is required. However, we did request that Annova assess air quality impacts for the Lower Rio Grande NWR, due to its proximity to the Project. Because the Project would be a minor PSD source with respect to emissions of the ozone precursor pollutants NO_x and VOC, an ozone impact assessment is also not required.

Modeling Results

Table 4.11.1-7 presents the results of modeling of total ambient impacts for the proposed stationary sources, which demonstrate that the stationary sources would not cause or contribute to an exceedance of a NAAQS. Annova is revising its SO_2 dispersion modeling as part of an update of the TCEQ minor source permit application and states it will provide in a future filing to FERC revised potential emissions from the heaters, thermal oxidizers, and flares.

TABLE 4.11.1-7

Stationary Source Ambient Impact Analysis Results

Pollutant	Averaging Period	Modeled Concentration (μg/m^3)	Background Concentration (μg/m^3)	Total Impact (Modeled + Background) (μg/m^3)	NAAQS (μg/m^3)	Exceed NAAQS?
Sulfur Dioxide (SO_2)	1-hour, 4th high	0.1	13.2	13.3	196	No
	3-hour, 2nd high	7.7	8.4	16.1	1,300	No
Carbon Monoxide (CO)	1-hour, 2nd high	19,163	1,258	20,421	40,000	No
	8-hour, 2nd high	6,378	800	7,178	10,000	No
Nitrogen Dioxide (NO_2)	1-hour, 8th high	16	36.4	52.4	188	No
	Annual, 1st high	0.71	3.4	4.1	100	No
Particulate Matter (PM_{10})	24-hour, 6th high	0.48	49.0	49.48	150	No
Particulate Matter ($PM_{2.5}$)	24-hour, 8th high	0.47	25.5	25.97	35	No
	Annual, 1st high	0.15	10.1	10.25	12	No

μg/m^3 = microgram per cubic meter; NAAQS = National Ambient Air Quality Standards

Table 4.11.1-8 presents the results of modeling of total ambient impacts for the proposed stationary sources plus mobile source emissions from one docked LNG carrier and one tugboat on standby. The analysis assumed that the LNG carrier would operate in hoteling mode while docked, with a single engine operating at low load to supply power for essential ship functions. It was also assumed the standby tugboat would be floating nearby with its propulsion engines shut off, and the other three tugboats serving the Project would be docked with engines off while an LNG carrier is berthed. These results also demonstrate compliance with the NAAQS. Annova is revising its SO_2 dispersion modeling as part of an update of the TCEQ minor source permit application and states it will provide in a future filing to FERC revised potential emissions from the heaters, thermal oxidizers, and flares.

TABLE 4.11.1-8 **Stationary Source Ambient Impact Analysis Results with LNG Ship**						
Pollutant	Averaging Period	Modeled Concentration ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	Total Impact (Modeled + Background) ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)	Exceed NAAQS?
Sulfur Dioxide (SO_2)	1-hour, 4th high	1.7	13.2	14.9	196	No
	3-hour, 2nd high	7.7	8.4	16.1	1,300	No
Carbon Monoxide (CO)	1-hour, 2nd high	19,163	1,258	20,421	40,000	No
	8-hour, 2nd high	6,378	800	7,178	10,000	No
Nitrogen Dioxide (NO_2)	1-hour, 8th high	16	36.4	52.4	188	No
	Annual, 1st high	1	3.4	4.4	100	No
Particulate Matter (PM_{10})	24-hour, 6th high	0.66	49.0	49.66	150	No
Particulate Matter ($PM_{2.5}$)	24-hour, 8th high	0.64	25.5	26.14	35	No
	Annual, 1st high	0.16	10.1	10.26	12	No

$\mu g/m^3$ = microgram per cubic meter; NAAQS = National Ambient Air Quality Standards

The Lower Rio Grande NWR is located within the 50-kilometer (30-mile) grid used for the air modeling. Therefore, the above modeling results also demonstrate that impacts at the Lower Rio Grande NWR would be in compliance with the NAAQS.

Combined Operational/Construction Emissions

According to the schedule included in its FERC application, Annova would commission the first stage (2 trains) beginning in the second quarter of year 4, the second stage in the third quarter of year 4, and the third stage in the fourth quarter of year 4. Commercial operation for the first stage would begin in the fourth quarter of year 4 for the second stage in the first quarter of year 5, and for the third stage in second quarter of year 5.

- Emissions year 1 = construction only
- Emissions year 2 = construction only
- Emissions year 3 = construction only
- Emissions year 4 = construction plus 6 train commission + ¼ operation of 2 trains
- Emissions year 5 = construction plus + 100% operation of 4 trains + ¾ operation of 2 trains

As indicated in section 2, commissioning of the first 2 trains would begin while construction of the later stages would still be underway. These overlapping emissions are shown in table 4.11.1-9 and would occur during the final two years of construction. The emissions shown for year 6 are the maximum potential annual emissions from stationary and mobile operating sources for the completed facility, and do not include any construction or commissioning emissions. During the years of simultaneous commissioning, construction, and operation, a higher level of emissions may occur and potentially result in exceedances of the NAAQS. Due to its variability, we do not believe these rare occurrences would result in a significant air quality impact on the local residents or the regional air quality.

TABLE 4.11.1-9

Estimated Combined Construction, Commissioning, and Operational Emissions of the Annova LNG Project

Year	Emissions (tons per year)							
	NO_x	CO	SO_2	PM_{10}	$PM_{2.5}$	VOC	CO_2e a/	Total HAPs
1	23	40	0.04	293	30	2.6	7,802	0.1
2	172	220	0.3	158	25	22	56,316	0.1
3	152	224	0.25	126	21	17	44,492	0.1
4	146.6	215.7	7.2	66.7	15.7	18.1	69,923	0.6
5	222	236.2	77.1	77.8	26.8	61.6	348,364	5.5
6	187.6	163.8	84	20.5	20.5	60.6	363,643	5.9

NOx = nitrogen oxides; CO = carbon monoxide; SO_2 = sulfur dioxide; $PM_{2.5}$ = particulate matter less than 2.5 microns; PM_{10} = particulate matter less than 10 microns; VOC = volatile organic compound; CO_2e = carbon dioxide equivalent; HAPs = hazardous air pollutants

4.11.1.7 Conclusion for Air Quality

During the construction period, residents in the vicinity of the Project may experience local impacts on air quality. During the period of construction and operation, nearby location would experience larger air quality impacts, however we do not expect these impacts would be significant. During operation, we have determined the Project would have minor impacts on the local and regional air quality but would not result in regionally significant impacts on air quality.

4.11.2 Noise

The noise environment can be affected during both construction and operation of the Project. The magnitude and frequency of environmental noise may vary considerably over the course of the day, throughout the week, and across seasons, in part due to changing weather conditions and the effects of seasonal vegetative cover. This section identifies the potential sources of noise, the magnitude of noise, and discusses the change in noise attributable to construction and operation of the Project.

Sound is a sequence of waves of pressure that propagates through compressible media such as air or water. When sound becomes excessive, annoying, or unwanted, it is referred to as noise. Construction and operation of the proposed projects would affect overall noise levels in the vicinity of project components. The ambient sound level of a region is defined by the total noise generated within the specific environment and usually comprises natural and man-made sounds.

Two measures used by some federal agencies to relate the time-varying quality of environmental noise with its known effect on people are the equivalent continuous sound level (L_{eq}) and the day-night average sound level (L_{dn}). The preferred single value figure to describe sound levels that vary over time is L_{eq}, which is defined as the sound pressure level of a noise fluctuating over a period of time, expressed as the amount of average energy. L_{dn} is defined as the 24-hour average of the equivalent average of the sound levels during the daytime (L_d – from 7:00 a.m. to 10:00 p.m.) and the equivalent average of the sound levels during the nighttime (L_n – 10:00 p.m. to 7:00 a.m.). Specifically, in the calculation of the L_{dn}, late night and early morning (10:00

p.m. to 7:00 a.m.) noise exposures are increased by 10 decibels (dB) to account for people's greater sensitivity to sound during nighttime hours. In general, if the sound energy does not vary over the given time period, the L_{dn} level will be equal to the L_{eq} level plus 6.4 dB. The 6.4 dB difference between the L_{dn} and the L_{eq} is a result of the 10 dB nighttime addition for the L_{dn} calculation.

Decibels are the units of measurement used to quantify the intensity of noise. To account for the human ear's sensitivity to low level noises the decibel values are corrected to weighted values known as decibels on the A-weighted scale (dBA). The A-weighted scale is used because human hearing is less sensitive to low and high frequencies than mid-range frequencies.

Decibels are relative units that compare two pressures: the sound pressure and a reference pressure. The reference pressures typically used for air and water are not the same, and a direct comparison of values between in-air and underwater noises is not appropriate. Underwater sounds use a reference pressure of 1 μPa while in air sounds have a reference pressure of 20 μPa. For in-air sound levels, the reference pressure is often not explicitly stated, as is the case in this text. The reference pressure of underwater sounds is typically stated, and is presented in this text. This is done to remind readers of the different reference pressures between underwater and in air sound levels, and avoid direct comparison. Therefore, in this text, in air sound levels are presented in decibels while underwater sound levels are presented as "dB referenced to (re) 1 μPa." Underwater sound levels may also include a distance to indicate setback from the sound source. For example, a setback distance of 1 meter would be expressed as "dB (re 1 μPa) at 1 meter." Propagation distances in water are farther than in air because water is denser; however, loudness underwater diminishes quickly with distance from the sound source.

Table 4.11.2-1 lists relative dBA noise levels of common sounds measured in the environment and industry. A 3 dB change of sound level is considered to be barely perceivable by the human ear, a 5 or 6 dB change of sound level is considered noticeable, and a 10 dB increase is perceived as if the sound intensity has doubled.

TABLE 4.11.2-1

Sound Levels and Relative Loudness

Noise Source or Activity	**Sound Level (dBA)**	**Subjective Impression a/**	**Relative Loudness (perception of change)**
Jet aircraft takeoff from carrier (50 feet)	140	Threshold of pain	64 times as loud
Loud rock concert near stage	120	Uncomfortably loud	16 times as loud
Jet takeoff (2,000 feet)	100	Very loud	4 times as loud
Garbage disposal / food blender (2 feet)	80	Loud	Reference loudness
Vacuum cleaner (10 feet)	70	Moderate	1/2 as loud
Light auto traffic (100 feet)	50	Quiet	1/8 as loud
Quiet library, soft whisper (15 feet)	30	Very quiet	1/32 a loud
Wilderness with no wind or animal activity	25	Extremely quiet	No perceptible change

a/ Barnes et al. 1977; EPA 1971

4.11.2.1 Regulatory Requirements

Federal Regulations

In 1974, the EPA published *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety* (EPA 1974). This document provides information for state and local governments to use in developing their own ambient noise standards. The EPA has determined that, to protect the public from activity interference and annoyance outdoors in residential areas, noise levels should not exceed an L_{dn} of 55 dBA. We have adopted this criterion and have used it to evaluate the potential noise impacts from the Project at noise sensitive areas (NSA). NSAs can be residences, hospitals, places of worship, temporary residences, and other areas that may have a greater sensitivity to noise than other locations. Due to the 10 dBA nighttime penalty added prior to calculation of the L_{dn}, for a facility to meet the L_{dn} 55 dBA limit, it must be designed such that actual constant noise levels on a 24-hour basis do not exceed 48.6 dBA L_{eq} at any NSA.

The Project would be located near the Palmito Ranch Battlefield NHL, which is managed by the NPS. NPS management policies include a requirement to "preserve, to the greatest extent possible, the natural soundscapes of parks" (NPS 2006). While the NPS management polices do not include specific quantitative requirements, preserving the natural soundscape can be interpreted as minimizing the sound level increase in lands and public facilities managed by the NPS. To facilitate this, the NPS completed a prediction of ambient sound levels nationwide (Mennitt et al. 2014). For the Palmito Ranch Battlefield NHL, which is 3.3 miles from the Project site, the NPS indicated that the median predicted daytime ambient sound level is 37 to 38 dBA.

State and Local Regulations

The state of Texas, Cameron County, and BND do not have noise regulations in place. The Project is located outside the city of Brownsville; therefore, the Brownsville Noise Ordinance (Chapter 46, Article III, Brownsville, TX, Code of Ordinances n.d.) is not applicable to the Project.

4.11.2.2 Existing Sound Levels and Noise Sensitive Areas

To determine the existing noise levels, an ambient sound level survey was conducted at locations representative of the nearest NSAs. The NSAs are shown on figure 4.11.2-1 and described below.

- NSA1 is 4.2 miles north of the Project site. It is a residential area near Port Isabel High School in Port Isabel, Texas. SH 100 is adjacent to NSA1 and SH 48 is less than 1 mile to the southeast. The nearby homes are a mix of single-family homes and apartment buildings.
- NSA2 is 4.6 miles east of the Project site. It is a small residential area north of SH 4 consisting of single-family, single-story homes.
- NSA3 is 2.3 miles south of the Project site. It is a small residential area north of SH 4 consisting of single-family, single-story homes, and is also representative of other nearby residences, including a residence about 1,300 feet east of NSA3 on the south side of SH 4, because of its similar distance from the Project boundary.
- NSA4 is 3.3 miles southwest of the Project site. It is the Palmito Ranch Battlefield NHL.

Figure 4.11.2-1 Noise Sensitive Areas and Noise Monitoring Locations

Sound levels were measured at four noise monitoring locations (NMLs), two that are representative of sound levels at the NSAs and two locations on the Project property boundary for informational purposes. The NMLs are shown on figure 4.11.2-1 and the measured sound levels are presented in table 4.11.2-2. To effectively quantify the existing sound levels, the survey included continuous sound level monitoring for 36 hours or more (including two nighttime periods, 10:00 p.m. to 7:00 a.m.). The continuous sound level monitors captured a variety of sound pressure level parameters, including the L_{eq}, which is used to determine the L_{dn}. The *Ambient Sound Level Survey Report* includes a detailed description of the survey methodology and the results of these surveys (Black and Veatch 2016g).

TABLE 4.11.2-2

Existing Sound Levels

Noise Monitoring Location	Description	NSA Represented by NML	Daytime Sound Level (dBA)	Nighttime Sound Level (L_{eq} dBA)	Average Day-Night Sound Level (L_{dn})
NML1	Residential area, Beacon Bay Drive cul-de-sac	NSA1	L_{eq} = 50	50	56 c/
NML2	Residential area, southwest end of Weens Road	NSA2, NSA3, NSA4	L_{eq} = 44	40	46
NML3	Southern project site boundary	NSA4	L_{eq} = 45	49 a/	54
NML4	Northeastern project site boundary	NA	L_{eq} = 47	54 a/	61 b/

a/ Nighttime sound levels were higher than daytime sound levels at NML3 and NML4 due to increased insect activity.

b/ The existing L_{dn} at NML1, which is representative of NSA 1, and NML4 exceeds the FERC regulatory limit of 55 dBA L_{dn} for noise resulting from a gas compression facility.

dBA = A-weighted decibel; L_{dn} = day-night average sound level; L_{eq} = equivalent continuous sound level; NA = not applicable; NML = noise monitoring location; NSA = noise sensitive area

The acoustic environment at all NMLs included the sounds of wind and insects. In particular, nighttime insect sounds influenced existing sound levels at NML3 and NML4. The acoustic environment at NML1 was typical of a busy suburban area, with sounds from traffic, children playing, and building ventilation equipment. The existing L_{dn} at NML1, which is representative of NSA 1, and NML4 exceeds 55 dBA L_{dn}. The acoustic environment at NML2 was typical of a rural residential area and included sound from traffic on SH4.

Existing vessel traffic in the BSC contributes to background underwater noise levels. In 2015, 194 port calls for vessels approximately 33,000 gross register tons were made at the Port of Brownsville (MARAD 2015). Three types of vessels dominate ship traffic in the BSC: bulk carriers, cargo ships, and chemical tankers. The underwater sound levels associated with these vessels are 184, 181, and 182 dB re 1 µPa at 1 meter, respectively. Therefore, background underwater noise levels in the BSC are expected to periodically exceed 120 dB re 1 µPa at 1 meter.

4.11.2.3 Construction Noise Impacts and Mitigation

Annova anticipates that construction activities would occur over a 48-month period. Annova states that construction would occur for 50 hours per week Monday through Friday, and work would not take place on federal holidays. However, to conduct a conservative noise analysis, construction was assumed to occur 24 hours per day. Dredging for the marine berth is estimated to occur in two, 10-hour shifts, 6 days per week. Pile driving is estimated to occur in two, 10-hour shifts, 5 days per week.

The Project would include construction of both land-based and marine facilities. Land-based construction activities would include clearing and grading associated with site preparation; foundation work (e.g., installation of piles and underground utilities); construction of aboveground facilities (e.g., major equipment, process equipment, and buildings); and site restoration. Construction of marine facilities would include construction of the marine berth, including dredging and pile driving; construction of the MOF and LNG carrier loading platform; and installation of shoreline protection features (i.e., riprap). Construction activities are described in detail in section 2.6.

During construction, sound levels at the property boundary and NSAs would vary depending on the phase of construction and the types of construction equipment required for each phase. Major construction phases for the Project would generally consist of site preparation, foundation construction, equipment and building assembly, and site cleanup and facility startup. Sound levels are generally highest during the site preparation phase and lowest during the site clean-up and facility start-up phases.

The most prevalent noise-generating equipment and activity during construction of the Project is anticipated to be pile driving, although internal combustion engines associated with general construction equipment and dredging would also produce sound levels that would be perceptible in the vicinity of the site. The various types of construction activities and estimated noise impacts are described below.

Facility Construction Activities

The estimated sound levels of common construction equipment that would be used are shown in table 4.11.2-3. The site preparation phase typically requires the use of heavy, diesel-powered earth-moving equipment such as backhoes, bulldozers, compactors, dump trucks, graders, and front-end loaders. Sound levels during this phase are typically dominated by diesel engine noise. The foundation construction phase primarily involves concrete-handling equipment such as concrete trucks, mixers, pumps, and pile-driving equipment; however, some earth-moving equipment is required to backfill the foundations. The equipment and building assembly phase uses equipment such as diesel-powered earth-moving equipment, mobile cranes, delivery trucks, drills, and air compressors.

TABLE 4.11.2-3

Sound Levels of Common Construction Equipment

Construction Equipment	Average Sound Level at 50 feet	Construction Equipment	Average Sound Level at 50 feet
Air compressor	76	Fork / Man lift	71
Backhoe	85	Front end loader	77
Roller / Compactor	79	Grader	79
Pump	74	Crane	80
Diesel generator	71	Pile driving	101
Dozer	77	Trucks	81
Drill	83	Welding machine	81
Hydraulic excavator	71	Tugboat	86
Dredging vessel	85	Light plants	71
Bus	80		

Source: Barnes et al. 1977; FHWA 2006; EPA 1971

To analyze noise impacts during construction, the predicted changes in sound level were calculated for each NSA. To provide for a conservative analysis, the calculations assumed there would be no attenuation (lessening) of sound due to ground absorption, atmospheric absorption, or shielding. Further, the calculations assumed that all equipment for each phase of construction would operate simultaneously at similar distances from the receptor. Due to the high sound levels associated with pile driving (with a maximum sound level of 101 dBA), a usage factor was calculated for each planned piling activity, and the worst-case usage factor determined was conservatively applied for the entire duration of pile-driving activities. Effects of start-up venting and blowdown/blowoff events were considered, but due to their intermittent nature and short duration, they would not influence the 24-hour L_{dn} values and thus were not included in the calculations. Because the assumptions for the calculations were conservative, actual construction sound levels could be lower than those calculated.

Table 4.11.2-4 lists predicted changes in sound level at each NSA during construction. Although the majority of construction would not occur at night, in order to provide a conservative analysis, all construction equipment listed in table 4.11.2-3 was assumed to operate 24 hours per day. Construction sound levels at the property boundary are anticipated to average 74 dBA L_{dn}.

TABLE 4.11.2-4

Predicted Changes to Sound Levels during Construction

Location	Distance from Property Boundary to NSA (mi)	Existing Sound Level (L_{dn} dBA)	Predicted Construction Sound Level (L_{dn} dBA)	Cumulative Sound Level (L_{dn} dBA)	Predicted Sound Level Increase (dBA)
NSA1	4.2	56	49	57	1
NSA2	4.6	46	48	50	4
NSA3	2.3	46	54	55	9
NSA4	3.3	43	52	53	10

For the purpose of this analysis assumes construction would occur 24 hours per day.
dBA = A-weighted decibel; L_{dn} = day-night average sound level; NSA = noise sensitive area

Construction sound levels attributable to the Project would be less than the 55 dBA L_{dn} threshold. In addition to the construction noise, traffic noise generated during construction would also add to overall sound levels. Construction activity would generate traffic resulting in potential noise effects, such as trucks traveling to and from the Project site on public roads.

NSA4 is the Palmito Ranch Battlefield NHL 3.3 miles southwest of the Project site. In a November 2015 letter to Annova, the NPS noted that existing noise levels at its sites vary. For example, traffic on Highway 4 is not continuous and more quiet periods may exist than those reported for NSA4. In addition, interior areas of its sites may be quieter than other portions. To accurately reflect these conditions, NPS requested that Annova conduct ambient sound level monitoring at interior areas of the NHL sites or use the NPS' geospatial ambient model data if interior sound level data are not available. To accommodate the NPS request, the existing ambient daytime sound level at NSA4 is conservatively assumed to be equivalent to 37 dBA L_{eq} (43 dBA L_{dn}) based on the NPS survey (Mennitt et al. 2014), which indicated that the daytime median sound level for the Palmito Ranch Battlefield NHL is 37 to 38 dBA L_{eq} or 43 to 44 dBA L_{dn}. Annova contacted the NPS and THC and requested comments on the noise assessment for the Project.

Typical construction noise would be audible at off-site locations. The noise would be clearly audible at NSA 4, and would be a doubling of ambient noise at NSAs 3 and 4. While noise levels are at or near 55 dBA L_{dn}, residents and visitors to the Palmito Ranch Battlefield NHL may experience increased noise annoyance considering the duration of construction. The noise impacts from standard construction should not result in interference with speech intelligibility or hearing.

Pile-Driving Activities

Annova would install pilings using land-based and in-water equipment, as described in chapter 2. Pile driving would create an impulsive source (pulsed noises) audible both on land and underwater. The sound levels associated with pile driving would vary depending on the type of pile (e.g., monopile, steel pile, concrete, or steel sheet pile) and installation method (e.g., impact hammer or vibratory hammer). Although most pile-driving activities for construction of the marine transfer facilities would be isolated from the estuarine environment, pile driving could result in periodic increases in underwater noise levels in the BSC for approximately 6 months.

Land-Based Pile Driving

Land-based pile driving would produce an impulsive sound that would be audible at off-site locations. Land-based pile driving is estimated to occur in two, 10-hour shifts, 5 days per week. During land-based pile driving, the earth would act as a sound buffer, thereby reducing the noise reaching the BSC. Pile driving is accounted for in combination with other construction equipment in table 4.11.2-4. Due to the high sound levels associated with pile driving (with a maximum sound level [L_{max}] of 101 dBA), a usage factor was calculated for each planned piling activity, and the worst-case usage factor determined was conservatively applied for the entire duration of pile-driving activities to determine the resulting sound levels at the NSAs.

As shown in table 4.11.2-4, which includes noise from pile driving, sound levels would be at or near 55 dBA L_{dn} and would not increase by more than 10 dBA L_{eq} at any NSA. Residents may experience increased noise annoyance during pile driving; however, pile driving is not expected to interfere with speech intelligibility or hearing. To ensure that actual noise from pile-driving activities are not significantly greater than predicted noise, **we recommend that:**

- **Annova should monitor pile-driving activities, and file weekly noise data with the Secretary following the start of pile-driving activities that identify the noise impact on the nearest NSAs. If any measured noise impacts (L_{max}) at the nearest NSAs are greater than 10 dBA over the L_{eq} ambient levels, Annova should:**
  - **a. cease pile-driving activities and implement noise mitigation measures;**
  - **b. file with the Secretary evidence of noise mitigation installation and request written notification from the Director of OEP that pile driving may resume.**

With the implementation of this recommendation, we conclude that noise from pile-driving activities would be partially mitigated but would result in moderate noise impacts at the NSAs.

In-Water Pile Driving

In-water pile driving would contribute to underwater sound levels and could occur up to 24 hours per day. The most applicable data regarding sound source levels available are for 96-inch-diameter steel piles in water depths of approximately 39 to 49 feet (12 to 15 meters) for the Benicia-Martinez Bridge crossing in the Carquinez Strait in Contra Costa County, California (ICF Jones & Stokes, and Illingworth and Rodkin, Inc. 2009). Underwater measurements for hydraulic impact-hammer pile driving from installation of steel piles at the Benicia-Martinez Bridge, which are comparable to those expected during construction, are shown in table 4.11.2-5.

TABLE 4.11.2-5

Unattenuated Underwater Sound Pressure Levels Measured for Pile Driving at the Benicia-Martinez Bridge

	Sound Pressure Levels (decibels re 1 μPa at 10 meters a/)		
Pile Type	Sound Pressure Level	Root Mean Squared	Sound Exposure Level
42-inch steel	208	195	180
96-inch steel	220	205	194

a/ Distance measured from the pile at about mid-depth (10 to 15 meters deep).
μPa = micropascal
Source: ICF Jones & Stokes, and Illingworth and Rodkin, Inc. 2009

The impacts of noise from pile driving on underwater species including marine mammals, sea turtles, and fish, and associated mitigation measures, are presented in section 4.7.

Vibration

Construction equipment, particularly impact activities such as pile driving, also generates vibrations that can pass through the ground and cause damage to structures. The vibration velocity at the nearest NSA is expected to be less than 0.1 millimeters per second (Attewell and Farmer 1973). This is less than the vibration criterion for structural effects on residential buildings, which is 0.2 millimeter per second (Attewell and Farmer 1973; Ungar et al. 1990); therefore, no structural effects are anticipated from vibration during construction.

Dredging Activities

Construction would require dredging, as described in section 2. Annova proposes to use a combination of land-based excavation and hydraulic cutter dredging for construction of the marine berth. Dredging for the marine berth is estimated to occur in two, 10-hour shifts, 6 days per week. To provide a conservative analysis, for the noise assessment dredging was assumed to occur 24 hours per day.

Dredging would typically generate ambient sound levels of 89 dBA at distance of 50 feet for hydraulic dredging and 81 dBA at 50 feet for mechanical dredging (Port of Oakland 1999). The equivalent noise levels at the nearest NSA (i.e., NSA3) would be 38 dBA for hydraulic dredging and 30 dBA for mechanical dredging, given the attenuation over distance. These levels are well below the 55 dBA L_{dn} FERC criterion. In addition, dredging operations would be of short-term duration at any given location along the BSC. As a result, noise impacts associated with dredging would be minor and short term.

Dredging would also produce underwater noise. The hydraulic cutter dredge is conservatively estimated to produce underwater sound levels of 172 to 185 dB (re 1 µPa) at 1 meter in the 100 to 500 frequency range (CEDA 2011) and 100 to 110 dB (re 1 μPa_{RMS}) at 1 meter in the 70 to 1,000 Hz range (Clarke et al. 2002). Underwater sound levels are likely to be lower than this due to the clay substrate that is likely found at the proposed berthing and turning basin. The predominant frequencies associated with large vessels are low, below several hundred hertz. The predominantly low-frequency noise from vessels in the Project area has the potential to affect the ambient (background) noise over a much larger area than higher frequencies that may exist near individual sources (e.g., smaller vessels or various industrial activities within the BSC). The impacts of noise from dredging on underwater species including marine mammals, sea turtles, and fish, and associated mitigation measures are presented in section 4.7.

4.11.2.4 Operation Noise Impacts and Mitigation

Operation of the LNG terminal would produce noise on a continual basis. Information about the major operational sound sources associated with the Project is provided in table 4.11.2-6. Estimated sound levels were compiled from manufacturer data, from the Institute of Electrical and Electronics Engineers, and Annova LNG's in-house data.

TABLE 4.11.2-6

Major Operational Equipment and Estimated Sound Levels

Equipment	Quantity	Height of Sound Source (feet above ground level)	Estimated Sound Level of One Unit, or Per Fan where indicated by Asterisk (dBA at 3 feet)
LNG compressor	6	23	83
Compressor inlet piping	For 6 compressors	50	83 to 88
Compressor discharge piping	For 6 compressors	50	92 to 93
Cooling units	12 (48 fans per unit)	66	97*
Boil-off gas compressor	2	17	115
Boil-off gas compressor motor	2	12	104
Transformers	42	13	68
Transformers	22	13	62
Powerhouses	16	33	85
Gas conditioner units	3 (26 fans per unit)	69	85*
Maintenance flaring	1	160	124

dBA = A-weighted decibel
* Sound level per fan

Estimated operational sound levels were calculated using the environmental noise prediction software Cadna/A version 4.5.151. The model simulates the outdoor propagation of sound from equipment and accounts for sound wave divergence, atmospheric and ground absorption, sound directivity, and shielding due to interceding barriers and terrain. Table 4.11.2-7 provides the predicted changes in sound level at each NSA during Project operation.

TABLE 4.11.2-7					
Predicted Changes to Sound Levels during Operation					
Location	Distance from Property Boundary to NSA (miles)	Existing Sound Level (dBA L_{dn})	Predicted Project-Only Sound Level (dBA L_{dn})	Predicted Future Sound Level (dBA L_{dn})	Predicted Sound Level Increase (dBA)
NSA1	4.2	56	≤ 39	56	<1
NSA2	4.6	46	≤ 39	47	1
NSA3	2.3	46	≤ 46	49	3
NSA4	3.3	46	≤ 42	47	1

dBA = A-weighted decibel; L_{dn} = day-night average sound level; NSA = noise sensitive area

As shown in table 4.11.2-7, the predicted sound levels at the NSAs during Project operation range from 47 to 56 dBA L_{dn}. Sound levels at NSA1 would be unchanged. Sound levels at NSA2 and NSA4 would increase 1 dBA L_{dn}, and sound levels would increase by 3 dBA L_{dn} at NSA3. Operational sound levels at all NSAs would be equal to existing noise levels (NSA1) and/or below the 55 dBA L_{dn} FERC criterion (at NSA2, NSA3, and NSA4). Because the assumptions for the calculations were conservative, actual operational sound levels could be lower than those calculated.

To ensure that the actual noise resulting from operation of the Project is not significant, **we recommend that:**

- **Annova should file a full power load noise survey with the Secretary for the LNG terminal no later than 60 days after each liquefaction train is placed into service. If the noise attributable to operation of the equipment at the LNG terminal exceeds an L_{dn} of 55 dBA at the nearest NSA, within 60 days Annova should modify operation of the liquefaction facilities or install additional noise controls until a noise level below an L_{dn} of 55 dBA at the NSA is achieved. Annova should confirm compliance with the above requirement by filing a second noise survey with the Secretary no later than 60 days after it installs the additional noise controls.**

In addition, **we recommend that:**

- **Annova should file a noise survey with the Secretary no later than 60 days after placing the entire LNG terminal into service. If a full load condition noise survey is not possible, Annova should provide an interim survey at the maximum possible horsepower load within 60 days of placing the LNG terminal into service and provide the full load survey within 6 months. If the noise attributable to operation of the equipment at the LNG terminal exceeds an L_{dn} of 55 dBA at the nearest NSA under interim or full horsepower load conditions, Annova should file a report on what changes are needed and should install the additional noise controls to meet the level within 1 year of the in-service date. Annova should confirm compliance with the above requirement by filing an additional noise survey with the Secretary no later than 60 days after it installs the additional noise controls.**

Flaring Noise Impacts

Flaring events would also produce noise. The purpose of a flare system is to protect plant systems from overpressure during start-up, shutdown, plant upsets, emergency conditions, and during certain LNG transfer conditions (described below). Flaring produces noise with a low-pitched “roaring” character that nearby residents or visitors would distinctly notice.

As described in section 2.1.5, the Project would include two flares: a 45-foot-tall marine flare and a 160-foot-tall combined warm and cold flare stack. The marine flare would operate only during the transfer of LNG to an LNG carrier that arrives with warm inert cargo tanks, which typically occurs when the LNG carrier arrives at its first port following dry dock maintenance. Annova estimates that the marine flare at the Project would operate about twice per year. The marine flare may operate for up to 25 hours per flaring event for an annual total of up to 50 hours per year. During this time, active flaring may occur for approximately 4 hours during each event, for an annual total of up to 8 hours. The combined warm and cold flare stack would only operate during start-up, shutdown, plant upsets, and emergency conditions. Sound generated from the combined warm and cold flare stack during these conditions, and by blowdown orifices during emergency blowdown events, were also considered, but due to their intermittent nature and short duration, they would not influence the 24-hour L_{dn} values and thus were not included in the operational sound calculations.

As shown in table 4.11.2-6, the peak sound pressure level for a flaring event is expected to be approximately 124 dBA L_{eq} at 3 feet. The estimated sound pressure level during a flaring event would be 52 dBA L_{eq} or less at the identified NSAs (NSAs 1 through 4).

Steady-State Operational Noise Impacts

Noise would be generated during standard operating conditions without flaring. Sound level contours of predicted steady-state sound levels (not L_{dn} sound levels) from Project operation are shown in figure 4.11.2-2. The contours represent only Project sound sources and do not include background sound. As shown in figure 4.11.2-2, the areas where steady-state sound levels would be greater than or equal to 55 dBA L_{dn} are predominately within the Project site boundaries. In addition, Annova has included a project design component that would likely reduce the predicted noise contours to the southwest. Annova would construct a 25-foot-tall concrete barrier wall on the western side of the site as part of a wildlife corridor. The barrier wall would further reduce sound transmission beyond the property boundary to the southwest, so sound levels to the southwest and at NSA4 would likely be less than those shown in figure 4.11.2-2.

Marine Vessel Activities

In addition to plant operations, some additional sound would be generated by the increased traffic in the BSC as LNG carriers, escort vehicles, and tugs travel to and from the facility (including passage by South Padre, Long, Brazos, and Clark Islands) and maneuver within the turning basin and berth. The Project would add approximately two LNG carrier visits per week, as well as intermittent security vessels and tugs, to the existing shipping channel traffic.

Assuming these vessels produce sound levels similar to that of the existing shipping channel traffic, the average sound level increase at the nearest NSA would be less than or equal to 1 dBA. A person’s threshold of perception for a perceivable change in loudness is approximately 3 dBA, so this change would generally not be perceptible.

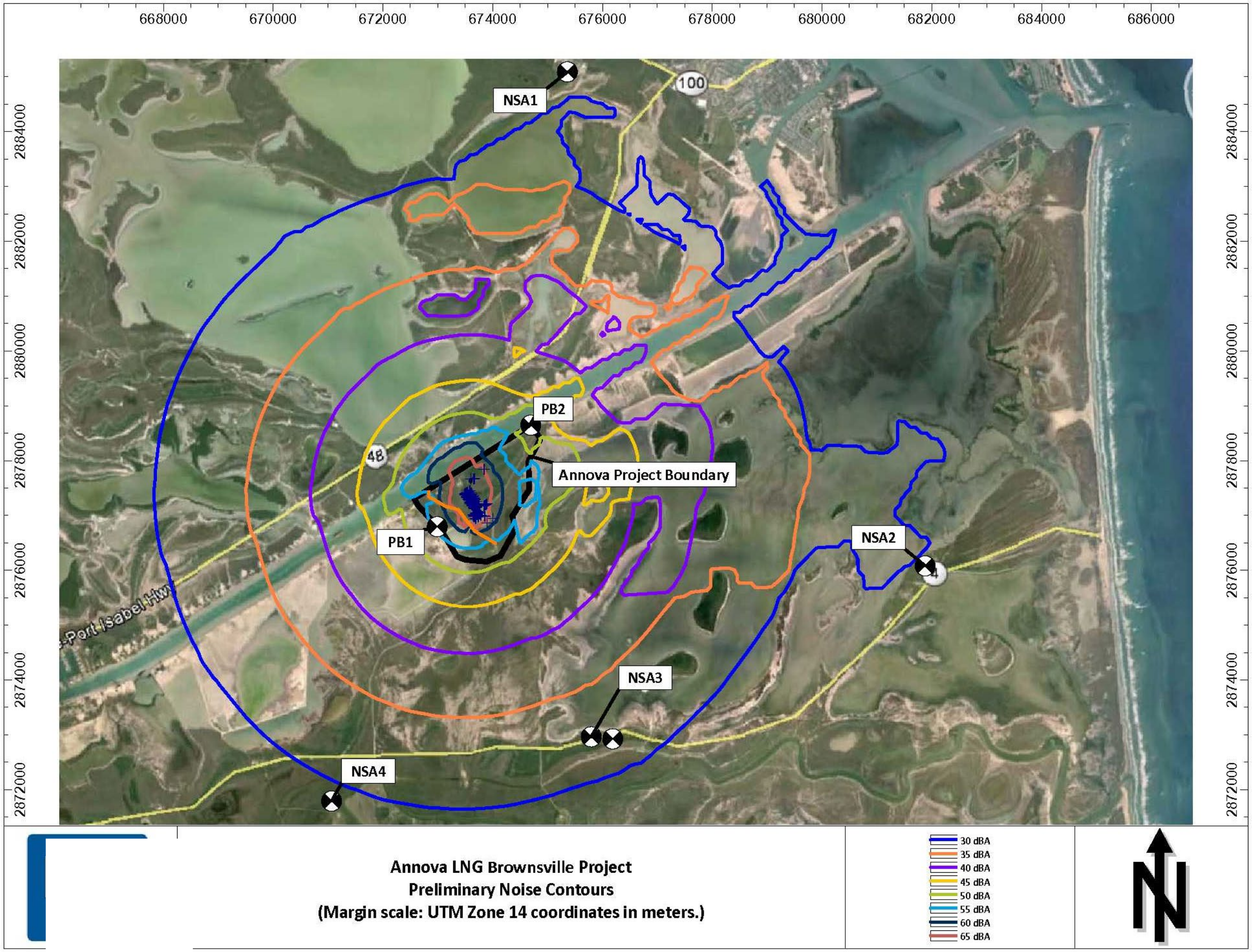

Figure 4.11.2-2 Operational Steady-State Noise Contours

Maintenance Dredging Activities

During operation, maintenance dredging would be required to remove accumulated sediments from the marine berth and turning basin. Maintenance dredging is not expected to cause a significant noise impact. Maintenance dredging would occur approximately every 2 years for 1 week (24 hours per day) and would be similar in technique to those conducted during construction. Maintenance dredging would use one dredge vessel that would be similar in size and type to the vessel anticipated to be used for construction of the marine berth. The average sound level increase at the nearest NSA from maintenance dredging would be less than or equal to 1 dBA L_{dn}, which would generally not be perceptible. In addition, dredging operations would be of short-term duration at any given location along the BSC. As a result, noise impacts associated with maintenance dredging would be minor and short term.

4.11.2.5 Conclusion for Noise

Based on the construction noise estimates provided by Annova, the maximum noise levels attributable to Project construction activities, with the exception of pile-driving activities, would be equal or similar to existing noise levels or less than or equal to the 55 dBA L_{dn} threshold at the NSAs. We have included a recommendation to address the potential for pile-driving activities to exceed the 55 dBA L_{dn} threshold at the NSAs. Therefore, we conclude that construction of the Project would have a moderate impact on the surrounding noise environment.

Based on the operation noise analysis, noise levels during Project operation would not exceed the 55 dBA L_{dn} FERC criterion at any of the NSAs. As shown in table 4.11.2-4, noise level increases during construction would range from 1 dBA at NSA 1 to 9 to 10 dBA at NSAs 3 and 4, respectively. As shown in table 4.11.2-7, steady-state operational noise level increases would range from less than 1 dBA at NSA 1 to 3 dBA at NSA 3. We conclude that operation and maintenance of the Project would not cause significant noise impacts although certain short-term activities such as flaring would be distinctly noticeable to residents or the public in the vicinity of the Project.

4.12 RELIABILITY AND SAFETY

4.12.1 LNG Facility Reliability, Safety, and Security Regulatory Oversight

LNG facilities handle flammable and sometimes toxic materials that can pose a risk to the public if not properly managed. These risks are managed by the companies owning the facilities, through selecting the site location and plant layout as well as through suitable design, engineering, construction, and operation of the LNG facilities. Multiple federal agencies share regulatory authority over the LNG facilities and the operator's approach to risk management. The safety, security, and reliability of the Annova LNG Project would be regulated by the DOT, the Coast Guard, and the FERC.

In February 2004, the DOT, the Coast Guard, and the FERC entered into an Interagency Agreement to ensure greater coordination among these three agencies in addressing the full range of safety and security issues at LNG terminals and LNG marine vessel operations, and maximizing the exchange of information related to the safety and security aspects of the LNG facilities and related marine operations. Under the Interagency Agreement, the FERC is the lead federal agency responsible for the preparation of the analysis required under NEPA for impacts associated with terminal construction and operation. The DOT and the Coast Guard participate as cooperating agencies but remain responsible for enforcing their regulations covering LNG facility siting, design, construction, operation, and maintenance. All three agencies have some oversight and responsibility for the inspection and compliance during the LNG facility's operation.

The DOT establishes and has the authority to enforce the federal safety standards for the location, design, installation, construction, inspection, testing, operation, and maintenance of onshore LNG facilities under the Natural Gas Pipeline Safety Act (49 USC 1671 *et seq.*). The DOT's LNG safety regulations are codified in 49 CFR 193, which prescribes safety standards for LNG facilities used in the transportation of gas by pipeline that are subject to federal pipeline safety laws (49 USC 60101 *et seq.*), and 49 CFR 192. On August 31, 2018, DOT and FERC signed a memorandum of understanding (MOU) regarding methods to improve coordination throughout the LNG permit application process for FERC jurisdictional LNG facilities. In the MOU, DOT agreed to issue a Letter of Determination (LOD) stating whether a proposed LNG facility would be capable of complying with location criteria and design standards contained in Subpart B of Part 193. The Commission committed to rely upon the DOT determination in conducting its review of whether the facilities would be consistent with the public interest. The issuance of the LOD does not abrogate DOT's continuing authority and responsibility over a proposed project's compliance with Part 193 during construction and future operation of the facility. The DOT's conclusion on the siting and hazard analysis required by Part 193 would be based on preliminary design information which may be revised as the engineering design progresses to final design. DOT regulations also contain requirements for the design, construction, installation, inspection, testing, operation, maintenance, qualifications and training of personnel, fire protection, and security for LNG facilities as defined in 49 CFR 193, which would be completed during later stages of the Project. If the Project is authorized and constructed, the LNG facilities as defined in 49 CFR 193, would be subject to the DOT's inspection and enforcement programs to ensure compliance with the requirements of 49 CFR 193.

The Coast Guard has authority over the safety of an LNG terminal's marine transfer area and LNG marine vessel traffic, as well as over security plans for the waterfront facilities handling

LNG terminal and LNG marine vessel traffic. The Coast Guard regulations for waterfront facilities handling LNG are codified in 33 CFR 105 and 33 CFR 127. As a cooperating agency, the Coast Guard assists the FERC staff in evaluating whether an applicant's proposed waterway would be suitable for LNG marine vessel traffic and whether the waterfront facilities handling LNG would be operated in accordance with 33 CFR 105 and 33 CFR 127. If the facilities are constructed and become operational, the facilities would be subject to the Coast Guard inspection program to ensure compliance with the requirements of 33 CFR 105 and 33 CFR 127.

The FERC authorizes the siting and construction of LNG terminals under the NGA and delegated authority from the DOE. The FERC requires standard information to be submitted to perform safety and reliability engineering reviews. FERC's filing regulations are codified in 18 CFR 380.12 (m) and (o), and requires each applicant to identify how its proposed design would comply with the DOT's siting requirements of 49 CFR 193 Subpart B. The level of detail necessary for this submittal requires the applicant to perform substantial front-end engineering of the complete project. The design information is required to be site-specific and developed to the extent that further detailed design would not result in significant changes to the siting considerations, basis of design, operating conditions, major equipment selections, equipment design conditions, or safety system designs. As part of the review required for a FERC order, we use this information from the applicant to assess whether the proposed facilities would have a public safety impact and to suggest additional mitigation measures for the Commission to consider for incorporation as conditions in the order. If the facilities are approved and the suggested mitigation measures are incorporated into the order as conditions, FERC staff would review material filed to satisfy the conditions of the order and conduct periodic inspections throughout construction and operation.

In addition, the Energy Policy Act of 2005 requires FERC to coordinate and consult with the U.S. Department of Defense (DOD) on the siting, construction, expansion, and operation of LNG terminals that would affect the military. On November 21, 2007, the FERC and the DOD (http://www.ferc.gov/legal/mou/mou-dod.pdf) entered into a MOU formalizing this process. In accordance with MOU, the FERC sent a letter to the DOD on August 4, 2015 requesting their comments on whether the planned project could potentially have an impact on the test, training, or operational activities of any active military installation. On September 18, 2015, the FERC received a response letter from the DOD Siting Clearinghouse stating that Annova LNG Project would have a minimal impact on military training and operations conducted in Cameron County, Texas.

4.12.2 DOT Siting Requirements and 49 CFR 193 Subpart B Determination

Siting LNG facilities as defined in 49 CFR 193, with regard to ensuring that the proposed site selection and location would not pose an unacceptable level or risk to public safety is required by DOT's regulations in 49 CFR 193, Subpart B. The Commission's regulations under 18 CFR 380.12 (o) (14) require Annova to identify how the proposed design complies with the siting requirements of 49 CFR 193, Subpart B. The scope of DOT's siting authority under 49 CFR

193 applies to LNG facilities used in the transportation of gas by pipeline subject to the federal pipeline safety laws and 49 CFR 192.[13]

The requirements in 49 CFR 193 Subpart B state that an operator or government agency must exercise legal control over the activities as long the facility is in operation that can occur within an "exclusion zone," defined as the area around an LNG facility that could be exposed to specified levels of thermal radiation or flammable vapor in the event of a release of LNG or ignition of LNG vapor. Approved mathematical models must be used to calculate the dimensions of these exclusion zones. The siting requirements specified in NFPA 59A (2001), an industry consensus standard for LNG facilities, are incorporated into 49 CFR 193 Subpart B by reference, with regulatory preemption in the event of conflict. The following sections of 49 CFR 193 Subpart B specifically address siting requirements:

- Section 193.2051, Scope, states that each LNG facility designed, replaced, relocated or significantly altered after March 31, 2000, must be provided with siting requirements in accordance with Subpart B and NFPA 59A (2001). In the event of a conflict with NFPA 59A (2001), the regulatory requirements in Part 193 prevail.
- Section 193.2057, Thermal radiation protection, requires that each LNG container and LNG transfer system have thermal exclusion zones in accordance with section 2.2.3.2 of NFPA 59A (2001).
- Section 193.2059, Flammable vapor-gas dispersion protection, requires that each LNG container and LNG transfer system have a dispersion exclusion zone in accordance with sections 2.2.3.3 and 2.2.3.4 of NFPA 59A (2001).
- Section 193.2067, Wind forces, requires that shop fabricated containers of LNG or other hazardous fluids less than 70,000 gallons must be designed to withstand wind forces based on the applicable wind load data in American Society of Civil Engineers (ASCE) 7 (2005). All other LNG facilities must be designed for a sustained wind velocity of not less than 150 mph unless the DOT Administrator finds a lower wind speed is justified or the most critical combination of wind velocity and duration for a 10,000-year mean return interval.

As stated in 49 CFR 193.2051, LNG facilities must meet the siting requirements of NFPA 59A (2001), Chapter 2, and include but may not be limited to:

- NFPA 59A (2001) section 2.1.1 (c) requires consideration of protection against forces of nature.
- NFPA 59A (2001) section 2.1.1 (d) requires that other factors applicable to the specific site that have a bearing on the safety of plant personnel and surrounding public be considered, including an evaluation of potential incidents and safety measures incorporated in the design or operation of the facility.

[13] 49 CFR 193.2001 (b) (3), Scope of part, excludes any matter other than siting provisions pertaining to marine cargo transfer systems between the LNG marine vessel and the last manifold (or in the absence of a manifold, the last valve) located immediately before a storage tank.

- NFPA 59A (2001) section 2.2.3.2 requires provisions to minimize the damaging effects of fire from reaching beyond a property line, and requires provisions to prevent a radiant heat flux level of 1,600 British thermal units per square foot per hour (Btu/ft^2-hr) from reaching beyond a property line that can be built upon. The distance to this flux level is to be calculated with LNGFIRE3 or with models that have been validated by experimental test data appropriate for the hazard to be evaluated and that have been approved by DOT.
- NFPA 59A (2001) section 2.2.3.4 requires provisions to minimize the possibility of any flammable mixture of vapors from a design spill from reaching a property line that can be built upon and that would result in a distinct hazard. Determination of the distance that the flammable vapors extend is to be determined with DEGADIS or approved alternative models that take into account physical factors influencing LNG vapor dispersion.[14]

Taken together, 49 CFR 193 Subpart B and NFPA 59A (2001) require that flammable LNG vapors from design spills do not extend beyond areas in which the operator or a government agency legally controls all activities. Furthermore, consideration of other hazards which may affect the public or plant personnel must be evaluated as prescribed in NFPA 59A (2001) section 2.1.1 (d).

Title 49 CFR 193 Subpart B and NFPA 59A (2001) also specify three radiant heat flux levels which must be considered for LNG storage tank spills for as long as the facility is in operation:

- 1,600 Btu/ft^2-hr - This level can extend beyond the plant property line that can be built upon but cannot include areas that are used for outdoor assembly by groups of 50 or more persons;[15]
- 3,000 Btu/ft^2-hr - This level can extend beyond the plant property line that can be built upon but cannot include areas that contain assembly, educational, health care, detention or residential buildings or structures;[16] and
- 10,000 Btu/ft^2-hr - This level cannot extend beyond the plant property line that can be built upon.[17]

[14] DOT has approved two additional models for the determination of vapor dispersion exclusion zones in accordance with 49 CFR 193.2059: FLACS 9.1 Release 2 (Oct. 7, 2011) and PHAST-UDM Version 6.6 and 6.7 (Oct. 7, 2011).

[15] The 1,600 Btu/ft^2-hr flux level is associated with producing pain in less than 15 seconds, first degree burns in 20 seconds, second degree burns in approximately 30-40 seconds, 1 percent mortality in approximately 120 seconds, and 100 percent mortality in approximately 400 seconds, assuming no shielding from the heat, and is typically the maximum allowable intensity for emergency operations with appropriate clothing based on average 10 minute exposure.

[16] The 3,000 Btu/ft^2-hr flux level is associated with producing pain in less than 5 seconds, first degree burns in 5 seconds, second degree burns in approximately 10-15 seconds, 1 percent mortality in approximately 50 seconds, and 100 percent mortality in approximately 180 seconds, assuming no shielding from the heat, and is typically the critical heat flux for piloted ignition of common building materials (e.g., wood, PVC, fiberglass, etc.) with prolonged exposures.

[17] The 10,000 Btu/ft^2-hr flux level is associated with producing pain in less than 1 seconds, first degree burns in 1 seconds, second degree burns in approximately 3 seconds, 1 percent mortality in approximately 10 seconds, and 100 percent mortality in approximately 35 seconds, assuming no shielding from the heat, and is typically the critical heat

The requirements for design spills from process or transfer areas are more stringent. For LNG spills, the 1,600 Btu/ft^2-hr flux level cannot extend beyond the plant property line onto a property that can be built upon. In addition, section 2.1.1 of NFPA 59A (2001) requires that factors applicable to the specific site with a bearing on the safety of plant personnel and the surrounding public must be considered, including an evaluation of potential incidents and safety measures incorporated into the design or operation of the facility. DOT has indicated that potential incidents, such as vapor cloud explosions and toxic releases should be considered to comply with Part 193 Subpart B.[18]

In accordance with the August 31, 2018 MOU, DOT will issue a LOD to the Commission after DOT completes its analysis of whether the proposed facilities would meet the DOT siting standards. The LOD will evaluate the hazard modeling results and endpoints used to establish exclusion zones, as well as Annova's evaluation on potential incidents and safety measures incorporated in the design or operation of the facility specific to the site that have a bearing on the safety of plant personnel and surrounding public. The LOD will serve as one of the considerations for the Commission to deliberate in its decision to authorize or deny an application.

4.12.3 Coast Guard Safety Regulatory Requirements and Letter of Recommendation

4.12.3.1 LNG Marine Vessel Historical Record

Since 1959, marine vessels have transported LNG without a major release of cargo or a major accident involving an LNG marine vessel. There are more than 370 LNG marine vessels in operation routinely transporting LNG between more than 100 import/export terminals currently in operation worldwide. Since U.S. LNG terminals first began operating under FERC jurisdiction in the 1970s, there have been thousands of individual LNG marine vessel arrivals at terminals in the U.S. For more than 40 years, LNG shipping operations have been safely conducted in U.S. ports and waterways.

A review of the history of LNG maritime transportation indicates that there has not been a serious accident at sea or in a port which resulted in a spill due to rupturing of the cargo tanks. However, insurance records, industry sources, and public websites identify a number of incidents involving LNG marine vessels, including minor collisions with other vessels of all sizes, groundings, minor LNG releases during cargo unloading operations, and mechanical/equipment failures typical of large vessels. Some of the more significant occurrences, representing the range of incidents experienced by the worldwide LNG marine vessel fleet, are described below:

- **El Paso Paul Kayser** grounded on a rock in June 1979 in the Straits of Gibraltar during a loaded voyage from Algeria to the United States. Extensive bottom damage to the ballast tanks resulted; however, no cargo was released because no damage was done to the cargo tanks. The entire cargo of LNG was subsequently transferred to another LNG marine vessel and delivered to its U.S. destination.

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flux for unpiloted ignition of common building materials (e.g., wood, PVC, fiberglass) and degradation of unprotected process equipment after approximate 10 minute exposure and to reinforced concrete after prolonged exposure.

[18] The US DOT PHMSA's "LNG Plant Requirements: Frequently Asked Questions" item H1, https://www.phmsa.dot.gov/pipeline/liquified-natural-gas/lng-plant-requirements-frequently-asked-questions, accessed Aug 2018.

- **Tellier** was blown by severe winds from its docking berth at Skikda, Algeria in February 1989 causing damage to the loading arms and the LNG marine vessel and shore piping. The cargo loading had been secured just before the wind struck, but the loading arms had not been drained. Consequently, the LNG remaining in the loading arms spilled onto the deck, causing fracture of some plating.
- **Mostefa Ben Boulaid** had an electrical fire in the engine control room during unloading at Everett, Massachusetts on February 5, 1996. The ship crew extinguished the fire and the ship completed unloading.
- **Khannur** had a cargo tank overfill into the LNG marine vessel's vapor handling system on September 10, 2001, during unloading at Everett, Massachusetts. Approximately 100 gallons of LNG were vented and sprayed onto the protective decking over the cargo tank dome, resulting in several cracks. After inspection by the Coast Guard, the Khannur was allowed to discharge its LNG cargo.
- **Mostefa Ben Boulaid** had LNG spill onto its deck during loading operations in Algeria in 2002. The spill, which is believed to have been caused by overflow rather than a mechanical failure, caused significant brittle fracturing of the steelwork. The LNG marine vessel was required to discharge its cargo, after which it proceeded to dock for repair.
- **Norman Lady** was struck by the USS Oklahoma City nuclear submarine while the submarine was rising to periscope depth near the Strait of Gibraltar in November 2002. The 87,000 m^3 LNG marine vessel, which had just unloaded its cargo at Barcelona, Spain, sustained only minor damage to the outer layer of its double hull but no damage to its cargo tanks.
- **Tenaga Lima** grounded on rocks while proceeding to open sea east of Mopko, South Korea due to strong current in November 2004. The shell plating was torn open and fractured over an approximate area of 20 by 80 feet, and internal breaches allowed water to enter the insulation space between the primary and secondary membranes. The LNG marine vessel was refloated, repaired, and returned to service.
- **Golar Freeze** moved away from its docking berth during unloading on March 14, 2006, in Savannah, Georgia. The powered emergency release couplings on the unloading arms activated as designed, and transfer operations were shut down.
- **Catalunya Spirit** lost propulsion and became adrift 35 miles east of Chatham, Massachusetts on February 11, 2008. Four tugs towed the LNG marine vessel to a safe anchorage for repairs. The Catalunya Spirit was repaired and taken to port to discharge its cargo.
- **Al Gharrafa** collided with a container ship, Hanjin Italy, in the Malacca Strait off Singapore on December 19, 2013. The bow of the Al Gharrafa and the middle of the starboard side of the Hanjin were damaged. Both ships were safely anchored after the incident. No loss of LNG was reported.
- **Al Oraiq** collided with a freight carrier, Flinterstar, near Zeebrugge, Belgium on October 6, 2015. The freight carrier sank, but the Al Oraiq was reported to have

sustained only minor damage to its bow and no damage to the LNG cargo tanks. According to reports, the Al Oraiq took on a little water but was towed to the Zeebrugge LNG terminal where its cargo was unloaded using normal procedures. No loss of LNG was reported.

- **Al Khattiya** suffered damage after a collision with an oil carrier off the Port of Fujairah on February 23, 2017. Al Khattiya had discharged its cargo and was anchored at the time of the incident. A small amount of LNG was retained within the LNG marine vessel to keep the cargo tanks cool. The collision damaged the hull and two ballast tanks on the Al Khattiya but did not cause any injury or water pollution. No loss of LNG was reported.

4.12.3.2 LNG Marine Vessel Safety Regulatory Oversight

The Coast Guard exercises regulatory authority over LNG marine vessels under 46 CFR 154, which contains the United States safety standards for self-propelled LNG marine vessels transporting bulk liquefied gases. The LNG marine vessels visiting the proposed facility would also be constructed and operated in accordance with the IMO *Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk* and the *International Convention for the Safety of Life at Sea*. All LNG marine vessels entering U.S. waters are required to possess a valid IMO Certificate of Fitness and either a Coast Guard Certificate of Inspection for U.S. flag vessels or a Coast Guard Certificate of Compliance for foreign flag vessels. These documents certify that the LNG marine vessel is designed and operating in accordance with both international standards and the U.S. regulations for bulk LNG marine vessels under 46 CFR 154.

The LNG marine vessels that would deliver or receive LNG to or from the proposed facility would also need to comply with various U.S. and international security requirements. The IMO adopted the *International Ship and Port Facility Security Code* in 2002. This code requires both ships and ports to conduct vulnerability assessments and to develop security plans. The purpose of the code is to prevent and suppress terrorism against ships; improve security aboard ships and ashore; and reduce the risk to passengers, crew, and port personnel on board ships and in port areas. All LNG marine vessels, as well as other cargo vessels (e.g., 500 gross tons and larger), and ports servicing those regulated vessels, must adhere to the IMO standards. Some of the IMO requirements for marine vessels are as follows:

- marine vessels must develop security plans and have a Vessel Security Officer;
- marine vessels must have a security alert system to transmit ship-to-shore security alerts identifying the marine vessel, its location, and an indication of whether the security of the marine vessel is under threat or has been compromised;
- marine vessels must have a comprehensive security plan for international port facilities, focusing on areas having direct contact with marine vessels; and
- marine vessels must have equipment onboard to help maintain or enhance the physical security of the marine vessel.

In 2002, the Maritime Transportation Security Act (MTSA) was enacted by the U.S. Congress and aligned domestic regulations with the maritime security standards of the *International Ship and Port Facility Security Code* and the *Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk* and the *International Convention for the*

Safety of Life at Sea. The Coast Guard's regulations in 33 CFR 104 require marine vessels to conduct a vessel security assessment and develop a vessel security plan that addresses each vulnerability identified in the vessel security assessments. All LNG marine vessels servicing the facility would have to comply with the MTSA requirements and associated regulations while in U.S. waters.

The Coast Guard also exercises regulatory authority over LNG facilities that affect the safety and security of port areas and navigable waterways under Executive Order 10173; the Magnuson Act (50 USC section 191); the Ports and Waterways Safety Act of 1972, as amended (33 USC section 1221, *et seq.*); and the MTSA of 2002 (46 USC section 701). The Coast Guard is responsible for matters related to navigation safety, LNG marine vessel engineering and safety standards, and all matters pertaining to the safety of facilities or equipment located in or adjacent to navigable waters up to the last valve immediately before the receiving tanks. The Coast Guard also has authority for LNG facility security plan review, approval, and compliance verification as provided in 33 CFR 105.

The Coast Guard regulations in 33 CFR 127 apply to the marine transfer area of waterfront facilities between the LNG marine vessel and the last manifold or valve immediately before the receiving tanks. Title 33 CFR 127 applies to the marine transfer area for LNG of each new waterfront facility handling LNG and to new construction in the marine transfer areas for LNG of each existing waterfront facility handling LNG. The scope of the regulations includes the design, construction, equipment, operations, inspections, maintenance, testing, personnel training, firefighting, and security of the marine transfer area of LNG waterfront facilities. The safety systems, including communications, emergency shutdown, gas detection, and fire protection, must comply with the regulations in 33 CFR 127. Under 33 CFR 127.019, Annova would be required to submit two copies of its Operations and Emergency Manuals to the Coast Guard Captain of the Port (COTP) for examination.

Both the Coast Guard regulations under 33 CFR 127 and FERC regulations under 18 CFR 157.21, require an applicant who intends to build an LNG terminal facility to submit a Letter of Intent (LOI) to the Coast Guard no later than the date that the owner/operator initiates pre-filing with FERC, but, in all cases, at least 1 year prior to the start of construction. In addition, the applicant must submit a Preliminary WSA to the COTP with the LOI.

The Preliminary WSA provides an initial explanation of the port community and the proposed facility and transit routes. It provides an overview of the expected impacts LNG operations may have on the port and the waterway. Generally, the Preliminary WSA does not contain detailed studies or conclusions. This document is used by the COTP to begin his or her evaluation of the suitability of the waterway for LNG marine traffic. The Preliminary WSA must provide an initial explanation of the following:

- port characterization;
- characterization of the LNG facility and the LNG marine vessel route;
- risk assessment for maritime safety and security;
- risk management strategies; and
- resource needs for maritime safety, security, and response.

A Follow-On WSA must be provided no later than the date the owner/operator files an application with FERC, but in all cases at least 180 days prior to transferring LNG. The Follow-on WSA must provide a detailed and accurate characterization of the waterfront facilities handling LNG, the LNG marine vessel route, and the port area. The Follow-on WSA provides a complete analysis of the topics outlined in the Preliminary WSA. It should identify credible security threats and navigational safety hazards for the LNG marine vessel traffic, along with appropriate risk management measures and the resources (i.e., federal, state, local, and private sector) needed to carry out those measures. Until a facility begins operation, applicants must also annually review their WSAs and submit a report to the COTP as to whether changes are required. This document is reviewed and validated by the Coast Guard and forms the basis for the agency's Letter of Recommendation (LOR) to the FERC.

In order to provide the Coast Guard COTPs/Federal Maritime Security Coordinators, members of the LNG industry, and port stakeholders with guidance on assessing the suitability of a waterway for LNG marine traffic, the Coast Guard has published a Navigation and Vessel Inspection Circular – *Guidance on Assessing the Suitability of a Waterway for Liquefied Natural Gas (LNG) Marine Traffic* (NVIC 01-11).

NVIC 01-11 directs the use of the three concentric Zones of Concern, based on LNG marine vessels with a cargo carrying capacity up to 265,000 m^3, used to assess the maritime safety and security risks of LNG marine traffic. The Zones of Concern are:

- Zone 1 – impacts on structures and organisms are expected to be significant within 500 meters (1,640 feet). The outer perimeter of Zone 1 is approximately the distance to thermal hazards of 37.5 kilowatts per square meter (kW/m^2) (12,000 Btu/ft^2-hr) from a pool fire.
- Zone 2 – impacts would be significant but reduced, and damage from radiant heat levels are expected to transition from severe to minimal between 500 and 1,600 meters (1,640 and 5,250 feet). The outer perimeter of Zone 2 is approximately the distance to thermal hazards of 5 kW/m^2 (1,600 Btu/ft^2-hr) from a pool fire.
- Zone 3 – impacts on people and property from a pool fire or an un-ignited LNG spill are expected to be minimal between 1,600 meters (5,250 feet) and a conservative maximum distance of 3,500 meters (11,500 feet or 2.2 miles). The outer perimeter of Zone 3 should be considered the vapor cloud dispersion distance to the lower flammability limit from a worst case un-ignited release. Impacts to people and property could be significant if the vapor cloud reaches an ignition source and burns back to the source.

Once the applicant submits a complete Follow-On WSA, the Coast Guard reviews the document to determine if it presents a realistic and credible analysis of the public safety and security implications from LNG marine traffic both in the waterway and when in port. As required by its regulations (33 CFR 127.009), the Coast Guard is responsible for issuing a LOR to the FERC regarding the suitability of the waterway for LNG marine traffic with respect to the following items:

- physical location and description of the facility;

- the LNG marine vessel's characteristics and the frequency of LNG shipments to or from the facility;
- waterway channels and commercial, industrial, environmentally sensitive, and residential areas in and adjacent to the waterway used by LNG marine vessels en route to the facility, within 25 kilometers (15.5 miles) of the facility;
- density and character of marine traffic in the waterway;
- locks, bridges, or other manmade obstructions in the waterway;
- depth of water;
- tidal range;
- protection from high seas;
- natural hazards, including reefs, rocks, and sandbars;
- underwater pipes and cables; and
- distance of berthed LNG marine vessels from the channel and the width of the channel.

The Coast Guard may also prepare an LOR Analysis, which serves as a record of review of the LOR and contains detailed information along with the rationale used in assessing the suitability of the waterway for LNG marine traffic.

4.12.3.3 Annova's Waterway Suitability Assessment

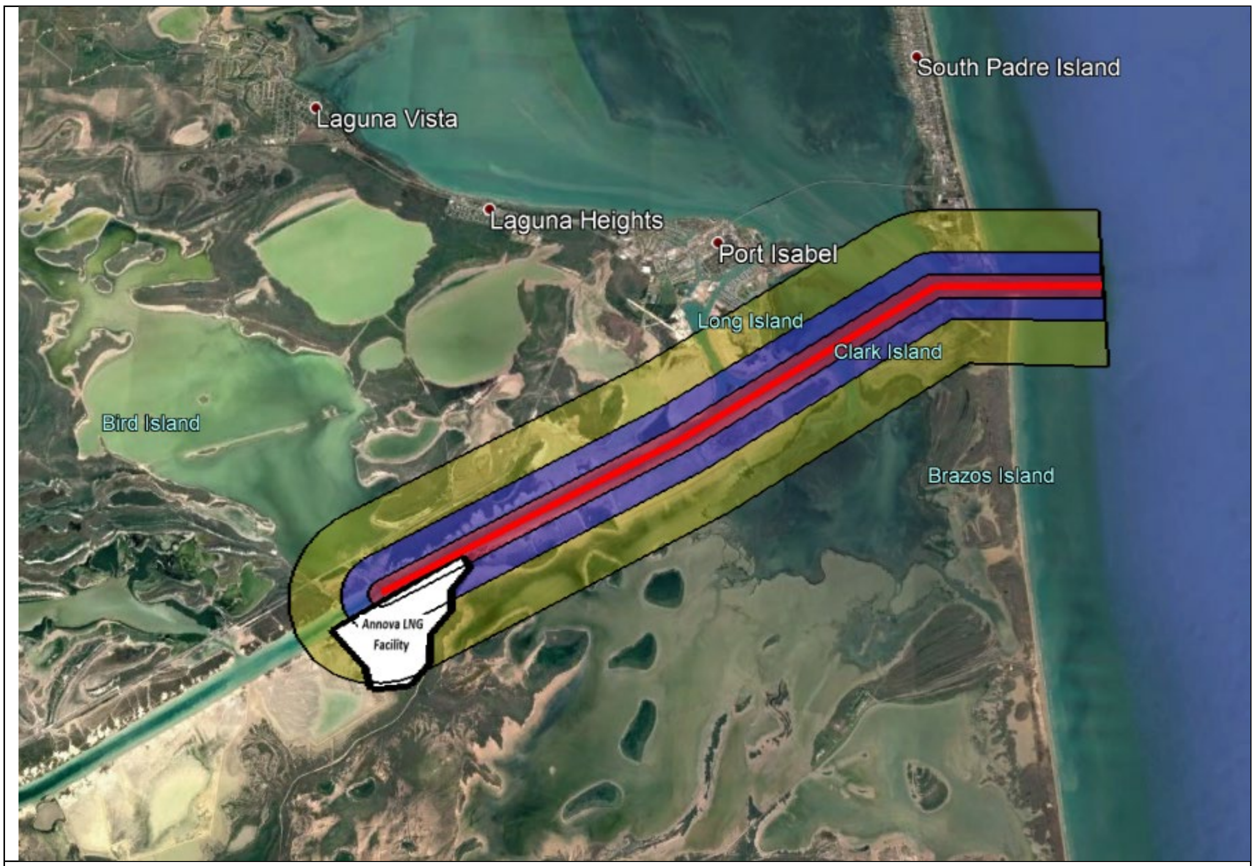
On February 23, 2015, Annova submitted a LOI and a Preliminary WSA to the COTP, Sector Corpus Christi to notify the Coast Guard that it proposed to construct an LNG export terminal. Annova submitted the Follow-On WSA to the Coast Guard on May 24, 2016.

4.12.3.4 LNG Marine Vessel Routes and Hazard Analysis

An LNG marine vessel's transit to and from the terminal would begin when it enters the U.S. Exclusive Economic Zone from well-established shipping lanes through the Gulf of Mexico. The LNG marine vessel would then enter the U.S. Territorial Sea limit (State Waters) to arrive at the Brazos Santiago Pass ocean buoy. At the Santiago Pass ocean buoy, pilots would board the LNG marine vessel before entering the Brownsville Ship Channel. Inland navigation from the Brazos Santiago Pass to the Project site would be about 8.7 miles. Pilotage is compulsory for foreign vessels and U.S. vessels under registry in foreign trade when in U.S. waters. All deep draft marine vessels currently entering the shared waterway would employ a U.S. pilot. The National Vessel Movement Center in the U.S. would require a 96-hour advance notice of arrival for deep draft vessels calling on U.S. ports. During transit, LNG marine vessels would be required to maintain voice contact with controllers and check in on designated frequencies at established way points.

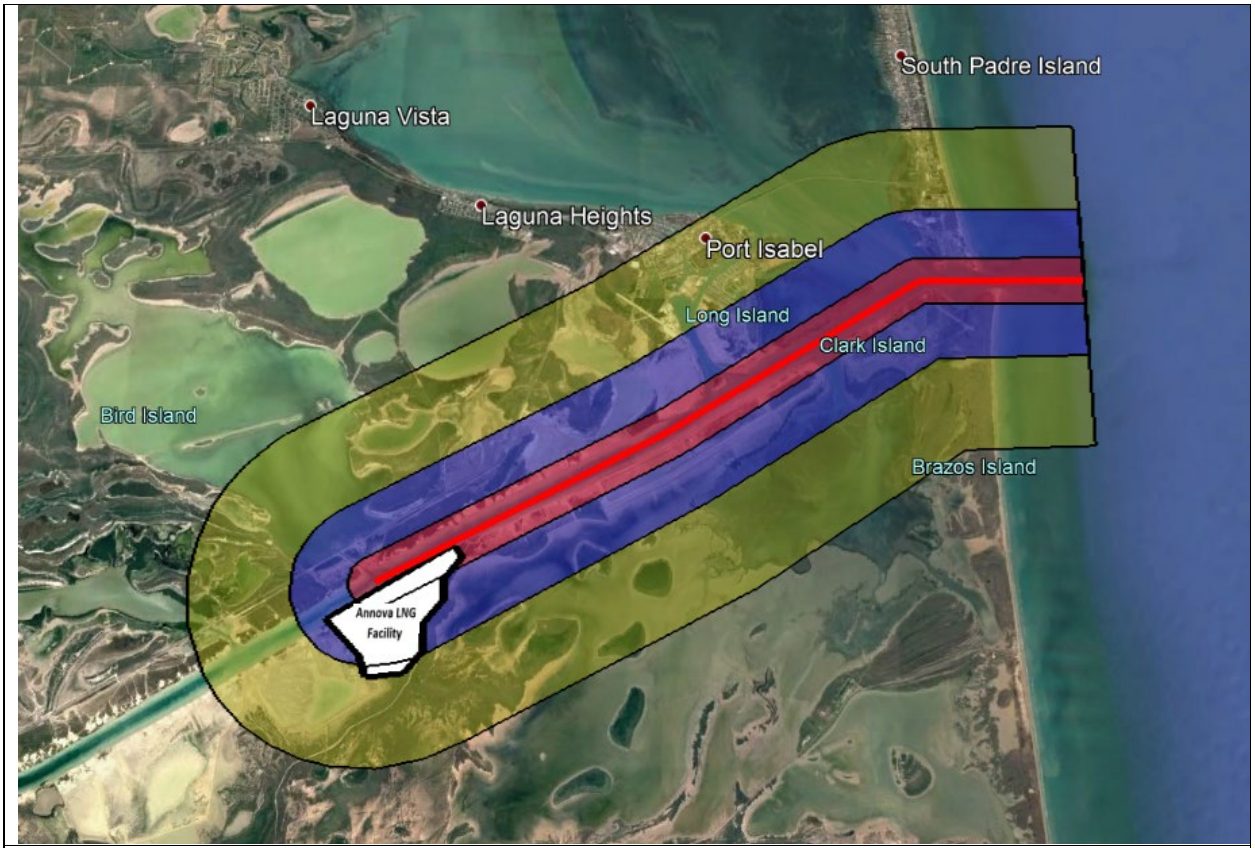
NVIC 01-11 references the "Zones of Concern" for assisting in a risk assessment of the waterway. As LNG marine vessels proceed along the intended transit route, no hospitals, cultural centers, city centers, or military installations would be located within any of the three zones of concern. Hazard Zone 1 would encompass coastal areas along South Padre Island, Port Isabel, and the Brownsville Navigation District, including a public boat ramp and approximately 30 Recreational Vehicles (RV) hook-ups on South Padre Island, and the marine facilities associated with the proposed Texas LNG and Rio Grande LNG projects. Commercial vessels, recreational and fishing vessels may also fall within Zone 1, depending on their course. Transit of such vessels through a Zone 1 area of concern can be avoided by timing and course changes, if conditions permit. Zone 2 would cover a wider swath of coastal areas along South Padre Island, Port Isabel, and the Brownsville Navigation District, including the Coast Guard Station at South Padre Island, multiple residential buildings, commercial buildings, industrial buildings, a church, a university lab building, Schlitterbahn Water Park, and Long Island. Zone 3 would span larger portions of South Padre Island, Port Isabel, and the Brownsville Navigation District, including the Port Isabel Police and Fire Departments, multiple residential, commercial, and industrial buildings, 9 churches, 2 elementary schools, and the causeway between Port Isabel and South Padre Island.

The areas impacted by the three different hazard zones are illustrated for accidental and intentional events in figures 4.12-1 and 4.12-2, respectively.



Annova LNG Facility
Ship Transit Route
Accidental Sandia Hazard Zone 1 (0 to 250 m)
Accidental Sandia Hazard Zone 2 (250 to 750 m)
Accidental Sandia Hazard Zone 3 (750 to 1700 m)

Figure 4.12-1 Accidental Hazard Zones along LNG Marine Vessel Route



Annova LNG Facility
Ship Transit Route
Accidental Sandia Hazard Zone 1 (0 to 500 m)
Accidental Sandia Hazard Zone 2 (500 to 1600 m)
Accidental Sandia Hazard Zone 3 (1600 to 3500 m)

Figure 4.12-2 Intentional Hazard Zones along LNG Marine Vessel Route

4.12.3.5 Coast Guard Letter of Recommendation and Analysis

In a letter dated February 13, 2018, the Coast Guard issued an LOR and LOR Analysis to FERC stating that the Brownsville Ship Channel would be considered suitable for accommodating the type and frequency of LNG marine traffic associated with this Project. The LOR also considered impacts related to the adjacent SpaceX rocket launch facility. As part of its assessment of the safety and security aspects of this project, the COTP Sector Corpus Christi consulted a variety of stakeholders including representatives from Port of Brownsville Navigation District, Port Isabel Navigation District, local facility security, the Brazos Santiago Pilots Association, and Signet Maritime. The LOR was based on full implementation of the strategies and risk management measures identified by the Coast Guard to Annova in its WSA.

Although Annova has suggested mitigation measures for responsibly managing the maritime safety and security risks associated with LNG marine vessel marine traffic, the necessary vessel traffic and/or facility control measures may change depending on changes in conditions along the waterway. The Coast Guard regulations in 33 CFR 127 require that applicants annually review WSAs until a facility begins operation. The annual review and report to the Coast Guard would identify any changes in conditions, such as changes to the port environment, the LNG facility, or the LNG marine vessel route, that would affect the suitability of the waterway.

The Coast Guard's LOR is a recommendation, regarding the current status of the waterway, to the FERC, the lead agency responsible for siting the on-shore LNG facility. Neither the Coast Guard nor the FERC has authority to require waterway resources of anyone other than the applicant under any statutory authority or under the ERP or the Cost Sharing Plan. As stated in the LOR, the Coast Guard would assess each transit on a case by case basis to identify what, if any, safety and security measures would be necessary to safeguard the public health and welfare, critical infrastructure and key resources, the port, the marine environment, and the LNG marine vessel.

Under the Ports and Waterways Safety Act, the Magnuson Act, the MTSA, and the Security and Accountability For Every (SAFE) Port Act, the COTP has the authority to prohibit LNG transfer or LNG marine vessel movements within his or her area of responsibility if he or she determines that such action is necessary to protect the waterway, port, or marine environment. If this Project is approved and if appropriate resources are not in place prior to LNG marine vessel movement along the waterway, then the COTP would consider at that time what, if any, vessel traffic and/or facility control measures would be appropriate to adequately address navigational safety and maritime security considerations.

4.12.4 LNG Facility Security Regulatory Requirements

The security requirements for the proposed project are governed by 33 CFR 105, 33 CFR 127, and 49 CFR 193 Subpart J. Title 33 CFR 105, as authorized by the MTSA, requires all terminal owners and operators to submit a Facility Security Assessment (FSA) and a Facility Security Plan (FSP) to the Coast Guard for review and approval before commencement of operations of the proposed project facilities. Annova would also be required to control and restrict access, patrol and monitor the plant, detect unauthorized access, and respond to security threats or breaches under 33 CFR 105. Some of the responsibilities of the applicant include, but are not limited to:

- designating a Facility Security Officer with a general knowledge of current security threats and patterns, security assessment methodology, vessel and facility operations, conditions, security measures, emergency preparedness, response, and contingency plans, who would be responsible for implementing the FSA and FSP and performing an annual audit for the life of the Project;
- conducting a FSA to identify site vulnerabilities, possible security threats and consequences of an attack, and facility protective measures; developing a FSP based on the FSA, with procedures for: responding to transportation security incidents; notification and coordination with federal, state, and local authorities; prevention of unauthorized access; measures to prevent or deter entrance with dangerous substances or devices; training; and evacuation;
- defining the security organizational structure with facility personnel with knowledge or training in current security threats and patterns; recognition and detection of dangerous substances and devices, recognition of characteristics and behavioral patterns of persons who are likely to threaten security; techniques to

circumvent security measures; emergency procedures and contingency plans; operation, testing, calibration, and maintenance of security equipment; and inspection, control, monitoring, and screening techniques;

- implementing scalable security measures to provide increasing levels of security at increasing maritime security levels for facility access control, restricted areas, cargo handling, LNG marine vessel stores and bunkers, and monitoring; ensuring that the TWIC program is properly implemented;
- ensuring coordination of shore leave for LNG marine vessel personnel or crew change out as well as access through the facility for visitors to the LNG marine vessel;
- conducting drills and exercises to test the proficiency of security and facility personnel on a quarterly and annual basis; and
- reporting all breaches of security and transportation security incidents to the National Response Center.

Title 33 CFR 127 has requirements for access controls, lighting, security systems, security personnel, protective enclosures, communications, and emergency power. In addition, an LNG facility regulated under 33 CFR 105 and 33 CFR 127 would be subject to the Transportation Worker Identification Credential (TWIC) Reader Requirements Rule issued by the Coast Guard on August 23, 2016. This rule requires owners and operators of certain vessels and facilities regulated by the Coast Guard to conduct electronic inspections of TWICs (e.g., readers with biometric fingerprint authentication) as an access control measure. The final rule would also include recordkeeping requirements and security plan amendments that would incorporate these TWIC requirements. The implementation of the rule was first proposed to be in effect August 23, 2018. In a subsequent notice issued on June 22, 2018, Coast Guard indicated delaying the effective date for certain facilities by 3 years, until August 23, 2021. On August 2, 2018, the President of the United States signed into law the Transportation Worker Identification Credential Accountability Act of 2018 (H.R. 5729). This law prohibits the Coast Guard from implementing the rule requiring electronic inspections of TWICs until after the Department of Homeland Security (DHS) has submitted a report to the Congress. Although the implementation of this rule has been postponed for certain facilities, the company may need to consider the rule when developing access control and security plan provisions for the facility.

Title 49 CFR 193 Subpart J also specifies security requirements for the onshore components of LNG terminals, including requirements for conducting security inspections and patrols, liaison with local law enforcement officials, design and construction of protective enclosures, lighting, monitoring, alternative power sources, and warning signs. If the Project is authorized, constructed, and operated, compliance with the security requirements of 33 CFR 105, 33 CFR 127, and 49 CFR 193 Subpart J would be subject to the respective Coast Guard and DOT inspection and enforcement programs.

Annova provided preliminary information as well as data request responses on these security features and indicated additional details would be completed in the final design. We recommend in section 4.12.6 that Annova provide final design details on these security features for review and approval. Furthermore, in accordance with the February 2004 Interagency

Agreement among FERC, DOT, and Coast Guard, FERC staff would collaborate with Coast Guard and DOT on the Project's security features.

4.12.5 FERC Engineering and Technical Review of the Preliminary Engineering Designs

4.12.5.1 LNG Facility Historical Record

The operating history of the U.S. LNG industry has been free of safety-related incidents resulting in adverse effects on the public or the environment with the exception of the October 20, 1944, failure at an LNG plant in Cleveland, Ohio. The 1944 incident in Cleveland led to a fire that killed 128 people and injured 200 to 400 more people.[19] The failure of the LNG storage tank was due to the use of materials not suited for cryogenic temperatures. LNG migrated through streets and into underground sewers due to inadequate spill impoundments at the site. Current regulatory requirements ensure that proper materials suited for cryogenic temperatures are used in the design and that spill impoundments are designed and constructed properly to contain a spill at the site. To ensure that this potential hazard would be addressed for proposed LNG facilities, we evaluate the preliminary and final specifications for suitable materials of construction and for the design of spill containment systems that would properly contain a spill at the site.

Another operational accident occurred in 1979 at the Cove Point LNG plant in Lusby, Maryland. A pump electrical seal located on a submerged electrical motor LNG pump leaked causing flammable gas vapors to enter an electrical conduit and settle in a confined space. When a worker switched off a circuit breaker, the flammable gas ignited, causing severe damage to the building and a worker fatality. With the participation of the FERC, lessons learned from the 1979 Cove Point accident led to changes in the national fire codes to better ensure that the situation would not occur again. To ensure that this potential hazard would be addressed for proposed facilities that have electrical seal interfaces, we evaluated the preliminary design and recommend in section 4.12.6 that Annova provide, for review and approval, the final design details of the electrical seal design at the interface between flammable fluids and the electrical conduit or wiring system, details of the electrical seal leak detection system, and the details of a downstream physical break (i.e., air gap) in the electrical conduit to prevent the migration of flammable vapors.

On January 19, 2004, a blast occurred at Sonatrach's Skikda, Algeria, LNG liquefaction plant that killed 27 and injured 56 workers. No members of the public were injured. Findings of the accident investigation suggested that a cold hydrocarbon leak occurred at Liquefaction Train 40 and was introduced into a high-pressure steam boiler by the combustion air fan. An explosion developed inside the boiler firebox, which subsequently triggered a larger explosion of the hydrocarbon vapors in the immediate vicinity. The resulting fire damaged the adjacent liquefaction process and liquid petroleum gas separation equipment of Train 40, and spread to Trains 20 and 30. Although Trains 10, 20, and 30 had been modernized in 1998 and 1999, Train 40 had been operating with its original equipment since start-up in 1981. To ensure that this potential hazard would be addressed for proposed facilities, we evaluate the preliminary design for mitigation of flammable vapor dispersion and ignition in buildings and combustion equipment to ensure they would be adequately covered by hazard detection equipment that could isolate and

[19] For a description of the incident and the findings of the investigation, see "U.S. Bureau of Mines, Report on the Investigation of the Fire at the Liquefaction, Storage, and Regasification Plant of the East Ohio Gas Co., Cleveland, Ohio, October 20, 1944," dated February 1946.

deactivate any combustion equipment whose continued operation could add to or sustain an emergency. We also recommend in section 4.12.6 that Annova provide, for review and approval, the final design details of hazard detection equipment, including the location and elevation of all detection equipment, instrument tag numbers, type and location, alarm indication locations, and shutdown functions of the hazard detection equipment.

On March 31, 2014, a detonation occurred within a gas heater at Northwest Pipeline Corporation's LNG peak-shaving plant in Plymouth, Washington[20]. This internal detonation subsequently caused the failure of pressurized equipment, resulting in high velocity projectiles. The plant was immediately shut down, and emergency procedures were activated, which included notifying local authorities and evacuating all plant personnel. No members of the public were injured, but one worker was sent to the hospital for injuries. As a result of the incident, the liquefaction trains and a compressor station located onsite were rendered inoperable. Projectiles from the incident also damaged the control building that was located near the pre-treatment facilities and penetrated the outer shell of one of the LNG storage tanks. All damaged facilities were ultimately taken out of service for repair. The accident investigation showed that an inadequate purge after maintenance activities resulted in a fuel-air mixture remaining in the system. The fuel-air mixture auto-ignited during startup after it passed through the gas heater at full operating pressure and temperature. To ensure that this potential hazard would be addressed for proposed facilities, we recommend in section 4.12.6 that Annova provide a plan for purging, for review and approval, which addresses the requirements of the American Gas Association *Purging Principles and Practice* and to provide justification if not using an inert or non-flammable gas for purging. In evaluating such plans, we would assess whether the purging could be done safely based on review of other plans and lessons learned from this and other past incidents. If a plan proposes the use of flammable mediums for cleaning, dry-out or other activities, we would evaluate the plans against other recommended and generally accepted good engineering practices, such as NFPA 56, *Standard for Fire and Explosion Prevention during Cleaning and Purging of Flammable Gas Piping Systems*.

We also recommend in section 4.12.6 that Annova provide, for review and approval, operating and maintenance plans, including safety procedures, prior to commissioning. In evaluating such plans, we would assess whether the plans cover all standard operations, including purging activities associated with startup and shutdown. Also, in order to prevent other sources of projectiles from affecting occupied buildings and storage tanks, we recommend in section 4.12.6 that Annova incorporate mitigation into their final design with supportive information, for review and approval, that demonstrates it would mitigate the risk of a pressure vessel burst or boiling liquid expanding vapor explosion (BLEVE) from occurring.

4.12.5.2 FERC Preliminary Engineering Review

FERC requires an applicant to provide safety, reliability, and engineering design information as part of its application, including hazard identification studies and front-end-engineering-design (FEED) information for its proposed Project. FERC staff evaluates this information with a focus on potential hazards from within and nearby the site, including external events, which may have the potential to cause damage or failure to the Project facilities, and the

[20] For a description of the incident and the findings of the investigation, see Root Cause Failure Analysis, Plymouth LNG Plant Incident Investigation under CP14-515.

engineering design and safety and reliability concepts of the various protection layers to mitigate the risks of potential hazards.

The primary concerns are those events that could lead to a hazardous release of sufficient magnitude to create an offsite hazard or interruption of service. Further, the potential hazards are dictated by the site location and the engineering details. In general, FERC staff considers an acceptable design to include various layers of protection or safeguards to reduce the risk of a potentially hazardous scenario from developing into an event that could impact the offsite public. These layers of protection are generally independent of one another so that any one layer would perform its function regardless of the initiating event or failure of any other protection layer. Such design features and safeguards typically include:

- a facility design that prevents hazardous events, including the use of inherently safer designs; suitable materials of construction; adequate design margins from operating limits for process piping, process vessels, and storage tanks; adequate design for wind, flood, seismic, and other outside hazards;
- control systems, including monitoring systems and process alarms, remotely-operated control and isolation valves, and operating procedures to ensure that the facility stays within the established operating and design limits;
- safety instrumented prevention systems, such as safety control valves and emergency shutdown systems, to prevent a release if operating and design limits are exceeded;
- physical protection systems, such as appropriate electrical area classification, proper equipment and building spacing, pressure relief valves, spill containment, and cryogenic, overpressure, and fire structural protection, to prevent escalation to a more severe event;
- site security measures for controlling access to the plant, including security inspections and patrols, response procedures to any breach of security, and liaison with local law enforcement officials; and
- onsite and offsite emergency response, including hazard detection and control equipment, firewater systems, and coordination with local first responders, to mitigate the consequences of a release and prevent it from escalating to an event that could impact the public.

The inclusion of such protection systems or safeguards in a plant design can minimize the potential for an initiating event to develop into an incident that could impact the safety of the offsite public. The review of the engineering designs for these layers of protection is initiated in the application process and carried through to the next phase of the proposed Project in final design if authorization is granted by the Commission.

The reliability of these layers of protection is informed by occurrence and likelihood of root causes and the potential severity of consequences based on past incidents and validated hazard modeling. As a result of the continuous engineering review, we recommend mitigation measures and continuous oversight to the Commission for consideration to include as conditions in the order. If a facility is authorized and recommendations are adopted as conditions to the order, FERC staff would continue its engineering review through final design, construction, commissioning, and operation.

4.12.5.3 Process Design

In order to liquefy natural gas, most liquefaction technologies require that the feed gas stream be pre-treated to remove components that could freeze out and clog the liquefaction equipment or would otherwise be incompatible with the liquefaction process or equipment, including H_2S, CO_2, water, mercury, and heavy hydrocarbons. For example, mercury is typically limited to concentrations less than 0.01 micrograms per normal cubic meter because it can cause embrittlement and corrosion resulting in a catastrophic failure of equipment.

The inlet gas would be conditioned to remove solids and water droplets and for pressure regulation prior to entering feed gas pretreatment processes. Once the inlet gas is conditioned, the feed gas would then contact an amine-based solvent solution in the amine contactor column to remove the H_2S and CO_2 (i.e., acid gas) present in the feed gas. Once the acid gas components accumulate in the amine solution, an amine stripper column would regenerate the amine solution by using heat to release the acid gas. The regenerated amine solution would be recycled back to the amine contactor column and the removed acid gas would be sent through a sulfur removal unit to remove H_2S. Then this stream is routed to a thermal oxidizer, where CO_2, trace amounts of H_2S not removed in the sulfur removal unit, and trace amounts of hydrocarbons would be incinerated. The feed gas exiting the amine contactor column then enters a knock out drum where bulk water would be recovered and recycled back to the amine contactor column. After the knock out drum, any remaining water in the feed gas would be removed using regenerative molecular sieve beds. Water collected during the molecular sieve regeneration process would be routed back to the amine contactor column. After water removal, the feed gas enters a mercury removal vessel that uses an activated carbon bed to remove trace amounts of mercury. The treated dry gas would then flow to the liquefaction unit.

Heavy hydrocarbon removal would be integrated into the liquefaction process. The first pass through the refrigeration process would be used to remove heavy hydrocarbons at intermediate temperatures. The feed gas would flow into a heavy hydrocarbon separator to remove the liquids. The vapor portion would reenter the refrigeration process and would be sub-cooled into LNG. The liquid portion from the heavy hydrocarbon separator would flow into the stabilizer to further separate the condensate product (C_4+) from the lighter hydrocarbons. The liquid condensate product exiting the stabilizer would be sent to the condensate storage tank and fuel gas system and the lighter hydrocarbons would be returned to the refrigeration process where it would also be sub-cooled into low pressure LNG. The LNG exiting the refrigeration process would flow to an LNG expander to reduce pressure, then into an LNG flash vessel before being pumped to two single containment LNG storage tanks.

In order to achieve the cryogenic temperatures needed to liquefy the natural gas stream in the above process, the gas would be cooled by a thermal exchange process driven by a closed loop refrigeration system using mixed refrigerants comprised of a mixture of nitrogen, methane, ethylene, propane, and pentane. Methane would be provided from the boil off gas (BOG) system and the other refrigerants required for the liquefaction process would be delivered by truck and stored onsite for initial filling and use, as needed, for make-up. Truck loading/unloading facilities would be provided to unload make-up refrigerants and to load condensate for offsite disposal.

As part of its engineering review, FERC staff evaluated the process flow diagrams (PFDs) and heat and material balances (HMBs) to determine the liquefaction capacities relative to the requested capacity in the application. While the application requests export with peak liquefaction rates of up to 6.95 million mtpa, the PFDs and HMBs do not cover this liquefaction range and suggest a maximum liquefaction rate of 6.47 mtpa. This is important as the PFDs and HMBs provide the flow rates, pressures, and temperatures that form the basis of design for other engineering documents, including piping and instrumentation diagrams (P&IDs), piping specifications, hazard analyses, and other pertinent engineering information. Therefore, we recommend in section 4.12.6 that Annova provide updated PFDs and HMBs and any other engineering documentation that demonstrate they would be capable of liquefying up to 6.95 mtpa.

During export operations, LNG stored within the LNG storage tanks would be sent out through multiple in-tank pumps (the pump discharge piping would penetrate through the roof and is an inherently safer design when compared to penetrating the side of an LNG storage tank) and would be routed through a marine transfer line and multiple liquid marine transfer arms connected to an LNG marine vessel. In order to keep the marine transfer line cold between LNG export cargoes, an LNG recirculation line would keep the marine transfer line cold and avoid cool down prior to every LNG marine vessel loading operation. The LNG transferred to the LNG marine vessel would displace vapors from the marine vessel, which would be sent back through a vapor marine transfer arm, a vapor return line, and into the boil-off gas (BOG) header. Once loaded, the LNG marine vessel would be disconnected and leave for export. Low pressure BOG generated from stored LNG (LNG is continuously boiling) as well as vapors returned during LNG marine vessel filling operations would be compressed and would be split and routed to the fuel gas system and to the liquefaction process. The closed BOG system would prevent the release of BOG to the atmosphere and would be in accordance with NFPA 59A. This would be an inherently safer design when compared to allowing the BOG to vent to the atmosphere.

The Project would include many utilities and associated auxiliary equipment. The major auxiliary systems required for the operation of the liquefaction facility include BOG, fuel gas, hot oil, flares, instrument and utility air supply, water supply, demineralized water, aqueous ammonia, nitrogen, and backup power. Hot oil would provide heat to the regeneration gas heater, steam exchanger, stabilizer reboiler, and fuel gas superheater. Three flare systems would be designed to handle and control the vent gases from the process areas. The warm and cold flare would be routed to a common flare stack and the marine flare would be routed to a separate stack. Electric power would be generated off-site. A small diesel tank would be provided to supply a black start diesel generator that would support the start-up of the backup natural gas generators. In addition, three diesel tanks would supply three diesel firewater pumps. Trucks would fill a liquid nitrogen storage tank and vaporizers would supply gaseous nitrogen for various uses in the plant including pre-commissioning, start-up, and refrigerant make-up. In addition, aqueous ammonia would be used for pH adjustment in the steam system.

The failure of process equipment could pose potential harm if not properly safeguarded through the use of appropriate engineering controls and operation. Annova would install process control valves and instrumentation to safely operate and monitor the facilities. Alarms would have visual and audible notification in the control room to warn operators that process conditions may be approaching design limits. Operators would have the capability to take action from the control room to mitigate an upset. Annova would develop facility operation procedures after completion of the final design; this timing is fully consistent with accepted industry practice. Annova would design their control systems and human machine interfaces to the International Society for Automation (ISA) Standards 5.3, 5.5, 60.1, 60.3, 60.4, and 60.6, and other standards and recommended practices. We recommend in section 4.12.6 that Annova provide more information, for review and approval, on the operating and maintenance procedures, including safety procedures, hot work procedures and permits, abnormal operating conditions procedures, and personnel training prior to commissioning. We would evaluate these procedures to ensure that an operator can operate and maintain all systems safely, based on benchmarking against other operating and maintenance plans and comparing against recommended and generally accepted good engineering practices, such as American Institute of Chemical Engineers, *Guidelines for Writing Effective Operating and Maintenance Procedures*. In addition, we recommend in section 4.12.6 that Annova tag and label instrumentation and valves, piping, and equipment and provide car-seals/locks to address human factor considerations and improve facility safety and prevent incidents. We also recommend in section 4.12.6 that Annova develop and implement an alarm management program, for review and approval to ensure the effectiveness of the alarms. FERC staff would evaluate the alarm management program against recommended and generally accepted good engineering practices, such as ISA Standard 18.2.

In the event of a process deviation, emergency shutdown (ESD) valves and instrumentation would be installed to monitor, alarm, shutdown, and isolate equipment and piping during process upsets or emergency conditions. The Project would have a plant-wide emergency shutdown system to initiate closure of valves and shutdown of the process during emergency situations as well as the ability to shutdown specific areas to address local emergency conditions. Safety-instrumented systems would comply with ISA Standard 84.00.01 and other recommended and generally accepted good engineering practices. We also recommend in section 4.12.6 that Annova file information, for review and approval, on the final design, installation, and commissioning of instrumentation and emergency shutdown equipment to ensure appropriate cause-and-effect alarm or shutdown logic and enhanced representation of the emergency shutdown system in the plant control room and throughout the plant.

In developing the FEED, Annova conducted a Preliminary Hazard and Operability (Pre-HAZOP) study on the project's preliminary design based on the proposed piping and instrumentation diagrams. The Pre-HAZOP study identifies potential hazards or environmental issues in the early stage of the project's design that could produce undesirable consequences through the occurrence of an incident by evaluating the materials, systems, process, and plant design.

A more detailed hazard and operability review (HAZOP) analysis would be performed by Annova during the final design to identify the major process hazards that may occur during the operation of the facilities. The HAZOP study would be intended to address hazards of the process, engineering, and administrative controls and would provide a qualitative evaluation of a range of possible safety, health, and environmental consequences that may result from the process hazard, and identify whether there are adequate safeguards (e.g., engineering and administrative controls) to prevent or mitigate the risk from such events. Where insufficient engineering or administrative controls were identified, recommendations to prevent or minimize these hazards would be generated from the results of the HAZOP review. We recommend in section 4.12.6 that Annova file the HAZOP study on the completed final design for review and approval. We would evaluate the HAZOP to ensure all systems and process deviations are addressed appropriately based on likelihood, severity, and risk values with commensurate layers of protection in accordance with recommended and generally accepted good engineering practices, such as American Institute of Chemical Engineers, *Guidelines for Hazard Evaluation Procedures*. We also recommend in section 4.12.6 that Annova file the resolutions of the recommendations generated by the HAZOP review be provided for review and approval by FERC staff. Once the design has been subjected to a HAZOP review, the design development team would track, manage, and keep records of changes in the facility design, construction, operations, documentation, and personnel. Annova would evaluate these changes to ensure that the safety, health, and environmental risks arising from these changes are addressed and controlled based on its management of change procedures. If our recommendations are adopted into the order, resolutions of the recommendations generated by the HAZOP review would be monitored by FERC staff. We also recommend in section 4.12.6 that Annova file all changes to their FEED for review and approval by FERC staff. However, major modifications could require an amendment or new proceeding.

If the Project is authorized and constructed, Annova would install equipment in accordance with its design. We recommend in section 4.12.6 that Project facilities be subject to construction inspections and that Annova provide, for review and approval, commissioning plans, procedures and commissioning demonstration tests that would verify the performance of equipment. In addition, we recommend in section 4.12.6 that Annova provide semi-annual reports that include abnormal operating conditions and planned facility modifications. Furthermore, we recommend in section 4.12.6 that the Project facilities be subject to regular inspections throughout the life of the facilities to verify that equipment is being properly maintained and to verify basis of design conditions, such as feed gas and sendout conditions, do not exceed the original basis of design.

4.12.5.4 Mechanical Design

Annova provided codes and standards for the design, fabrication, construction, and installation of piping and equipment and specifications for the facility. The design specifies materials of construction and ratings suitable for the pressure and temperature conditions of the process design. Piping would be designed, fabricated, assembled, erected, inspected, examined, and tested in accordance with the ASME Standards B31.3, B31.5, B36.10, and B36.19. Pressure vessels must be designed, fabricated, inspected, examined, and tested in accordance with ASME Boiler and Pressure Vessel Code (BPVC) Section VIII and must be code-stamped per NFPA 59A (2001), as incorporated by reference in 49 CFR 193 Subparts C, D, and E. Portions of the facility regulated under 33 CFR 127 for the marine transfer system, including piping, hoses, and loading arms should also be tested in accordance with 33 CFR 127.407. In addition, the operator should verify the set pressure of the pressure relief valves meet the requirements in 33 CFR 127.407.

LNG storage tanks must be design, fabricated, tested, and inspected in accordance with 49 CFR 193 Subpart D, NFPA 59A (2001 and 2006), and API Standard 620. In addition, Annova would design, fabricate, test, and inspect the LNG storage tanks in accordance with API Standard 625. Other low-pressure storage tanks such as the amine and condensate storage tanks, would be designed, inspected, and maintained in accordance with the API Standards 650 and 653. All LNG storage tanks would also include boil-off gas compression to prevent the release of boil-off to the atmosphere in accordance with NFPA 59A (2001) for an inherently safer design. Heat exchangers would be designed to ASME BPVC Section VIII standards; API Standards 660, 661, and 662; and the Tubular Exchanger Manufacturers Association standards. Rotating equipment would be designed to standards and recommended practices, such as API Standards 610, 613, 614, 617, 670, 671, 675, 676, and 682; and ASME Standards B73.1 and B73.2. Valves would be designed to standards and recommended practices such as API Standards 594, 598, 600, 602, 603, 607, 608, and 609; ASME Standards B16.5, B16.10, B16.20, B16.25, and B16.34; and ISA Standards 75.01.01, 75.05.01, and 75.08.01.

Pressure and vacuum safety relief valves and flares would be installed to protect the storage containers, pressure vessels, process equipment, and piping from an unexpected or uncontrolled pressure excursion. The safety relief valves would be designed to handle process upsets and thermal expansion, per NFPA 59A (2001), ASME Standard B31.3, and ASME BPVC Section VIII; and would be designed in accordance with API Standards 520, 521, 526, 527, 537, 2000, and other recommended and generally accepted good engineering practices. In addition, we recommend in section 4.12.6 Annova provide final design information on pressure and vacuum relief devices, for review and approval, to ensure that the final sizing, design, and installation of these components are adequate and in accordance with the standards reference and other recommended and generally accepted good engineering practices.

Although many of the codes and standards were listed as ones the project would meet, Annova did not make reference to all codes and standards required by regulations or are recommended and generally accepted good engineering practices. Annova plans to evaluate the missing codes and standards and update its list accordingly. Therefore, we recommend in section 4.12.6 that Annova provide the final specifications for all equipment and a summarized list of all referenced codes and standards for review and approval. If the Project is authorized and constructed, Annova would install equipment in accordance with its design and FERC staff would verify equipment nameplates to ensure equipment is being installed based on the approved design. In addition, FERC staff would conduct construction inspections including reviewing quality assurance and quality control plans to ensure construction work is being performed according to proposed Project specifications, procedures, codes, and standards. We recommend in section 4.12.6 Annova provide semi-annual reports that include equipment malfunctions and abnormal maintenance activities. In addition, we recommend in section 4.12.6 that the Project facilities be subject to inspections to verify that the equipment is being properly maintained during the life of the facility.

4.12.5.5 Hazard Mitigation Design

If operational control of the facilities were lost and operational controls and emergency shutdown systems failed to maintain the Project within the design limits of the piping, containers, and safety relief valves, a release could potentially occur. FERC regulations under 18 CFR 380.12 (o) (1) through (4) require applicants to provide information on spill containment, spacing and plant layout, hazard detection, hazard control, and firewater systems. In addition, 18 CFR 380.12 (o) (7) require applicants to provide engineering studies on the design approach and 18 CFR 380.12 (o) (14) requires applicants to demonstrate how they comply with 49 CFR 193 and NFPA 59A. As required by 49 CFR 193 Subpart I and by incorporation of section 9.1.2 of NFPA 59A (2001), fire protection must be provided for all DOT regulated LNG plant facilities based on an evaluation of sound fire protection engineering principles, analysis of local conditions, hazards within the facility, and exposure to or from other property. NFPA 59A (2001) also requires the evaluation on the type, quantity, and location of hazard detection and hazard control, passive fire protection, emergency shutdown and depressurizing systems, and emergency response equipment, training, and qualifications. If authorized and constructed, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 Subpart I and would be subject to DOT's inspection and enforcement programs. However, NFPA 59A (2001) also indicates the wide range in size, design, and location of LNG facilities precludes the inclusion of detailed fire protection provisions that apply to all facilities comprehensively and includes subjective performance-based language on where ESD systems and hazard control are required and does not provide any additional guidance on placement or selection of hazard detection equipment and provides minimal requirements on firewater. Also, the project marine facilities would be subject to 33 CFR 127, which incorporates sections of NFPA 59A (1994), which have similar performance-based guidance. Therefore, FERC staff evaluated the proposed spill containment and spacing, hazard detection, emergency shutdown and depressurization systems, hazard control, firewater coverage, structural protection, and onsite and offsite emergency response to ensure they would provide adequate protection of the LNG facilities as described more fully below.

Annova performed a preliminary fire protection evaluation to ensure that adequate mitigation would be in place, including spill containment and spacing, hazard detection, emergency shutdown and depressurization systems, hazard control, firewater coverage, structural protection, and onsite and offsite emergency response. We recommend in section 4.12.6 that Annova provide a final fire protection evaluation for review and approval, and to provide more information on the final design, installation, and commissioning of spill containment, hazard detection, hazard control, firewater systems, structural fire protection, and onsite and offsite emergency response procedures.

Spill Containment

In the event of a release, sloped areas at the base of storage and process facilities would direct a spill away from equipment and into the impoundment system. This arrangement would minimize the dispersion of flammable vapors into confined, occupied, or public areas and minimize the potential for heat from a fire to impact adjacent equipment, occupied buildings, or public areas if ignition were to occur.

Title 49 CFR 193.2181 Subpart C specifies that each impounding system serving an LNG storage tank must have a minimum volumetric liquid capacity of 110 percent of the LNG tank's maximum design liquid capacity for an impoundment serving a single tank, unless surge is accounted for in the impoundment design. If authorized and constructed, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 Subpart C and would be subject to DOT's inspection and enforcement programs. Annova proposes two single containment LNG storage tanks surrounded by dike walls that would serve as the impoundment system. FERC staff verified that the dike walls would have a liquid capacity of at least 110 percent of the inner LNG tank's maximum liquid capacity.

Annova proposes to install curbing, paving, and trenches to direct potential LNG, mixed refrigerant, or condensate liquid releases in each liquefaction area to either the North Process Area Impoundment Basin or the East Process Area Impoundment Basin. LNG releases from the rundown header, on top of each LNG storage tank, or during LNG marine vessel loading operations would be collected in a trench system and would be routed to the Marine Area

Impoundment Basin. Releases in the refrigerant storage area or from refrigerant delivery trucks would be collected in curbed areas and directed to the Refrigerant Makeup Impoundment Basin. This basin capacity would be sized to be greater than the largest refrigerant storage tank. Local bunds would be provided to contain liquid releases from the amine make-up tank and the condensate storage tank. In addition, local curbing would be provided around pretreatment equipment that would direct amine releases to the amine sump pit. Local curbing would also be provided for the flare knockout drums, inlet gas HP separator, liquid nitrogen storage tanks, Fuel Gas Scrubber, Condensate Flash Drum, and equipment handling hot oil. These curbed areas would direct process releases to trenches that drain to either the Heat Medium Impoundment Basin or the East Process Area Impoundment Basin. Each diesel firewater pump would be provided with a double containment diesel storage tank.

Under NFPA 59A (2001) section 2.2.2.2, the capacity of impounding areas for vaporization, process, or LNG transfer areas must equal the greatest volume that can be discharged from any single accidental leakage source during a 10-minute period or during a shorter time period based upon demonstrable surveillance and shutdown provisions acceptable to the DOT. If authorized and constructed, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 Subpart C and would be subject to DOT's inspection and enforcement programs. The impoundment system design for the marine facilities would be subject to the Coast Guard's 33 CFR 127, which does not specify a spill or duration for impoundment sizing. However, we evaluate whether all hazardous liquids are provided with spill containment based on the largest flow capacity from a single pipe for 10 minutes accounting for de-inventory or the liquid capacity of the largest vessel served, whichever is greater. In addition, the details on how the spill trench system would cross roadways would be provided in final design. Therefore, we recommend in section 4.12.6 that Annova provide additional information on the final design of the impoundment systems for review and approval.

Annova indicated that all piping, hoses, and equipment that could produce a hazardous liquid spill would be provided with spill collection and/or spill conveyance systems. Furthermore, Annova indicates that the stormwater pumps would be automatically operated by level control and interlocked using low temperature detectors to prevent pumps from operating if LNG is present. However, Annova's stormwater removal system would be designed to remove bulk water from each spill basin and may not ensure complete removal of residual water from each spill basin floor. Therefore, we recommend in section 4.12.6 that Annova provide spill basin details, for review and approval, to show that the spill basin floor would slope to a sump pit that would be equipped with a small water removal pump. In addition, low temperature detectors would not stop the stormwater removal pumps from operating in the event a warm refrigerant, hot oil, or heavy hydrocarbon release reaches the Process Area Impoundment Basins. Therefore, we recommend in section 4.12.6 that if applicable, Annova provide additional interlocks to prevent the stormwater removal pumps from operating if warm refrigerant, heavy hydrocarbon, or hot oil releases reach the Process Area Impoundment Basins.

Furthermore, stormwater removal pumps would be proposed for the large impoundment basins and bunded areas described above, however Annova also proposes to install normally-closed valves on local curbed areas to allow analysis of stormwater prior to routing it to the drainage channels. Annova is consulting with DOT on the use of normally-closed valves instead of stormwater removal pumps required in 49 CFR 193 Subpart C. Therefore, we recommend in section 4.12.6 that Annova provide DOT correspondence accepting the use of normally closed valves to remove stormwater from curbed areas. If authorized and constructed, final compliance with the requirements of 49 CFR 193 Subpart C would be subject to DOT's inspection and enforcement programs.

If the Project is authorized and constructed, Annova would install spill impoundments in accordance with its design and FERC staff would verify during construction inspections that the spill containment system including dimensions, slopes of curbing and trenches, and volumetric capacity matches final design information. In addition, we recommend in section 4.12.6 that Project facilities be subject to regular inspections throughout the life of the facility to verify that impoundments are being properly maintained.

Spacing and Plant Layout

The spacing of vessels and equipment between each other, from ignition sources, and to the property line must meet the requirements of 49 CFR 193 Subparts C, D, and E, which incorporate NFPA 59A (2001). NFPA 59A (2001) further references NFPA 30, NFPA 58, and NFPA 59 for additional spacing and plant layout requirements. If the facilities are authorized and constructed, Annova must comply with the requirements of 49 CFR 193 and would be subject to DOT's inspection and enforcement programs.

To minimize risk for flammable or toxic vapor ingress into buildings, we recommend in section 4.12.6 that Annova conduct a technical review of facility, for review and approval, identifying all combustion/ventilation air intake equipment and the distances to any possible flammable gas or toxic release; and verify that these areas would be adequately covered by hazard detection devices that would isolate or shut down any combustion or heating ventilation and air conditioning equipment whose continued operation could add to or sustain an emergency. We also recommend in section 4.12.6 that Project facilities be subject to periodic inspections during construction to verify flammable/toxic gas detection equipment is installed in heating, ventilation, and air condition intakes of buildings at appropriate locations. In addition, we recommend in section 4.12.6 that Project facilities be subject to regular inspections throughout the life of the facilities to continue to verify that flammable/toxic gas detection equipment installed in building air intakes function as designed and are being maintained and calibrated.

In addition, FERC staff evaluated the spacing to determine if there could be cascading damage and to inform what fire protection measures may be necessary to reduce the risk of cascading damage. A pool fire within one LNG storage tank's dike walls would result in high radiant heats at the adjacent LNG storage tank. Annova proposes to install a remotely operated water deluge system on each LNG storage tank to protect each LNG storage tank shell from high radiant heats. Therefore, we recommend in section 4.12.6 that Annova provide the final design of these thermal mitigation measures, for review and approval, to demonstrate cascading events would be mitigated. In addition, a pool fire within the Heat Medium Impoundment Basin would result in high radiant heats at the nearby condensate storage tank. Therefore, we recommend in section 4.12.6 that Annova either demonstrate the radiant heat would not result in damage to the condensate tank; prevent cascading damage to the condensate storage tank through use of high expansion foam, firewalls, relocation of the impoundment or condensate tank; or other approved mitigation or combination thereof. Similarly, we recommend in section 4.12.6 that Annova analyzes fires originating from the amine sump pit and the condensate storage area berm and as applicable, demonstrate how the resulting radiant heat would not result in cascading damage to surrounding equipment.

If the Project is authorized, Annova would finalize the plot plan and we recommend in section 4.12.6 that Annova provide any changes for review and approval to ensure capacities and setbacks are maintained. If the facilities are constructed, Annova would install equipment in accordance with the spacing indicated on the plot plans. In addition, we recommend in section 4.12.6 that Project facilities be subject to periodic inspections during construction to verify equipment is installed in appropriate locations and the spacing is met in the field. We also recommend in section 4.12.6 that Project facilities be subject to regular inspections throughout the life of the facilities to verify that equipment setbacks from other equipment and ignition sources are being maintained during operations.

Ignition Controls

Annova's plant areas would be designated with an appropriate hazardous electrical classification and process seals commensurate with the risk of the hazardous fluids being handled in accordance with NFPA 59A (2001), 70, 497, and API RP 500. If authorized and constructed, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 and would be subject to DOT's inspection and enforcement programs, which require compliance, by incorporation by reference, with NFPA 59A (2001) and NFPA 70 (1999). The marine facilities must comply with similar electrical area classification requirements of NFPA 59A (1994) and NFPA 70 (1993), which are incorporated by reference into the Coast Guard regulations in 33 CFR 127. Depending on the risk level, these areas would either be unclassified or classified as Class 1 Division 1, or Class 1 Division 2. Electrical equipment located in these classified areas would be designed such that in the event a flammable vapor is present, the equipment would have a minimal risk of igniting the vapor. We evaluated Annova's electrical area classification drawings to determine whether Annova would meet these electrical area classification requirements and good engineering practices in NFPA 59A, 70, 497, and API RP 500.

If the Project is authorized, Annova would finalize the electrical area classification drawings and would describe changes made from the FEED design. We recommend in section 4.12.6 that Annova file the final design of the electrical area classification drawings for review and approval. If facilities are constructed, Annova would install appropriately classed electrical equipment, and we recommend in section 4.12.6 that project facilities be subject to periodic inspections during construction for FERC staff to spot check electrical equipment and verify equipment is installed per classification and are properly bonded or grounded in accordance with NFPA 70. In addition, we recommend in section 4.12.6 that project facilities be subject to regular inspections throughout the life of the facility to ensure electrical equipment is maintained (e.g., bolts on explosion proof equipment properly installed and maintained, panels provided with purge, etc.), and electrical equipment are appropriately de-energized and locked out and tagged out when being serviced.

In addition, submerged pumps and instrumentation must be equipped with electrical process seals, and instrumentation in accordance with NFPA 59A (2001) and NFPA 70 at each interface between a flammable fluid system and an electrical conduit or wiring system. We recommend in section 4.12.6 that Annova provide, for review and approval, final design drawings showing process seals installed at the interface between a flammable fluid system and an electrical conduit or wiring system that meet the requirements of NFPA 59A (2001) and NFPA 70. In addition, we recommend in section 4.12.6 that Annova file, for review and approval, details of an air gap or vent equipped with a leak detection device that should continuously monitor for the presence of a flammable fluid, alarm the hazardous condition, and shut down the appropriate systems. In addition, we recommend in section 4.12.6 that Project facilities be subject to regular inspections throughout the life of the facility to ensure electrical process seals for submerged pumps continue to conform to NFPA 59A and NFPA 70 and that air gaps are being properly maintained.

Hazard Detection, Emergency Shutdown, and Depressurization Systems

Annova would also install hazard detection systems to detect cryogenic spills, flammable and toxic vapors, and fires. The hazard detection systems would alarm and notify personnel in the area and control room to initiate an emergency shutdown, depressurization, or initiate appropriate procedures, and would meet NFPA 72, ISA Standard 12.13, and other recommended and generally accepted good engineering practices. In addition, we recommend in section 4.12.6 that Annova provide specifications, for review and approval, of the final design of fire safety specifications, including hazard detection, hazard control, and firewater systems.

FERC staff also evaluated the adequacy of the general hazard detection type, location, and layout to ensure adequate coverage to detect cryogenic spills, flammable and toxic vapors, and fires near potential release sources (i.e., pumps, compressors, sumps, trenches, flanges, and instrument and valve connections). Annova did not provide the fire and gas system cause and effect matrices that indicate how each detector would initiate an alarm, shutdown, depressurization, or conduct other action. Therefore, we recommend in section 4.12.6 that Annova provide, for review and approval, the cause and effect matrices for process instrumentation, fire and gas detection system, and emergency shutdown system. In addition, Annova did not propose to install low oxygen detectors in the liquid nitrogen storage area. Therefore, we recommend in section 4.12.6 that Annova to provide oxygen detectors to notify operators of potential liquid nitrogen releases.

Furthermore, we recommend in section 4.12.6 that Annova provide additional information, for review and approval, on the final design of all hazard detection systems (e.g., manufacturer and model, elevations, etc.) and hazard detection layout drawings. If the Project is authorized and constructed, Annova would install hazard detectors according to its specifications, and we recommend in section 4.12.6 that Project facilities be subject to periodic inspections during construction to verify hazard detectors and ESD pushbuttons are appropriately installed per approved design and functional based on cause and effect matrixes prior to introduction of hazardous fluids. In addition, we recommend in section 4.12.6 that Project facilities be subject to regular inspections throughout the life of the facility to verify hazard detector coverage and functionality is being maintained and are not being bypassed without appropriate precautions.

Hazard Control

If ignition of flammable vapors occurred, hazard control devices would be installed to extinguish or control incipient fires and releases, and would meet NFPA 59A (2001), 10, 12, 17, and 2001; API 2510A; and other recommended and generally accepted good engineering practices. We evaluated the adequacy of the number and availability of handheld, wheeled, and fixed fire extinguishing devices throughout the site based on the FEED. FERC staff also evaluated whether the spacing of the fire extinguishers would meet NFPA 10 and agent type and capacities meet NFPA 59A (2009 and later editions). The hazard control plans appeared to meet NFPA 10 travel distances to nearly all components containing flammable or combustible fluids (Class B) for hand-held fire extinguishers (30-50 feet) but did not originally indicate any wheeled extinguishers (100 feet) or hand-held fire extinguishers (75 feet) for ordinary combustible (Class A) hazards or electrical (Class C) hazards. Upon a data request, Annova added wheeled and hand-held extinguishers for Class C electrical hazards and committed to providing hand-held fire extinguishers for ordinary combustible (Class A) hazards in all buildings in accordance with NFPA 10 requirements, including placement at each entry/exit. The agent storage capacities for hand-held (minimum 20 pounds [lb]) and wheeled (minimum 125 lb) also appear to meet NFPA 59A requirements, but Annova did not yet indicate the agent type (e.g., potassium bicarbonate, sodium bicarbonate, etc.). In addition, travel distances, installation heights, visibility, flow rate capacities, and other requirements should be confirmed in final design and in the field where design details, such as manufacturer, obstructions, and elevations, would be better known. Therefore, we recommend in section 4.12.1.5 that Annova files the final design of these systems, for review and approval, where details are yet to be determined (e.g., manufacturer and model, elevations, flowrate, capacities, etc.) and where the final design could change as a result of these details or other changes in the final design of the Project.

In addition, FERC staff evaluated whether fire protection systems would be installed in gas turbine enclosures. Annova indicated that depending on enclosure details and vendor proposals, the fire suppression system may be carbon dioxide in accordance with NFPA 12, water mist in accordance with NFPA 750, or clean agent in accordance with NFPA 2001. In addition, FERC staff recommend clean agent systems be installed in all instrumentation buildings systems in accordance with NFPA 2001. If the Project is authorized and constructed, Annova would install hazard control equipment, and we recommend in section 4.12.6 that Project facilities be subject to periodic inspections during construction to verify hazard control equipment is installed in the field and functional prior to introduction of hazardous fluids. In addition, we recommend in section 4.12.6 that Project facilities be subject to regular inspections throughout the life of the facility to verify in the field that hazard control coverage and is being properly maintained and inspected.

Passive Cryogenic and Fire Protection

If a fire could not be separated, controlled, or extinguished to limit fire exposures or cryogenic releases onto facility components to insignificant levels, passive protection (e.g., fireproofing structural steel, cryogenic protection, etc.) should be provided to prevent failure of structural supports of equipment and pipe racks. The structural fire protection would comply with NFPA 59A (2001), API 2218, and other recommended and generally accepted good engineering practices. FERC staff evaluated whether passive cryogenic and fire protection would be applied to pressure vessels and structural supports to facilities that could be exposed to cryogenic liquids or to radiant heats of 4,000 Btu/ft^2-hr or greater from fires with durations that could result in failures[21] and that they are specified in accordance with recommended and generally accepted good engineering practices with a fire protection rating commensurate to the radiant heat and

[21] Pool fires from impoundments are generally mitigated through use of emergency shutdowns, depressurization systems, structural fire protection, and firewater, while jet fires are primarily mitigated through the use of emergency shutdowns, depressurization systems, and firewater without structural fire protection.

duration. In addition, we recommend in section 4.12.6 that Annova provide additional information on the final design of these systems, for review and approval, where details are yet to be determined (e.g., calculation of structural fire protection materials, thicknesses, etc.) and where the final design could change as a result of these details or other changes in the final design of the Project. We also recommend in section 4.12.6 that Annova file drawings and specifications, for review and approval, for the structural passive protection systems to protect equipment and supports from cryogenic releases.

If the Project is authorized and constructed, Annova would install structural cryogenic and fire protection according to its design, and we recommend in section 4.12.6 that Project facilities be subject to periodic inspections during construction to verify structural cryogenic and fire protection is properly installed in the field as designed prior to introduction of hazardous fluids. In addition, we recommend in section 4.12.6 that Project facilities be subject to regular inspections throughout the life of the facility to continue to verify that passive protection is being properly maintained.

Firewater Systems

Annova would also provide firewater systems, including remotely operated firewater monitors, sprinkler systems, fixed water spray systems, and firewater hydrants and hoses for use during an emergency to cool the surface of storage vessels, piping, and equipment exposed to heat from a fire. These firewater systems would be designed, tested, and maintained to meet NFPA 59A (2001), 13, 14, 15, 20, 22, 24, 25, and 750 requirements. FERC staff evaluated the adequacy of the general firewater and foam system coverage and verified the appropriateness of the associated firewater demands of those systems and worst-case fire scenarios to size the firewater and foam pumps. Annova would provide firewater monitors, hydrants, and deluge systems throughout the plant that seemed to adequately cover facilities handling flammable and combustible materials, including deluge water coverage on each LNG storage tank roof and wall portions facing the adjacent LNG storage tank to address radiant heat from an adjacent LNG storage tank dike fire. Annova also indicated that the turbine enclosures may be provided with a water mist system in accordance with NFPA 750. Annova would also install high expansion foam systems to reduce vaporization rates from LNG pools and would meet NFPA 59A (2001) and 11. We recommend in section 4.12.6 that Annova file additional information on the final design of these systems, for review and approval, where details are yet to be determined (e.g., manufacturer and model, nozzle types, etc.) and where the final design could change as a result of these details or other changes in the final design of the Project. In addition, we recommend in section 4.12.6 that Annova provide additional details on how the deluge system would mitigate the effects of radiant heat from an adjacent LNG storage tank dike fire.

FERC staff also assessed whether the reliability of the firewater pumps and firewater source are appropriate. Firewater would be supplied from the channel or fresh water tank through multiple firewater pumps, including both diesel and electric. The channel would supply firewater for the tank deluge system and act as a backup to the fresh water tank, which would not be able to supply the tank deluge system. Annova indicates in its codes and standards list and in its fire protection evaluation report that it would meet NFPA 22. However, the fresh water data sheet used for firewater supply denotes the tank would be designed to API 650, and does not make reference to NFPA 22. Therefore, we recommend in section 4.12.6 that Annova design the firewater tank in accordance with NFPA 22 or justify how API 650 provides an equivalent or better level of safety.

If the Project is authorized and constructed, Annova would install the firewater and foam systems as designed, and we recommend in section 4.12.6 that Project facilities be subject to periodic inspections during construction and that companies provide results of commissioning tests to verify the firewater and foam systems are installed and functional as designed prior to introduction of hazardous fluids. In addition, we recommend in section 4.12.6 that Project facilities be subject to regular inspections throughout the life of the facility to ensure firewater and foam systems are being properly maintained and tested.

4.12.5.6 Geotechnical and Structural Design

Annova provided geotechnical and structural design information for its facilities to demonstrate the site preparation and foundation designs would be appropriate for the underlying soil characteristics and to ensure the structural design of the Project facilities would be in accordance with federal regulations, standards, and recommended and generally accepted good engineering practices. The application focuses on the resilience of the Project facilities against natural hazards, including extreme geological, meteorological, and hydrological events, such as earthquakes, tsunamis, seiche, hurricanes, tornadoes, floods, rain, ice, snow, regional subsidence, sea level rise, landslides, wildfires, volcanic activity, and geomagnetism.

Geotechnical Evaluation

FERC regulations under 18 CFR 380.12 (h) (3) require geotechnical investigations to be provided. In addition, FERC regulations under 18 CFR 380.12 (o) (14) require an applicant to demonstrate compliance with regulations under 49 CFR 193 and NFPA 59A (2001). If authorized and constructed, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 and would be subject to DOT's inspection and enforcement programs. DOT regulations incorporate by reference NFPA 59A (2001). NFPA 59A (2001), section 2.1.4 requires soil and general investigations of the site to determine the design basis for the facility. However, no additional requirements are set forth in 49 CFR 193 or NFPA 59A on minimum requirements for evaluating existing soil site conditions or evaluating the adequacy of the foundations, therefore FERC staff evaluated the existing site conditions, geotechnical report, and proposed foundations to ensure they are adequate for the LNG facilities as described below.

The Project would be located in the West Gulf section of the Coastal Plain physiographic province (USGS 2000). The Coastal Plain lies along the Atlantic seaboard and Gulf Coast of the U.S., stretching 100 to 200 miles inland and 100 to 200 miles offshore, to the edge of the continental shelf. This belt of Late Cretaceous to Holocene sedimentary rocks comprises an elevated sea bottom with low topographic relief dipping seaward. In Texas, the Coastal Plain includes a system of alternating synclines (troughs) and anticlines (peaks) oriented perpendicular to the coastline (Hosman 1996). The surficial geology underlying the region is composed of Quaternary Holocene and Pleistocene-aged sediments made of alluvium of the Rio Grande and coastal deposits of dune, estuary, lagoon, deltaic, tidal-flat, beach, and barrier island environments (Page et al. 2005).

Annova contracted Black and Veatch to conduct geotechnical investigations to evaluate the existing soil site conditions and proposed foundation design for the Project. The existing site elevation ranges from +5 feet to +25 feet North American Vertical Datum 1988 (NAVD 88). The site would be cleared, grubbed, and prepared using standard earthmoving and compaction equipment. Site preparation would result in a final grade elevations of +6 feet NAVD 88 for the LNG tank area, +21 feet NAVD 88 for the crest of the LNG tank earthen berms, +16.5 feet NAVD 88 for the process area, and +10 feet NAVD 88 for the marine terminal area. The offshore berth area would be dredged to as deep as 45 feet below the mean lower low water (MLLW) level along the Brownsville Ship Channel. All site elevations were determined to protect critical facilities from storm surge as discussed in more detail later in this section. There is no planned fill export (with the exception of dredge material) or import from the overall project site; thus, any fill material required is planned to be obtained by the use of on-site borrow pits. The onsite fill would be tested using ASTM D1557 to determine the moisture contents of any on-site fill. Annova would, as necessary, either dry onsite fill or mix with lime or other material to ensure the fill meets compact requirements.

Black and Veatch conducted a subsurface investigation in two phases. The Phase I investigation was based on a proposed site arrangement that was subsequently revised. The Phase II supplemental investigation was based on a revised site arrangement that relocated the liquefaction trains and LNG tanks to areas which had little investigation during Phase I. In total between both phases, Black and Veatch conducted 31 soil borings to depths ranging from 38 feet to 200 feet below existing grade, 36 cone penetration tests (CPTs) to depths ranging from 10 feet to 119 feet (or to refusal) below existing grade, and 4 seismic cone penetration tests (SCPTs) to depths ranging from 90 feet to 100 feet below existing grade. Over 15 different tests were conducted on over 200 recovered soil samples, including soil identification and classification tests (water content, Atterberg liquid and plastic limits, sieve tests), strength and compressibility tests (consolidation tests and triaxial shear tests), swell tests, corrosion potential tests (pH, sulfate, chloride), CPTs, SCPTs, vane shear tests, pressure modulus tests, and dynamic cone penetrometer tests in general accordance with pertinent ASTM standards.

FERC staff evaluated the geotechnical investigation to ensure the adequacy in the number, coverage, and types of the geotechnical borings, CPTs, SCPTs, and other tests and found the number borings at the new LNG tank locations to be limited. Therefore, we recommend in section 4.12.6 that Annova conduct a more extensive geotechnical field investigation, specifically beneath proposed LNG tank foundations and associated facilities (i.e., pipe racks). FERC staff will continue its review of the results of these additional geotechnical investigation to ensure foundation designs are appropriate prior to construction of final design.

Based on the test borings conducted, the site is composed of approximately 0 to between 20 and 50 feet of surficial soil consisting of high to low plasticity clay, sand from 40 to 60 feet below ground surface, clay from 60 feet to 150 feet below ground surface, and dense sand below 150 feet below the ground surface. Corrosion tests indicate there is a high potential for corrosion of steel based on chloride ion concentration and a moderate deterioration potential of concrete based on sulfate ion concentrations. Based on these results, Annova has considered potential for corrosion and concrete degradation in the design.

Based on the subsurface conditions, shallow foundations would be suitable for some lightly loaded structures; however, for heavier structures in areas with these types of soil conditions, the LNG storage tanks, liquefaction trains, and many associated structures would require deep foundations. Therefore, Annova is proposing to use driven precast concrete piles for facilities including, but not limited to: LNG storage tanks, liquefaction trains, gas conditioning units, heavies handling system, BOG compressors, pipe racks, heat medium fired heaters, and switchyard structures. Additionally, Annova is proposing to use steel pipe drive piles for the marine areas. Piles are proposed to be embedded between 30 and 85 feet below grade, depending on the equipment being supported, pile spacing, pile type, and pile diameter.

Subsidence is the sudden sinking or gradual downward settling of land with little or no horizontal motion, caused by movements on surface faults or by subsurface mining or pumping of oil, natural gas, or ground water. The results of Annova's geotechnical investigation at the proposed project site indicate that subsurface conditions are generally suitable for the proposed facilities, if adequate site preparation, foundation design, and construction methods are implemented. Annova would monitor foundations and other critical facilities to ensure they are maintained within acceptable limits. Site preparation activities would be monitored to ensure adherence to the geotechnical design. Surface subsidence would be controlled by potential use of lime stabilization of the fill materials during placement, if required, and compaction with monitoring settlement and systematic reworking, as needed. Foundations would be constructed with pile supports to protect equipment and interconnecting piping from differential movement. LNG tank earthen containment embankments would be earth-supported and constricted with wide bases with a slope ratio of 3 horizontal distance to 1 vertical distance (3H:1V) to ensure stability. Earth-supported elements, such as plant roads, would require periodic maintenance to mitigate the long-term effects of settlements and differential movements. Because site-specific geotechnical mitigation has been incorporated into the Project (e.g., pile-supported foundations) in accordance with NFPA 59A (2001) and where applicable, NFPA 59A (2006), subsidence would not be a significant hazard to the proposed facilities.

Dredging of approximately 5.3 million cubic yards would occur to create the marine berth area to achieve the proposed final grade of -45 feet MLLW. The existing shoreline of the BSC would be excavated, dredged, and sloped during construction. To prevent slumping of the dredged slope, maintain the berthing line position, and provide structural integrity support to the landside facilities, the excavated shoreline would be reinforced with rip-rap armoring. The proposed rip-rap armoring would minimize the potential for erosion where the shoreline would be excavated.

The results of Annova's geotechnical investigation at the Project site indicate that subsurface conditions are suitable for the proposed facilities, if proposed site preparation, foundation design, and construction methods are implemented in addition to the satisfaction of proposed recommendations.

Structural and Natural Hazard Evaluation

FERC regulations under 18 CFR 380.12 (m) requires applicants address the potential hazard to the public from failure of facility components resulting from accidents or natural catastrophes, evaluate how these events would affect reliability, and describe the design features and procedures that would be used to reduce potential hazards. In addition, 18 CFR 380.12 (o) (14) require an applicant to demonstrate how they would comply with 49 CFR 193 and NFPA

59A. DOT regulations under 49 CFR 193 have some specific requirements on designs to withstand certain loads from natural hazards and also incorporate by reference NFPA 59A (2001 and 2006) and ASCE 7-05 and ASCE 7-93 via NFPA 59A (2001). NFPA 59A (2001) section 2.1.1 (c) also requires that Annova consider the plant site location in the design of the Project, with respect to the proposed facilities being protected, within the limits of practicality, against natural hazards, such as from the effects of flooding, storm surge, and seismic activities. This would be covered in PHMSA's LOD on 49 CFR 193 Subpart B. However, the LOD would not cover whether the facility is designed appropriately against these hazards, which would be part of 49 CFR 193 Subpart C. Unlike other natural hazards, wind loads are covered in 49 CFR 193 Subpart B and would be covered in the LOD. If authorized and constructed, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 and would be subject to DOT's inspection and enforcement programs. The marine facilities would be subject to 33 CFR 127, which requires if the waterfront facility handling LNG is in a region subject to earthquakes the piers and wharves must be designed to resist earthquake forces. In addition, Coast Guard regulations under 33 CFR 127 incorporates by reference certain portions of NFPA 59A (1994) and ASCE 7-88 via NFPA 59A (1994). However, Coast Guard regulations do not provide criteria for a region subject to earthquakes or the earthquake forces the piers and wharves are to withstand and NFPA 59A (1994) section referenced in 33 CFR 127 is for seismic design only and is applicable to stationary LNG containers, which would not be under 33 CFR 127. Therefore, we evaluated the basis of design for all facilities for all natural hazards under FERC jurisdiction, including those under DOT and Coast Guard jurisdiction.

If authorized, the proposed facilities would be constructed to the requirements in the 2009 International Building Code (IBC) and ASCE 7-05. These standards require various structural loads to be applied to the design of the facilities, including live (i.e., dynamic) loads, dead (i.e., static) loads, and environmental loads. FERC staff evaluated the potential of the engineering design to withstand impacts from natural hazards, such as earthquakes, tsunamis, seiche, hurricanes, tornadoes, floods, rain, ice, snow, regional subsidence, sea level rise, landslides, wildfires, volcanic activity, and geomagnetism. We recommend in section 4.12.6 that Annova file final design information (e.g., drawings, specifications, and calculations) and associated quality assurance and quality control procedures with the documents reviewed, approved, and stamped and sealed by a professional engineer of record.

If a project is authorized and constructed, the company would install equipment in accordance with its final design. In addition, we recommend in section 4.12.6 that Annova file, for review and approval, settlement results during hydrostatic tests of the LNG storage containers and periodically thereafter to verify settlement is as expected and does not exceed the applicable criteria in API 620, API 625, and API 653.

Earthquakes, Tsunamis, and Seiche

FERC regulations under 18 CFR 380.12 (h) (5) require evaluation of earthquake hazards based on whether there is potential seismicity, surface faulting, or liquefaction. Earthquakes and tsunamis have the potential to cause damage from shaking ground motion and fault ruptures. Earthquakes and tsunamis often result from sudden slips along fractures in the earth's crust (i.e., faults) and the resultant ground motions caused by those movements, but can also be a result of volcanic activity or other causes of vibration in the earth's crust. The damage that could occur as a result of ground motions is affected by the type/direction and severity of the fault activity and the distance and type of soils the seismic waves must travel from the hypocenter (or point below the epicenter where seismic activity occurs). To assess the potential impact from earthquakes and tsunamis, Annova evaluated historic earthquakes along fault locations and their resultant ground motions.

The Project is located within the Gulf Coast Basin geologic tectonic province. The province's sedimentary strata thickens toward the south, with salt domes and relatively shallow listric growth faults that runs parallel to the Gulf of Mexico Coastline and extended outside of Texas. The USGS maintains a database containing information on surface and subsurface faults and folds in the United States that are believed to be sources of earthquakes greater than 6.0 magnitude occurring during the past 1.6 million years (Quaternary Period). The Annova Project would not be near such seismographic faults, which are primarily on the West Coast. However, in the Gulf Coastal Plains, there are several hundred growth faults that are known or suspected to be active. Most of these growth faults are located within the Houston-Galveston (Texas) area subsidence bowl, but many others are known to exist from Brownsville, Texas to east of New Orleans, Louisiana. Evidence of modern activity of these growth faults includes changes in elevation that can lead to damage to pavement, buildings, and other structures. Despite the evidence of movement of growth faults, movement within the fault system has been classified as a general creeps as opposed to the breaking of rocks, which is often associated with earthquake events (Stevenson and McCulloh 2001).

Annova conducted a site-specific seismic risk analysis for the proposed project involving field investigations and subsequent data evaluation. Annova's *Seismic Ground Motion Hazard* report includes the examination of growth faults in the region of the Project area. These growth fault systems have previously been assessed by the USGS as not being capable of generating significant earthquakes, and these faults have not previously been considered as seismogenic sources. While growth faults are not a source of seismic hazard for the Project site, there may be a potential source of surface deformation. And while the presence of faults can require special consideration, the presence or lack of faults identified near the site does not define whether earthquake ground motions can impact the site because ground motions can be felt large distances away from an earthquake hypocenter depending on number of factors.

To address the potential ground motions at the proposed site, DOT regulations in 49 CFR 193.2101 Subpart C require that field-fabricated LNG tanks must comply with section 7.2.2 of NFPA 59A (2006) for seismic design. NFPA 59A (2006) requires LNG storage tanks be designed to continue safely operating with earthquake ground motions at the ground surface at the site that have a 10 percent probability of being exceeded in 50 years (475-year mean return interval), termed the operating basis earthquake (OBE). In addition, DOT regulations in 49 CFR 193.2101 Subpart C require that LNG storage tanks be designed to have the ability to safely shutdown when subjected to earthquake ground motions at the ground surface at the site that have a 2 percent probability of being exceeded in 50 years (2,475-year mean return interval), termed the safe shutdown earthquake (SSE). DOT regulations in 49 CFR 193.2101 Subpart C also incorporate by reference NFPA 59A (2001) Chapter 6, which require piping systems conveying flammable liquids and flammable gases with service temperatures below -20 degrees Fahrenheit, be designed as required for seismic ground motions. If authorized and constructed, the proposed LNG facilities as defined in 49 CFR 193, would be subject to the DOT's inspection and enforcement programs.

In addition, FERC staff recognizes Annova would also need to address hazardous fluid piping with service temperatures at -20 degrees Fahrenheit and higher and equipment other than piping and LNG storage (shop-built and field fabricated) containers. We also recognize the current FERC regulations under 18 CFR 380.12 (h) (5) continues to incorporate National Bureau of Standards Information Report (NBSIR) 84-2833. NBSIR 84-2833 provides guidance on classifying stationary storage containers and related safety equipment as Category I and classifying the remainder of the LNG project structures, systems, and components as either Category II or Category III, but does not provide specific guidance for the seismic design requirements for them. Absent any other regulatory requirements, this guidance recommends that other LNG project structures classified as Seismic Category II or Category III be seismically designed to satisfy the Design Earthquake (DE) and seismic requirements of the ASCE 7-05 in order to demonstrate there is not a significant impact on public safety. ASCE 7-05 is recommended as it is a complete American National Standards Institute (ANSI) consensus design standard, its seismic requirements are based directly on the National Earthquake Hazards Reduction Program (NEHRP) Recommended Provisions, and it is referenced directly by the IBC. Having a link directly to the IBC and ASCE 7 is important to accommodate seals by the engineer of record because the IBC is directly linked to state professional licensing laws while the NEHRP Recommended Provisions are not.

The geotechnical investigation of the proposed site indicates the site is classified as Site Class D[22] based on a site average shear wave velocity that ranged between 650 and 668 feet per second (Black and Veatch 2016a) in the upper 100 feet of strata. This is in accordance with ASCE 7-05, which is incorporated directly into 49 CFR 193 for shop fabricated containers less than 70,000 gallons and via NFPA 59A (2006) for field fabricated containers. This is also in accordance with IBC (2006). Sites with soil conditions of this type could experience significant amplifications of surface earthquake ground motions. However, due to the absence of a major fault in proximity to the site and lower ground motions, the seismic risk to the site is considered low.

Black and Veatch performed a site-specific seismic hazard study for the site. The study concluded that the site would have an OBE peak ground acceleration (PGA) of 0.01 g, a SSE PGA of 0.044 g, a DE 0.2-second design spectral acceleration (S_{DS}) of 0.065 g, a DE 1.0-second design spectral acceleration (S_{D1}) of 0.039 g and a DE PGA of 0.029 g (Black and Veatch 2016c). FERC staff independently evaluated the OBE PGA, SSE PGA, S_{DS}, and S_{D1} values for the site using the USGS Earthquake Hazards Program Seismic Design Maps[23] and Unified Hazard[24] tools for all occupancy categories (I through IV). We determined that the SSE PGA, OBE PGA, and 5-percent damped spectral design accelerations (S_{DS} and S_{D1}) used by Annova are acceptable. These ground motions are relatively low compared to other locations in the United States.

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[22] There are six different site classes in ASCE 7-05, A through F, that are representative of different soil conditions that impact the ground motions and potential hazard ranging from Hard Rock (Site Class A), Rock (Site Class B), Very dense soil and soft rock (Site Class C), Stiff Soil (Site Class D), Soft Clay Soil (Site Class E), to soils vulnerable to potential failure or collapse, such as liquefiable soils, quick and highly sensitive clays, and collapsible weakly cemented soils (Site Class F).

[23] https://earthquake.usgs.gov/designmaps/us/application.php

[24] https://earthquake.usgs.gov/hazards/interactive/

ASCE 7-05 also requires determination of the Seismic Design Category based on the Occupancy Category (or Risk Category in ASCE7-10 and 7-16) and severity of the earthquake design motion. The Occupancy Category (or Risk Category) is based on the importance of the facility and the risk it poses to the public.[25] FERC staff has identified the project as a Seismic Design Category A based on the ground motions for the site for all Occupancy Categories (or Risk Categories), I through IV, consistent with the IBC (2009) and ASCE 7-05 (and ASCE 7-10).

Seismic events can also result in soil liquefaction in which saturated, non-cohesive soils temporarily lose their strength/cohesion and liquefy (i.e., behave like viscous liquid) as a result of increased pore pressure and reduced effective stress when subjected to dynamic forces such as intense and prolonged ground shaking. Areas susceptible to liquefaction may include saturated soils that are generally sandy or silty. Typically, these soils are located along rivers, streams, lakes, and shorelines or in areas with shallow groundwater. The site-specific geotechnical investigations indicate the presence of layers of silty sands and sandy silts that are dense to very dense. These sand layers could be liquefiable under sufficiently strong ground motions. However, due to the low seismicity of the region, the potential for soil liquefaction to occur is low. In addition, Project facilities would be constructed on deep foundations and would be less susceptible to the effects of soil liquefaction soil strength by using piles in the foundation design.

Seismic events in waterbodies can also cause tsunamis or seiches by sudden displacement of the sea floors in the ocean or standing water. Tsunamis and seiche may also be generated from volcanic eruptions or landslides. Tsunami wave action can cause extensive damage to coastal regions and facilities. The Terminal site's low-lying position would make it potentially vulnerable were a tsunami to occur. There is little evidence that the northern Gulf of Mexico is prone to tsunami events, but the occurrence of a tsunami is possible. Two did occur in the Gulf of Mexico in the early 20th century and had wave heights of 3 feet or less (USGS 2009), which is not significantly higher than the average breaking wave height of 1.5 feet (Owen, 2008). Hydrodynamic modeling conducted off the coast of south Texas in 2004 indicated that the maximum tsunami run-up could be as high as 12 feet above mean sea level. No earthquake generating faults have been identified that are likely to produce tsunamis, despite recorded seismic activity in the area.

The potential for tsunamis associated with submarine landslides is more likely a source in the Gulf of Mexico and remains a focus of government research (USGS 2009). Annova's *Seismic Ground Motion Hazard Study* included a Tsunami Hazard Assessment for the Project area. There are four main submarine landslide hazard zones in the Gulf of Mexico including the Northwest

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[25] ASCE 7-05 defines Occupancy Categories I, II, III, and IV. Occupancy Category I represents facilities with a low hazard to human life in even of failure, such as agricultural facilities; Occupancy Category III represents facilities with a substantial hazard to human life in the event of failure or with a substantial economic impact or disruption of day to day civilian life in the event of failure, such as buildings where more than 300 people aggregate, daycare facilities with facilities greater than 150, schools with capacities greater than 250 for elementary and secondary and greater than 500 for colleges, health care facilities with 50 or more patients, jails and detention facilities, power generating stations, water treatment facilities, telecommunication centers, hazardous facilities that could impact public; Occupancy Category IV represents essential facilities, such as hospitals, fire, rescue, and police stations, emergency shelters, power generating stations and utilities needed in an emergency, aviation control towers, water storage and pump structures for fire suppression, national defense facilities, and hazardous facilities that could substantially impact public; and Occupancy Category II represents all other facilities. ASCE 7-10 changed the term to Risk Categories I, II, III, and IV with some modification.

Gulf of Mexico, Mississippi Canyon and Fan, the Florida Escarpment, and the Campeche Escarpment (USGS 2009). Based on modeling and limited historical data, it is estimated that tsunamis generated from landslides would be significantly less than the hurricane design storm surge elevations discussed below, so any tsunami hazard has been inherently considered in design.

Hurricanes, Tornadoes, and other Meteorological Events

Hurricanes, tornadoes, and other meteorological events have the potential to cause damage or failure of facilities due to high winds and floods, including failures from flying or floating debris. To assess the potential impact from hurricanes, tornadoes, and other meteorological events, Annova evaluated such events historically. The severity of these events is often determined on the probability that they occur and are sometimes referred to as the average number years that the event is expected to re-occur, or in terms of its mean return/recurrence interval.

Because of its location, the Project site would likely be subject to hurricane force winds during the life of the Project. Annova would design all project facilities to withstand a 183 mph 3-second gust (150-mph sustained) with the exception of the Administration Building and Maintenance Building, which would be designed in accordance with the design speed specified in ASCE 7-05. A 183 mph 3-second gust would convert to a sustained wind speed of 150 mph, using the Durst Curve in ASCE 7-05 or using a 1.23 gust factor recommended for offshore winds at a coast line in World Meteorological Organization, *Guidelines for Converting between Various Wind Averaging Periods in Tropical Cyclone Conditions*. These wind speeds are equivalent to approximately 30,500-year mean return interval or 0.16 percent probability of exceedance in a 50-year period for the site, based on ASCE 7-05 wind speed return period conversions. The 183 mph 3-second gust equates to a strong Category 4 Hurricane using the Saffir-Simpson scale (130-156 mph sustained winds, 166-195 mph 3-second gusts). FERC staff also utilized the ATC hazard tool, which interpolates site specific wind speed using ASCE's 3-second gust wind speed, to evaluate the ASCE 7-05 the 3-second gust wind speed and found it to be 140 mph. Annova must meet 49 CFR 193.2067 Subpart B for wind load requirements. In accordance with the MOU, the DOT will evaluate in its LOD whether an applicant's proposed project meets the DOT siting requirements under Subpart B. If the project is authorized and constructed, the facilities would be subject to the DOT's inspection and enforcement programs. Final determination of whether the facilities are in compliance with the requirements of 49 CFR 193 Subpart B would be made by the DOT staff.

In addition, as noted in section 6.5.4.3 of ASCE 7-05 (wind speed limitation), tornadoes were not considered in developing basic wind speed distributions. This leaves a potential gap in potential impacts from tornadoes. Therefore, FERC staff evaluated the potential for tornadoes. Appendix C of ASCE 7-05 makes reference to American Nuclear Society 2.3 (1983 edition), *Standard for Estimating Tornado and Extreme Wind Characteristics at Nuclear Power Sites*. This document has since been revised in 2011 and reaffirmed in 2016 and is consistent with NUREG/*CR 4461, Tornado Climatology of the Contiguous U.S.,* Rev. 2 (NUREG 2007). These documents provide maps of a 100,000-year mean return period for tornadoes using 2 degree latitude and longitude boxes in the region to estimate a tornado striking within 4,000 feet of an area. Figures 5-8 and 8-1 from NUREG/CR-4461 indicate a 100,000-year maximum tornado wind speeds would be approximately 114 mph 3-second gusts for the Project site location. Later editions of ASCE 7 (ASCE 7-10 and ASCE 7-16) make reference to International Code Council (ICC) 500, *Standard for Design and Construction of Storm Shelters*, for 10,000-year tornadoes. However, the ICC 500 maps were conservatively developed based on tornadoes striking regions and indicate a 200 mph 3-second gust for a 10,000-year event, which is higher than the 114 mph 3-second gust in American Nuclear Society 2.3 and NUREG/CR 4461. As a result, we conclude the use of an equivalent 183 mph 3-second gust, is adequate for the LNG storage tanks and conservative from a risk standpoint for the other LNG and hazardous facilities. DOT will provide a LOD on the Project's compliance with 49 CFR 193 Subpart B in regard to wind speed. This determination will be provided to the Commission as further consideration to the Commission on its decision to authorize or deny the Project.

ASCE 7 also recognizes the proposed site would be in a wind-borne debris region. Wind borne debris has the potential to perforate equipment and the LNG storage tank if not properly designed to withstand such impacts. The potential impact is dependent on the equivalent projectile wind speed, characteristics of projectile, and methodology or model used to determine whether penetration or perforation would occur. However, no criteria are provided in 49 CFR 193 or ASCE 7 for these specific parameters. In order to address the potential impact, we recommend in section 4.12.6 that Annova provide a projectile analysis, for review and approval, to demonstrate that the LNG tank could withstand wind borne projectiles prior to construction of the final design and, if the tank cannot withstand a direct impact from a wind-borne missile, that the dikes will provide sufficient containment for any spilled LNG. The analysis should detail the projectile speeds and characteristics and method used to determine penetration or perforation depths. FERC staff would compare the analysis and specified projectiles and speeds to guidance published by the DOE Ballistics Research Lab or Lee's Loss Prevention High Pressure Safety Code.

In addition, FERC staff evaluated historical tropical storm, hurricane, and tornado tracks in the vicinity of the project facilities using data from the Department of Homeland Security (DHS) Homeland Infrastructure Foundation Level Data (HILFD) and NOAA Historical Hurricane Tracker.[26,27] Brownsville has had 30 tropical storms or hurricanes hit within 65 nautical miles since 1900, and Cameron County has been impacted by 10 hurricanes or tropical storms since 1900. The most recent major hurricane was Hurricane Bret, 1999, just north of Cameron County, which peaked as a Category 4 hurricane with 144 mph sustained winds and made landfall as a Category 3 hurricane with 115 mph sustained winds.[28] Prior to Hurricane Bret, Cameron County was hit by Hurricane Allen (Cat 5 peak, Cat 3 landfall) in 1980, Hurricane Beulah (Cat 5 peak, Cat 5 landfall) in 1967 and two unnamed hurricanes in 1933 (Cat 5 peak, Cat 3 landfall) and 1916 (Cat 4 peak, Cat 4 landfall). Hurricanes in Cameron County have been observed to have peaked when reaching landfall with 161 mph sustained winds and to have produced storm surges up to 18 feet. The estimated return period for a major hurricane passing within 50 nautical miles of the coast of Cameron County is about 30 years (NOAA 2016a).

Potential flood levels may also be informed from the FEMA Flood Insurance Rate Maps, which identify Special Flood Hazard Areas (base flood) that have a 1 percent probability of exceedance in 1 year to flood (or a 100-year mean return interval) and moderate flood hazard areas that have a 0.2 percent probability of exceedance in 1 year to flood (or a 500-year mean return

[26] DHS, Homeland Infrastructure Foundation Level Data, https://hifld-geoplatform.opendata.arcgis.com/, August 2018.
[27] NOAA, Historical Hurricane Tracker, https://coast.noaa.gov/hurricanes/, August 2018.
[28] A major hurricane is defined as a hurricane that has been classified as Hurricane Category 3 or higher.

interval). According to the FEMA National Flood Insurance Rate Maps for Cameron County, Texas, the Project site would be located in the 100-year floodplain with base flood elevations ranging between +11 and +14 feet NAVD 88. Note a portion of the channel-side area of the Project site would not be located within either the 100-year or 500-year floodplain (FEMA 2018a). We recognize that a 500-year flood event has been recommended as the basis of design for critical infrastructure in publications, including ASCE 24, *Flood Resistant Design and Construction*. Therefore, it is our opinion that it is good practice to design critical energy infrastructure to withstand a 500-year event from a safety and reliability standpoint for both storm surge stillwater elevation (SWEL) and wave crests. Furthermore, we determined the use of intermediate values from NOAA for sea level rise and subsidence is more appropriate for design and higher projections are more appropriate for planning in accordance with NOAA (2017)[29] which recommends defining a central estimate or mid-range scenario as baseline for shorter-term planning, such as setting initial adaptation plans for the next two decades and defining upper bound scenarios as a guide for long-term adaptation strategies and a general planning envelope.

The Project site would be graded to +16.5 feet NAVD 88 for process equipment, +20 feet NAVD 88 for the control and administration buildings, +6 feet NAVD 88 for the LNG storage tanks, and +21 feet NAVD 88 crest elevation for the earthen berms surrounding each LNG storage tank. Annova's *Storm Surge Study* determined a 14.0 foot 100-year design storm consisting of 11.4 feet of SWEL, 0.5 feet of sea level rise, and 2.1 feet of wave effects; similarly, the study determined a 15.4 foot 500-year storm consisting of 14.9 feet of SWEL and 0.5 feet of sea level rise (note the 500-year storm surge determined by Annova does not include wave effects). FERC independently determined a 500-year storm surge level to compare to the storm surge provided by Annova using the 2018 FEMA Flood Insurance Study (FIS) for Cameron County, Texas (FEMA 2018b). The FIS provides various transection lines and associated 10-, 50-, 100-, and 500-year SWELs, 500-year wave envelopes, and 500-year wave effects along the length of the transection lines. Transection lines 38 and 46 from the FIS transect the Project site and have a maximum 500-year wave envelopes (which include SWEL and wave effects) as high as 19.0 feet on the tank-side of the site transected by Line 46 and as high as 16.0 feet on the channel side of the site transected by Line 38. FERC also evaluated sea level rise using the NOAA / COE Sea Level Rise Calculator and found the intermediate sea level rise projection from the period of 2020 through 2050 to be 1.01 feet (NOAA 2017). As a result of FEMA FIS data and NOAA / COE sea level rise projections, we would expect a berm height or site grades of between 17.0 feet NAVD88 and 20.0 feet NAVD88, depending on the location in the Project site. As a result, we recommend Annova should evaluate the potential for storm surge induced by a 500-year event at the Project site. We recommend in section 4.12.6 that Annova employ a settlement monitoring program to ensure the site grade is always maintained at a minimum of 16.5 feet NAVD88 and LNG earthen impoundment berms are maintained at a minimum crest of 21 feet NAVD88. We also recommend in section 4.12.6 that Annova provide the monitoring and maintenance plan prior commencement of service. Lastly, we recommend in section 4.12.6 that Annova provide a more detailed storm surge study to determine the flood elevation associated with a 500-year event, including 500-year SWEL, sea level rise, subsidence, wave effects, potential run up, as well as an overtopping analysis

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[29] *Global and Regional Sea Level Rise Scenarios for the United States*. U.S. Department of Commerce. National Ocean and Atmospheric Administration. National Ocean Service Center for Operational Oceanographic Products and Services. January 2017.

for the Project to determine if equipment or other occupied facilities are at risk of being flooded as a result.

The Texas and Louisiana Gulf Coast area is experiencing the highest rates of coastal erosion and wetland loss in the United States (Ruple 1993). The average coastal erosion rate is -1.2 meters per year between 2000 and 2012 along the Texas coastal shoreline, with South Padre Island experiencing a shoreline loss rate of -1.6 meters per year between 2000 and 2012 (McKenna 2014). Shoreline erosion could occur at the Project site and along the opposite shoreline as a result of waves, currents, and vessel wakes. To prevent erosion, new revetment in the form rip rap would be installed in the dredged marine berth and maneuvering areas. Even though shoreline erosion is a concern at the site, the proposed mitigation measures would minimize erosion and scour impacts.

Landslides and Other Natural Hazards

Due to the low relief across the Project site and absence of major seismic activity, there is little likelihood that landslides or slope movement at the site would be a realistic hazard. Landslides involve the downslope movement of earth materials under force of gravity due to natural or human causes. The Project area has low relief which reduces the possibility of landslides.

Volcanic activity is primarily a concern along plate boundaries on the West Coast and Alaska and also Hawaii. Based on FERC staff review of maps from USGS[30] and DHS[31] of the nearly 1,500 volcanoes with eruptions since the Holocene period (in the past 10,000 years) there are no known active or historic volcanic activity within approximately several hundred miles of the site with the closest being approximately 400 miles away across the Gulf of Mexico in Los Atlixcos, Mexico.

Geomagnetic disturbances (GMDs) may occur due to solar flares or other natural events with varying frequencies that can cause geomagnetically induced currents, which can disrupt the operation of transformers and other electrical equipment. USGS provides a map of GMD intensities with an estimated 100 year mean return interval.[32] The map indicates the Project site could experience GMD intensities of 100-150 nano-Tesla (nT) with a 100 year mean return interval. However, Annova would be designed such that if a loss of power were to occur the valves would move into a fail-safe position. In addition, Annova LNG is an export facility that does not serve any U.S. customers.

4.12.5.7 External Impacts

To assess the potential impact from external events, FERC staff conducted a series of reviews to evaluate transportation routes, land use, and activities within the facility and surrounding the Project site, and the safeguards in place to mitigate the risk from events, where warranted. FERC staff coordinated the results of the reviews with other federal agencies to assess

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[30] United States Geological Survey. U.S. Volcanoes and Current Activity Alerts. Available at: https://volcanoes.usgs.gov/index.html. Accessed August 2018.
[31] Department of Homeland Security. Homeland Infrastructure. Foundation-Level data (HIFLD). Natural Hazards. hifld-geoplatform.opendata.arcgis.com. accessed Aug 2018
[32] United States Geological Survey. Magnetic Anomaly Maps and Data for North America. Available at: https://mrdata.usgs.gov/magnetic/map-us.html#home. Accessed August 2018.

potential impacts from vehicles and rail; aircraft impacts to and from nearby airports and heliports; pipeline impacts from nearby pipelines; impacts to and from adjacent facilities that handle hazardous materials under EPA's Risk Management Plan (RMP) regulations and power plants, including nuclear facilities under Nuclear Regulatory Commission regulations. Specific mitigation of impacts from use of external roadways, rail, helipads, airstrips, or pipelines are also considered as part of the engineering review done in conjunction with the NEPA review.

FERC staff uses a risk-based approach to assess the potential impact of the external events and the adequacy of the mitigation measures. The risk-based approach uses data based on the frequency of events that could lead to an impact and the potential severity of consequences posed to the Project site and the resulting consequences to the public beyond the initiating events. The frequency data is based on past incidents and the consequences are based on past incidents and/or hazard modeling of potential failures.

Road

FERC staff reviewed whether any truck operations would be associated with the Project and whether any existing roads would be located near the site. FERC staff uses this information to evaluate whether the project and any associated truck operations could increase the risk along the roadways and subsequently to the public and whether any pre-existing unassociated vehicular traffic could adversely increase the risk to the Project site and subsequently increase the risk to the public. In addition, if authorized and constructed, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 and would be subject to DOT's inspection and enforcement programs. DOT regulations under 49 CFR 193.2155 (a) (5) (ii) Subpart C require that structural members of an impoundment system must be designed and constructed to prevent impairment of the system's performance reliability and structural integrity as a result of a collision by or explosion of a tank truck that could reasonably be expected to cause the most severe loading if the liquefaction facility adjoins the right-of-way of any highway. Similarly, NFPA 59A (2001), section 8.5.4, requires transfer piping, pumps, and compressors to be located or protected by barriers so that they are safe from damage by rail or vehicle movements. However, the DOT regulations and NFPA 59A (2001) requirements do not indicate what collision(s) or explosion(s) could reasonably be expected to cause the most severe loading. FERC staff evaluated consequence and frequency data from these events to evaluate these potential impacts.

FERC staff evaluated the risk of the truck operations based on the consequences from a release, incident data from the DOT's Federal Highway Administration (FHWA), National Highway Traffic Safety Administration (NHTSA), and PHMSA, and frequency of trucks and proposed mitigation to prevent or reduce the impacts of a vehicular incident. Unmitigated consequences under worst case weather conditions from catastrophic failures of trucks proposed at the site generally can range from 200 to 2,000 feet for flammable vapor dispersion, 850 to 1,500 feet for radiant heat of 5 kW/m^2 from fireballs, and 275 to 350 feet for radiant heat of 5 kW/m^2 from jet fires with projectiles from BLEVEs possibly extending farther. These values are also close to the distances provided by the FHWA for designating hazardous material trucking routes (0.5 miles for flammable gases for potential impact distance) and PHMSA for emergency response (0.5 to 1 mile for initial evacuation and 1 mile for potential BLEVEs for flammable gases). Unmitigated consequences under average ambient conditions from releases of 1,000 gallons through a 1-inch hole would result in much more modest distances ranging from 25 to 200 feet for flammable vapor dispersion, and 75 to 175 feet for jet fires.

Incident data from DOT FHWA, NHTSA, and PHMSA, indicates hazardous material incidents are very infrequent (4e-3 incidents per lane mile per year) and nearly 75 to 80 percent of hazardous material vehicular incidents occur during unloading and loading operations while the other 20 to 25 percent occur while in transit or in transit storage. In addition, approximately 99 percent of releases are 1,000 gallons or less and catastrophic events that would spill 10,000 gallons or more make up less than 0.1 percent of releases. In addition, less than 1 percent of all reportable hazardous material incidents with spillage result in injuries and less than 0.1 percent of all reportable hazardous material incidents with spillage result in fatalities.

During startup and operation of the project, approximately 1300 trucks or tanker trucks would transport commodities (e.g., refrigerants, diesel, hot oil, liquid nitrogen, condensate product, etc.) to or from the facility each year. FERC staff did not identify any major highways or roads within close proximity to piping or equipment containing hazardous materials at the site. For site access, Annova would install a new, two-lane, 3.5-mile-long road connecting existing state highway 4 to the facility. The new access road would split to the LNG terminal entrance and to provide access to the pipeline gas receiving and metering equipment. The roadway leading up to the terminal entrance would employ precast concrete barriers that would require reduced speed horizontal turns to mitigate accidental and intentional vehicle impacts. However, Annova did not provide fencing around the pipeline gas receiving and metering equipment and also did not indicate how this area would be protected from vehicular impacts. Therefore, we recommend in section 4.12.6 that Annova file fencing details and vehicular barrier specifications, for review and approval, for the pipeline gas receiving and metering equipment. Also for the LNG terminal site, we recommend in section 4.12.6 that Annova file specifications and drawings of vehicle barriers at the access points, for review and approval, to further mitigate accidental and intentional vehicle impacts.

Therefore, we conclude that the proposed project would not pose a significant risk or significant increase in risk to the public due to vehicle impacts as a result of the potential consequences, incident data, frequency of trucks, proposed mitigation by Annova and additional mitigation measures proposed by FERC staff.

Rail

FERC staff reviewed whether any rail operations would be associated with the Project and whether any existing rail lines would be located near the site. FERC staff uses this information to evaluate whether the Project and any associated rail operations could increase the risk along the rail line and subsequently to the public and whether any pre-existing unassociated rail operations could adversely increase the risk to the Annova site and subsequently increase the risk to the public. In addition, if authorized and constructed, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 and would be subject to DOT's inspection and enforcement programs. DOT regulations under 49 CFR 193.2155 (a) (5) (ii) Subpart C state if the LNG facility adjoins the right-of-way of any railroad, the structural members of an impoundment system must be designed and constructed to prevent impairment of the system's performance reliability and structural integrity as a result of a collision by or explosion of a train or tank car that could reasonably be expected to cause the most severe loading.

Section 8.5.4 of NFPA 59A (2001), incorporated by reference in 49 CFR 193, requires transfer piping, pumps, and compressors to be located or protected by barriers so that they are safe from damage by rail or vehicle movements. However, the DOT regulations and NFPA 59A (2001) requirements do not indicate what collision(s) or explosion(s) could reasonably be expected to cause the most severe loading. Therefore, FERC staff evaluated consequence and frequency data from these events to evaluate these potential impacts. There would be no rail transportation associated with the Project. FERC staff evaluated the risk of the rail operations based on the consequences from a release, incident data from the Federal Rail Administration (FRA) and PHMSA, and frequency of rail operations nearby Annova.

Unmitigated consequences under worst-case weather conditions from catastrophic failures of rail cars containing various flammable products generally can range from 300 to 3,000 feet for flammable vapor dispersion, 1,250 to 2,100 feet for radiant heat of 5 kW/m^2 from fireballs, and 450 to 575 feet for radiant heat of 5 kW/m^2 from jet fires with projectiles from BLEVEs possibly extending farther. These values are also close to the distances provided by DOT PHMSA for emergency response (0.5 to 1 mile for initial evacuation and 1 mile for potential BLEVEs for flammable gases). Unmitigated consequences under average ambient conditions from releases of 1,000 gallons through a 1-inch hole would result in much more modest distances ranging from 25 to 200 feet for flammable vapor dispersion, and 75 to175 feet for jet fires.

Incident data from FRA and PHMSA indicates hazardous material incidents are very infrequent (6e-3 incidents per rail mile per year). In addition, approximately 95 percent of releases are 1,000 gallons or less and catastrophic events that would spill 30,000 gallons or more make up less than 1 percent of releases. In addition, less than 1 percent of hazardous material incidents result in injuries and less than 0.1 percent of hazardous material incidents result in fatalities. The closest rail line is located approximately 5.3 miles to the west of the Project site. This would be farther than the consequence distances under worst case weather conditions and events. Given the distance and position of the closest rail lines relative to the populated areas to the east of the LNG Terminal, we conclude that the proposed Project would not pose a significant increase in risk to the public as a result of the proximity of the Project to the rail lines.

Air

FERC staff reviewed whether any aircraft operations would be associated with the Project and whether any existing aircraft operations would be located near the site. FERC staff uses this information to evaluate whether the Project and any associated aircraft operations could increase the risk to the public and whether any pre-existing unassociated aircraft operations could adversely increase the risk to the Project site and subsequently increase the risk to the public. In addition, if authorized and constructed, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 and would be subject to DOT's inspection and enforcement programs. DOT regulations under 49 CFR 193.2155 (b) Subpart C require an LNG storage tank must not be located within a horizontal distance of one mile from the ends, or 0.25 mile from the nearest point of a runway, whichever is longer and that the height of LNG structures in the vicinity of an airport must comply with FAA requirements. In addition, FERC staff evaluated the risk of an aircraft impact from nearby airports.

Two mixed use aviation airports, Brownsville / South Padre Island International Airport and Port Isabel – Cameron County Airport, would be located 12.2 miles southwest and 12.3 miles north-northwest of the proposed Project site, respectively. The four general aviation airports are the Resaca Airstrip located 10.5 miles west-southwest of the proposed Project site, Drennan Farm Airport located 13.0 miles northwest of the proposed Project site, Reynolds Ranch Airport located 13.2 miles northwest of the proposed Project Site, and Rancho Buena Vista Airport located 17.2 miles north of the proposed Project site. These are all farther than the 0.25-mile distance referenced in DOT regulations.

FAA regulations in 14 CFR 77 require Annova to provide a notice to the FAA of its proposed construction. This notification should identify all equipment that are more than 200 feet above ground level or lesser heights if the facilities are within 20,000 feet of an airport (at 100:1 ratio or 50:1 ratio depending on length of runway) or within 5,000 feet of a helipad (at 100:1 ratio). In addition, mobile objects, including the LNG marine vessel that would be above the height of the highest mobile object that would normally traverse it would require notification to FAA. Annova proposes to limit heights of permanent structures to 200 feet. On July 26, 2017, Annova received a FAA Determination of No Hazard to Air Navigation in accordance with 14 CFR 77 for the temporary construction cranes that would exceed 200 feet in height. Annova would also need to file a notice to FAA for the LNG marine vessel if it would be higher than other objects that currently traverse the waterway. Therefore, we recommend in section 4.12.6 that Annova determines if LNG marine vessels would be above the height of the highest mobile object that would normally traverse the waterway, and if so for Annova to file a notice to FAA for the LNG marine vessel.

FERC staff used Department of Energy (DOE) Standard 3014, *Accident Analysis for Aircraft Crash into Hazardous Facilities*, which utilizes a 22-mile threshold radius around the hazardous facility for consideration of hazards posed by airport and heliport operations to the Project facilities. There are three heliports, two mixed use airports (commercial, military, and general aviation), and four general aviation airports within the 22-mile radius. Per the DOE standard 3014, heliports need only be considered if there are local overflights associated with facility operations and/or area operations; because the Project site does not have facility or area-associated helicopter flights, and does not have an on-site heliport, the impact risk due to heliport operations is considered insignificant. The methodology described in DOE Standard 3014 was employed to assess the risk posed to the operation of the proposed Project facilities by aircraft departing from or landing at airports within the 22-mile threshold radius and was found to be insignificant.

Comments from the public and feedback from FAA indicated potential impacts to and from the Project and the nearby SpaceX launch facility. FERC staff conducted internal analyses, utilized a third-party contractor, and requested information from the applicant on the likelihood and consequences from a potential launch failure impacting the Project. In our review, we determined while there would be debris above a threshold of 3e-5 years, which is the failure rate level we evaluate the potential for cascading damage and the failure rates used by FAA in space launch failures prior to 2017,[33] the cascading damage at the Project site would not impact the public. In addition, the Coast Guard would determine any mitigation measures needed on a case by case basis to safeguard public health and welfare from LNG marine vessel operations during

[33] FAA's 14 CFR 417.107 (b) regulations were updated from 3e-5 casualties for three different events (in 2016 edition) to 1e-4 casualties cumulative (in 2017 edition).

rocket launch activity. However, our review determined that rocket launch failures could impact onsite construction workers and plant personnel. Therefore, we recommend in section 4.12.6 that construction crews be positioned outside of higher risk areas during rocket launch activity and for plant personnel to monitor the rocket launches and shut down operating equipment in the event of a rocket launch failure.

In addition, the federal government indemnifies, subject to Congressional appropriations, commercial space licensees from liability for any claims above the liability insurance required under regulation. The maximum probable loss used to determine the insurance and liability uses $3 million for each casualty from direct and indirect effects from a failed launch. Since the LNG facilities would be valued up to approximately $25 billion, conventional LNG marine vessels would be valued at $200-250 million, and a peak construction workforce would total over 5,000 workers, a potential exists for the federal government to be liable for a large sum of money that could exceed the current indemnification levels by a large margin. As a result, the Project may have possible impact to the SpaceX operation due to the insurance premiums that could increase costs to SpaceX, limit the frequency and types of launches out of the Brownsville SpaceX launch site. Depending on the reliance of the National Space Program on the Brownsville SpaceX launch site, this could also have an impact on the National Space Program. There is also potential impact to the liability of the federal government due to indemnification by the federal government for losses above 3.1 billion dollars. However, the extent of these impacts would not be fully known until SpaceX submits an application requesting to launch with the FAA and whether the LNG plant is under construction or in operation.

Pipelines

FERC staff reviewed whether any pipeline operations would be associated with the Project and whether any existing pipelines would be located near the site. FERC staff uses this information to evaluate whether the Project and any associated pipeline operations could increase the risk to the pipeline facilities and subsequently to the public and whether any pre-existing unassociated pipeline operations could adversely increase the risk to the Project site and subsequently increase the risk to the public. In addition, pipelines associated with this project must meet DOT regulations under 49 CFR 192. If authorized and constructed, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 192 and 49 CFR 193 and would be subject to DOT's inspection and enforcement programs. FERC staff evaluated the risk of a pipeline incident impacting the Project and the potential of cascading damage increasing the risk to the public based on the consequences from a release, incident data from PHMSA, and proposed mitigation to prevent or reduce the impacts of a pipeline incident from Annova.

For existing pipelines, FERC staff identified an abandoned gas gathering pipeline located 0.5 miles on the opposite side of the BSC. The nearest active gas gathering pipeline would also be on the opposite side of the BSC and would be located approximately 1.5 miles northwest of the Project site. These pipelines would be inactive or located too far to impact the Project site in the event of an incident.

In addition, FERC identified Enbridge's 42-inch diameter non-jurisdictional Valley Crossing Pipeline currently under construction routed near the Project site. The Valley Crossing Pipeline route runs on the opposite side of the Brownsville Ship Channel and through the proposed

Rio Grande LNG Project[34] (RG LNG) site's 75-feet wide utility easement. Based on a February 1, 2018 FERC information request on the RG LNG Project, FERC in consultation with DOT indicated that the Valley Crossing Pipeline would have a Potential Impact Radius (PIR) of 1,587 feet (based on the pipeline diameter of 42 inches and a maximum allowable operating pressure of 3,000 pounds per square inch).[35] For Annova, a berthed LNG marine vessel would be the closest point to the Valley Crossing Pipeline and would be approximately 4,000 feet away.

In addition, based on the potential likelihood of pipeline incidents and potential consequences from a pipeline incident, we conclude that the proposed Project would not significantly increase the risk to the public beyond existing risk levels that would be present from a pipeline leak or pipeline rupture worst-case event near the Project site. Furthermore, we conclude that the proposed Project would not pose a significant increase in risk to the public as a result of the proximity of the Project to the Valley Crossing Pipeline.

Hazardous Material Facilities and Power Plants

FERC staff reviewed whether any EPA RMP regulated facilities handling hazardous materials and power plants were located near the site to evaluate whether the facilities could adversely increase the risk to the project site and whether the project site could increase the risk to the EPA RMP facilities and power plants and subsequently increase the risk to the public.

There were no facilities handling hazardous materials or power plants identified adjacent to the site. The closest EPA RMP regulated facilities handling hazardous materials would be the Port Isabel Wastewater Treatment Plant located approximately 4.4 miles away, Port Isabel Water Treatment Plant located approximately 4.5 miles away, and Texas Pack, Inc. located approximately 4.4 miles away. The closest power plant identified would be Silas Ray Gas Plant approximately 17 miles away with the closest nuclear plant located over 200 miles NE of the site.

In addition, the proposed Rio Grande LNG Terminal and the Texas LNG Terminal would be located across the Brownsville Ship Channel. These proposals would be subject to 49 CFR 193 Subpart B regulatory requirements that establishes exclusion zones for safety of plant personnel and the surrounding public. Each proposal would consider potential incidents and safety measures that would need to be incorporated in the design or operation to ensure risk to surrounding public is not increased. Given the distances and locations of the facilities relative to the populated areas of the Port Isabel, South Padre Island, and Brownsville communities, we conclude that the proposed Project would not pose a significant increase in risk to the public or that the hazardous material facilities and power plants would pose a significant risk to the Project and subsequently to the public.

[34] On May 5, 2016, Rio Grande LNG, LLC (RG LNG) filed an application with the FERC in Docket Number CP16-454-000 to construct and operate natural gas pipelines and a liquefaction export terminal along the Brownsville Ship Channel about 5.5 miles inland from the channel entrance, in Cameron County, Texas.

[35] Potential impact radius (PIR) is defined in 49 CFR 192.903 as the radius of a circle on either side of a pipeline centerline which the potential failure of the pipeline could have significant impact on people or property. PIR is determined based upon a calculation using the pipeline diameter, maximum allowable operating pressure (MAOP), and a composition factor for natural gas.

4.12.5.8 Onsite and Offsite Emergency Response Plans

As part of its application, Annova indicated that the Project would develop a comprehensive ERP with local, state, and federal agencies and emergency response officials to discuss the Facilities. Annova would continue these collaborative efforts during the development, design, and construction of the Project. The emergency procedures would provide for the protection of personnel and the public as well as the prevention of property damage that may occur as a result of incidents at the project facilities. The facility would also provide appropriate personnel protective equipment to enable operations personnel and first responder access to the area.

As required by 49 CFR 193.2509 under Subpart F, Annova would need to prepare emergency procedures manuals that provide for: a) responding to controllable emergencies and recognizing an uncontrollable emergency; b) taking action to minimize harm to the public including the possible need to evacuate the public; and c) coordination and cooperation with appropriate local officials. Specifically, 49 CFR 193.2509 (b) (3) requires "Coordinating with appropriate local officials in preparation of an emergency evacuation plan…," which sets forth the steps required to protect the public in the event of an emergency, including catastrophic failure of an LNG storage tank. DOT regulations under 49 CFR 193.2905 under Subpart J also require at least two access points in each protective enclosure to be located to minimize the escape distance in the event of emergency.

Title 33 CFR 127.307 also requires the development of emergency manual that incorporates additional material, including LNG release response and emergency shutdown procedures, a description of fire equipment, emergency lighting, and power systems, telephone contacts, shelters, and first aid procedures. In addition, 33 CFR 127.207 establishes requirements for warning alarm systems. Specifically, 33 CFR 127.207 (a) requires that the LNG marine transfer area to be equipped with a rotating or flashing amber light with a minimum effective flash intensity, in the horizontal plane, of 5000 candelas with at least 50 percent of the required effective flash intensity in all directions from 1.0 degree above to 1.0 degree below the horizontal plane. Furthermore, 33 CFR 127.207 (b) requires the marine transfer area for LNG to have a siren with a minimum 1⁄3 octave band sound pressure level at 1 meter of 125 decibels referenced to 0.0002 microbars. The siren must be located so that the sound signal produced is audible over 360 degrees in a horizontal plane. Lastly, 33 CFR 127.207 (c) requires that each light and siren must be located so that the warning alarm is not obstructed for a distance of 1.6 km (1 mile) in all directions. The warning alarms would be required to be tested in order to meet 33 CFR 127. Annova would be required to meet the warning alarms requirements specified in 33 CFR 127.207.

In accordance with the EPAct 2005, FERC must also approve an emergency response plan (ERP) covering the terminal and ship transit prior to construction. Section 3A (e) of the NGA, added by Section 311 of the EPAct 2005, stipulates that in any order authorizing an LNG terminal, the Commission must require the LNG terminal operator to develop an ERP in consultation with the Coast Guard and state and local agencies. The final ERP would need to be evaluated by appropriate emergency response personnel and officials. Section 3A (e) of the NGA (as amended by EPAct 2005) specifies that the ERP must include a Cost-Sharing Plan that contains a description of any direct cost reimbursements the applicant agrees to provide to any state and local agencies with responsibility for security and safety at the LNG terminal and in proximity to LNG marine vessels that serve the facility. The Cost-Sharing Plan must specify what the LNG terminal operator would provide to cover the cost of the state and local resources required to manage the security of the LNG terminal and LNG marine vessel, and the state and local resources required for safety and emergency management, including:

- direct reimbursement for any per-transit security and/or emergency management costs (for example, overtime for police or fire department personnel);
- capital costs associated with security/emergency management equipment and personnel base (for example, patrol boats, firefighting equipment); and
- annual costs for providing specialized training for local fire departments, mutual aid departments, and emergency response personnel; and for conducting exercises.

The cost-sharing plan must include the LNG terminal operator's letter of commitment with agency acknowledgement for each state and local agency designated to receive resources.

Annova submitted a draft ERP to address emergency events and potential release scenarios in the Application. The ERP would include public notification, protection, and evacuation. As part of FEED, FERC staff evaluate the initial draft of the emergency response procedures to assure that it covers the hazards associated with the Project. In addition, we recommend in section 4.12.6 that Annova provide additional information, for review and approval, on development of updated emergency response plans prior to initial site preparation. We also recommend in section 4.12.6 that Annova file three dimensional drawings, for review and approval, that demonstrate there is a sufficient number of access and egress locations. If this project is authorized and constructed, Annova would coordinate with local, state, and federal agencies on the development of an emergency response plan and cost sharing plan. We recommend in section 4.12.6 that Annova provide periodic updates on the development of these plans for review and approval, and ensure they are in place prior to introduction of hazardous fluids. In addition, we recommend in section 4.12.6 that project facilities be subject to regular inspections throughout the life of the facility and would continue to require companies to file updates to the ERP.

4.12.6 Recommendations from FERC Preliminary Engineering and Technical Review

Based on FERC staff's preliminary engineering and technical review of the reliability and safety of the Annova Project, we recommend the following mitigation measures to the Commission for consideration to incorporate as possible conditions to an order. These recommendations would be implemented prior to initial site preparation, prior to construction of final design, prior to commissioning, prior to introduction of hazardous fluids, prior to commencement of service, and throughout the life of the facility to enhance the reliability and safety of the facility and to mitigate the risk of impact on the public.

- **<u>Prior to the end of the draft EIS comment period</u>, Annova should determine if the heights of the LNG marine vessels would be higher than other objects that traverse the waterway and if applicable, file for an Aeronautical Study under 14 CFR 77 for LNG marine vessels that may exceed the height requirements in 14 CFR 77.9.**

- **<u>Prior to the end of the draft EIS comment period</u>, Annova should consult with DOT PHMSA on whether using normally-closed valves as a stormwater removal device on curbed areas would meet the requirements of 49 CFR 193.**

- **<u>Prior to the end of the draft EIS comment period</u>, Annova should clarify how liquid releases in each heavies handling train area (consisting of the stabilizer, stabilizer reboiler, and the LNG expander) would be contained.**

- **<u>Prior to the end of the draft EIS comment period</u>, Annova should file with the Secretary a plan to conduct a comprehensive supplemental geotechnical field investigation and geotechnical report at the proposed locations for the new LNG facilities and a date by which the investigation and report are expected to be completed by.**

- **<u>Prior to the end of the draft EIS comment period</u>, Annova should file with the Secretary a wave overtopping analysis for a 500-year storm and include a discussion on the impacts to the public and surrounding LNG facilities. The overtopping analysis should also include a more detailed storm surge study to determine the flood elevation associated with a 500-year event, including 500-year SWEL, sea level rise, subsidence, wave effects, and potential run up.**

- **<u>Prior to initial site preparation</u>, Annova should file with the Secretary documentation demonstrating LNG marine vessels would be no higher than existing ship traffic or it has received a determination of no hazard (with or without conditions) by FAA for mobile objects that exceed the height requirements in 14 CFR 77.9.**

- **<u>Prior to construction of final design</u>, Annova should file with the Secretary the following information, stamped and sealed by the professional engineer-of-record registered in Texas:**

  a. site preparation drawings and specifications;

  b. LNG terminal structures and foundation design drawings and calculations (including prefabricated and field constructed structures);

  c. seismic specifications for procured equipment; and

  d. quality control procedures to be used for civil/structural design and construction.

  In addition, Annova should file, in its Implementation Plan, the schedule for producing this information.

- **<u>Prior to construction of final design</u>, Annova should file with the Secretary a monitoring and maintenance plan, stamped and sealed by the professional engineer-of-record registered in Texas, to ensure the site is maintained at a minimum elevation of 16.5 feet NAVD 88 and the crest elevation of the earthen berm around each LNG storage tank is maintained at a minimum crest of 21**

feet NAVD 88 for the life of the facility considering settlement, subsidence, and sea level rise.

The following recommendations apply to the Annova LNG terminal facilities. Information pertaining to these specific recommendations should be filed with the Secretary for review and written approval by the Director of OEP, or the Director's designee, within the timeframe indicated by each recommendation. Specific engineering, vulnerability, or detailed design information meeting the criteria specified in Order No. 833 (Docket No. RM16-15-000), including security information, should be submitted as critical energy infrastructure information pursuant to 18 CFR 388.113. See Critical Electric Infrastructure Security and Amending Critical Energy Infrastructure Information, Order No. 833, 81 Fed. Reg. 93,732 (December 21, 2016), FERC Stats. & Regs. 31,389 (2016). Information pertaining to items such as offsite emergency response, procedures for public notification and evacuation, and construction and operating reporting requirements would be subject to public disclosure. All information should be filed a minimum of 30 days before approval to proceed is requested.

- **Prior to initial site preparation, Annova should file an overall project schedule, which includes the proposed stages of the commissioning plan.**

- **Prior to initial site preparation, Annova should file quality assurance and quality control procedures for construction activities.**

- **Prior to initial site preparation, Annova should file procedures for controlling access during construction.**

- **Prior to initial site preparation, Annova should develop, file, and implement procedures to position construction crews outside of areas that could be impacted by rocket debris of a failed launch from the SpaceX facility during initial moments of rocket launch activity.**

- **Prior to initial site preparation, Annova should conduct and provide results of a minimum of five equally distributed borings, cone penetration tests, and/or seismic cone penetration tests to a depth of at least 100 feet or refusal underneath the revised locations of each LNG storage tank to affirm or better characterize underlying conditions.**

- **Prior to initial site preparation, Annova should develop an Emergency Response Plan (including evacuation) and coordinate procedures with the Coast Guard; state, county, and local emergency planning groups; fire departments; state and local law enforcement; and appropriate federal agencies. This plan should include at a minimum:**

  a. designated contacts with state and local emergency response agencies;

  b. scalable procedures for the prompt notification of appropriate local officials and emergency response agencies based on the level and severity of potential incidents;

c. procedures for notifying residents and recreational users within areas of potential hazard;

d. evacuation routes/methods for residents and public use areas that are within any transient hazard areas along the route of the LNG marine transit;

e. locations of permanent sirens and other warning devices; and

f. an "emergency coordinator" on each LNG marine vessel to activate sirens and other warning devices.

Annova should notify the FERC staff of all planning meetings in advance and should report progress on the development of its Emergency Response Plan at 3-month intervals.

- **<u>Prior to initial site preparation</u>, Annova should file a Cost-Sharing Plan identifying the mechanisms for funding all Project-specific security/emergency management costs that would be imposed on state and local agencies. This comprehensive plan should include funding mechanisms for the capital costs associated with any necessary security/emergency management equipment and personnel base. Annova should notify FERC staff of all planning meetings in advance and should report progress on the development of its Cost Sharing Plan at 3-month intervals.**

- **<u>Prior to construction of final design</u>, Annova should file change logs that list and explain any changes made from the front end engineering design provided in Annova's application and filings. A list of all changes with an explanation for the design alteration should be provided and all changes should be clearly indicated on all diagrams and drawings.**

- **<u>Prior to construction of final design</u>, Annova should file information/revisions pertaining to its response to numbers 4, 5, 6, 10 11, 14, 17, 18, 19, 20, 21, 22, 24, 25, 26, 27, 28, 29, 31, 33, 34, 35, 36, 38, 43, and 49 of the February 14, 2017 data request and to its response to numbers 11, 12, 13, 17, 18a, 18e, 19, and 21f of the October 19, 2018 data request, which indicated features to be included or considered in the final design.**

- **<u>Prior to construction of final design</u>, Annova should file a plot plan of the final design showing all major equipment, structures, buildings, and impoundment systems.**

- **<u>Prior to construction of final design</u>, Annova should file three-dimensional plant drawings to confirm plant layout for maintenance, access, egress, and congestion.**

- **<u>Prior to construction of final design</u>, Annova should file an up-to-date equipment list, process and mechanical data sheets, and specifications. The specifications should include:**

a. **building specifications (e.g., control buildings, electrical buildings, compressor buildings, storage buildings, pressurized buildings, ventilated buildings, blast resistant buildings);**

b. **mechanical specifications (e.g., piping, valve, insulation, rotating equipment, heat exchanger, storage tank and vessel, other specialized equipment);**

c. **electrical and instrumentation specifications (e.g., power system, control system, safety instrument system [SIS], cable, other electrical and instrumentation); and**

d. **security and fire safety specifications (e.g., security, passive protection, hazard detection, hazard control, firewater)**

- **Prior to construction of final design, Annova should file a summary of all codes and standards referenced in the final specifications.**

- **Prior to construction of final design, Annova should file a complete LNG storage tank specification and design drawings. The specification should define the battery limits (i.e., engineering design, structural design, supports, piping components, piping connections, electrical power, control, and utilities) of the LNG storage tank.**

- **Prior to construction of final design, the LNG storage tank specification should clearly define the roof top load requirements for the LNG pump platform as well as other laydown areas required for maintenance activities.**

- **Prior to construction of final design, Annova should file drawings of the storage tank piping support structure and support of horizontal piping at grade including pump columns, relief valves, pipe penetrations, instrumentation, and appurtenances.**

- **Prior to construction of final design, Annova should provide process data sheets that specify the start-up, operating, and shutdown conditions for the BOG Compressors.**

- **Prior to construction of final design, Annova should file up-to-date process flow diagrams (PFDs) that demonstrate the peak liquefaction rate of 6.95 mtpa is achievable and piping and instrument diagrams (P&IDs). The PFDs should include heat and material balances. The P&IDs should include the following information:**

  a. **equipment tag number, name, size, duty, capacity, and design conditions;**

  b. **equipment insulation type and thickness;**

  c. **storage tank pipe penetration size and nozzle schedule;**

d. valve high pressure side and internal and external vent locations;

e. piping with line number, piping class specification, size, and insulation type and thickness;

f. piping specification breaks and insulation limits;

g. all control and manual valves numbered;

h. relief valves with size and set points; and

i. drawing revision number and date.

- **Prior to construction of final design, Annova should file P&IDs, specifications, and procedures that clearly show and specify the tie-in details required to safely connect subsequently constructed facilities with the operational facilities.**

- **Prior to construction of final design, Annova should file a car seal philosophy and a list of all car-sealed and locked valves consistent with the P&IDs.**

- **Prior to construction of final design, Annova should file a hazard and operability review prior to issuing the P&IDs for construction. A copy of the review, a list of the recommendations, and actions taken on the recommendations should be filed.**

- **Prior to construction of final design, Annova should provide specifications and piping and instrumentation diagrams of the Refrigerant Compressor motor cooling system.**

- **Prior to construction of final design, Annova should file the safe operating limits (upper and lower), alarm and shutdown set points for all instrumentation (i.e., temperature, pressures, flows, and compositions).**

- **Prior to construction of final design, Annova should file cause-and-effect matrices for the process instrumentation, fire and gas detection system, and emergency shutdown system for review and approval. The cause-and-effect matrices should include alarms and shutdown functions, details of the voting and shutdown logic, and set points.**

- **Prior to construction of final design, Annova should file an evaluation of emergency shutdown valve closure times. The evaluation should account for the time to detect an upset or hazardous condition, notify plant personnel, and close the emergency shutdown valve.**

- **Prior to construction of final design, Annova should file an evaluation of dynamic pressure surge effects from valve opening and closure times and pump startup and shutdown operations.**

- **<u>Prior to construction of final design</u>, Annova should demonstrate that, for hazardous fluids, piping and piping nipples 2 inches or less in diameter are designed to withstand external loads, including vibrational loads in the vicinity of rotating equipment and operator live loads in areas accessible by operators.**

- **<u>Prior to construction of final design</u>, Annova should file electrical area classification drawings.**

- **<u>Prior to construction of final design</u>, Annova should file drawings and details of how process seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system meet the requirements of NFPA 59A (2001).**

- **<u>Prior to construction of final design</u>, Annova should file details of an air gap or vent installed downstream of process seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system. Each air gap should vent to a safe location and be equipped with a leak detection device that should continuously monitor for the presence of a flammable fluid, alarm the hazardous condition, and shut down the appropriate systems.**

- **<u>Prior to construction of final design</u>, Annova should include layout and design specifications of the pig trap, inlet separation and liquid disposal, inlet/send-out meter station, and pressure control.**

- **<u>Prior to construction of final design</u>, Annova should include LNG storage tank fill flow measurement with high flow alarm.**

- **<u>Prior to construction of final design</u>, Annova should include BOG flow measurement from each LNG storage tank.**

- **<u>Prior to construction of final design</u>, Annova should specify how each LNG storage tank dome's vent valve HV-0014/HV-0054 will be isolated with administrative controls in the event that the vent valve cannot be closed or requires maintenance work.**

- **<u>Prior to construction of final design</u>, Annova should file the sizing basis and capacity for the final design of the flares and/or vent stacks as well as the pressure and vacuum relief valves for major process equipment, vessels, and storage tanks.**

- **<u>Prior to construction of final design</u>, Annova should provide the Refrigerant Surge Drum, Ethylene Make-up Drum, Propane Make-up Drum, and Iso-pentane Make-up Drum with dual full capacity relief valves that allow the isolation with administrative controls of individual pressure relief valves while providing full relief capacity during pressure relief valve maintenance or testing.**

- **<u>Prior to construction of final design</u>, Annova should file a drawing showing the location of the emergency shutdown buttons. Emergency shutdown buttons should be easily accessible, conspicuously labeled, and located in an area which would be accessible during an emergency.**

- **<u>Prior to construction of final design</u>, Annova should specify that all ESD valves are to be equipped with open and closed position switches connected to the Distributed Control System/Safety Instrumented System.**

- **<u>Prior to construction of final design</u>, Annova should specify how the BOG system will prevent pipeline gas from back flowing into the BOG Metering Skid.**

- **<u>Prior to construction of final design</u>, Annova should specify how the Heat Medium Expansion Drum pressure indicator, 1090-PI-0241, will notify operators of excessive venting through pressure regulator, 1090-PCV-0240.**

- **<u>Prior to construction of final design</u>, Annova should file drawings and specifications for vehicle barriers at each facility entrance for access control.**

- **<u>Prior to construction of final design</u>, Annova should file drawings of the security fence. The fencing should extend around the pigging and metering equipment. The fencing drawings should provide details of fencing that demonstrates it would restrict and deter access around the entire facility and has a setback from exterior features (e.g., power lines, trees, etc.) and from interior features (e.g., piping, equipment, buildings, etc.) that does not allow the fence to be overcome.**

- **<u>Prior to construction of final design</u>, Annova should file drawings of internal road vehicle protections, such as guard rails, barriers, and bollards to protect transfer piping, pumps, and compressors, etc. to ensure that they are located away from roadway or protected from inadvertent damage from vehicles.**

- **<u>Prior to construction of final design</u>, Annova should file security camera and intrusion detection drawings. The security camera drawings should show the locations, areas covered, and features of each camera (e.g., fixed, tilt/pan/zoom, motion detection alerts, low light, mounting height, etc.) to verify coverage of the entire perimeter with redundancies for cameras interior to the facility to enable rapid monitoring of the facility. The intrusion detection drawings should show or note the location of the intrusion detection to verify coverage of the entire perimeter of the facility.**

- **<u>Prior to construction of final design</u>, Annova should file lighting drawings. The lighting drawings should show the location, elevation, type of light fixture, and lux levels of the lighting system and should cover the entire perimeter of the facility, process equipment, and along paths/roads of access and egress.**

- **<u>Prior to construction of final design</u>, Annova should file an updated fire protection evaluation of the proposed facilities. A copy of the evaluation, a list of recommendations and supporting justifications, and actions taken on the recommendations should be filed.**

- **<u>Prior to construction of final design</u>, Annova should file spill containment system drawings with dimensions and slopes of curbing, trenches, impoundments, and capacity calculations considering any foundations and equipment within impoundments, as well as the sizing and design of the down-comer that would transfer spills from the tank top to the ground-level impoundment system. The spill containment drawings should show containment for all hazardous fluids, including all liquids handled above their flashpoint, from the largest flow from a single line for 10 minutes, including de-inventory, or the maximum liquid from the largest vessel (or total of impounded vessels) or otherwise demonstrate that providing spill containment would not significantly reduce the flammable vapor dispersion or radiant heat consequences of a spill. In addition, Annova should demonstrate that the stainless steel piping spill trays at each LNG storage tank would withstand the force and shock of a sudden cryogenic release.**

- **<u>Prior to construction of final design</u>, Annova should specify how residual water within each spill basin will be removed after the stormwater removal pumps shut down on low water level.**

- **<u>Prior to construction of final design</u>, Annova should review each Process Area Impoundment Basin stormwater removal system. If applicable, each stormwater removal pump should be equipped with an interlock to prevent inadvertent discharge of warm refrigerant, heavy hydrocarbon, or hot oil releases.**

- **<u>Prior to construction of final design</u>, Annova should file complete drawings and a list of the hazard detection equipment. The drawings should clearly show the location and elevation of all detection equipment. The list should include the instrument tag number, type and location, alarm indication locations, and shutdown functions of the hazard detection equipment.**

- **<u>Prior to construction of final design</u>, Annova should file a list of alarm and shutdown set points for all hazard detectors that account for the calibration gas of the hazard detectors when determining the lower flammable limit set points for methane, propane, ethylene, pentane, and condensate.**

- **<u>Prior to construction of final design</u>, Annova should file a list of alarm and shutdown set points for all hazard detectors that account for the calibration gas of hazard detectors when determining the set points for toxic components such as aqueous ammonia, natural gas liquids and hydrogen sulfide.**

- **<u>Prior to construction of final design</u>, Annova should file a technical review of facility design that:**

  a. identifies all combustion/ventilation air intake equipment and the distances to any possible flammable gas or toxic release; and

  b. demonstrates that these areas are adequately covered by hazard detection devices and indicates how these devices would isolate or shutdown any combustion or heating ventilation and air conditioning equipment whose continued operation could add to or sustain an emergency.

- **<u>Prior to construction of final design</u>, Annova should file a design that includes hazard detection suitable to detect high temperatures and smoldering combustion products in electrical buildings and control room buildings.**

- **<u>Prior to construction of final design</u>, Annova should provide low oxygen detectors to notify operators of liquid nitrogen releases.**

- **<u>Prior to construction of final design</u>, Annova should file an evaluation of the voting logic and voting degradation for hazard detectors.**

- **<u>Prior to construction of final design</u>, Annova should file facility plan drawings and a list of the fixed and wheeled dry-chemical, hand-held fire extinguishers, and other hazard control equipment. Plan drawings should clearly show the location and elevation by tag number of all fixed dry chemical systems in accordance with NFPA 17, and wheeled and hand-held extinguishers location travel distances are along normal paths of access and egress in accordance with NFPA 10. The list shall include the equipment tag number, type, capacity, equipment covered, discharge rate, and automatic and manual remote signals initiating discharge of the units.**

- **<u>Prior to construction of final design</u>, Annova should file a design that includes clean agent systems in the instrumentation buildings.**

- **<u>Prior to construction of final design</u>, Annova should file facility plan drawings showing the proposed location of the firewater and any foam systems. Plan drawings should clearly show the location of firewater and foam piping, post indicator valves, and the location and area covered by, each monitor, hydrant, hose, water curtain, deluge system, foam system, water-mist system, and sprinkler. The drawings should also include piping and instrumentation diagrams of the firewater and foam systems.**

- **<u>Prior to construction of final design</u>, Annova should specify two firewater jockey pumps and appurtenances that can operate simultaneously in the event that the primary jockey pump cannot maintain system pressure. The flow rate capacity from the jockey pumps shall be supported with calculations.**

- **<u>Prior to construction of final design</u>, Annova should include or demonstrate the firewater storage volume for its facilities has minimum reserved capacity for its most demanding firewater scenario plus 1,000 gpm for no less than 2 hours. The firewater storage should also demonstrate compliance with NFPA 22 or demonstrate how API 650 provides an equivalent or better level of safety.**

- **<u>Prior to construction of final design</u>, Annova should consider additional options for firewater pump flow test metering. The design should include a flow transmitter and pressure transmitter connected to the DCS to maintain a historical record of pump performance tests.**

- **<u>Prior to construction of final design</u>, Annova should file detailed calculations to confirm that the final fire water volumes would be accounted for when evaluating the capacity of the impoundment system during a spill and fire scenario.**

- **<u>Prior to construction of final design</u>, Annova should specify that both freshwater pump shelter and the firewater intake and pumps shelter are designed to remove the largest firewater pump or other component for maintenance with an overhead or external crane.**

- **<u>Prior to construction of final design</u>, Annova should file drawings and specifications for the structural passive protection systems to protect equipment and supports from cryogenic releases.**

- **<u>Prior to construction of final design</u>, Annova should file a detailed quantitative analysis to demonstrate that adequate thermal mitigation would be provided for each significant component within the 4,000 BTU/ft^2-hr zone from an impoundment (including amine sump pit and condensate storage tank berm), or provide an analysis to assess the consequence of pressure vessel bursts and boiling liquid expanding vapor explosions. Trucks at the truck loading/unloading areas should be included in the analysis. Passive mitigation should be supported by calculations for the thickness limiting temperature rise and active mitigation should be supported by calculations demonstrating flow rates and durations of any cooling water would mitigate the heat absorbed by the vessel.**

- **<u>Prior to construction of final design</u>, Annova should file a projectile analysis that demonstrates whether each LNG storage tank would withstand wind born projectiles, or demonstrate whether protective measures are in place to ensure the structural integrity of each LNG storage tank. If the analysis demonstrates the tank would be penetrated, Annova should file an analysis indicating the containment dikes would sufficiently contain an LNG spill.**

- **<u>Prior to construction of final design</u>, Annova should file an analysis demonstrating that each LNG storage tank's water deluge system would**

provide adequate thermal mitigation to withstand the radiant heat from an adjacent LNG storage tank dike fire.

- **<u>Prior to construction of final design</u>, Annova should specify how cascading damage to the condensate storage tank would be mitigated from a pool fire in the Heat Medium Impoundment Basin. Alternatively, Annova should reposition the condensate storage tank or the Heat Medium Impoundment Basin to prevent high radiant heat zones over the condensate storage tank.**

- **<u>Prior to construction of final design</u>, Annova should provide an evaluation of impacts from any size jetting releases from each LNG storage tank platform, marine dock and trestle, and the ethylene make-up drum area. As applicable, the evaluation should demonstrate that adequate mitigation would be provided to prevent cascading damage.**

- **<u>Prior to commissioning</u>, Annova should file a detailed schedule for commissioning through equipment startup. The schedule should include milestones for all procedures and tests to be completed: prior to introduction of hazardous fluids and during commissioning and startup. Annova should file documentation certifying that each of these milestones has been completed before authorization to commence the next phase of commissioning and startup will be issued.**

- **<u>Prior to commissioning</u>, Annova should file detailed plans and procedures for: testing the integrity of onsite mechanical installation; functional tests; introduction of hazardous fluids; operational tests; and placing the equipment into service.**

- **<u>Prior to commissioning</u>, Annova should file a plan for clean-out, dry-out, purging, and tightness testing. This plan should address the requirements of the American Gas Association's Purging Principles and Practice, and should provide justification if not using an inert or non-flammable gas for clean-out, dry-out, purging, and tightness testing.**

- **<u>Prior to commissioning</u>, Annova should file the procedures for pressure/leak tests which address the requirements of ASME VIII and ASME B31.3. The procedures should include a line list of pneumatic and hydrostatic test pressures.**

- **<u>Prior to commissioning</u>, Annova should file the settlement results from hydrostatic testing of the LNG storage containers as well as a routine monitoring program to ensure settlements are as expected and do not exceed applicable criteria in API 620, 625, and 653.**

- **<u>Prior to commissioning</u>, Annova should equip the LNG storage tank and adjacent piping and supports with permanent settlement monitors to allow personnel to observe and record the relative settlement between the LNG**

storage tank and adjacent piping. The settlement record should be reported in the semi-annual operational reports.

- **Prior to commissioning, Annova should file the operation and maintenance procedures and manuals, as well as safety procedures, hot work procedures and permits, abnormal operating conditions reporting procedures, simultaneous operations procedures, and management of change procedures and forms.**

- **Prior to commissioning, Annova should tag all equipment, instrumentation, and valves in the field, including drain valves, vent valves, main valves, and car-sealed or locked valves.**

- **Prior to commissioning, Annova should file a plan and maintain a detailed training log to demonstrate that operating, maintenance, and emergency response staff has completed the required training.**

- **Prior to introduction of hazardous fluids, Annova should complete and document all pertinent tests (Factory Acceptance Tests, Site Acceptance Tests, Site Integration Tests) associated with the DCS and SIS that demonstrates full functionality and operability of the system.**

- **Prior to introduction of hazardous fluids, Annova should develop and implement an alarm management program to reduce alarm complacency and maximize the effectiveness of operator response to alarms.**

- **Prior to introduction of hazardous fluids, Annova should develop and implement procedures for plant personnel to monitor all rocket launches and shut down operating equipment in the event of a rocket launch failure.**

- **Prior to introduction of hazardous fluids, Annova should complete and document a firewater pump acceptance test and firewater monitor and hydrant coverage test. The actual coverage area from each monitor and hydrant should be shown on facility plot plan(s).**

- **Prior to introduction of hazardous fluids, Annova should complete and document a pre-startup safety review to ensure that installed equipment meets the design and operating intent of the facility. The pre-startup safety review should include any changes since the last hazard review, operating procedures, and operator training. A copy of the review with a list of recommendations, and actions taken on each recommendation, should be filed.**

- **Annova should file a request for written authorization from the Director of OEP prior to unloading or loading the first LNG commissioning cargo. After production of first LNG, Annova should file weekly reports on the commissioning of the proposed systems that detail the progress toward demonstrating the facilities can safely and reliably operate at or near the**

design production rate. The reports should include a summary of activities, problems encountered, and remedial actions taken. The weekly reports should also include the latest commissioning schedule, including projected and actual LNG production by each liquefaction train, LNG storage inventories in each storage tank, and the number of anticipated and actual LNG commissioning cargoes, along with the associated volumes loaded or unloaded. Further, the weekly reports should include a status and list of all planned and completed safety and reliability tests, work authorizations, and punch list items. Problems of significant magnitude should be reported to the FERC within 24 hours.

- **<u>Prior to commencement of service</u>, Annova should label piping with fluid service and direction of flow in the field, in addition to the pipe labeling requirements of NFPA 59A (2001).**

- **<u>Prior to commencement of service</u>, Annova should provide plans for any preventative and predictive maintenance program that performs periodic or continuous equipment condition monitoring.**

- **<u>Prior to commencement of service</u>, Annova should develop procedures for handling offsite contractors including responsibilities, restrictions, and limitations and for supervision of these contractors by Annova staff.**

- **<u>Prior to commencement of service</u>, Annova should notify the FERC staff of any proposed revisions to the security plan and physical security of the plant.**

- **<u>Prior to commencement of service</u>, Annova should file a request for written authorization from the Director of OEP. Such authorization would only be granted following a determination by the Coast Guard, under its authorities under the Ports and Waterways Safety Act, the Magnuson Act, the MTSA of 2002, and the Security and Accountability For Every Port Act, that appropriate measures to ensure the safety and security of the facility and the waterway have been put into place by Annova or other appropriate parties.**

In addition, we recommend that the following measures should apply <u>throughout the life of the Annova LNG terminal</u>:

- **The facility should be subject to regular FERC staff technical reviews and site inspections on at least an <u>annual basis</u> or more frequently as circumstances indicate. Prior to each FERC staff technical review and site inspection, Annova should respond to a specific data request including information relating to possible design and operating conditions that may have been imposed by other agencies or organizations. Up-to-date detailed P&IDs reflecting facility modifications and provision of other pertinent information not included in the semi-annual reports described below, including facility events that have taken place since the previously submitted semi-annual report, should be submitted.**

- **Semi-annual operational reports should be filed with the Secretary to identify changes in facility design and operating conditions; abnormal operating experiences; activities (e.g., ship arrivals, quantity and composition of imported and exported LNG, liquefied and vaporized quantities, boil off/flash gas); and plant modifications, including future plans and progress thereof. Abnormalities should include, but not be limited to, unloading/loading/shipping problems, potential hazardous conditions from offsite vessels, storage tank stratification or rollover, geysering, storage tank pressure excursions, cold spots on the storage tanks, storage tank vibrations and/or vibrations in associated cryogenic piping, storage tank settlement, significant equipment or instrumentation malfunctions or failures, non-scheduled maintenance or repair (and reasons therefore), relative movement of storage tank inner vessels, hazardous fluids releases, fires involving hazardous fluids and/or from other sources, negative pressure (vacuum) within a storage tank, and higher than predicted boil off rates. Adverse weather conditions and the effect on the facility also should be reported. Reports should be submitted within 45 days after each period ending June 30 and December 31. In addition to the above items, a section entitled "Significant Plant Modifications Proposed for the Next 12 Months (dates)" should be included in the semi-annual operational reports. Such information would provide the FERC staff with early notice of anticipated future construction/maintenance at the LNG facilities.**

- **In the event the temperature of any region of the LNG storage container becomes less than the minimum specified operating temperature for the material, the Commission should be notified within 24 hours and procedures for corrective action should be specified.**

- **Significant non-scheduled events, including safety-related incidents (e.g., LNG, condensate, refrigerant, or natural gas releases; fires; explosions; mechanical failures; unusual over pressurization; and major injuries) and security-related incidents (e.g., attempts to enter site, suspicious activities) should be reported to the FERC staff. In the event that an abnormality is of significant magnitude to threaten public or employee safety, cause significant property damage, or interrupt service, notification should be made immediately, without unduly interfering with any necessary or appropriate emergency repair, alarm, or other emergency procedure. In all instances, notification should be made to the FERC staff within 24 hours. This notification practice should be incorporated into the LNG terminal's emergency plan. Examples of reportable hazardous fluids-related incidents include:**

    a. **fire;**

    b. **explosion;**

    c. **estimated property damage of $50,000 or more;**

d. death or personal injury necessitating in-patient hospitalization;

e. release of hazardous fluids for 5 minutes or more;

f. unintended movement or abnormal loading by environmental causes, such as an earthquake, landslide, or flood, that impairs the serviceability, structural integrity, or reliability of facility that contains, controls, or processes hazardous fluids;

g. any crack or other material defect that impairs the structural integrity or reliability of facility that contains, controls, or processes hazardous fluids;

h. any malfunction or operating error that causes the pressure of a pipeline or facility that contains or processes hazardous fluids to rise above its maximum allowable operating pressure (or working pressure for LNG facilities) plus the build-up allowed for operation of pressure-limiting or control devices;

i. a leak in facility that contains or processes hazardous fluids that constitutes an emergency;

j. inner tank leakage, ineffective insulation, or frost heave that impairs the structural integrity of an LNG storage tank;

k. any safety-related condition that could lead to an imminent hazard and cause (either directly or indirectly by remedial action of the operator), for purposes other than abandonment, a 20 percent reduction in operating pressure or shutdown of operation of a pipeline or facility that contains or processes hazardous fluids;

l. safety-related incidents from hazardous fluids transportation occurring at or en route to and from the facility; or

m. an event that is significant in the judgment of the operator and/or management even though it did not meet the above criteria or the guidelines set forth in an LNG terminal's incident management plan.

In the event of an incident, the Director of OEP has delegated authority to take whatever steps are necessary to ensure operational reliability and to protect human life, health, property, or the environment, including authority to direct the LNG terminal to cease operations. Following the initial company notification, the FERC staff would determine the need for a separate follow-up report or follow up in the upcoming semi-annual operational report. All company follow-up reports should include investigation results and recommendations to minimize a reoccurrence of the incident.

4.12.7 Conclusions on LNG Facility and Marine Vessel Reliability and Safety

As part of the NEPA review and NGA determinations, Commission staff assesses the potential impact to the human environment in terms of safety and whether the proposed facilities would operate safely, reliably, and securely.

As a cooperating agency, the DOT assists the FERC by determining whether Annova's proposed design would meet the DOT's 49 CFR 193 Subpart B siting requirements. The DOT will provide a LOD on the project's compliance with 49 CFR 193 Subpart B. This determination will be provided to the Commission as further consideration to the Commission on its decision to authorize or deny the Project. If the Project is authorized and constructed, the facility would be subject to the DOT's inspection and enforcement program; final determination of whether a facility is in compliance with the requirements of 49 CFR 193 would be made by the DOT staff.

As a cooperating agency, the Coast Guard also assisted the FERC staff by reviewing the proposed LNG terminal and the associated LNG marine vessel traffic. The Coast Guard reviewed a WSA submitted by Annova that focused on the navigation safety and maritime security aspects of LNG marine vessel transits along the affected waterway. On February 13, 2018, the Coast Guard issued an LOR that recommended that the BSC be considered suitable for accommodating the type and frequency of LNG marine traffic for the Project, based on the WSA and in accordance with the guidance in the Coast Guard's NVIC 01-11. If the Project is authorized and constructed, the facilities would be subject to the Coast Guard's inspection and enforcement program to ensure compliance with the requirements of 33 CFR 105 and 33 CFR 127.

As a cooperating agency, the FAA assisted FERC staff in evaluating impacts on and from the SpaceX rocket launch facility in Cameron County. Specific recommendations are included to address potential impacts from rocket launch failures on the Project. However, the extent of impacts on SpaceX operations, the National Space Program, and to the federal government would not fully be known until SpaceX submits an application with the FAA requesting to launch and whether the LNG Terminal is under construction or in operation at that time.

FERC staff conducted a preliminary engineering and technical review of the Annova design, including potential external impacts based on the site location. Based on this review, we recommend a number of mitigation measures, which would ensure continuous oversight prior to initial site preparation, prior to construction of final design, prior to commissioning, prior to introduction of hazardous fluids, prior to commencement of service, and throughout life of the facility, in order to enhance the reliability and safety of the facility to mitigate the risk of impact on the public. With the incorporation of these mitigation measures and oversight, FERC staff concluded that Annova's terminal design would include acceptable layers of protection or safeguards that would reduce the risk of a potentially hazardous scenario from developing into an event that could impact the offsite public.

4.13 CUMULATIVE IMPACTS

NEPA requires the lead federal agency to consider the potential cumulative impacts of proposals under its review. Cumulative impacts may result when the environmental effects associated with the proposed action (in this case the Annova LNG Project, or Project) are superimposed on, or added to, impacts associated with other past, present, and reasonably foreseeable future projects (project, or projects) regardless of what agency or person undertakes such other actions. Although the individual impact of each separate project may be minor, the additive or synergistic effects of multiple projects could be significant.

This cumulative impacts analysis uses an approach consistent with the methodology set forth in relevant guidance (CEQ 1997b, 2005; EPA 1999b). Under these guidelines, inclusion of actions within the analysis is based on identifying commonalities between the impacts that would result from the Annova LNG Project and the impacts likely to be associated with other potential projects.

The Project-specific impacts of the Annova LNG Project are discussed in detail in other sections of this EIS. The purpose of this section is to identify and describe cumulative impacts that would potentially result from implementation of the proposed Project along with other projects in the vicinity that could affect the same resources during the same approximate timeframe. To ensure that this analysis focuses on relevant projects and potentially significant impacts, the actions included in the cumulative impact analysis include projects that:

- impact a resource potentially affected by the proposed Project;
- impact that resource within all or part of the time span encompassed by the proposed or reasonably expected construction and operation schedule of the proposed Project; and
- impact that resource within all or part of the same geographic area affected by the proposed Project. The geographic area considered varies depending on the resource being discussed, which is the general area in which the projects could contribute to cumulative impacts on that particular resource (geographic scope of analysis).

4.13.1 Temporal and Geographic Distribution (Geographic Scope)

For the purpose of this analysis, the temporal extent of other projects would extend out for the expected duration of the impacts caused by the Project. Some Project impacts from construction could occur as soon as site preparation begins during construction, while operational impacts are assumed to exist throughout the life of the facility. The Project is expected to have a 25 year life span, but the facilities would be designed and capable of operating for 50 years or more with proper maintenance.

The geographic distribution of the area considered in the cumulative effects analysis varies by resource. The cumulative impact analysis area, or geographic scope, for a resource may be substantially greater than the corresponding Project-specific area of impact in order to consider an area large enough to encompass likely effects from other projects on the same resource. The CEQ (1997) recommends setting the geographic scope based on the natural boundaries of the resource affected, rather than jurisdictional boundaries. We have used the Bahia Grande-Brownsville Ship Channel watershed (HUC-121102080900) (HUC-12 watershed) as our basic analysis area for most resources. The HUC-12 watershed considered here covers a large area. The Bahia Grande-Brownsville Ship Channel watershed has a total area of about 234,353 acres. Table 4.13.1-1 provides the geographic scope considered for each resource.

TABLE 4.13.1-1

Geographic Scope by Resource for the Annova LNG Project

Resource	Geographic Scope	Rationale for Potential Cumulative Impact Analysis Area
Geologic Resources and Soils	Area that would be affected by and adjacent to the LNG terminal	Geology and soils are relatively static resources that would not be affected outside of the Project footprint and immediately adjacent area, with implementation of the Annova *Plan and Procedures*.
Water Resources	HUC-12 watershed and some distance downstream for consideration of turbidity and tidal influence	Projects within the HUC-12 watershed could contribute to downstream impacts on water quality; therefore, the LNG terminal would result in additional incremental impacts on waters further downstream. Also, to account for the potential of inadvertent spills within the watershed affecting groundwater.
Wetlands and Vegetation	HUC-12 watershed	Projects within the HUC-12 watershed could contribute to impacts on wetlands and vegetation within the watershed; therefore, the LNG terminal would result in additional incremental impacts on wetlands and vegetation within the HUC-12 watershed.
Wildlife and Aquatic Resources	HUC-12 watershed	Impacts occurring within the construction workspaces could affect mobile wildlife within the HUC-12 watershed, which accounts for a typical range of wildlife movements off the Project site. Projects within the HUC-12 watershed could contribute to downstream impacts on aquatic species and habitat; therefore, the LNG terminal would result in additional incremental impacts within the watershed.
Threatened & Endangered Species (land)	HUC-12 watershed	Impacts occurring within the construction workspaces could affect mobile wildlife within the HUC-12 watershed, which accounts for a typical range of wildlife movements off the Project site.
Threatened and Endangered Species (marine)	Marine/estuarine waterbodies in the HUC-12 watershed and established shipping channels used by LNG carriers	Projects within the marine/estuarine waterbodies in the HUC-12 watershed, and shipping lanes in the Gulf of Mexico, could contribute to impacts on listed marine species.
Land Use and Recreation	Cameron County	Cameron County - to encompass any large areas with specialized or recreational uses.
Visuals	Within 5.1 miles of Annova LNG Project	Impacts on aesthetics or visual integrity depend on distance, setting, and contrast. As determined in the Visual Impact Assessment, the farthest distance to a visual receptor or Key Observation Point at which the Project impacts were Moderate, Moderately High, or High, is 5.1 miles.
Socioeconomics	Cameron County and Willacy County	Impacts occur within the Brownsville-Harlingen-Raymondville Combined Statistical Area, which includes Cameron and Willacy Counties and extends 59 miles from the Project site and main access road.
Socioeconomics (Land Transportation)	Major roads and intersections that would be used during construction and operation (e.g., impacts on SH 48 and SH 4)	Construction and operational staff would increase traffic on a subset of roads, depending on their point of origin.
Socioeconomics (Marine Trans.)	BSC and established shipping lanes	Construction and operations would increase vessel traffic in the BSC.
Cultural Resources	300 feet on either side of the main access road (direct) and 0.5 mile from the Project site (indirect)	Impact area is the Area of Potential Effect as defined by the FERC and Texas Historical Commission (the State Historic Preservation Office).

TABLE 4.13.1-1 (continued) **Geographic Scope by Resource for the Annova LNG Project**		
Resource	Geographic Scope	Rationale for Potential Cumulative Impact Analysis Area
Air Quality	Construction: within 1 mile of LNG terminal sites	Localized construction impacts could occur within 1 mile of the LNG project construction sites
	Operation: Within 31 miles (50 km) of the Annova LNG Project	Impacts could occur within 31 miles (50 kilometers). Includes only criteria pollutants, HAPs and VOCs as GHG emissions do not have a local impact.
Noise	Any facility that can cause an impact at NSAs within 1 mile of the Project	Impacts from noise-producing equipment and activities considered intrusive, other than the proposed Project, are typically limited to within 1 mile of the Project site during construction and operation. Noise impacts from the proposed Project were evaluated at the nearest NSA (NSA #3). NSA #3 is a residence on SH 4, located 2.3 miles south of the Project site.
Safety	Area adjacent to and in the vicinity of the LNG terminal site and vessel travel routes in the Brazos Santiago Pass and BSC	Construction and operational safety impacts would occur near the LNG terminal or within nearby vessel travel routes.

4.13.2 Projects and Activities Considered

The current regional landscape in south Texas, which is a mix of large tracts of open land that support ranch and cattle operations, NWRs, and an assortment of industrial facilities already sited along the BSC, forms the environmental baseline described in other sections of this EIS and against which the impacts of recent, concurrent, and reasonably foreseeable future actions are considered. CEQ guidance states that an adequate cumulative effects analysis may be conducted by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions. In this analysis, we consider the impacts of past projects within the resource geographic scopes as part of the affected environment (environmental baseline) which was described and evaluated in the preceding environmental analysis. However, present effects of past actions that are relevant and useful are also considered.

Reasonably foreseeable projects that might cause cumulative impacts in combination with the proposed Project include projects that are under construction, approved, proposed, or planned. For FERC-regulated projects, proposed projects are those for which the proponent has submitted a formal application to the FERC, and planned projects are projects that are either in pre-filing or have been announced but have not been officially proposed. Planned projects also include projects not under the FERC's jurisdiction that have been identified through publicly available information such as press releases, internet searches, and the applicants' communications with local agencies.

Table H-1 in appendix H lists the projects and activities that we considered in this cumulative impact analysis, including the location, distance from the Annova LNG Project, project timeframe, and resource(s) potentially cumulatively affected in conjunction with the Annova LNG Project. Figure 4.13.2-1 displays these projects in relation to the Annova LNG Project. Descriptions of potential cumulative impacts by resource category are discussed in section 4.13.3. For some projects, we were unable to obtain quantitative information (e.g., size, area of impact, status of permitting, etc.), and in these cases our analysis relies on qualitative information.

4.13.2.1 Non-jurisdictional Facilities Associated with the Annova LNG Project

As described in section 1.4, the Project would require certain non-jurisdictional facilities, including an interconnect to the natural gas supply pipeline, an electrical transmission line and switch yard, and a potable waterline. In addition, in its application Annova described the natural gas supply pipeline that would provide gas to the LNG terminal, and as described, the natural gas supply pipeline would also be a non-jurisdictional facility. Each of these Project components has been included in our cumulative impacts analysis and all are described below.

Natural Gas Supply Lateral Pipeline

The Project would receive natural gas supply from a third-party–owned and –operated intrastate pipeline that would connect to the Valley Crossing Pipeline System. The approximately 9-mile-long, 36-inch-diameter natural gas supply lateral would begin at an existing Valley Crossing compressor station north of Highway 48 within the Port of Brownsville, cross the BSC using HDD, and continue generally south and then east to the Project site. Construction of the natural gas supply lateral would affect about 110 acres of land, all of which would be located within Cameron County, and result in a permanent footprint of about 50 acres within the right-of-way. The supply lateral would be an intrastate pipeline and therefore would not be under the FERC's jurisdiction. The general location of the supply lateral is shown on figure 1.4.1-1.

Natural Gas Interconnection Facilities

Annova would take custody of natural gas delivered to the LNG terminal through interconnection and metering facilities that would be constructed and operated by the same third-party entity that would construct, own, and operate the natural gas supply lateral. The interconnection facilities would be located in a 200-foot by 300-foot fenced yard in the southwest corner of the Annova LNG Project site. These facilities would include valves and gas measurement devices, as well as related instrumentation and communications equipment. The interconnection facilities would also provide the necessary infrastructure for the natural gas supply lateral to measure and receive compressed boil-off gas (BOG) from the Project. The location of the natural gas interconnection facilities is shown on figure 1.4.2-1.

Transmission Line and Switchyard

The STEC would supply power to the Project through a tie-in to STEC's existing transmission system and construction of a new transmission line to the Project site. The connection and transmission system would be permitted, constructed, owned, and operated by STEC, and would include:

- modifications of the existing Highway 511 and Waterport Electric Substations to provide interconnection to the new 138-kV line;
- a new 138-kV switchyard on the Project site; and
- a new 138-kV line between an existing switchyard and the new switchyard on the Project site.

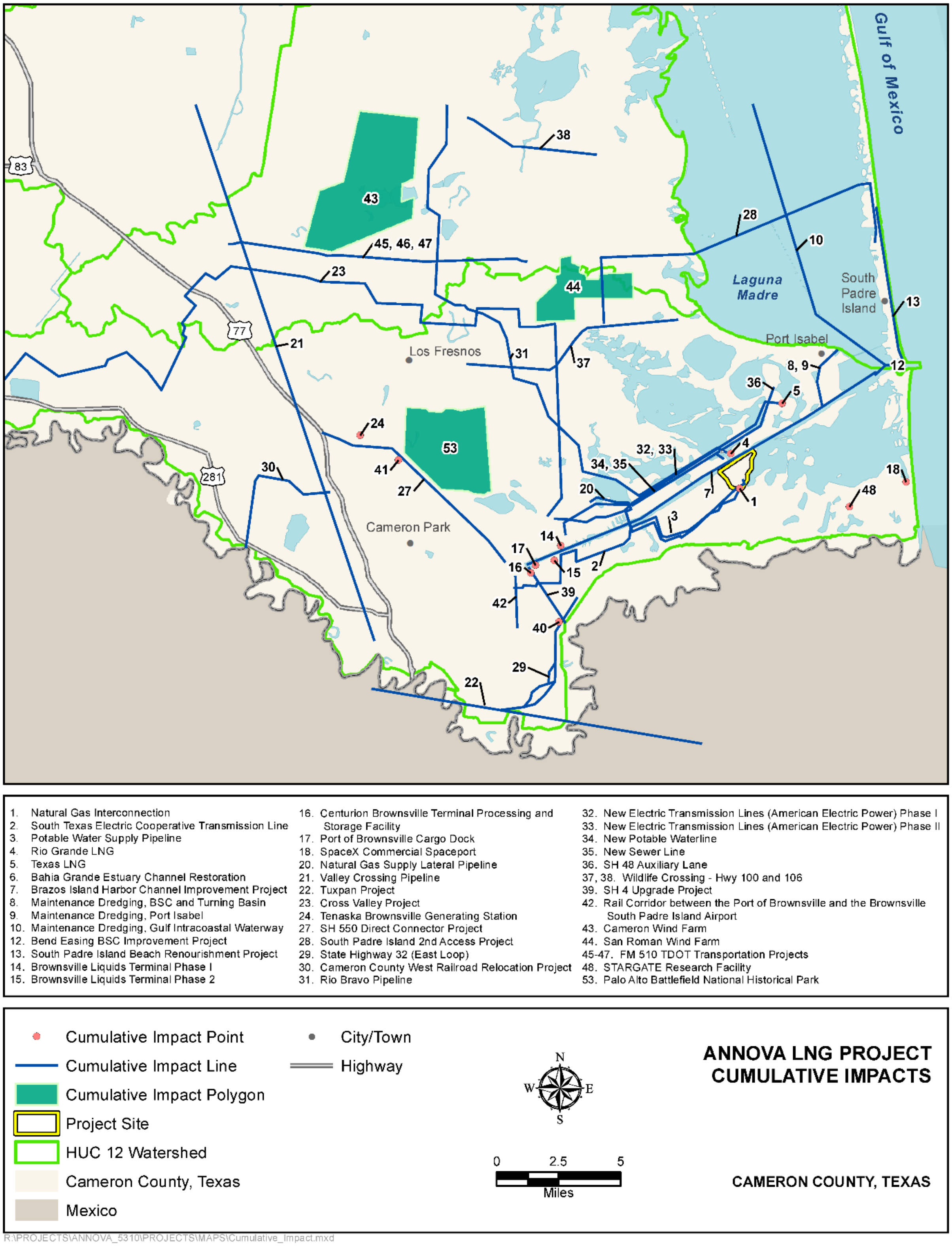

Figure 4.13.2-1 Projects Included in Cumulative Impact Analysis

The new 138-kV transmission line from the existing substation to the Project site would be approximately 15 miles long and supported by poles 90 to 110 feet high and spaced approximately 600 feet apart. The initial design calls for a right-of-way width of 100 feet. While the final route has not been determined by STEC, Annova identified an example potential route for the transmission line for the purpose of describing non-jurisdictional facilities and evaluating cumulative impacts. See figure 1.4.3-1.

Potable Water Pipeline

The BND would provide potable water to the Project during construction and operation through an extension of an existing pipeline from its current termination point to the Project site. The total length of the potable water pipeline would be about 5.9 miles. Annova identified a potential route for the water pipeline for the purpose of describing non-jurisdictional facilities and evaluating cumulative impacts. See figure 1.4.4-1.

4.13.2.2 Liquefaction and LNG Export Projects

Rio Grande LNG Project and Pipeline

Rio Grande LNG, LLC is proposing to construct and operate a new LNG export terminal that would be located along the north side of the BSC as part of its Rio Grande LNG Project. The Rio Grande LNG Project would be capable of producing 27 mtpa of LNG for export and would consist of six liquefaction trains, a marine berth capable of receiving two LNG carriers at a time, and four 180,000 square meters LNG storage tanks. The Rio Grande LNG Project would be located on a 984-acre parcel, of which about 770 acres would be affected. Additional land would be affected the heavy haul road, offsite construction areas, and dredge disposal for a total impact of about 1,150 acres.

The Rio Grande project includes the Rio Bravo pipeline. The Rio Bravo Pipeline Project consists of two 130-mile-long, parallel, 42-inch-diameter natural gas pipelines from the Agua Dulce Market Area in Kleberg County, Texas, to the proposed Rio Grande LNG Project. The Rio Bravo Pipeline Project also includes three 180,000-hp compressor stations, two 30,000-hp interconnect booster stations, and a 2.4-mile-long header pipeline. Construction of the Rio Bravo pipeline and associated aboveground facilities would affect about 3,655 acres of land, and operation would affect about 2,148 acres. Non-jurisdictional projects associated with the Rio Grande LNG Project include LNG trucking of 12 to 15 tanker trucks per day, utilities (water, sewer, and electric services), and widening of SH 48.

Texas LNG Terminal Project and Pipeline

Texas LNG Brownsville LLC (Texas LNG) has proposed a liquefaction and LNG export terminal on the BSC in Cameron County bordering the northeast boundary of the Rio Grande LNG Project site about 2.2 miles east of the Annova LNG Project. The Texas LNG Project would impact about 300 acres of land and would include two LNG trains with an overall LNG capacity of approximately 4.0 mtpa, two 210,000 square meters LNG storage tanks, and a marine berth to accommodate one LNG carrier. Natural gas would be delivered to the Texas LNG Project via a non-jurisdictional intrastate natural gas pipeline that would be constructed, owned, and operated by a third party, separate from Texas LNG. Texas LNG anticipates that the 30-inch-diameter pipeline would be approximately 10.2 miles long (1.3 miles of which would be within the project site.) Construction and operation of the pipeline would affect about 108 acres and 50 acres, respectively, outside of the LNG project site. Other non-jurisdictional facilities, including electricity and water, would be provided by AEP and BND, respectively.

Barca, Eos, and Gulf Coast LNG Projects

During scoping, we received comments about the potential Gulf Coast LNG Export, Eos LNG, and Barca LNG projects. Barca and Eos were planning to develop an LNG export facility at the Port of Brownsville. While the DOE authorized Eos and Barca to export to FTA nations, the applicants have not requested to participate in the FERC pre-filing process and have not submitted applications to any state agencies. Further, the lease option with BND has expired.

Gulf Coast LNG Export, LLC (Gulf Coast) was planning to develop a liquefaction and LNG export facility on a 500-acre site at the Port of Brownsville. In May 2016, Gulf Coast filed a request to withdraw its application and vacate its authorization previously received from DOE to export to FTA nations and non-FTA nations. Gulf Coast has also not started the pre-filing process with FERC and has not submitted an application to FERC or any state agency.

We conclude that these LNG projects are currently not reasonably foreseeable and are not further considered in this assessment.

4.13.2.3 Gas Pipeline Projects

Valley Crossing Pipeline (also known as the Nueces-Brownsville Pipeline)

Valley Crossing Pipeline, LLC (VCP) is constructing a 165-mile-long intrastate pipeline to supply gas to the Comisión Federal de Electricidad Tuxpan Pipeline. Once completed, the pipeline will originate near the Agua Dulce Hub in Nueces County, Texas, and extend offshore, about 30 miles east of Brownsville, Texas. In the vicinity of the Project, it is expected to parallel SH 48 on the north side of the BSC before crossing the BSC via horizontal directional drilling east of the Project. The Valley Crossing Project will connect to the Marina Pipeline via proposed natural gas transmission facilities known as the Border Crossing Project. The Border Crossing project was constructed by VCP and includes 1,000 feet of 42-inch-diameter natural gas transmission pipeline across the international boundary between the United States and Mexico in the Gulf of Mexico. The pipeline project is expected to impact more than 2,500 acres of land. Construction of the Valley Crossing Project began in 2017 with an in-service date in 2019.

Tuxpan Pipeline (Sur de Texas – Tuxpan)

The Tuxpan Pipeline will consist of 497 miles of 42-inch-diamter natural gas pipeline, primarily located offshore in the Gulf of Mexico from its connection to the Valley Crossing Pipeline at the Border Crossing Project to its terminus in Tuxpan, Mexico. Construction of the project began in 2017 with full operation underway by late 2018. Because the Tuxpan Pipeline would not impact the same resources potentially affected by the proposed Project within the geographic scopes identified in table 4.13.1-1, the Tuxpan Pipeline was not included in our cumulative impacts analysis.

The natural gas supply lateral is discussed under non-jurisdictional facilities associated with the Annova LNG Project (section 4.13.2.1). The Rio Bravo Pipeline and the intrastate pipeline to the Texas LNG Project are discussed along with their associated LNG projects under Liquefaction and LNG Export Projects, section 4.13.2.1.

4.13.2.4 Electric Transmission and Generation Projects

Wind Farms

The 93-MW San Roman Wind Farm was completed in 2016 and includes thirty-one 3-MW wind turbines within a 4,000-acre area in Cameron County, about 8 miles northwest of the Annova LNG Project.

The Cameron Wind Farm was built by Apex Clean Energy in 2015. The 165-MW facility comprises 55 turbines on 15,000 acres of leased agricultural land approximately 11 miles north of Brownsville in Cameron County, about 16 miles from the Annova LNG Project.

The Cross Valley Project (North Edinburg - Loma Alta Transmission project) is a 95-mile-long, 345-kV transmission line approved by Public Utility Commission of Texas in April 2014 as part of the Cross Valley Project to ensure reliable electric service for Lower Rio Grande Valley. The project was completed in 2016 (Sharyland 2017) and the transmission line runs from North Edinburg (Hidalgo County) to the Loma Alta Substation adjacent to the BSC.

The Tenaska Brownsville Generating Station is proposed for construction on 270 acres in Cameron County, about 7 miles west of the Pipeline System near MP 128. Tenaska anticipates the facility will be placed in service in 2019.

AEP's new 138-kV electric transmission line is planned to provide electricity to the proposed Rio Grande LNG and Texas LNG projects on the north side of the BSC. The line would start at an existing substation several miles from the LNG projects and would be constructed in two phases. The total length would be about 12 miles and a portion would run along SH 48 within a utility easement. Timing for construction would depend on the status of permitting for the two LNG projects.

4.13.2.5 Transportation Projects

The Highway 550 Connector and Toll project became operational in June of 2015 based on a collaborative effort between TxDOT and the Cameron County Regional Mobility Authority (TxDOT 2016). This limited access toll road provides access to the BSC and begins about 10 miles west of the Annova LNG Project.

Construction of South Padre Island Second Access roadway and bridge to Padre Island was scheduled to begin in 2018 but is currently under review. TxDOT and the Federal Highway Administration, in partnership with Cameron County Regional Mobility Authority, are planning the 17.6-mile project that would be about 8 miles northeast of the Annova LNG Project at its nearest point.

TxDOT is planning an East-Loop of Highway 32, which includes a four-lane highway that would run from the Port of Brownsville to Veterans Bridge at Los Tomates (CCRMA 2015). The goal of the loop is to improve traffic flow in the area around and near the Port of Brownsville, including SH 48, and improve the route for international trade-related truck traffic. This project would be 15 miles southwest of the Annova Project site, with an unknown construction schedule.

Associated with the Texas LNG project, a SH 48 auxiliary lane is recommended on the northbound approach to the main driveway of the Texas LNG site. The auxiliary lane would be 6 feet wide, with a 150-foot taper, 830 feet of deceleration length, and 100 feet of storage area. The lane would continue to approximately 1,100 feet north of the northern proposed driveway of Texas LNG to permit acceleration by vehicles exiting the site. TxDOT would construct and own this auxiliary lane; however, the timing is unknown.

In addition to the modifications of SH 48 associated with access to the Texas LNG Project site, TxDOT is planning a SH 48 widening project to improve 8.7 miles of SH 48 between Farm to Market Road (FM) 550 and SH 100. The project would widen the highway and install a raised median. The construction schedule is currently unknown (TxDOT 2016).

TxDOT is planning multiple FM 510 rehabilitation projects on portions of the roadway from FM 803 to FM 1847, from FM 3462 to FM 803, and from FM 1847 to FM 2480. These road segments are located between 11 and 18 miles from the Annova LNG Project site. The timing of these highway projects is unknown.

Cameron County West Railroad Relocation project includes the relocation of about 7 miles of track and subgrade, a portion of new Brownsville West Bridge to facilitate freight rail crossing over Rio Grande, and a two-story Department of Homeland Security facility for inspecting railcars.

TxDOT has installed wildlife crossings under SH 100 between Laguna Vista and Los Fresnos. Additionally, eight permanent wildlife crossings under FM 106 are being constructed as a part of an ongoing road project.

A new 16-inch-diameter potable water line and a new 12-inch-diameter sewer line are planned to extend approximately 7 miles within a Port of Brownsville easement/utility corridor on the south side of SH 48, across the BSC from the Annova LNG Project site, to serve the Rio Grande LNG Terminal and likely the Texas LNG Terminal. Construction would require a 30-foot-wide right–of-way within the 100-foot-wide Port of Brownsville easement.

TxDOT is also planning a 1.4-mile-long upgrade to SH 4, comprising a two-lane, undivided highway to a planned entrance to the Port of Brownsville (TxDOT 2016). Construction schedules are currently unknown.

4.13.2.6 Port of Brownsville Projects

Brownsville Liquids Terminal

The Brownsville Liquids terminal was completed in 2014 (Phase I) and comprises 21 liquid storage tanks that can accommodate up to 221,000 barrels of liquid storage; it is located about 5 miles from the Project. Phase II expanded the facility, adding four tanks which increased the terminal's capacity up to 700,000 barrels with future expansions (Howard Midstream 2015).

GEOTRAC Industrial Hub

One of America's largest private railroad and transportation management companies, OmniTRAX, developed in 2015 a large-scale industrial park on 1,400 acres of BND-owned land (GEOTRAC Industrial Hub). The park provides opportunities for light and heavy manufacturing, logistics, energy services, technology development, and export/import warehousing.

Centurion Brownsville Terminal Processing and Storage Facility

The Centurion Brownsville Terminal Processing and Storage Facility is a 1.5+ million-barrel storage facility and includes a liquid cargo dock, three-track rail spur, 10-truck lease automatic custody transfer skids, and an initial two condensate processing towers to produce products for local markets or export. The facility is located about 9 miles west of the Annova LNG Project site.

Port of Brownsville Cargo Dock 16

Port of Brownsville Cargo Dock 16 became operational in 2015. The 600-foot dock can accommodate cargo vessels with drafts up to 39.5 feet and is the second heavy-load capacity dock in Brownsville. Dock 16 is about 6.5 miles west of the Annova LNG Project site.

4.13.2.7 Waterway Improvement Projects

Several dredging and waterway maintenance projects were identified as having the potential to contribute to cumulative impacts. Four of these projects are associated with the COE's ongoing maintenance efforts and include maintenance dredging of the BSC and turning basin, Port Isabel, the Brazos Island Harbor (BIH) Channel, and the Gulf Intercoastal Waterway to facilitate movement of vessels through these waterways (COE 2015). All of these projects, less the Bahia Grande Channel Restoration, are currently underway or have recently been completed and similar projects are expected to occur in the future as needed to maintain these waterways.

The Bahia Grande Estuary Channel Restoration project is part of a comprehensive restoration plan and includes expansion of the Bahia Grande Channel from about 34 feet wide to 250 feet wide and was proposed in 2015. Dredged material, approximately 220,000 cubic yards, would be placed in two new placement areas adjacent to the main channel. The existing channel is located on the north side of the BSC, adjacent to the proposed Rio Grande LNG Project site.

The BND is investigating the need to modify the entrance to the BSC to provide greater flexibility, accommodate the deeper draft of the largest vessels that transit the expanded Panama Canal, and allow for safe navigation of deep draft vessels, especially in inclement weather. The timing of these improvement activities is currently unknown.

The city of South Padre Island has a partnership with the COE to utilize dredged sand from the Brazos-Santiago Pass to nourish the South Padre Island beach (via the South Padre Island Beach Re-nourishment project). The COE is responsible for maintaining the Brazos-Santiago Pass and the BSC and, through its partnership with South Padre Island, can repurpose some of the removed sand for a beneficial use. The beach-quality sand retrieved during the dredging is along the jetty channel, Brazos-Santiago Pass. This activity is about 7.1 miles northeast of the Annova LNG Project site.

4.13.2.8 Other Projects and Activities Considered

Development of a commercial space launch facility, SpaceX, about 6.3 miles southeast of the Annova LNG Project site, began in September 2014, and the first launch is anticipated as soon as late 2018 (SpaceX 2014). A related "Stargate Facility" would be located on a 2.3-acre parcel adjacent to the SpaceX facilities. The Stargate Facility would accommodate a 12,000- square-foot research center, currently being designed, where students and professors of the University of Texas, Rio Grande Valley can track spacecraft (University of Texas Brownsville 2015). Construction of the facility began in 2016 and would be fully operational in late 2018/early 2019 (University of Texas-Rio Grande Valley 2018). United Fuel Supply submitted a rezoning application in 2014 to build a truck stop at FM 511 and Paredes Line Road on approximately 14 acres of land. The rezoning from general retail to light industrial was approved in 2014, but United Fuel Supply has not taken further action on the development after the zoning was approved. Because we have not identified any further information about this project, it is not considered reasonably foreseeable and is not further considered in this assessment.

The U.S. Customs and Border Patrol proposed to develop a larger facility at the U.S. Customs Highway 4 Fort Brown Checkpoint Station. The project has not been funded yet and has been put on hold. As this project is currently unfunded, it is not further considered in this analysis.

The NPS and Palo Alto Battlefield National Historical Park developed an Integrated Vegetation Management Plan in 2014 with the goal of restoring and maintaining the landscape and vegetation within the battlefield for cultural and historic preservation (NPS 2016b). This effort would be an ongoing effort on land that is about 13 miles northwest of the Annova Project site.

4.13.3 Potential Cumulative Impacts by Resource

The following sections address the potential cumulative impacts of the activities identified within the geographic scope on specific environmental resources. Table 4.13.3-1 provides a summary of cumulative impact for key resources where information is available.

4.13.3.1 Geologic Resources and Soils

The geographic scope for geologic resources and soils was defined as the area that would be affected by, or immediately adjacent to, the Annova LNG Project. Other projects encompassed by the impact area that may have impacts on geologic resources or soils include the non-jurisdictional facilities associated with the Annova LNG Project where they occur adjacent to or within the Project site. Large projects with ground-disturbance and excavation associated with construction and permanent aboveground facilities would have the greatest impacts on geologic resources and soils.

Projects that would be constructed in close proximity to one another, and require evacuation or considerable grading, would generally have greater impacts on geological resources and soils than projects with limited ground disturbance or those projects that are separated by time and space. Therefore, the potential increase for erosion and impact on geological hazards would be highly localized and limited primarily to the period of construction.

TABLE 4.13.3-1

Summary of Cumulative Impacts

	Site			Water	Wetlands and Vegetation		Socioeconomics		Transportation		
	Project Area	Disturbance Area (Constructions)	Disturbance Area (Operation)	Waterbodies Affected/Crossed	Wetlands	Upland Scrub/Shrub	Employment (Construction)	Employment (Operation)	Vehicle Traffic (Construction)	Vessel Traffic (Construction)	Vessel Traffic (Operation)
Map Number and Activity/Project	acres	acres	acres	No.	acres	acres	No. of jobs	No. of jobs	trips per day	vessels per year	vessels per year
Annova LNG Project	731	491	412	1	58	224	700-1,200	165	2,000	36	80
Non-jurisdictional Facilities Associated with the Annova LNG Project											
1. Natural Gas Interconnection	U	U	U	O	1.3	0.07	U	U	U	U	U
2. South Texas Electric Cooperative	100	U	U	3	26.1	2.9	U	U	U	U	U
3. Potable Water Supply Pipeline	30	U	U	1	6.3	0.5	U	U	U	U	U
20. Natural Gas Supply Lateral	110	110	49	1	42.1	6.4	U	U	U	0	0
LNG Facilities											
4. Rio Grande LNG	1,148	1,100	770	O	236	U	2,950–5,225	270	4,750	180	312
5. Texas LNG (and pipeline)	652	420	334	1	254	87	700-1,312	110	1,454	109	75
Pipeline Facilities											
21. Nueces to Brownsville Gas Pipeline	U	U	U	U	U	U	U	U	0	0	0
31. Rio Bravo Pipeline	3,094	U	U	140	79	852	760 – 1,500	20	1,950	O	O
34, 35. New Potable Waterline and Sewer Line in Cameron County (Port of Brownsville)	1	U	U	6	U	O	U	U	U	U	U
Electrical Transmission and Generation Projects											
24. Tenaska Brownsville Generating Station	270	U	U	U	O	U	700	23	U	U	U
44. San Roman Wind Farm	156	U	U	15	0	U	80	U	U	U	U
43. Cameron Wind Farm (Apex Clean Energy Wind Energy Project)	10,243	U	U	O	O	O	90	U	O	O	O
23. Cross Valley Project	1,745	U	U	U	24	U	U	U	U	U	U
32, 33. New Electric Transmission Line (American Electric Power) Phase 1 and 2	142	U	U	7	U	9	U	U	U	U	U

TABLE 4.13.3-1 (continued)

Summary of Cumulative Impacts

	Site			Water	Wetlands and Vegetation		Socioeconomics		Transportation		
	Project Area	Disturbance Area (Constructions)	Disturbance Area (Operation)	Waterbodies Affected/Crossed	Wetlands	Upland Scrub/Shrub	Employment (Construction)	Employment (Operation)	Vehicle Traffic (Construction)	Vessel Traffic (Construction)	Vessel Traffic (Operation)
Map Number and Activity/Project	acres	acres	acres	No.	acres	acres	No. of jobs	No. of jobs	trips per day	vessels per year	vessels per year
Transportation Projects											
29. State Highway 32 (East Loop)	U	U	U	U	U	U	U	U	U	U	U
28. South Padre Island 2nd Access Project	U	U	U	U	U	U	U	U	U	U	U
39. SH 4 Upgrade Project	U	U	U	U	U	U	U	U	U	U	U
37. Wildlife Crossings Along SH100 (between Share 27 Rd. and Palm Blvd)	U	U	U	U	U	U	U	U	U	U	U
38. Wildlife Crossings on FM 106 (Atascosa National Wildlife Refuge)	U	U	U	O	O	O	U	U	U	U	U
27. SH 550 Direct Connector Project	U	U	U	U	U	U	55	U	U	U	U
30. Cameron County West Railroad Relocation Project	U	U	U	U	U	U	U	U	O	O	O
51. State Highway 48 Widening Project	U	U	U	4	U	U	U	U	U	U	U
42. Rail Corridor Between the Port of Brownsville and Brownsville-South Padre Island International Airport	U	U	U	3	U	U	U	U	U	U	U
45. FM 510, Texas Department of Transportation (FM 803 to FM 1847)	U	U	U	O	O	O	U	U	U	U	U
46. FM 510, Texas Department of Transportation (FM 3462 to FM 803)	U	U	U	O	O	O	U	U	O	O	O
47. FM 510, Texas Department of Transportation (FM 1847 to FM 2480)	U	U	U	7	U	U	U	U	U	U	U
36. State Highway (SH) 48 Auxiliary Lane	U	U	U	1	U	U	U	U	U	U	U
Port of Brownville Projects											
14. Brownsville Liquids Terminal Phase 1	U	U	U	U	U	U	150	5	U	U	U
15. Brownsville Liquids Terminal Phase 2	U	U	U	U	U	U	U	U	U	U	U
17. Port of Brownsville Cargo Dock	U	U	U	U	U	U	U	U	U	U	U

TABLE 4.13.3-1 (continued)

Summary of Cumulative Impacts

	Site			Water	Wetlands and Vegetation		Socioeconomics		Transportation		
	Project Area	Disturbance Area (Constructions)	Disturbance Area (Operation)	Waterbodies Affected/Crossed	Wetlands	Upland Scrub/Shrub	Employment (Construction)	Employment (Operation)	Vehicle Traffic (Construction)	Vessel Traffic (Construction)	Vessel Traffic (Operation)
Map Number and Activity/Project	acres	acres	acres	No.	acres	acres	No. of jobs	No. of jobs	trips per day	vessels per year	vessels per year
16. Centurion Brownsville Terminal Processing and Storage Facility	280	U	U	U	U	U	Up to 500	35	U	U	U
GEOTRAC Industrial Hub	1,400	U	U	U	81	U	U	U	U	U	U
Waterway Improvement Projects											
7. Brazos Island Harbor Channel Improvement Project	U	U	U	1	U	U	U	U	U	U	U
6. Bahia Grande Estuary Channel Restoration	U	U	U	1	U	U	U	U	U	U	U
8. Maintenance Dredging, BSC and Turning Basin	U	U	U	1	U	U	U	U	U	140	140
9. Maintenance Dredging, Port Isabel	U	U	U	1	U	U	U	U	U	140	140
10. Maintenance Dredging, Gulf Intracoastal Waterway	U	U	U	O	O	O	O	O	U	140	140
Other Projects and Activities Considered											
18. SpaceX Commercial Spaceport	70	U	U	O	4	16	Up to 50	150	U	U	U
48. STARGATE Research Facility (University of Texas)	2.3	U	U	U	U	U	U	U	U	U	U
13. South Padre Island Beach Renourishment	U	U	U	0	O	O	U	U	U	U	U
53. Palo Alto Battlefield National Historical Park	U	U	U	O	U	U	U	U	U	U	U
TOTAL	**20,174**	**2,121**	**1,231**	**194**	**812**	**1,198**	**---**	**---**	**---**	**---**	**---**

U=Unknown; NA=Not Applicable

Geologic Resources

Construction of the Annova LNG Project would permanently modify the topographic contours present at the site. Projects occurring within the geographic scope include the non-jurisdictional facilities associated with the proposed Project, consisting of the natural gas interconnection (included within the overall facility footprint) and the STEC electrical transmission line, potable water supply pipeline, and the Kingsville to Brownsville Pipeline where they occur adjacent or within the Project site. Within the geographic scope for cumulative impacts on geologic resources, these non-jurisdictional facilities would likely require clearing and grading for construction. It is anticipated that contours would be restored following the completion of construction of the pipelines and electric transmission line. The BIH Channel Improvement Project would deepen the BSC from -42 feet to -52 feet, which would also alter topographic contours near the proposed Project. The BSC and Turning Basin Maintenance Dredging waterway improvement project involves expansion of the channel from about 34 feet wide to 250 feet wide.

As described in section 4.1.3, the potential for impacts on or by the Project from a geologic hazards perspective would be low. Hurricanes and/or storm surge are the geologic hazards with the greatest potential to affect the Project. Annova LNG, Rio Grande LNG, and Texas LNG have designed their respective facilities to withstand predicted maximum hurricane force winds and storm surge. The non-jurisdictional facilities are not anticipated to exacerbate potential impacts associated with a hurricane or storm surge; however, aboveground components, such as the electric transmission lines, could be damaged. The deepening of the BSC associated with the BIH Channel Improvement Project is not anticipated to affect storm surge during hurricanes or other large storms; therefore, no cumulative impacts on geologic hazards would occur from this project (COE 2014). The risk of seismic hazards (earthquakes, faults), soil liquefaction, subsidence, and landslides is low (see section 4.1.3 for detailed discussion).

Overall, cumulative impacts on geologic resources from construction and operation of the Project and other projects identified in the geographic scope would primarily consist of permanent modification to existing contours. No mineral resources would be affected by the Annova LNG Project and potential effects associated with geologic hazards have been acceptably mitigated for through facility design. Therefore, we have determined that the Annova Project, along with other projects, would contribute to minor cumulative impacts on geologic resources.

Soils

Cumulative impacts on soils may occur when adjacent projects increase the area of soil disturbance, resulting in greater potential for the adverse impacts identified above, or when projects disturb the same area in succession. In the latter circumstance, soil disturbance may be prolonged and revegetation delayed, so that soils are not sufficiently stabilized resulting in increased potential for runoff and erosion. Non-jurisdictional facilities related to the Annova LNG Project would be expected to have a similar effect on soil resources as the Project; however, the impacts would be less due to the smaller size and scope of the projects. The BIH Channel Improvement Project and the Bahia Grande Channel Restoration projects would also be located adjacent to the Project site; however, because all activities would occur within the BSC or the Bahia Grande Channel, no impacts on soils would occur. Impacts on sediments associated with this project are also discussed in section 4.13.3.2.

The cumulative impacts of the Project on soils, when considered with other projects, would be temporary (during construction of buried or temporary project components) to permanent (within aboveground facility footprints), and moderate.

4.13.3.2 Water Resources

The geographic scope established for water resources is the HUC-12 watershed and the underlying aquifers. Any projects listed in table H-1 in appendix H involving ground disturbance or chemical use or storage within the HUC-12 watershed could result in cumulative impacts on water resources, most likely through contamination by inadvertent spills. This includes the majority of the current, proposed, and reasonably foreseeable projects, identified in table H-1 in appendix H.

Groundwater

Cumulative impacts on groundwater may occur through construction activities, including clearing and grading, dewatering, contamination through fuel and other hazardous material spills, and groundwater withdrawal. Most of the potential impacts on groundwater resources associated with the proposed Project would be short term and localized, primarily associated with clearing, grading, excavating, filling, and placement of piles and foundations, with groundwater effects limited to water table elevations in the immediate vicinity of the Project site. Most of the other projects considered for cumulative impacts on groundwater would involve similar ground disturbing activities that could temporarily affect groundwater levels near the projects.

Annova LNG would not directly withdraw groundwater during construction or operation of the Project and would instead obtain water from the local utility; however, water sourced from the local utility would include both surface water from reservoirs along the Rio Grande River and groundwater from wells located west of Brownsville. Because the Brownsville Public Utilities Board has stated that it has sufficient capacity to meet the construction and operational needs of the LNG Terminal without affecting water availability for other uses, and no new groundwater wells would be required for construction and operation of the LNG Terminal, the LNG Terminal is not expected to affect the quantity of available groundwater. Proposed groundwater use is not known for most of the other projects considered; therefore, a quantitative analysis of anticipated groundwater withdrawals is not feasible. However, because groundwater is not the primary source of potable water in the region, and the proposed Project would not directly withdraw groundwater, cumulative impacts on groundwater are anticipated to be minor.

Annova would grade, excavate, add fill, and install foundations and underground utilities near or adjacent to the BSC where groundwater is near the surface. These activities would have localized and short-term effects on the shallow groundwater during construction, with effects limited to water table elevations in the immediate vicinity of the site. Potential impacts on groundwater recharge and elevations would be minimal due to the localized nature of the effects.

Shallow groundwater areas could be vulnerable to contamination caused by inadvertent surface spills of hazardous materials (e.g., fuels, lubricants, and coolants) used during construction and operation of the Annova LNG Project and other projects within HUC-12. However, Annova would implement its project-specific *Plan and Procedures*, as well as its SPCC Plan, to minimize the risk of occurrence and potential impacts. Groundwater impacts resulting from construction or operation of the Project are not anticipated and, should they occur, would be localized and would not affect other groundwater users. Therefore, the Project would not contribute to significant cumulative impacts on groundwater with other projects in the geographic scope.

Surface Water

Several projects listed in table H-1 in appendix H could be under construction at the same time as the proposed Project, including both of the other Brownsville LNG projects (Texas LNG and Rio Grande LNG) and associated non-jurisdictional facilities, non-jurisdictional facilities associated with the proposed Project, pipeline projects, electric transmission and generation projects, waterway improvement projects, transportation projects, Port of Brownsville projects, the Stargate Facility and other industrial developments. Thus, there is the potential for cumulative impacts on water quality within the HUC-12 watershed if the proposed Project was constructed during the same time period as these other projects or has overlapping operational effects.

In-water activities, such as dredging and open-cut pipeline crossing techniques have the greatest potential to contribute to cumulative impacts on surface water resources. If dredging associated with the proposed Project were to occur concurrently with other in-water activities, especially those requiring dredging (Texas LNG Project, Rio Grande LNG Project, and waterway improvement projects) adverse impacts on water quality associated with increased turbidity and sedimentation could be exacerbated. Pipeline projects may also impact surface water resources through increases of turbidity and sedimentation, if the waterbodies are crossed via an open-cut crossing technique; however, these impacts are typically minor due to the short duration of in-water activities and would be unlikely to reach the BSC. Further, it is anticipated that larger waterbodies, such as the BSC, would be crossed via horizontal directional drill for pipeline projects including the natural gas supply lateral, thereby avoiding direct impacts on the waterbodies.

Concurrent dredging of the proposed Project, Texas LNG Project, Rio Grande LNG Project, and the BIH Channel Improvement Project, would result in the greatest cumulative impacts on surface water resources. All of these projects currently have similar proposed construction schedules that could overlap if all regulatory approvals and authorizations are obtained as currently foreseen by the project proponents. Dredging associated with the proposed Project would occur over an approximately 1-year period. It is anticipated that timelines for dredging of the other LNG projects would be similar, though Rio Grande LNG anticipates up to 3 years. All three LNG projects are proposing to utilize hydraulic cutterhead dredges that would minimize turbidity to the extent practicable; however, if conducted concurrently, dredging of the Brazos Island Harbor Channel Improvement Project and the Brownsville LNG projects would further contribute to cumulative increases in turbidity and sedimentation within the BSC. Further, the concurrent dredging and thus concurrent placement of dredged material in confined dredged material placement areas would also result in increased effluent discharge into the BSC. Increased effluent discharge would likely result in increased turbidity and suspended solids in the vicinity of the discharge structures.

Annova LNG evaluated the potential cumulative impact on sedimentation from dredging during construction; this assessment considered the potential for contributions from the Rio Grande LNG and Texas LNG Projects, as well as other projects occurring within the BSC. The majority of expected sedimentation due to construction is attributed to the LNG projects, which results in an estimated maximum sedimentation of 0.3, 0.4, and 0.2 inches for the Annova, Rio Grande, and Texas LNG Projects, respectively. The Bahia Grande Channel Restoration Project could also contribute an estimated 0.5 inch of additional sedimentation. The BIH Channel Improvement project is not expected to result in long-term net sediment accumulation as the purpose of the project is to deepen the main channel. During operation, although sedimentation patterns may be affected by the LNG projects, overall accumulation is expected to be minor. Increased accumulation during operation will be driven by any changes in hydrodynamic characteristics associated with the BIH Channel Improvement Project, and would be limited to 0.4 inch within the main channel of the BSC.

Like the Annova LNG Project, each of the projects would be required to comply with water quality standards and cumulative impacts on water quality would be temporary, with turbidity and sedimentation levels returning to pre-dredging conditions following the cessation of dredging activities. Therefore, the Annova LNG Project with other projects in the vicinity, would contribute to minor to moderate, but temporary, impacts on water quality within the BSC.

The BIH Channel Improvement Project and the three Brownsville LNG projects may use DMPA 5A for placement of dredged material during construction and maintenance dredging. Preliminary analysis indicates that Port of Brownsville PA 5A would not have the capacity, even if the perimeter containment levees were raised to the maximum effective/acceptable height, for all construction- and maintenance-dredged material from the three proposed LNG projects. However, alternative dredged material placement areas could accommodate some or all of the material, and the final management of dredged material will be determined by the BND and COE, in consultation with other federal, state, and local resource agencies.

Concurrent construction of other projects involving clearing, grading, or other earthwork within the watershed may also increase the potential for cumulative impacts on water quality from increased stormwater runoff. Several of the projects identified in table H-1 in appendix H would require hydrostatic testing of storage tanks or pipelines. All project proponents would be required to adhere to state and federal regulations regarding hydrostatic, construction, and industrial stormwater and wastewater discharges. Compliance with these regulations by Annova and the other project proponents, and implementation of BMPs in the Project-specific *Plan and Procedures*, would minimize potential cumulative impacts on surface water resources from stormwater runoff and wastewater discharges.

Surface water could be subject to contamination caused by inadvertent surface spills of hazardous materials (e.g., fuels, lubricants, and coolants) used during construction and operation of the LNG Terminal and other projects within the HUC-12 watershed. However, Annova would implement its *Plan and Procedures*, as well as its SPCC Plan, to minimize the risk of occurrence and potential impacts. Similarly, all projects considered in the cumulative impacts analysis for surface water resources would likely use equipment and or materials that could be hazardous to the environment in the event of a spill. However, it is anticipated that these projects would prepare and implement spill prevention and response procedures to prevent spills of hazardous materials from reaching surface water resources, as well as the measures to be implemented if such a spill occurs. Therefore, overall cumulative impacts on surface water resources as a result of stormwater runoff, hydrostatic test water withdrawals and discharges, as well as spills of hazardous materials are anticipated to be minor and incidental.

Current vessel traffic in the BSC is estimated to be 1,059 vessels annually. The operation of all three proposed Brownsville LNG projects would result in an increase in the number of large, ocean-going vessels transiting the BSC (estimated to be about 467 LNG carriers per year combined), which equates to a 48 percent increase in vessel traffic within the BSC. Other industrial projects located along the BSC (i.e., the Port of Brownsville projects identified in table H-1 in appendix H) are also anticipated to result in increased ship traffic within the BSC, although the exact number of additional vessels is unknown.

Impacts on turbidity would be limited to the duration of each vessel's transit time in the BSC and would be greater for larger ships such as the LNG carriers. It is anticipated that the water quality could return to baseline conditions once each LNG carrier docks or leaves the BSC. Shoreline erosion would primarily occur while the LNG carriers or other large vessels requiring the assistance of tug boats are maneuvering at each of the LNG terminals or other project docks. Each of the three LNG projects has designed its facilities to minimize shoreline erosion through placement of rock rip-rap along the shoreline, or similar measures. It is anticipated that other projects along the BSC would implement similar measures to protect the shoreline. Each project would also be responsible for maintaining the shoreline protection to prevent future erosion. Further, the use of waterways by LNG carriers, barges, and support vessels during construction and operation of the LNG Terminal would be consistent with the planned purpose and use of the BSC, an active shipping channel. However, given the substantial increase in large vessel traffic within the BSC related to the three Brownsville LNG projects, and other projects, it is expected that cumulative impacts on surface water resources associated with shoreline erosion and turbidity from increased vessel traffic would be moderate and relatively persistent throughout the life of the projects, particularly along unarmored portions of the BSC.

Increased vessel traffic would also result in increased cooling and ballast water exchanges. Cooling water exchanges would result in minor changes in water temperature at the point of discharge, but these impacts are not anticipated to extend beyond the immediate vicinity of the vessel, with temperatures quickly returning to ambient temperatures. Therefore, cumulative impacts as a result of cooling water are anticipated to be minor. The Coast Guard requires that all vessels carry out an open-ocean ballast water exchange prior to calling at U.S. ports. Ballast water can affect water quality by discharging water that differs in the physiochemical properties of the ambient water, including pH, salinity, and temperature. Based on the anticipated volumes and frequency of ballast water discharge that would occur as a result of the proposed Project, any changes in the physiochemical properties of water within the BSC would be localized and negligible. Similarly, it is anticipated that ballast water and cooling water impacts associated with LNG carriers calling on the Texas LNG and Rio Grande LNG terminals would also be localized and minor. As the discharges of these vessels for each project are generally not anticipated to comingle, cumulative impacts on water quality as a result of the ballast and cooling water exchanges associated with the Project and other projects in the vicinity are anticipated to be minor.

4.13.3.3 Wetlands and Vegetation

The geographic scope established for wetlands and vegetation is the HUC-12 watershed. Projects that could potentially contribute to cumulative impacts on wetlands and vegetation include the majority of the current, proposed, and reasonably foreseeable projects identified in table H-1 in appendix H. Other projects located within the geographic scope for wetlands and vegetation resources that are included in the cumulative impacts analysis include the Rio Grande LNG Project and associated non-jurisdictional facilities, Texas LNG Project and associated non-jurisdictional facilities, non-jurisdictional facilities associated with the proposed Project, Valley Crossing Pipeline, San Roman Wind Farm, Cross Valley Project, transportation projects, Port of Brownsville projects, SpaceX Commercial Spaceport Project, Stargate Facility, and Palo Alto Battlefield Cultural Landscape Restoration..

Wetlands

As described in section 4.4.2, construction and operation of the Project would result in the temporary and permanent disturbance of 56 and 52 acres of wetlands, respectively. Wetlands that would be affected by the Project include estuarine emergent marsh, estuarine scrub-shrub (mangrove) marsh, and palustrine emergent wetlands. Most of these impacts would be to palustrine emergent wetlands. Annova had developed a draft *Conceptual Mitigation Plan*, including a wetlands functional assessment, and is consulting with the COE to finalize the wetland functional assessment and the compensatory mitigation that would be required to offset cumulative impacts on wetlands.

The wetland impacts of the non-jurisdictional natural gas interconnection facilities are included in the Project impacts. Construction of the three non-jurisdictional facilities would impact about 75 additional acres of wetlands within the HUC-12 watershed.

As identified in table 4.13.3-1, several other projects in this area could contribute to cumulative impacts on wetlands including both of the other Brownsville LNG projects (Texas LNG and Rio Grande LNG) and associated non-jurisdictional facilities, non-jurisdictional facilities associated with the proposed Project, pipeline projects, electric transmission and generation projects, transportation projects, Port of Brownsville projects, and other industrial developments.

Any of the other projects within the HUC-12 watershed that impact wetlands would contribute incrementally to the impacts from the Annova LNG Project, including the other two LNG projects. The Rio Grande LNG Project would permanently affect about 182 acres of wetlands by converting them to uplands for the terminal and an additional 54 acres associated with its non-jurisdictional facilities. Another 79 acres of wetlands would be affected by the associated Rio Bravo pipeline. Similarly, the Texas LNG Project would permanently affect about 45 acres of wetlands. Other projects considered for cumulative effects for which wetland impacts are available include the SpaceX Commercial Spaceport (4 acres affected) and the Cross Valley Pipeline Project (24 acres affected) and the GEOTRAC Industrial Hub Phases I and II (62 acres and 19 acres affected, respectively).

Development of the Bahia Grande Estuary Channel Restoration project would expand the Bahia Grande Channel, increasing tidal exchange and improving estuary function, and resulting in positive cumulative impacts on estuarine wetlands within the HUC-12 watershed.

The total known wetland impacts associated with the other projects, as identified above and in table 4.13.3-1, is about 812 acres, including the proposed Project impacts. The HUC-12 watershed has a total area of 234,353 acres. Based on National Wetlands Inventory data developed by the FWS, approximately 49,220 acres of wetlands are present within the Bahia Grande-

Brownsville Ship Channel HUC-12 watershed; therefore, it is anticipated that, at a minimum, approximately 1.6 percent of the wetlands within the watershed would be affected by the projects considered in our cumulative impacts analysis.

Wetlands provide important ecosystem functions due to their ability to retain water, minimizing flooding and improving water quality by filtering contaminants before reaching surface waterbodies. Therefore, conversion of wetlands to uplands or developed land can affect water quality, as well as flooding, within a watershed. Wetlands also provide valuable wildlife habitat. Several of the projects identified in table H-1 in appendix H are not anticipated to result in significant permanent impacts on wetlands. For example, the majority of pipeline and electric transmission projects would only temporarily impact wetlands during construction. These types of projects may result in a permanent conversion of cover type within wetlands such as forested or scrub shrub to herbaceous; however, following completion of construction, areas affected by these types of projects typically maintain their functionality as a wetland. In addition, all projects and activities would be required to comply with the CWA by avoiding, minimizing, or mitigating wetland impacts. Therefore, while the proposed LNG Terminal would contribute to cumulative impacts on wetlands, along with other projects in the area, this impact would not be significant.

Vegetation

The geographic scope for vegetation and wildlife was determined to be the HUC-12 watershed. The projects listed in table H-1 in appendix H would disturb thousands of acres of habitat. Projects with permanent aboveground facilities (such as the Brownsville LNG terminals), wind energy projects, and roads would have greater impacts on vegetation than buried utilities, which allow for restoration of vegetation following construction. Therefore, with the exception of aboveground facilities and the permanent right-of-way, pipeline projects typically only have temporary impacts on vegetation and wildlife. The majority of long-term or permanent impacts are associated with vegetation clearing and maintenance of the pipeline right-of-way.

Construction and operation of the Project would temporarily and permanently impact vegetation. About 407 acres of upland vegetation would be affected during construction of the Annova LNG Project. Most of these impacts would be to the following vegetative communities: South Texas: Loma Evergreen Shrubland; Gulf Coast: salty prairie; South Texas: Loma Grassland/Shrubland; and Coastal: Sea Ox-eye Daisy Flats. Temporary workspaces would be replanted with native grasses with the goal of restoring grassland/herbaceous wildlife habitat. No state-designated vegetation communities of special concern (including rare, threatened, or endangered plants) occur on the Project area.

The non-jurisdictional facilities associated with the Project would contribute to cumulative impacts on vegetation. After construction, temporarily affected areas within the utility corridors would be restored with vegetative habitat, though some vegetation may be converted from scrub-shrub to upland grassland/herbaceous to prevent tree growth within the utility and gas pipeline corridors. The effects of the interconnection facility are included with the overall Project effects.

Several linear projects included in the cumulative impacts analysis extend outside of the HUC-12 watershed, including the Valley Crossing Pipeline, Rio Bravo Pipeline, Cross Valley Project, and South Padre Island Second Access Project. While information is available for the total impacts associated with most of these projects, data is not presented for impacts within individual HUC-12 watersheds (with the exception of the Rio Bravo Pipeline). Therefore, we calculated the percent of the project impacts in the HUC-12 watershed based on the length of each project within the watershed. We then applied this percentage to the total project impacts to estimate the acres of vegetation that would be affected by each project in the HUC-12 watershed.

Overall, an estimated total of approximately 5,544 acres of vegetation would be affected by the projects identified above within the Bahia Grande-Brownsville Ship Channel watershed HUC-12. This accounts for approximately 2 percent of the total watershed area (234,353 acres). Certain projects such as the South Padre Island Beach Re-nourishment and the Palo Alto Battlefield Cultural Landscape Restoration are focused on maintenance or enhancement of the natural environment; as such, these projects may result in positive effects on vegetation in the geographic scope.

Vegetation plays an important role in an ecosystem, providing wildlife habitat, stabilizing soils, assisting in drainage, and providing filtration of stormwater within the watershed. Removal of vegetation can lead to loss or degradation of wildlife habitat, increased stormwater runoff, decreased water quality, increased erosion, and increased flooding. In addition, the proposed Project, Rio Grande LNG Project, and Texas LNG Project would all impact rare or unique plant communities, including those associated with the loma landforms. While sufficient information is unavailable to accurately quantify the extent that all projects considered for cumulative impacts on vegetation would impact rare or unique plant communities, it can be reasonably assumed that at least some of the projects, in addition to the FERC-regulated projects for which information is available, would impact these resources.

All projects potentially contributing to cumulative impacts on vegetation would be required to adhere to applicable federal, state, and local regulations regarding water quality, erosion control, and construction within floodplains. In addition, most of the projects considered for cumulative impacts on vegetation are located within the eastern portion of the watershed, where coastal processes have a greater impact on the vegetation communities, as well as the soil characteristics and revegetation potential. Due to dry weather conditions and saline soils characteristic of the region, revegetation is anticipated to be difficult for the proposed Project, as well as most other projects considered. However, linear utilities may be required to meet restoration requirements per agency consultations. As discussed above, several of the projects considered for cumulative impacts on vegetation consist of large industrial developments that would result in the permanent loss of vegetation.

Due to the relatively large proportion of the HUC-12 watershed that would be affected by the projects considered, as well as the low revegetation potential and presence of rare or unique plant communities in the HUC-12 watershed, we have determined that the Project would contribute to moderate cumulative impacts on vegetation with other projects in the geographic scope.

4.13.3.4 Wildlife and Aquatic Resources

The geographic scope established for wildlife and aquatic resources is the HUC-12 watershed. Table H-1 in appendix H identifies numerous projects or activities within the HUC-12 watershed that could contribute to cumulative impacts on wildlife and aquatic resources.

Wildlife

Impacts on wildlife associated with the Annova Project include disturbance, loss, and/or conversion of approximately 465 acres of wildlife habitat. In addition, direct mortality of less mobile individuals such as small mammals, amphibians, or reptiles may occur during the initial clearing and grading activities. Other impacts on wildlife include impacts from elevated structures (bird strikes), construction and operation noise, facility lighting, and increased road traffic.

It is anticipated that most of the projects identified above that were considered for cumulative impacts on wildlife would result in similar impacts as those described for the proposed Project. The waterway improvement projects are anticipated to directly impact aquatic wildlife, as further discussed below; however, the impact on other wildlife is anticipated to be more indirect, likely associated with temporary increases in noise and light. As detailed in table H-1 in appendix H, construction and/or operation of many of the projects identified above are anticipated to be concurrent with the Project.

Habitat (vegetation) loss and conversion associated with the projects identified above accounts for the primary direct impact on wildlife species. Increased development and loss of habitat within the HUC-12 watershed would cause wildlife to either adapt to new conditions (in the case of some generalist species) or relocate to undisturbed suitable habitat. Displacement of wildlife could result in additional stress and increased competition in available habitats. Further, the projects considered are located within bird migration routes. Development, construction activities, and removal of habitat could require migrating birds to travel greater distances to locate suitable stopover habitat or stop in less suitable habitat. Depending on the additional distances traveled and/or quality of habitat found this could result in increased energy expenditure, competition, and/or predation.

Alternatively, conservation and restoration projects, such as the Palo Alto Cultural Landscape Restoration, and ongoing management and acquisition of National Wildlife Refuge and state preserve lands, would have a positive cumulative impact on wildlife habitat. Conservation of these areas in perpetuity ensures that no future development would occur. Thus, these areas will continue to serve as suitable wildlife habitat in the area. Nevertheless, as discussed above, given the number of large-scale developments in the area, cumulative impacts on wildlife habitat (vegetation) are anticipated to be moderate.

Cumulative impacts on wildlife as a result of increased noise, lighting, road traffic, and general human activity, would be greatest during the concurrent construction of the proposed Project and other projects considered; however, due to operational noise and permanent facility lighting associated with the three LNG terminals and several of the other projects that have permanent facilities, permanent cumulative impacts would also occur. While portions of the HUC-12 watershed are already developed and characterized by industrial activities such as those projects closer to Brownsville, other areas such as the northern and eastern portions of the watershed, including the proposed terminal site, are less developed (see figure 4.13.1-1). In general, projects located in areas characterized by more extensive existing development are anticipated to have less of an impact on wildlife than projects located in areas where there is less development. Wildlife inhabiting developed areas is likely to consist of human commensal species or individuals that have otherwise become acclimated to human activity.

Cumulative impacts on wildlife resulting from noise would be greatest during the concurrent construction of the projects considered, but would also occur to a lesser degree during operation. Quantitative cumulative noise impacts are further discussed in section 4.13.3.9. While noise contributions from the proposed Project would not directly impact wildlife beyond the geographic scope for cumulative noise impacts, an overall increase in noise associated with projects located throughout the HUC-12 watershed could limit the available habitat not affected by noise to which disturbed wildlife can relocate. Wildlife that cannot relocate away from noise-emitting sources could be adversely affected by increasing stress levels and masking auditory cues necessary to avoid predation or hunt prey and find mates.

Construction lighting requirements likely vary among the projects considered; however, it can reasonably be assumed that several of the larger industrial projects, waterway improvement projects, and transportation projects could require nighttime construction lighting. Most of the projects considered are not anticipated to require operational facility lighting, with the exception of the industrial developments (e.g., the proposed Project, Texas LNG Project, Rio Grande LNG Project, and the Port of Brownsville projects). Increased lighting can cause more mobile wildlife such as migrating birds to become disoriented, and can increase predation on prey species by making them more visible to predators. Artificial lighting can also adversely affect wildlife behavior by causing individuals to avoid the area or alter sleep/activity patterns. FERC-regulated projects would minimize impacts on wildlife as a result of lighting by implementing project-specific facility lighting plans that incorporate the use of shielded, down-facing lights, to the extent practicable (see section 4.6.1.2). Other facilities with federal permitting requirements may utilize similar methods to minimize the impacts of lighting on wildlife.

Elevated structures such as storage tanks, communication towers, flares, and transmission lines would also contribute to cumulative impacts on migratory birds. Annova would minimize the likelihood of bird strikes and disturbance to birds by employing directional lighting at the LNG terminal, following a lighting control plan, and by lowering construction crane booms when not in use. Other projects with elevated structures and federal permitting requirements may implement similar measures to minimize impacts on migratory birds; however, bird strikes with elevated structures could still occur.

Increased road traffic associated with the projects considered would result in cumulative impacts on wildlife as a result of increased noise, light, and wildlife-vehicle collisions. The effects of increased noise and light on wildlife are discussed above. However, wildlife in the area are currently exposed to traffic along existing roads, and wildlife-crossing projects reduce the risk of collision where they have been implemented. Further, the majority of workers would be travelling to and from the project areas during daylight hours and, because the traffic associated with construction and operation of the Project and other projects within the geographic scope would be within the capacity of existing roadways, cumulative impacts on wildlife due to increased road traffic would be minor to moderate.

Overall, cumulative impacts on wildlife would be greatest during the concurrent construction of the projects considered, and would continue to a lesser extent during operation. Cumulative impacts on wildlife would occur as a result of habitat disturbance and loss and increased noise, light, and road traffic. While most projects considered are anticipated to implement best management practices to ensure restoration of temporarily affected wildlife habitat and minimize noise and lighting, we have determined that cumulative impacts on wildlife, including migratory birds, would be moderate.

Marine Wildlife and Other Aquatic Resources

Impacts on marine wildlife could occur from construction and operation of the Project as a result of dredging and excavating for the turning basin within the BSC and the adjacent marine berth. Section 4.6.2.1 provides detailed information on marine mammals that could occur in the BSC, including whales, dolphins, and manatee, though only the bottlenose and Atlantic spotted dolphins are common. Five species of ESA-listed sea turtles also occur in the Project area, as well as common fish and invertebrates, though the BSC supports little submerged vegetation, and seagrasses that support commercially important fish and crustaceans are not expected to occur there. Activities with the potential to affect fisheries also include hydrostatic testing of the LNG tanks, additional vessel traffic in the BSC, discharge of ballast water, cooling water intake and discharge, engine noise, stormwater runoff or spills, lighting, and noise from pile driving. Construction of the marine facilities would permanently alter approximately 6 acres of currently open water in the BSC. Direct impacts on fish resources would be limited to the BSC.

Impacts on marine wildlife associated with dredging include suspension of sediment and increased turbidities, which can reduce feeding efficiency. Annova plans to use hydraulic cutter dredges, which would reduce the potential for entrainment. Most aquatic species are mobile and would be able to escape the dredge's intake velocity. The Project impacts are expected to be short term and minimal, with water quality returning to baseline conditions after construction activity. Pile-driving during construction would be conducted mainly on the land, and the land would act as a sound buffer reducing underwater noise in the BSC. Any pile-driving conducted in the water would have minor sedimentation effects and would temporarily disturb any nearby marine wildlife, causing them to relocate.

Vessel traffic in the BSC would increase temporarily due to transportation of construction equipment, materials, and prefabricated modules to the Project site for construction. As described in section 4.9, the BSC sees an average of 1,057 vessel calls per year, including river and ocean-going vessels. The additional traffic from the Project represents up to a 3.4 percent increase in vessel calls per year during construction and up to a 7 percent increase in vessel calls per year during operation. Increased vessel traffic in the BSC and the Gulf Intracoastal Waterway could pose an increased risk to marine species from vessel strikes. However, based on the relatively small increase in shipping activity relative to the total shipping traffic occurring in the Gulf of Mexico, the slower speed of the LNG carrier traffic, and because Annova would provide LNG carrier captains with NOAA Fisheries' recommended strike avoidance measures, the potential for the Project to result in increased vessel strikes to marine mammals or sea turtles is discountable.

The Rio Grande LNG and Texas LNG projects also require dredging and pile-driving activities that would impact marine wildlife and fish in the BSC. These projects would also increase vessel traffic, with impacts similar to Annova's vessel traffic impacts. If all three LNG projects were constructed, a substantial increase in the number of large ocean-going vessels in the BSC would occur, estimated to be about 467 LNG carriers per year combined (80, 312, and 75 vessels per year for the Annova LNG, Rio Grande LNG, and Texas LNG projects, respectively). Although the slower speeds of the LNG carriers would reduce the potential for vessel strikes, the opportunity would clearly increase if all three projects are operational.

Increases in turbidity and potential decreases in dissolved oxygen associated with dredging could result in adverse effects to aquatic resources. Measures to minimize impacts during dredging are summarized in section 4.6.2.2. The waterway improvement projects identified in table H-1 in appendix H and the Rio Grande LNG and Texas LNG projects also require dredging table H-1 in appendix Hand could contribute to cumulative impacts on marine wildlife and aquatic species in the BSC. The improvement projects include the Bahia Grande Estuary Channel Widening, BIH Channel Improvement Project, and maintenance dredging of the BSC. The maintenance dredging for Port Isabel, and the Gulf Intracoastal Waterway would not impact the BSC. Maintenance dredging of the BSC, the BIH Channel Improvement Project, and Bahia Grande Estuary Channel widening activities would have impacts similar to those described for the Project. Impacts from dredging activities that occur periodically would be short term.

Discharge of hydrostatic test water may cause localized, short-term turbidity in the BSC, but potential impacts on aquatic resources would be localized and temporary. Ballast water discharged by LNG carriers docked at the marine berth would have minimal effect on the salinity regime, dissolved oxygen levels, water temperature, or pH in the BSC with temporary and minor impacts on aquatic resources. Cooling water intake and discharge by LNG vessels would have intermittent and minor effects on marine and aquatic resources, as would LNG carrier engine noise. Implementation of NPDES regulations, Annova's SPCC Plan, and its Plan and Procedures would all reduce the potential for spills or impacts on the waterway; therefore, impacts on fisheries due to stormwater discharge are expected to be negligible. In-water pile driving could have short-term, temporary effects on fisheries during construction. Mitigation measures for noise-related effects on fish would be determined based on consultation with NOAA Fisheries.

During operation, the three LNG projects would receive LNG carriers and while at the LNG terminals the LNG carriers would withdraw and discharge water for engine cooling. Withdrawal of cooling water would have direct effects on ichthyoplankton. Combined, engine cooling water withdrawal by LNG carriers for all three projects would have a minor impact on ichthyoplankton within the BSC.

The three linear non-jurisdictional facilities have the potential to impact the BSC by temporarily disturbing soils during construction; however, with the implementation of appropriate erosion and sediment control measures, these temporary impacts would be minimized. The natural gas supply lateral would cross the BSC using HDD which would avoid direct impact on aquatic habitat, fish, and marine wildlife.

Any of the other projects occurring within the HUC-12 watershed could impact aquatic species in the BSC if they cause surface water quality impacts of great enough magnitude and duration to adversely affect water quality in the BSC, though the likelihood of this diminishes with distance. Aquatic species would most likely be affected by pipeline projects that can impact surface water quality if the waterbodies are crossed via an open-cut crossing technique; however, these impacts are typically minor due to the short duration of in-water activities. Further, it is anticipated that larger waterbodies, such as the BSC, would be crossed via horizontal directional drill for pipeline projects including the natural gas supply lateral and Valley Crossing Pipeline, thereby avoiding direct impacts on aquatic species. We conclude that cumulative impacts on marine wildlife and other aquatic species would be moderate as a result of the potential for increased vessel strikes.

4.13.3.5 Special Status Species

The geographic scope for threatened and endangered species was generally determined to be the HUC-12 watershed; however, due to the diversity in life history and range of threatened and endangered species potentially affected by the proposed Project, cumulative impacts were independently reviewed for each species. For example, threatened or endangered bird species are more mobile with larger ranges when compared to terrestrial reptiles that may not extend beyond a relatively small area. Discussions of cumulative impacts on threatened and endangered species are grouped by taxa and are limited to only those threatened and endangered species identified in section 4.7 as potentially affected by the proposed Project. Species that are not anticipated to be present at the Project site, or otherwise affected by the proposed Project, due to a lack of suitable habitat or species range, are not discussed further with regard to cumulative impacts.

Terrestrial Mammals

<u>Ocelot and Jaguarundi</u>

The geographic scope for cumulative impacts on the ocelot and jaguarundi was considered to be terrestrial projects located within the HUC-12 watershed affected by the proposed Project. Projects considered for cumulative impacts on the ocelot and jaguarundi include the Rio Grande LNG Project and associated non-jurisdictional facilities, Texas LNG Project and associated non-jurisdictional facilities, non-jurisdictional facilities associated with the proposed Project, Valley Crossing Pipeline, San Roman Wind Farm, Cross Valley Project, transportation projects, Port of Brownsville projects, SpaceX Commercial Spaceport Project, Stargate Facility, and Palo Alto Battlefield Cultural Landscape Restoration.

The size and distribution of loma thornscrub in the Project area may support transient or resident ocelots and the surrounding BND and FWS refuge properties outside the Project area would likely provide additional protection and cover for this species. Moreover, the Project is located within a region considered by the FWS as being an important component of the coastal ocelot corridor connecting Texas and Mexico. This corridor is referred to by the FWS as the South Texas Coastal Corridor. The FWS believes that this corridor is essential for the movement and the genetic viability of the ocelot.

The Project would reduce habitat for ocelots and jaguarondi and could decrease the effectiveness of the habitat linkage provided by the South Texas Coastal Corridor. Further, these species could be struck by project vehicles or disturbed by increased human presence and artificial lighting. To address effects on the South Texas Coastal Corridor, Annova proposes to maintain a 185-acre wildlife corridor along the western site boundary. While Annova has proposed measures to minimize Project impacts on the ocelot and jaguarondi, we have determined that the proposed Project is likely to adversely affect the ocelot and jaguarundi; however, consultations under Section 7 of the ESA have not been completed (see our recommendation in section 4.7.3).

Not all of the projects listed above are anticipated to impact ocelot and jaguarundi habitat, such as the San Roman Wind Farm, which is located in primarily agricultural and open land, and the Port of Brownsville projects, which are located within densely developed, previously disturbed areas. In addition the Highway 100 wildlife crossings project is intended to minimize impacts from road traffic. The other two LNG projects, as well as the pipeline projects proposed in the area, are anticipated to have the greatest impacts on ocelot habitat through removal and conversion of habitats to industrial uses as well as fragmentation of existing habitats. In addition, these projects along with several of the transportation projects could result in increased road traffic and/or additional roads for transiting ocelots and jaguarundis to cross. Direct mortality as a result of the projects considered in this cumulative impact analysis for ocelots and jaguarundi are unlikely due to the mobility of the species; however, long-term impacts resulting from habitat loss/fragmentation and the potential for subsequent reduced genetic diversity from inbreeding could occur.

As discussed above, the past and continued development in and around Brownsville and across the border in Mexico has decreased the available corridor habitat necessary to connect ocelot and jaguarundi populations in Mexico and the U.S. While relatively small barriers such as the BSC and SH 4 do not create a significant impediment to individual movements, ocelots and jaguarundi require contiguous dense thornscrub for cover over longer distances (TPWD 2017b; 2017c). In addition, ocelots and jaguarundis are elusive species with relatively large home ranges and low population densities that tend to avoid human development and activity (FWS 2010b). The current remaining habitat corridor in the region to connect U.S. and Mexico populations is located adjacent to and within the proposed Rio Grande LNG and Texas LNG sites north of the BSC and within the proposed Project site south of the BSC. The area adjacent to the proposed Rio Grande LNG Project site is a conservation easement that will not be developed in the future. Annova LNG has been working closely with the FWS to configure their proposed project to reduce potential impacts on ocelots and jaguarundis to the maximum extent practicable. This includes maintaining an approximately 1,500-foot-wide corridor to the west of the Annova LNG terminal, directly across from the existing wildlife corridor on the north side of the BSC.

While a travel corridor would be maintained to allow ocelots and jaguarundis to move between Mexico and the U.S., the addition of three large industrial facilities in proximity to that corridor (Annova LNG, Rio Grande LNG, and Texas LNG projects) would create additional noise, light, and traffic, all of which could deter ocelots or jaguarundis from utilizing the corridor. However, in an effort to minimize impacts as a result of increased light pollution on all wildlife, including ocelots and jaguarundis, all three LNG projects have indicated that they would utilize down-facing lights. Other impacts, such as those associated with noise, would be minimized by the projects to the extent practicable; however, due to the proximity of the Project and Rio Grande LNG Project to the wildlife corridors, facility-generated noise during construction and operation would still be audible to ocelots and jaguarundis utilizing the wildlife corridor.

In addition, increased road traffic along SH 4 associated with the Annova LNG Project, natural gas supply lateral, Valley Crossing Pipeline, SpaceX Commercial Spaceport Project, and the Stargate Facility, as well as increased traffic along SH 48 associated with the proposed Project, Rio Grande LNG Project, natural gas supply lateral, Valley Crossing Pipeline, and the Port of Brownsville projects could result in increased potential for vehicle strikes on ocelots and jaguarundis.

As described above, there is potential for the continued reduction of suitable ocelot and jaguarundi habitat to a single, narrow corridor among industrial facilities. This loss, degradation, and fragmentation of habitat have been cited by the FWS in its 2010 Recovery Plan, as the primary threat to U.S. ocelot and jaguarundi populations. The further narrowing of this corridor could result in decreased dispersal of individuals between U.S. and Mexico populations, resulting in decreased genetic diversity. Further, the projects assessed for cumulative impacts on ocelots and jaguarundis would increase road traffic, particularly during periods of concurrent construction (see table 4.13.1-1), which is the primary cause of direct mortality on U.S. ocelot and jaguarundi populations (TPWD 2017b, 2017c). Due to the past, present, and proposed future development throughout the geographic scope for assessing cumulative impacts on ocelots and jaguarundis, as well as the associated increases in road traffic, light, and noise, we have determined that cumulative impacts on ocelots and jaguarundis would adversely affect these species.

Birds

Four bird species of concern have the potential to occur in the vicinity of the Project. These include the federally listed northern Aplomado falcon, piping plover (and its critical habitat), red-crowned parrot (candidate for federal listing), and the red knot. As discussed in section 4.7.1, we have determined that the Project would be unlikely to cause a trend towards federal listing for the red-crowned parrot (candidate for listing) due to the lack of nesting habitat at the Project site. The three federally listed birds with higher potential to use the Project site are discussed further below.

The geographic scope for cumulative impacts on the northern Aplomado falcon was considered to be terrestrial projects located within the HUC-12 watershed affected by the proposed Project. Projects considered for cumulative impacts on the northern Aplomado falcon include the Rio Grande LNG Project and associated non-jurisdictional facilities, Texas LNG Project and associated non-jurisdictional facilities, non-jurisdictional facilities associated with the proposed Project, Valley Crossing Pipeline, San Roman Wind Farm, Cross Valley Project, transportation projects, Port of Brownsville projects, SpaceX Commercial Spaceport Project, Stargate Facility, and Palo Alto Battlefield Cultural Landscape Restoration. Listed shorebirds are also discussed here, however, only projects that affect their shoreline habitats are considered.

Approximately 186 acres of potentially suitable habitat for listed bird species would be affected during construction and 147 acres would be affected during operation of the Project. Land clearing could negatively impact some of the federally listed or candidate bird species by removing suitable habitat, especially northern Aplomado falcons that rely on larger plants to perch and nest, such as yuccas. Loss of grassland and yuccas from within the Project site could result in loss of habitat for the northern Aplomado falcons. Listed birds could be further affected by Project noise, lighting, and increased human activity and vehicle traffic. There is also potential that federally listed birds could collide with the flare stack structures or the flares.

Because this species is highly mobile and typically departs at the approach of humans and considering that Annova would implement measures to minimize effects, we have determined that the Project may affect, but is not likely to adversely affect the northern Aplomado falcon.

For the majority of projects considered, impacts on northern Aplomado falcons are not known; however, suitable habitat is also present on the Texas LNG and Rio Grande LNG sites and would likely be crossed by the linear transmission and pipeline projects in the area, although the Texas LNG and Rio Grande LNG projects have also determined that neither of these projects are likely to adversely affect the norther Aplomado falcon. The Port of Brownsville projects are primarily located in an already industrialized area that likely does not provide suitable habitat for northern Aplomado falcons. The San Roman Wind Farm, LNG projects, and overhead transmission line projects include elevated structures and wires that could result in bird strikes. These impacts would be similar to those discussed in section 4.13.2.6 for migratory birds. Impacts on habitat associated with the pipeline and transmission lines are anticipated to be temporary with construction areas restored following the completion of activities.

Although suitable piping plover and red knot habitat would be permanently affected by the Project, only 1 acre of habitat would be removed, and there is abundant high-quality wintering habitat in the vicinity of the Project site. Therefore, we have determined that the Project may affect, but is not likely to adversely affect, the piping plover and red knot, nor would it significantly destroy or adversely modify piping plover critical habitat. Regarding listed shorebirds (piping plover and red knot), the other industrial development projects considered, including the LNG projects and Port of Brownsville projects, are anticipated to result in similar impacts. The proposed Project, other LNG projects, and some of the Port of Brownsville projects, would result in the permanent conversion of the existing shoreline habitat to industrial land; however, the dredging of the Texas LNG marine berth would likely restore tidal flats north of the Project site, potentially creating additional habitat for shorebirds. The projects considered would result in a cumulative impact on piping plover and red knot; however, there is abundant wintering habitat present throughout the southern Texas coast, including within the Laguna Atascosa NWR, Lower Rio Grande Valley NWR, and the Los Lomas Ecological Preserve. We conclude that cumulative impacts on bird species of concern would be less than significant.

Sea Turtles

Other projects considered for cumulative impacts on sea turtles are those that would conduct activities within or otherwise affect the BSC. Projects considered for impacts on sea turtles include the Rio Grande LNG Project, Annova LNG Project, Valley Crossing Pipeline, natural gas supply lateral, four waterway improvement projects, and four Port of Brownsville projects.

As discussed in section 4.7.1.3, we have determined that the proposed Project is not likely to adversely affect sea turtles; however, consultations under Section 7 of the ESA have not been completed (see our recommendation in section 4.7.3). Impacts on sea turtles associated with the proposed Project are most likely to occur as a result of dredging and pile driving activities, as well as increased vessel traffic during construction and operation. Annova has indicated that it would implement measures designed to minimize potential impacts on sea turtles including conducting the majority of pile driving from land, prior to dredging, utilizing a cutterhead suction dredge, and providing all vessels associated with the Project guidance regarding measures to be implemented to avoid vessel strikes. Based on the implementation of these measures, we have determined that the proposed Project is not likely to adversely affect sea turtles; however, due to the concurrent construction schedules and scopes of the other projects considered, cumulative impacts on sea turtles would be likely to occur.

Impacts on sea turtles resulting from the other two LNG projects considered (Rio Grande LNG and Texas LNG) would be similar to those discussed for the proposed Project, as would the measures that would be implemented to minimize impacts. While both the Valley Crossing Pipeline and the natural gas supply lateral would cross the BSC, it is anticipated that these crossings would be conducted via HDD and would not result in any direct impacts on the BSC. Therefore, these pipeline projects are not anticipated to affect sea turtles. The Port of Brownsville projects considered were all recently completed and would not overlap with construction of the proposed Project; therefore, they would not contribute to cumulative impacts on sea turtles.

Based on the biological opinion issued for the Brazos Island Channel Improvement Project, dredging activities in the BSC utilizing hopper dredges routinely result in the direct mortality of sea turtles (COE, 2014). While the COE would implement numerous measures to reduce sea turtle mortality, such as pre-dredging trawls to safely remove sea turtles from the area, NOAA Fisheries has conducted a jeopardy analysis and issued a take permit to the COE with limits on the number of sea turtles that can be taken during dredging activities. It is anticipated that the other four waterway improvement projects, all of which require dredging activities, would have the potential to similarly impact sea turtles.

Publicly available information regarding the current anticipated schedules for the projects discussed above indicate that it is possible that construction activities associated with several of the waterway improvement projects and both of the other LNG projects would be concurrent with the proposed Project. In general, sea turtles present in the area at the start of construction activities are anticipated to relocate to nearby suitable habitat or avoid the area. However, the concurrent construction activities within the BSC could limit the habitat available to which sea turtles could relocate. For instance, a sea turtle startled into moving from one project area may relocate to another project area, and so on until suitable habitat is found. During dredging activities in which hopper dredges are used, such as the BIH Channel Improvement Project, this could cause sea turtles to move into the dredging area that might otherwise have been avoided by the turtle.

Similar to the impacts discussed in section 4.13.2.6 for other wildlife species, increased disturbance and searching for available habitat could result in increased stress and energy expenditure for sea turtles. Further, increases in sedimentation and turbidity (see section 4.13.2.3) as well as disturbance of benthic environments that serve as habitat for sea turtle prey species could also result in cumulative impacts on sea turtles by reducing water quality and prey availability.

Concurrent pile driving and dredging activities could result in cumulative increases in underwater sound pressure levels, as discussed in section 4.13.2.12. The only other projects considered for which pile driving might overlap with the proposed Project are the other two LNG projects. Both of these projects are anticipated to implement measures to minimize effects.

In addition to impacts on sea turtles resulting from construction activities, increased vessel traffic associated with the LNG projects and anticipated to occur as a result of the Port of Brownsville projects could also affect sea turtles in the area. Vessel strikes are a common cause of sea turtle mortality; however, it is anticipated that most vessels would adhere to the NOAA Fisheries Southeast Region's *Vessel Strike Avoidance Measures and Reporting for Mariners* (2008). Further, the BSC is an active vessel transit route to the Port of Brownsville and receives over 1,000 ships per year (BND 2017). Therefore, the increase in ship traffic could increase the likelihood of vessel strikes; however, this increase would be small due to implementation of NOAA Fisheries' guidance.

Based on the size and proximity of the projects considered, as well as the overlapping construction schedules, a cumulative impact on sea turtles is anticipated to occur. All projects are subject to the requirements of the ESA and are thus required to consult with NOAA Fisheries regarding potential impacts on sea turtles. Through this consultation process, the projects considered may be required to implement best management practices and/or other measures recommended by NOAA Fisheries to minimize potential impacts on sea turtles. In some instances, such as the BIH Channel Improvement Project, take of sea turtles may still be likely and NOAA Fisheries would issue a take permit. In other cases, such as the proposed Project, implementation of these measures may result in a determination that the project is not likely to adversely affect sea turtles. Individually, the projects considered are anticipated to have minor impacts on sea turtles; however, the density and nature of activities potentially occurring within the area would result in moderate cumulative impacts on resident sea turtles; however, these impacts are not anticipated to have population-level effects.

Marine Mammals

Whales

Other projects considered for cumulative impacts on whales (including the blue whale, fin whale, sei whale, sperm whale, and Gulf of Mexico Bryde's whale) are those that would include large ocean-going vessels, such as LNG carriers, transiting in the open Gulf of Mexico. Projects considered for cumulative impacts on whales include the Rio Grande LNG Project, Texas LNG Project, and Port of Brownsville projects that would contribute to large vessel traffic.

As discussed in section 4.7.1.1, we have determined that the proposed Project is not likely to adversely affect whales; however, consultations under Section 7 of the ESA have not been completed (see our recommendation in section 4.7.3). Although no whale species are expected to venture into the relatively shallow waters surrounding the Project, individual whales may be subjected to strikes by LNG carriers transiting in the open Gulf of Mexico to and from the Project. Although the whale species in the Gulf of Mexico vary in distribution, habitat, and behavior, effects of the proposed Project are expected to be similar for any species of whale. The LOR states that up to 80 LNG carriers per year would visit the Project; however, the likelihood of collision with a whale is low because whales are generally able to detect and avoid large vessels and Annova would provide LNG carrier captains with NOAA Fisheries' recommended strike avoidance measures as described in *Vessel Strike Avoidance Measures and Reporting for Mariners* (revised February 2008), which include vessel operators watching for and avoiding marine mammals.

Impacts on whales resulting from the other two LNG projects considered (Rio Grande LNG and Texas LNG) would be similar to those discussed for the proposed Project and additive. During operations, up to 80 LNG vessels would call on the Annova Project per year; about 312 and 75 vessels per year would call on the Rio Grande LNG and Texas LNG terminals, respectively. It is anticipated that vessels calling on other Port of Brownsville facilities, including the Annova LNG and Rio Grande LNG projects, would also comply with NOAA Fisheries' measures to minimize vessel strikes. Nevertheless, the three LNG projects would result in an increase in ship traffic by about 722 vessels per year within the BSC during construction and 467 vessels per year during operation, which would increase the likelihood of vessel strikes. However, the probability of any whale encountering an LNG carrier in the open Gulf is low because whales are generally able to detect and avoid large vessels and NOAA Fisheries and the Coast Guard provide educational materials to vessel operators to increase awareness of whales in sensitive areas. Therefore, cumulative impacts on marine mammals from increased vessel traffic is anticipated to be minor.

West Indian Manatee

Other projects considered for cumulative impacts on West Indian manatees are those that would conduct activities within or otherwise affect the BSC. Projects considered for cumulative impacts on West Indian manatee include the Rio Grande LNG Project, Texas LNG Project, Valley Crossing Pipeline, natural gas supply lateral, four waterway improvement projects, and four Port of Brownsville projects.

As discussed in section 4.7.1, we have determined that the proposed Project is not likely to adversely affect the West Indian manatee; however, consultations under Section 7 of the ESA have not been completed (see our recommendation in section 4.7.3). Impacts on West Indian manatee resulting from the proposed Project could result from dredging and pile driving activities, as well as increased vessel traffic during construction and operation. However, due to the rarity of manatee occurrence in the Brownsville area, as well as the lack of suitable foraging habitat, impacts are not anticipated.

Impacts on West Indian manatees resulting from the other two LNG projects considered (Rio Grande LNG and Texas LNG) would be similar to those discussed for the proposed Project. While both the Valley Crossing Pipeline and the natural gas supply lateral would cross the BSC, it is anticipated that these crossings would be conducted via HDD and would not result in any direct impacts on the BSC. Therefore, these pipeline projects are not anticipated to affect West Indian manatee. In addition, the four Port of Brownsville projects considered were all recently completed and would not overlap with construction of the proposed Project. Therefore, the Port of Brownsville projects are not anticipated to contribute to cumulative impacts on West Indian manatees.

Publicly available information regarding the current anticipated schedules for the projects discussed above indicate that it is possible that construction activities associated with several of the waterway improvement projects and both of the other LNG projects would be concurrent with the proposed Project. All projects operating within the BSC are anticipated to implement measures identified by FWS (see section 4.7.1.2) to minimize potential impacts on manatees. Due to the rarity of the West Indian manatee and measures that would be implemented if a manatee were to occur within the BSC, cumulative impacts are not anticipated to occur.

4.13.3.6 Land Use and Recreation, and Visual Resources

Land Use and Recreation

The geographic scope for land use and recreation areas for the Annova LNG Project was determined to be Cameron County. The projects listed in table H-1 in appendix H would disturb thousands of additional acres of land affecting a variety of land uses. The Texas LNG and Rio Grande LNG projects and associated non-jurisdictional facilities, non-jurisdictional facilities associated with the proposed Project, the Valley Crossing Pipeline, the San Roman and Cameron Wind Farms, the Cross Valley Project, several transportation projects, all of the waterway improvement projects, and the other large industrial projects identified in table H-1 in appendix H have the most potential to contribute to cumulative impacts on land use and recreation areas.

Projects with permanent aboveground components (e.g., buildings), wind energy projects, roads, and aboveground electrical transmission lines would generally have greater impacts on land use than the operational impacts of a pipeline, which would be buried and thus allow for most uses of the land following construction. Therefore, with the exception of aboveground facilities and the permanent right-of-way, pipeline projects typically only have temporary impacts on land use. The majority of long-term or permanent impacts from buried pipelines on land use are associated with vegetation clearing and right-of-way maintenance.

As discussed in section 4.8, the Project site is located entirely on BND land designated for industrial development, although it is currently undeveloped. As a result, the area that would be affected by the Project includes open land (87 percent), non-forested wetlands (11 percent), barren land (1 percent), and open water (1 percent). Construction and operation of the Project is not expected to affect existing or planned residential or commercial land uses, restrict land use on adjacent properties, or displace any residences or businesses, including the proposed SpaceX vertical launch area or the STARGATE Research Facility, located approximately 6.3 and 4.3 miles east-southeast of the Project, respectively.

The lands surrounding the Project site are largely undeveloped, providing a variety of dispersed outdoor recreational activities, including fishing and bird/wildlife watching. There are also designated recreation sites and facilities located in the Project vicinity. During construction, some recreationists may experience short-term increases in levels of dust, noise, and traffic, as well as visual impacts. Project construction and operation would not permanently affect access to the majority of regional fishing locations in the waters in the vicinity of the Project site. During Project operation, LNG carriers transiting the BSC to and from the Project site could potentially impact recreational boaters as a result of delays.

During construction, non-jurisdictional facilities related to the Annova LNG Project would be expected to have a similar effect on land use and recreation as the Project; however, the impacts would be less due to the smaller size and scope of the projects. The STEC electric transmission line servicing the Annova LNG Project would also be a new feature in an area that is currently undeveloped. After construction, temporarily affected areas within the linear corridors would be restored with vegetative habitat, though some vegetation may be converted from scrub-shrub to upland grassland/herbaceous to prevent tree growth within the buried utility and gas pipeline corridors.

Ongoing and recently completed projects, such as the San Roman Wind Farm (4,000 acres) and the Cameron Wind Farm (15,000 acres), have contributed to the conversion of the land in Cameron County to industrial use; however, given that the actual acreage of conversion within these facilities is minimal (i.e., the majority of land is still able to be used for agricultural purposes), contributions to cumulative impacts on land use from these projects would be permanent, but negligible, when considered with the total available land in Cameron County. Construction of the Highway 100 Wildlife Crossings would be within or adjacent to an existing roadway; therefore, contributions to cumulative impacts from construction of these crossings would also be negligible.

If the Rio Grande LNG and Texas LNG projects are permitted and constructed, these projects would convert additional land in Cameron County from the current land use to industrial land. While cumulative impacts on land use would be permanent, these types of projects are consistent with BND's long-term plan for the Port of Brownsville and the BSC, which identifies the area as intended for heavy industrial use. In total, the three Brownsville LNG terminals would permanently affect about 1,573 acres of generally undeveloped land, including a mixture of vegetated (herbaceous or scrub-shrub) and unvegetated land, 1,464 acres of which would be permanently converted to developed land. Although we do not have project-specific land use information for projects not under the jurisdiction of the FERC, we can estimate the total impact of each project based on the length of the project and industry standards on the right-of-way width for a given diameter pipeline. Assuming a construction right-of-way width of 125 and 150 feet, respectively, the Valley Crossing Pipeline would impact about 2,546 acres of land and the Cross Valley project would impact about 1,746 acres of land, of which about 751 and 867 acres, respectively, would be in Cameron County; land crossed is assumed to be similar in cover type to that crossed by the Rio Bravo Pipeline System. Similarly, the Rio Bravo Pipeline is anticipated to affect about 1,357 acres, though not all of this would be in Cameron County. While the Project would be consistent with BND's long-term plan, construction and operation of this and other projects would result in permanent changes in land use and would contribute to a cumulative impact on land use in Cameron County.

Based on the information currently available for the other projects, the Rio Grande LNG and Texas LNG projects, and their associated new pipelines and non-jurisdictional facilities, could impact recreation and special use areas that would be in proximity to the Annova LNG Project. Construction of these projects at the same time and at nearby locations as the proposed Project would result in short-term cumulative impacts on the recreation and special use areas. However, none of these recreation areas would be affected by the footprint of the proposed LNG facilities. Further, given the existing inventory of recreation areas in Cameron County and their large geographic area with multiple access points, cumulative impacts on recreation would be minor.

In summary, the Annova LNG Project would result in temporary and permanent impacts on existing land use and short-term impacts on recreation areas. If other projects in Cameron County are built at the same time as the proposed Project, cumulative impacts on land use and recreation would be additive. However, certain projects such as the South Padre Island Beach Re-nourishment, the Highway 100 Wildlife Crossings, and the Palo Alto Battlefield Cultural Landscape Restoration are focused on maintenance or enhancement of the natural environment; as such, these projects may result in positive effects on land use and recreation in Cameron County. Overall, the cumulative impacts of the Project when considered with other projects would be permanent and minor given the area of Cameron County (more than 800,000 acres) and the large inventory of recreation areas with multiple access points. Further, the Project would be consistent with BND's long-term plan, which identifies the area as intended for heavy industrial use.

Visual Resources

The geographic scope for visual resources was considered to be the area within 5.1 miles of the Annova LNG Project site, which was determined to be the farthest distance at which Project impacts on a visual receptor or KOP would be moderate or greater.

Short-term impacts during construction would include the presence of equipment and workers, the increase in construction related traffic (on land and in the BSC), and the installation of large structures at the terminal sites. For land- and water-based mobile receptors, this impact would be short, lasting only the duration of time for the vehicle or vessel to pass the site.

Visual sensitivity in the Project area is generally considered to be high because a large proportion of the viewers in the area are there for recreation and leisure activities. Annova evaluated 10 KOPs at representative visually sensitive areas, including areas used for recreation and wildlife viewing, key travel routes, and other public gathering areas. Potential visual impacts ranged from low to moderate, with the exception of the KOP at the SH 48 pull-off near Bahia Grande Pilot Channel where impacts would be moderately high.

The towers and wires of the STEC transmission line would be visible and affect the visual quality in portions of the area that are currently undeveloped. The natural gas and water supply pipelines would be buried and not visible once installed. The natural gas interconnection facilities would be on the Project site and not individually contribute to visual impacts.

Construction of the other two proposed LNG projects on existing undeveloped land on the north side of the BSC would also contribute to changes in the visual quality in portions of the area. The Rio Grande LNG Project would include four LNG storage tanks, combustion turbine stacks, and flare stacks. The visual impacts would be greater than those described above for the Annova LNG Project given the larger size and the location adjacent to SH 48. The Texas LNG Project would include two LNG storage tanks and two flare stacks. Although the Texas LNG Project would be smaller than the Annova LNG Project, the visual impacts could be greater than those described above for the Annova LNG Project because the Texas LNG Project would be relatively close to SH 48.

The five dredging activities identified in table H-1 in appendix H as overlapping with the Project geographic scope for visual resources would use vessels in the BSC, usually for several months during each dredging cycle. Dredging vessels would be visible to other vessels on the BSC and from the Jaime J. Zapata Memorial Boat Ramp. However, visual impacts from these dredging activities would be short term and negligible.

The Brownsville Liquids Terminal (Phase 1) is a completed liquids storage terminal that includes a 10-railcar loading facility, a 4-bay rack, and 21 liquid storage tanks located on the north side of the BSC near the turning basin in an area with similar existing facilities. Completion of the Brownsville Liquids Terminal (Phase 1) contributes to the increased industrial character along the BSC. The planned STARGATE facility would contribute additional changes to the visual character and quality. The natural gas supply lateral and Nueces to Brownsville pipelines and the gas pipelines associated with the other LNG projects would all be buried, and once constructed, any visual impact would be limited to compressor stations and locations where the permanently maintained pipeline right-of-way would cross wooded areas. The change in vegetation on the pipeline rights-of way would have a minimal impact on the visual quality of the area.

Based on consultations with the NPS on the Palmito Ranch Battlefield NHL and the Palo Alto Battlefield NHL, Annova examined potential visual impacts from the Project on these sites. Visual simulations created from points located in proximity to the battlefields represent views of visitors to the battlefields. The overall visual impact on the Palmito Ranch Battlefield NHL and the Palo Alto Battlefield NHL KOPs would range from no effect or negligible in some areas to moderate or moderately high in other areas, depending on varying degrees of distance, partial screening, and foreground vegetation.

As multiple industrial facilities are constructed along the BSC and nearby, the visual quality of the area would change from natural and partially developed to more industrial. Although each project evaluated would be located within designated industrialized areas, and would be in context with planned industrial development, the changes to visual quality would be apparent. Views looking south or west from north of the BSC would generally be dominated by the Rio Grande LNG and Texas LNG projects. For these views, the Project's contribution to cumulative aesthetic impacts would be minor. For views looking west, north, or east from south of the BSC, and for views looking east from north of the BSC, the Project would be dominant or codominant with the Rio Grande LNG and Texas LNG projects. For these views, the Project's incremental contribution to cumulative aesthetic impacts would be moderate to high.

The Annova Project would result in temporary, short-term, and permanent visual impacts. If other projects visible from a common vantage point are constructed, cumulative impacts on the viewshed would occur. In consideration of the BND's long-term plan, which identifies use of the area of the three LNG projects as industrial, we conclude that cumulative impacts on visual resources from the Project when considered with other projects would be moderate.

4.13.3.7 Socioeconomics

Population and Employment

An average of 700 workers, of which 253 would be non-local, would be employed during the 48-month construction period for the Project, with as many as 1,200 (including 780 non-local) workers employed during the peak of construction. Non-local workers may temporarily relocate to the region. Project-related construction impacts on the regional population would result in a short-term, moderate increase to the local population, and Project operation would result in a negligible, long-term increase. Operation of the LNG terminal would result in the creation of 165 permanent positions (see section 4.9).

Several of the projects listed in table H-1 in appendix H would also require construction workers during the same period, most notably the Rio Grande LNG and Texas LNG projects. If the three LNG projects were constructed concurrently, the construction labor requirements would be highest during construction beginning in for the first four years when all three projects would be under construction. Based on the average construction workforce, these projects would be expected to employ about 4,350 construction workers in total and at peak construction the combined workforces would be about 7,737 workers.

Following construction, the three LNG projects would result in the addition of about 545 workers. In addition to this direct employment, the projects would likely result in increased indirect employment based on the purchases of goods and services. Collectively, the three LNG terminals would spend an estimated $4.9 billion on direct expenditures. These expenditures and workforce associated with construction and operation of the LNG projects would result in cumulative positive, short-term and permanent impacts, respectively, on the local economy.

Other projects identified in table H-1 in appendix H would likely have staggered timelines for specific labor needs, so some construction personnel working within the geographic scope may be able to support multiple projects. This would have a cumulative effect of decreasing the overall labor force required to meet the needs for all projects, however based on the size and types of these other projects, as well as the temporary nature of construction, the overall impact would likely be negligible. Finally, some of the projects identified in table H-1 in appendix H may not be permitted and/or built, which would reduce the total labor need within the geographic scope of analysis.

The Annova LNG Project would reduce unemployment in the Project area and potentially could result in the need to hire and train construction workers from outside the Project area to meet the needs of all projects in the geographic scope. Positive benefits from the new jobs and workers in the area would include increasing revenue for local business owners and generating new tax revenue in the geographic scope of analysis. Expenditures and the workforce required for construction of the Project, in combination with other projects in the geographic scope, would result in temporary cumulative impacts during the construction period; operation of the proposed Project and other projects would result in a positive, permanent impact on the local economy.

Housing and Public Services

The influx of non-local workers associated with construction of the Project would affect the availability of housing in Cameron County. The cumulative impact on local housing may result in increased rental rates and housing shortages if all the proposed and planned projects in the geographic scope of analysis are implemented according to the expected timeframes. This would benefit the local housing market but would adversely affect those seeking housing.

The combined construction workforces for the projects identified in table 4.13.3-1 would increase the need for some public services, such as police, medical services, and schools. The need for these services would generally be spread throughout the counties that house the workforce for the projects, but there may be an increased cumulative need for medical and emergency services in Cameron County where the three proposed LNG projects would be developed and associated construction workers are expected to be concentrated. Annova would work directly with local law enforcement, fire departments, and emergency medical services to coordinate for effective emergency response at the Project site. Annova does not anticipate the need for additional local emergency services and facilities during normal Project operations.

With construction of the three LNG terminal projects lasting several years, it is likely that some non-local construction workers would relocate to the area with their families, including school-age children. This would increase the enrollment in some schools in counties housing the workers with families; however, as increased enrollments would likely be spread throughout many school districts, the cumulative effect on schools would be long-term, but minor.

Based on the number of available rental units and motels/hotels in Project area, it is anticipated that there would be sufficient housing available for the anticipated peak workforce for the Annova LNG Project as well as the other two LNG projects. While the other LNG projects may be constructed concurrently with the proposed Project, and non-local workers for these projects are expected to find housing in similar areas, and specifically Cameron County, the county has sufficient temporary housing to accommodate the influx of workers. Similarly, the increased need for public services and school enrollment to support non-local workers and their families for the Annova and other projects would be spread across the geographic scope. Further, with the expected increase in local taxes and government revenue associated with the proposed projects, we conclude that cumulative impacts on available housing and public services during construction of the proposed Project would be temporary and minor. Operation of the Project would require

165 new full-time workers and would, with other projects in the vicinity, contribute to minor cumulative impacts on housing resources and public services.

Land Transportation

Unlike other socioeconomic impacts that could occur throughout the two counties, land transportation impacts would be more localized. For this reason, we considered a 15-mile radius for the geographic scope in evaluating cumulative impacts on land transportation. During construction and operation of the proposed Project and the other LNG terminal projects described above and in table H-1 in appendix H, roadways in the area would experience a substantial increase in daily vehicle trips as a result of material and equipment deliveries and commuting of construction personnel to and from the LNG terminal sites. Due to staggered construction schedules and the distance between the project sites for other projects identified in table H-1 in appendix H, cumulative impacts on traffic from projects that are not located adjacent to the BSC may be substantial at times, but are expected to be intermittent, short term, and localized.

Potential land transportation impacts were assessed by evaluating how construction and operation of the Project would likely affect traffic volumes, circulation patterns, and Level of Service (LOS, which is a qualitative measure of traffic flow) on roadways within the Project area. The Project would increase traffic on several roadways and intersections during construction when up to 2,000 vehicle trips would occur each day. The greatest impacts on roadway traffic from the Annova LNG Project would occur on SH 48, SH 4, and FM 511. Annova proposes to transport construction workers to and from the construction site from a centralized location via passenger buses to further reduce potential impacts and reduce potential delays at the Border Patrol checkpoint on SH 4 (Boca Chica Boulevard).

The construction and operation activities of the Rio Grande LNG and Texas LNG projects would also directly impact vehicle traffic. Roadways in the area would see a substantial increase in daily vehicle trips as a result of material and equipment deliveries and commuting by construction personnel. Because these two LNG projects are located on the north side of the BSC, construction traffic accessing those sites from Brownsville would primarily use SH 48 and FM 511. The Rio Grande LNG Project proposes to reduce vehicle traffic using buses; however, construction workers would use local roads to reach the parking and staging area for buses. Due to the possibility of staggered construction schedules and the distance between the facilities, impacts on traffic from construction would be substantial, short term, and localized.

If the three LNG projects were constructed concurrently, the combined impact of construction traffic would be approximately 8,204 daily trips during active construction. This cumulative impact would result in increased wait times and congestion on local roadways. Wait times and congestion would return to near pre-construction conditions during operation of the projects. The Annova LNG Project accounts for approximately 14 percent of the estimated increase in vehicle trips.

Construction traffic for the three linear non-jurisdictional facilities may increase traffic on many of the same roadways, including SH 48, SH 4, and FM 511. The spatial and temporal overlap of the linear features with the Project is expected to occur over weeks or months at most. Due to their relatively small size of construction overlap at any time, construction of the three linear non-jurisdictional facilities and the Nueces to Brownsville pipeline would contribute negligibly to cumulative impacts on vehicle traffic.

Most of the projects and activities listed in table H-1 in appendix H occur within 15 miles of the Project and could contribute to cumulative impacts on vehicle traffic (excluding the dredging or waterway improvement activities). Impacts would be greatest if construction of multiple projects occurred concurrently. The commerce and industry activities identified in table H-1 in appendix H as overlapping with the Project's geographic scope for traffic would also increase traffic conditions if the same local road network is used at the same time. However, several infrastructure and transportation projects or activities would by design likely have a positive impact on transportation once completed.

Based on the results of the commissioned studies for the proposed Project and other LNG terminal projects, the Annova LNG Project and other projects would contribute to a moderate cumulative impact on roadways during the construction period. The proposed Project would contribute to a permanent but negligible impact on roadway transportation during operations, because a relatively small number of new permanent employees would be required to operate the Annova LNG Project facilities.

Marine Transportation

Only those projects or activities that could contribute to vessel traffic on the BSC were evaluated for potential cumulative impacts. Projects or activities listed in table H-1 in appendix H that could contribute to cumulative vessel traffic impacts on the BSC include the proposed LNG projects and the seven dredging or waterway improvement projects.

Current vessel traffic in the BSC is about 1,059 vessels per year, which equates to an average of about 88 vessels per month, including 61 barges (Port of Brownsville 2015b). Construction and operation of the Annova LNG Project would result in an increase in marine traffic in the area. During construction, the Project would generate up to 36 barge trips per year, which represents an increase of about 3 percent of similar sized vessel calls in the BSC per year. This represents a negligible incremental contribution to the vessel traffic. When combined with deliveries associated with the construction of other reasonable foreseeable projects, concurrent construction would noticeably increase the number of barges transiting the channel. Impacts on other users of the waterway from barge traffic associated with construction would be consistent with existing use of the waterway.

During operation, up to 80 LNG carriers would call on the Annova LNG Terminal per year; about 312 and 75 LNG carriers per year would call on the Rio Grande LNG and Texas LNG terminals, respectively. Because large vessel traffic in the BSC is one-way, and LNG vessels are subject to a moving security zone during transit, LNG vessels in transit to the Annova LNG, Rio Grande LNG, and Texas LNG projects could preclude other vessel traffic. To minimize impacts on other users of the BSC, it is anticipated that vessels would follow required procedures including the requirement to notify LNG terminal managers and relevant authorities of the expected arrival of an LNG vessel in advance to ensure that the timing of LNG vessel channel transits are aligned with other shipping schedules. The LNG vessels calling at the Rio Grande LNG and Texas LNG terminals would be subject to similar requirements.

The LNG carriers, like other ocean-going vessels, would stage in the Gulf of Mexico until directed to enter the BSC. This staging typically occurs as part of a port vessel traffic plan designed to manage marine traffic and reduce delays. The total estimated corresponding annual delay time for small vessels from the cumulative additional 467 inbound plus outbound LNG carrier trips ranges from 11 to 32 percent of daylight hours per year. The Project's 80 LNG carrier trips per year would account for approximately 22 percent of this increase.

As previously described, construction of the Project and other projects are likely to temporarily increase barge and support vessel traffic in the BSC. Concurrent construction would likely result in a cumulative impact on vessel traffic in the waterway, primarily by increasing vessel travel times due to congestion. During operations, LNG vessels calling on the Annova Project and other LNG facilities along the BSC would have moving security zones that could preclude other vessels from transiting the waterway. Prior notice of expected LNG vessel arrivals would minimize impacts on other vessels. As a result, we conclude that there would be a moderate cumulative impact on vessel traffic in the BSC during construction and operation of the Project.

Environmental Justice

In section 4.9.9, we present the minority and low-income population percentages in the State of Texas, Cameron County, and the corresponding census blocks groups (tables 4.9.9-1). Because minority populations and low-income communities, as defined per the EPA guidelines, are present in the geographic scope, they may be subject to cumulative impacts from the proposed Project and other projects considered. The geographic scope for environmental justice was determined to be those communities within 2 miles of the Project site because they would be the most likely to experience effects from the Project due to proximity.

As discussed in section 4.9.9, the nearest residential areas associated with environmental justice communities are about 2.3 miles from the proposed Project site. Although outside of the geographic scope for cumulative impacts for environmental justice, individuals may experience traffic delays, increased enrollment at public schools, and displacement of recreational fishermen and other visitors to the public use areas near the Project site. These impacts would be minor and short term, with the greatest impacts primarily occurring during construction.

Several of the projects listed in table H-1 in appendix H could contribute to potential impacts on minority populations and low-income communities, most notably the Texas LNG and Rio Grande LNG projects. Contractors working on these projects would be required to comply with applicable equal opportunity and non-discrimination laws and policies. The criteria for all positions would be based upon qualifications and in accordance with applicable, federal, state, and local employment laws and policies. Like the proposed Project, tax revenues generated from construction of these projects could be used to offset impacts on public schools and infrastructure.

Potential air pollutant emissions from operation of the proposed Project would be below the threshold for unhealthy air quality. Other projects that are permitted and built would be held to the same air quality standards. Therefore, the proposed Project's contribution to cumulative impacts on the low-income or minority populations in the Project area would be limited to minor and temporary traffic delays and potential impacts on public schools during construction.

FERC and Annova LNG have made documents and notices about the Project available to the public. FERC held public scoping meetings, as described in section 4.9.9, during which materials were provided in both English and Spanish to accommodate the local Hispanic and Latino population. In addition, during the public scoping meeting in Port Isabel for the Rio Grande LNG, Annova LNG, and Texas LNG projects, both English and Spanish-speakers were present to converse one-on-one with stakeholders in attendance. While one environmental justice community has been identified just outside of the geographic scope for the proposed Project, the Project impacts discussed in this EIS such as traffic delays during construction, impediment of fishing/recreational opportunities at discrete locations, constraints on public services, and impacts on air quality and noise would be the same for all communities, regardless of race or income. Therefore, the proposed Project is not expected to contribute discernable cumulative disproportionate, adverse effects on minority and low-income residents in the area.

4.13.3.8 Cultural Resources

The geographic scope for cultural resources was determined to be the Annova LNG Project site, access road, DMPA 5A, and a 0.5-mile area around the Project site. Eight other projects or activities listed in table H-1 in appendix H would be within this geographic scope and could contribute to cumulative impacts on cultural resources. Four of these would be located in the BSC or on the opposite side of the BSC from the Project (Rio Grande LNG, Rio Bravo Pipeline, Bahia Grande Estuary Channel widening, and BIH Channel Improvement projects). The projects within 0.5 mile of the Project site south of the BSC include the four non-jurisdictional facilities.

No archaeological or historic architectural resources listed in or eligible for listing in the NRHP were identified that would be affected by the Project. A small portion of the Project has not been surveyed for cultural resources but no other project overlaps with the footprint of the Annova LNG Project site, therefore, we find that the Project would not contribute to cumulative impacts on archaeological or historic resources.

Based on consultations with the NPS on the Palmito Ranch Battlefield NHL and the Palo Alto Battlefield NHL, potential Project-related visual impacts would occur to these sites. Visual simulations created from points located in proximity to the battlefields represent views of visitors to the battlefields. The overall visual impact on the Palmito Ranch Battlefield NHL and the Palo Alto Battlefield NHL KOPs would range from no effect or negligible in some areas to moderate or moderately high in other areas, due to varying degrees of distance, partial screening, and foreground vegetation.

4.13.3.9 Air Quality and Noise

Air Quality

Construction

The geographic scope for assessment of cumulative impacts on air quality during construction of the Project is the area within 1.0 mile of the LNG terminal[36], because construction

[36] Although the typical construction geographic scope for air quality is 0.25 mile, we expand this on a case-by-case basis for large projects like LNG terminals.

emissions would be highly localized.[37] The projects within the construction geographic scope that are most likely to contribute to cumulative air impacts include the Annova LNG and Texas LNG Projects, non-jurisdictional facilities associated with the Rio Grande LNG Project, and waterway improvement projects within the BSC.

Construction of the Annova LNG Terminal would affect air quality due to emissions from combustion engines used to power construction equipment, vehicle emissions traveling to- and from the LNG terminal site, marine deliveries of construction materials, and fugitive dust resulting from earth-disturbing activities and equipment movement on dirt roads. Criteria, VOC, and HAPs air emissions from projects in the vicinity of the Project would be additive.

General Conformity applicability thresholds do not apply at the LNG terminal site because the Project area is in attainment for all the NAAQS. Table 4.13.3-2 estimates the total cumulative emissions from concurrent construction of the Rio Grande LNG, Annova LNG, and Texas LNG Projects. While estimates for construction emissions from non-jurisdictional projects and waterway improvement projects within the BSC are not available, based on the intermittent and short-term nature of construction, these projects would have a minor impact on cumulative air emissions when considered with the proposed LNG terminals (including the Annova Project).

Cumulative impacts from construction would be limited to the duration of the construction period. However, with other projects in the vicinity, construction of the Annova LNG Project would contribute to localized elevated emissions near construction areas during the period(s) when construction of these activities would overlap. Due to the magnitude of the combined emissions, the greatest potential for cumulative impacts would be during years 3 and 4 (see table 4.13.3-1). When compared with the EPA's most recently available national emissions inventory data, cumulative construction emissions of NO_x, SO_2, PM_{10}, and $PM_{2.5}$, would represent greater than 5 percent of the 2014 inventory emissions levels (about 7.5, 52.4, 18.9, and 11.9 percent, respectively).

The EPA's national emissions inventory data include estimated emissions from on- and off-road mobile sources (vehicle travel), point sources (such as electric power generation facilities), and nonpoint sources (stationary sources that are individually small and numerous, such as residential heating and commercial marine vessels; EPA 2014). Previous national emissions inventories conducted in 2008 and 2011 documented greater total emissions for criteria pollutants than the 2014 data; however, we have presented data from 2014 as a conservative estimate and to present the most recent inventory data. Further, since the 2014 emissions inventory, economic growth in Cameron County may have resulted in increased air emissions. Given the high level of construction emissions estimated for the three LNG terminals relative to the most recently inventoried emissions in the Project area, simultaneous construction of these projects could result in a temporary, moderate to major increase in emissions of criteria pollutants during construction. Construction emissions are localized, and impacts would be greatest in the immediate vicinity of the LNG terminal sites.

[37] GHGs have no localized impact.

TABLE 4.13.3-2

Estimated Construction Emissions for the Brownsville LNG Projects

Facility and Year	Emission Type (tons per year) a/,b/					
	NO_x	CO	SO_2	PM_{10}	$PM_{2.5}$	VOC
Rio Grande LNG Terminal						
Year 1	12.0	18.6	2.0	589.4	60	0.7
Year 2	69.7	111.4	11.8	1,199.5	125.8	4.2
Year 3	127.8	174.3	23.5	1,146.6	125.8	6.4
Year 4	59.3	118.5	10.6	91.4	14.2	3.6
Year 5	45.0	106.7	8.0	56.1	9.2	2.9
Year 6	39.0	70.2	7.1	26.9	5.8	2.1
Year 7	1.2	10.4	<0.1	13.9	1.4	0.1
Year 8	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Annova LNG						
Year 1	23	40	0.04	293	30	2.6
Year 2	172	220	0.3	158	25	22
Year 3	152	224	0.25	126	21	17
Year 4	131	202	0.22	65	14	13
Year 5	50	86	0.08	59	8	6
Texas LNG						
Year 1	1.1	0.6	0.1	3.0	0.5	0.1
Year 2	62.3	35.9	4.2	177.7	28.7	4.0
Year 3	284.9	164.4	19.2	812.9	131.0	18.4
Year 4	397.9	229.6	26.8	1,135.3	183.0	25.7
Year 5	243.3	140.4	16.4	694.4	111.9	15.7
Year 6	31.9	18.4	2.2	91.1	14.7	2.1
Total Annual Construction Emissions						
Year 1	36.1	59.2	2.14	885.4	90.5	3.4
Year 2	304	367.3	16.3	1,535.2	179.5	30.2
Year 3	564.7	562.7	42.95	2,085.5	277.8	41.8
Year 4	588.2	550.1	37.62	1,291.7	211.2	42.3
Year 5	338.3	333.1	24.48	809.5	129.1	24.6
Year 6	70.9	88.6	9.3	118	20.5	4.2
Year 7	1.2	10.4	<0.1	13.9	1.4	0.1
Year 8	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PA National Emissions Inventory, Cameron County c/						
2008	9,366.2	52,511.8	107.0	32,165.8	4,371.8	28,884.9
2011	9,101.9	52,167.4	217.1	21,988.4	3,167.0	30,044.6
2014	7,864.3	43,352.9	82.0	11,023.3	2,340.3	24,701.4

a/ Emissions estimates include construction emissions from on- and off-road vehicle activity, truck deliveries, vessel activity, worker commutes, and fugitive dust.

b/ RG LNG estimated annual fugitive emissions from use of the temporary haul road; to estimate annual construction emissions, the total fugitive emissions were included for years 1, 2, and 3. In year 1, given that construction would not commence until about 6 months into the year, annual estimated fugitive emissions from the haul road were assumed to be half of those estimated for years 2 and 3.

c/ Due to refinements and modifications in the methods used to compile each inventory, the inventory results should not be used to describe year-to-year emissions trends.

Annova LNG, Rio Grande LNG, and Texas LNG would implement mitigation measures to minimize construction impacts on air quality, including application of water to minimize fugitive dust, limit engine idling, and using recent models of construction of equipment manufactured to meet air quality standards. Further, transport of construction materials associated with the Project could occur within the HGB area, which is a marginal nonattainment area for the 2015 8-hour ozone standard. Similarly, the Rio Grande LNG and Texas LNG Projects would also receive deliveries of construction materials originating from or being transported through the HGB area. Although cumulative emissions are not subject to General Conformity, the cumulative construction emissions from the Annova LNG, Rio Grande LNG, and Texas LNG Projects occurring within the HGB area would not be expected to result in an exceedance of applicable general conformity thresholds for the HGB area.

<u>Operation</u>

Traditional air pollutants such as criteria pollutants, volatile organic compounds, and hazardous air pollutants were listed for chronic and acute health impacts due to inhalation, as well as secondary environmental effects. For these pollutants, we can consider a geographic scope for cumulative impacts up to 50 kilometers.

GHGs were identified by the EPA as pollutants in the context of climate change. GHG emission do not cause local impacts, it is the combined concentration in the atmosphere that causes global climate (see Climate Change below) and these are fundamentally global impacts that feedback to localized climate change impacts. Thus, the geographic scope for cumulative analysis of GHG emissions is global rather than local or regional. For example, a project 1 mile away emitting 1 ton of GHGs would contribute to climate change in a similar manner as a project 2,000 miles distant also emitting 1 ton of GHGs.

The Annova Project would be considered a minor source because its emissions would be below regulatory thresholds defining major source emissions, thus, it is not subject to PSD review. Modeling of emissions from the Project combined with background concentrations of air pollutants demonstrates that the emission sources would not cause or contribute to an exceedance of a NAAQS. Projects that are most likely to contribute to cumulative air impacts with operation of the Project include the Rio Grande LNG and Texas LNG projects, non-jurisdictional facilities, and waterway improvement projects. Rio Grande LNG would be a major source of air emissions because it would exceed the regulatory thresholds defining major source emissions.

Operation of the Project would generate emissions from stationary equipment (e.g., heaters, flares, oxidizers, and emergency generators) and mobile sources (e.g., LNG carriers and tugs, personal vehicles). The region in the vicinity of the LNG terminal is currently in attainment with the NAAQS; however, increases in industrial point sources could affect local and regional air quality. During operation, stationary sources would not cause or contribute to an exceedance of a NAAQS (see section 4.11.1.6).

Emissions from currently operational facilities, such as the Brownsville Liquids Terminal and Port of Brownsville Marine Cargo Dock 16 and Storage Yard, are captured in ambient air quality monitoring data. While estimates of construction emissions from non-jurisdictional projects and waterway improvement projects within the BSC are not available, based on the intermittent and short-term nature of construction, these projects would have a negligible impact on cumulative air emissions if they are concurrent with operation of the Annova LNG Project.

To get a more refined cumulative impact analysis than a qualitative assessment at 50 km, we assessed the air dispersion modeling results provided for the Annova LNG, Texas LNG, and Rio Grande LNG Terminals and used these models to estimate the cumulative air emissions during concurrent operation at all three facilities. Table 4.13.3-3 includes the modeled ambient pollutant concentrations for the three Brownsville LNG terminals operating during full build-out, including LNG carriers and support vessels operating during LNG loading at the terminal sites. The estimated cumulative peak concentration is based on combining the predicted concentrations from each project at each receptor location regardless of the time when is occurs. Since the timing and location of the maximum predicted impacts from each terminal would differ, and because it is unlikely that all three terminals would be loading LNG carriers simultaneously, the method used to develop the peak cumulative concentrations is conservative.

Peak estimated concentration for criteria pollutants and averaging periods were compared to the NAAQS, which represent standardized air quality criteria and were therefore used as a benchmark for comparison against model results. For all pollutants, except for 1-hour NO_2, cumulative impacts are predicted to be below the NAAQS and would disperse before reaching population centers in Port Isabel and Laguna Heights. For 1-hour NO_2, the predicted maximum cumulative impact is estimated to exceed the short-term NAAQS of 188 $\mu g/m^3$. The predicted peak cumulative impact, however, is located between the fence lines of the Rio Grande LNG and Texas LNG terminals. It is unlikely, but possible, that people may be exposed to the NO_2 concentrations above the 1-hour NAAQS, which would occur on property within the Port of Brownsville. Concentrations of 1-hour NO_2 in residential areas in Port Isabel and Laguna Heights are estimated to be below 75 $\mu g/m^3$, which is well below the 1-hour NAAQS. While concurrent maximal operations of the LNG facilities would result in increased concentrations of air pollutants in the immediate vicinity of the facilities, the projects emissions are not expected to result in a significant impact on regional air quality, nor would any exceedance of the NAAQS occur in a populated area.

While the cumulative ambient modeling assessment does not account for concurrent construction, commissioning, and operations emissions, the greatest emissions from each LNG terminal are associated with operations. We are aware that each LNG terminal could be constructed within the same time period, and the concurrent construction, commissioning, and operations emissions of the Annova LNG Project and the other proposed LNG terminals could contribute significantly, potentially exceed the NAAQS in local areas, and result in cumulatively greater local air quality impacts. While these concurrent activities would result in greater ambient pollutant concentrations than those presented in table 4.13.3-3, emissions levels would not be expected to result in a long-term impact on regional air quality. Concurrent activities would be limited to the timeframe of construction and commissioning and start-up.

TABLE 4.13.3-3

Peak Concentrations Estimated in Cumulative Air Dispersion Modeling for Stationary Source and LNG carriers for the Brownsville LNG Projects

Criteria Air Pollutant	Averaging Period	Background Concentration a/ (µg/m3)	Peak Concentration based on Modeled Results (µg/m^3) b/				NAAQS (µg/m3)
			Rio Grande LNG Terminal	Annova LNG	Texas LNG	Peak Cumulative Concentration c/	
CO	1-hour	2,175.5	276.1	247.9	470.6	2,746	40,000
	8-hour	1,259.5	174.0	101.7	83.4	1,453	10,000
NO_2	1-hour	49.9	78.9	39.3	134.7	196	188
	Annual	6.1	2.7	0.5	1.8	9	100
SO_2	1-hour	10.6	2.0	3.8	10.3	23	196
PM_{10}	24-hour	62.0	1.4	0.7	2.3	64	150
$PM_{2.5}$	24-hour	22.9	1.3	0.7	2.0	25	35
	Annual	9.1	0.3	0.1	0.1	9	12

a/ Background concentrations retrieved from tables 4-1 and 4-2 of the dispersion modeling report provided for the Texas LNG Project (available on FERC's eLibrary website, located at http://www.ferc.gov/docs-filing/elibrary.asp, by searching Docket Number CP16-116 and accession number 20170928-5165).

b/ Modeled impacts include stationary sources and LNG carriers at the LNG terminal sites.

c/ Peak concentrations predicted for each of the three projects for each receptor location were conservatively combined without regard to day or time of occurrence, and include background concentrations. The peak cumulative concentration for each pollutant and averaging period does not equal the sum of the peak concentrations for each terminal and background, since peak concentrations associated with each terminal occur at different locations.

In addition to operation of the LNG terminal and the vessel emissions described in section 4.11.1.3, air emissions from LNG carriers, considered mobile sources of air emissions, would occur along the entire LNG carrier route during operations. These mobile sources would be transitory in nature and emissions would occur over a large area; however, the cumulative ship emissions would result in long term elevated emissions for the area. In summary, the Annova LNG Project would result in temporary impacts on air quality during construction and long-term impacts during operations. Cumulative impacts from construction would be limited to the duration of the construction period. However, with other projects in the vicinity, construction of the Project would contribute to localized moderate elevated emissions near construction areas during the period(s) when construction of these activities would overlap.

Operational criteria, VOC, and HAPs air emissions from the Project would contribute to cumulative emissions with other projects in the geographic scope and would be required to comply with applicable air quality regulations. Therefore, cumulative impacts on regional air quality as a result of the operation of the Annova LNG Project and other facilities would be permanent, but minor. Due to the transitory nature of marine traffic associated with Project operation and the large area covered, cumulative impacts on air quality along the carrier routes due to these associated mobile source emissions would be temporary and minor.

Overall, impacts from the Annova LNG Project along with the other facilities would cause elevated levels of air contaminants in the area and a potential exceedance of the 1-hour NO_2 NAAQS in an uninhabited area between the facilities. Therefore, cumulative impacts on regional air quality as a result of the operation of the Annova LNG Project and other facilities would be long-term during the operational life of the Project, but minor. We are aware that each LNG Terminal could be constructed within the same time period, and the concurrent construction, commissioning, and operations emissions of the proposed Brownsville LNG terminals could contribute significantly, potentially exceed the NAAQS in local areas, and result in cumulatively greater local air quality impacts. In addition, emissions from LNG carriers would occur along vessel transit routes and would be cumulative with the other ships using the ship channel. These emissions sources would be transitory in nature and emissions would occur over a large area, however the cumulative ship emissions would result in long term elevated emissions for the area.

Climate Change

Climate change is the change in climate over time, and cannot be represented by single annual events or individual weather anomalies. While a single large flood event, a particularly cold summer; or warm winter are not necessarily strong indications of climate change; a series of floods or warm years that statistically change the average precipitation or temperature over years or decades may indicate climate change. However, recent research has begun to attribute certain extreme weather events to climate change (USGCRP 2017).

Earth's climate is now changing faster than at any point in the history of modern civilization, primarily as a result of human activities. The warming trend observed over the past century can only be explained by the effects that human activities, especially emissions of greenhouse gases, have had on the climate (Hayhoe et al. 2018). The current time period (1901 to 2016) is now the warmest in the history of modern civilization. The magnitude of climate change beyond the next few decades will depend primarily on the amount of GHG emitted globally (USGCRP 2018).

Climate Change has already resulted in a wide range of impacts across every region of the United States and those impacts extend beyond atmospheric climate change alone and include changes to water resources, agriculture, ecosystems, and human health. As climate change is currently happening, the United States and the world are warming; global sea level is rising and acidifying; and certain extreme weather events are becoming more frequent and more severe. These changes are driven by the accumulation of GHG in the atmosphere primarily through combustion of fossil fuels (coal, petroleum, and natural gas), combined with agricultural emissions and clearing of forests. These impacts have accelerated throughout the end of the 20th, century, and the rate and magnitude of expected changes will exceed those experienced in the last century (USGCRP 2018). Existing adaptation and planning efforts are inadequate to respond to these projected impacts (USGCRP 2018).

Climate change is a global concern, however for this analysis, we will focus on the potential cumulative climate change impacts on the Project area. The following are observations of existing environmental impacts, as well as predicted climate change impacts with a high or very high level of confidence in the South Texas region (NOAA 2017; USGCRP 2017; Kloesel et al. 2018):

- global average temperature has increased by about 1.8°F from 1901 to 2016, and observational evidence does not support any credible natural explanations for this amount of warming; instead, the evidence consistently points to human activities, especially emissions of greenhouse or heat-trapping gases, as the dominant cause;
- along the Texas coastline, sea levels have risen 5 to 17 inches over the last 100 years, depending on local topography and subsidence;
- nighttime low temperatures have increase by approximately 1°F;
- the warming of bay waters on the Texas coast has been documented for at least 35 years;
- ocean heat content has increased at all depth and surface waters have warmed by a rate of about 1.3°F per century;
- the world's oceans are currently absorbing more than a quarter of the CO_2 emitted to the atmosphere annually from human activities, making them more acidic;
- as sea levels have risen, the number of tidal floods each year that cause minor impacts have increased 5 to 10-fold since the 1960s in several U.S. coastal cities, and rates of increase are accelerating in many Atlantic and Gulf Coast cities;
- rising temperatures are also causing changes to growing seasons and migration patterns of birds and butterflies;
- winters are warmer and spring is arriving earlier;
- black mangroves are expanding northward along the coast, and red mangroves, formerly not found in Texas, are now appearing there;
- annual average temperatures in the Project area are projected to increase by 3.6 to 5.1°F by the mid-21st century and by 4.4 to 8.4°F by the late 21st century;
- tidal flooding will continue increasing in depth, frequency, and extent this century;
- sea level rise along the western Gulf of Mexico during the remainder of the 21st century is likely to be greater than the projected global average of 1 to 4 feet or more, exacerbated by land subsidence at many locations;
- the region is projected to experience an additional 30 to 60 days per year above 100°F than it does currently;

- decreases in protein and macronutrients will occur in grains, tubers, rice, wheat, and barley because of rising CO_2 levels;
- within the Southern Great Plains (including Texas), changes in extreme temperatures are projected to result in between 1,000 to 1,300 deaths per year;
- rising temperatures and precipitation alter the habitats of vectors (mosquitoes, ticks, rodents, and fleas) that transmit a variety of human diseases;
- large projected lost wages and the number of working hours due to temperature extremes will occur under high emissions scenarios, and the Project area would experience higher than average impacts; and
- low-income and minority communities are often already overburdened with poor environmental conditions and may be disproportionately affected by, and less resilient to, the health impacts of climate change.

It should be noted that while the impacts noted above taken individually may be manageable for certain communities, the impacts of compound extreme events (such as simultaneous heat and drought, wildfires associated with hot and dry conditions, or flooding associated with high precipitation on top of snow or waterlogged ground) can be greater than the sum of the parts.

In 2014 and 2015, the USGCRP reported that global GHG emission growth rates slowed as economic growth became less carbon-intensive. This trend continued through 2017, however 2018 is projected to have large GHG emissions increases, reversing this trend. This is at a rate that would cause global average temperature change to exceed an increase of 3.6°F above preindustrial levels by 2100.

There is no generally accepted significance criteria for GHG emissions. In addition, we cannot determine a project's incremental physical impacts on the environment caused by GHG emissions. Therefore, we cannot determine whether a projects' contribution to climate change would be significant. There is no standard methodology to determine whether, and to what extent, a project's incremental contribution to GHG emissions would result in physical effects on the environment for the purposes of evaluating the project's impacts on climate change, either locally or nationally. Although certain models do exist, the Commission has determined that they are not informative for a NEPA analysis.

The construction and operation of the Project, as well as downstream emissions, would increase the atmospheric concentration of GHGs, in combination with past and future emissions from all other sources, and contribute incrementally to future climate change impacts.

The state of Texas has not set any GHG reduction or climate goals. Because we cannot determine the Project's incremental physical impacts due to climate change on the environment, we cannot determine whether or not the Project's contribution to cumulative impacts on climate change would be significant.

Noise

The geographic scope for construction noise typically includes other identified projects within 0.25 mile of the Project. However, due to the duration of construction and similar timelines, we have included the Texas Grande LNG and Annova LNG projects in this cumulative construction noise impact analysis (described further below). Cumulative noise impacts on residences and other NSAs are related to the distance from the disparate noise sources as well as the timing of each noise source. Projects within the construction and operational noise geographic scopes are identified in table H-1 in appendix H.

The geographic scope for operational noise from long-term projects includes any facilities that can cause an impact at NSAs within 1 mile of the Project. The Texas LNG and Rio Grande LNG projects have been included in the cumulative effect impact assessment, as well as other existing and proposed projects in the area.

After construction is completed for the non-LNG projects, including the gas and water pipeline projects, power line projects, channel improvements and maintenance dredging, and road projects, there would be minimal operational noise impacts. Therefore, these projects are not expected to have any significant long-term operational cumulative impacts.

Construction noise from the non-jurisdictional facilities associated with the Rio Grande LNG and Texas LNG projects is expected to be localized and limited in duration and would occur on the opposite side of the BSC from the Annova LNG Project. These projects are small compared to the scope of the proposed three LNG projects, and are generally linear activities with construction moving through the length of the right-of-way with limited durations near any given location. These projects are not expected to occur within 0.25 mile of any of the Project NSAs; therefore, the construction activities associated with the non-jurisdictional facilities are not expected to result in cumulative noise impacts at NSAs.

Maintenance dredging and channel improvement activities would result in periodic small increases in the sound level impacts due to operation of dredging equipment. Sound levels from the maintenance dredging are not expected to cause a significant impact at the NSAs.

The SpaceX Commercial Spaceport Project, located approximately 6.3 miles southeast of the Project, anticipates rocket launches starting as soon as late 2018. Once they commence, commercial spaceflight launches would be a significant noise source at the NSAs. However, spaceflight launches are not expected to cause a significant cumulative environmental noise impact because they are short-duration events lasting only a few minutes from start to finish, they are typically scheduled during the daytime, and each launch would be well publicized, so nearby residents would be ready for the short-term intense noise of the rocket launch. During the launches, noise from the launch would dominate the sound levels at the nearby residences and low-frequency noise would likely cause noise-induced-structural vibration. Project-related noise contributions would not be significant during this brief period because the sound field would be dominated by launch noise.

As significant cumulative noise impacts are not expected from the non-LNG projects considered, as discussed above, the cumulative assessment for noise impacts focuses on the two other LNG projects in the planning and permitting stages in the general vicinity of the Project: the Texas LNG and Rio Grande LNG projects. The potential cumulative noise impact of these three LNG projects has been evaluated for construction and facility operations, for both airborne and underwater sound. Construction noise impacts would be cumulative only if construction activities occur simultaneously. Given the current schedule for the three Brownsville LNG projects, it is likely that there would be some overlap in construction activities because of the long duration of construction for the three projects. For the purposes of this analysis, we have assumed that peak construction of all three projects would overlap; however, the construction phases may not coincide, so maximum construction sound levels may not occur at all projects simultaneously.

Construction – Airborne Noise

Construction activities for the three LNG projects would be similar and would include heavy equipment operation, pile driving, dredging, and other activities such as those described in section 4.11.2.3. To evaluate the potential cumulative impact of construction activities, basic sound propagation calculations were used to estimate the combined construction sound levels at a set of standardized NSAs and calculation point (CP) locations. The process is summarized below and described in greater detail in appendix I.

The standardized NSA and CP locations were selected using the common NSAs for each of the three proposed projects. NSAs and CPs in close proximity were combined into single representative NSA or CP positions for the cumulative analysis. Three CP locations were included for each project: the Palmito Ranch Battlefield (CP-1), a central CP location (CP-2) in the Laguna Atascosa National Wildlife Refuge (LANWR), and at the location in the LANWR at the closest approach to the given LNG project. CP-1 and CP-2 were the same for all projects.

In order to quantify the highest sound level contribution from each project in the LANWR, the closest location in the LANWR for each of the projects was specified as a calculation point. Each was given a unique designation for each project: CP-TX, CP-AN, and CP-RG for Texas LNG, Annova LNG, and Rio Grande LNG projects, respectively. Each project reported the project operations sound level contribution at the project-specific CP. These three CPs have not been used to calculate impacts in the cumulative tables; rather, they are presented separately for each project to indicate the highest expected project sound level contributions in the LANWR for operations noise. A list of the standardized NSAs and CPs is presented in table 4.13.3-4. A map showing the location of the standardized cumulative NSAs and CPs is shown in figure 4.13.3-1.

Cumulative effects of construction noise were analyzed by combining the predicted construction sound levels for each project. Each of the three LNG projects used a slightly different methodology for calculating construction noise impacts. These variations were normalized during the cumulative assessment process, and all predicted values were compared on an L_{dn} basis (day-night average sound level). For those cumulative NSAs at which the construction noise had not been calculated by a project in their FERC application, a hemispherical spreading calculation was used to estimate the construction contributions based on reported construction sound levels at other NSAs. The existing ambient sound levels for each NSA, as reported in table 4.13.3-4, was determined by using the lowest measured ambient level at a corresponding project NSA for the three projects. For example, if the measured ambient sound level at NSA C2 differed among FERC applications for the three projects, the lowest ambient sound level reported was used as the ambient for the cumulative analysis. The source of ambient sound level data is provided in table 4.13.3-5.

Figure 4.13.3-1 Cumulative Impact NSAs and Calculation Point Locations

TABLE 4.13.3-4

Standardized NSAs and Calculation Point Locations for Cumulative Noise Analysis

NSA	Location	Coordinates
NSA C1	Laguna Heights neighborhood, Lincoln Ave. and Pennsylvania Ave.	26.077312° -97.249653°
NSA C2	Residences, Mobile home park, on Port Rd., southeast of Woodys Ln.	26.067031° -97.217732°
NSA C3	Residences, Northwest end of West Scallop	26.063153° -97.208717°
NSA C4	Residences, Weems Rd. and LBJ St.	25.993437° -97.182485
NSA C5	Residences, North end of 199, north of Boca Chica Blvd.	25.965084° -97.245563°
NSA C6	Residence located east of Palmito Hill Rd. on private drive	25.952706° -97.289272°
CP	**Locations**	**Coordinates**
CP-1	Palmito Ranch Battlefield	25.959536° -97.303490°
CP-2	Laguna Atascosa NWR, Calculation Point	26.028053° -97.265482°
CP-AN, CP-TX, CP-RG a/	Laguna Atascosa NWR, Closest location to given Facility	Varies

a/ The CP-AN, CP-TX, and CP-RG points represent the locations of the highest sound level contribution from each individual facility in the nearby LANWR. These are reported for operational effects only.

TABLE 4.13.3-5

Summary of Cumulative LNG Construction Impacts at Standardized NSA and CP Locations, All Levels are dBA L_{dn}

	Predicted Construction Sound Level Contributions a/							
Location	Annova LNG	Rio Grande LNG	Texas LNG	Cumulative LNG	Existing Ambient	Ambient Data b/	Combined Ambient plus Cumul. LNG	Predicted Increase over Ambient
NSA C1	49.0	49.2	**50.3**	54.3	56.0	AN NSA 1	58.2	2.2
NSA C2	47.1	43.1	**54.9**	55.8	50.2	TX NSAs 1 & 2	56.9	6.7
NSA C3	46.8	42.7	**54.6**	55.5	50.2	TX NSA 3	56.6	6.4
NSA C4	**48.0**	46.7	46.0	51.8	46.0	AN NSA 2	52.8	6.8
NSA C5	**54.0**	47.9	44.2	55.3	46.0	AN NSA 2	55.8	9.8
NSA C6	**49.8**	46.0	41.7	51.7	46.0	AN NSA 2	52.8	6.8
CP-1	**52.0**	39.9	41.6	52.6	43.0	AN NSA 4	53.1	10.1
CP-2	**56.9**	48.7	51.0	58.4	59.0	TX LANWR	62.1	2.7

a/ The **bold** values highlight the highest individual LNG facility contributions, as used in table 4.13.3-6.
b/ The existing ambient sound levels shown are the lowest reported levels at project NSAs near the standardized NSAs. AN = Annova LNG, RG = Rio Grande LNG, and TX = Texas LNG.

There was some variation in the assumptions included in the three projects for construction activities. For example, Annova LNG assumed 24-hour construction activities while Rio Grande LNG and Texas LNG used 12-hour daytime shifts for general construction and pile driving, and 24-hour operations for dredging. These assumptions were carried into the cumulative assessment. Annova LNG and Texas LNG reported construction sound levels as 24-hour L_{dn} values, while Rio Grande LNG reported construction contributions as daytime L_{eq}. In order to directly compare the construction sound level contributions, the sound level metrics were standardized to the 24-hour L_{dn} and the reported sound levels for Rio Grande LNG were adjusted to the 24-hour L_{dn}.

Table 4.13.3-4 shows the individual project and cumulative construction noise contributions of the three LNG projects at the NSAs and CPs. The individual sound level contribution predictions from all construction activities are lower than 55 dBA L_{dn} at all NSAs. However, the cumulative construction sound level from the three projects ranges from 51.7 to 55.8 dBA L_{dn}, and exceeds 55 dBA L_{dn} at NSAs C2, C3, and C5. The cumulative sound levels are also expected to exceed 55 dBA L_{dn} at locations in the LANWR, with cumulative sound levels at CP-2 of 58.4 dBA L_{dn}. Construction sound levels would be expected to exceed 55 dBA L_{dn} at locations in the LANWR within about 0.75 mile of SH 48. The predicted increase in the ambient sound levels would range from 2.2 to 9.8 dBA at the NSAs, and from 3.1 to 10.1 dBA at the two CP locations. An increase of greater than 10 dBA is typically perceived as a doubling of loudness.

The evaluation above is a very conservative estimate of the potential cumulative impact of construction noise because it combines the maximum and simultaneous construction sound levels from the three projects. This would require that all three project schedules align so that pile driving, dredging, and site preparation occur at full intensity at the same time. To obtain a more realistic and likely evaluation of the construction impact, an incremental analysis was made by comparing the increase in sound level at each NSA and CP due to only the highest predicted individual project contribution to the additional increase due to the other two projects. This analysis shows the potential cumulative impact of all three projects compared to the most significant single project. The impacts derived from this analysis represent a more likely scenario in which the three project construction schedules do not align exactly.

Table 4.13.3-6 shows the incremental effect of cumulative construction noise at each NSA and CP, compared with the highest predicted *individual* project contribution affecting each NSA. This table shows that cumulative construction noise causes an incremental increase of between 0.7 and 2.7 dB at the NSAs and CPs, compared to the highest individual project construction noise. NSA C4, with an increase of 2.7 dBA L_{dn}, shows the largest cumulative effect. A 3 dB increase is generally considered perceptible to most people, so the cumulative impact of construction noise at NSA C4 would be considered perceptible. At other NSAs, the cumulative increases are 1.5 dBA L_{dn} or lower and would generally be considered imperceptible. At these NSAs, due to the distance between the projects, the *closest* construction activity sound levels would typically dominate the acoustical environment at the NSA.

The sound levels at the project-specific CPs during construction were an Annova LNG contribution of 60.6 dBA L_{dn} at CP-AN, a Rio Grande LNG contribution of 48.7 dBA L_{dn} at CP-RG (based on 12-hour per day construction and 51.7 L_{max} dBA), and a Texas LNG contribution of 63.5 dBA L_{dn} at CP-TX. This demonstrates that construction sound levels in the Laguna Atascosa NWR would be dominated by contributions from Texas LNG.

TABLE 4.13.3-6

Calculation of the Incremental Impact of Cumulative LNG Construction Noise at Standardized NSA and CP Locations, Measured as dBA L_{dn}

Location	Existing Ambient a/	Highest Individual LNG Construction Contribution	Highest Contribution Plus Ambient	Increase over Ambient Due to only the Single Highest LNG Contribution	Additional Increase Caused by Cumulative Construction Noise
NSA C1	56.0	50.3	57.0	1.0	1.2
NSA C2	50.2	54.9	56.2	6.0	0.7
NSA C3	50.2	54.6	55.9	5.7	0.7
NSA C4	46.0	48.0	50.1	4.1	2.7
NSA C5	46.0	54.0	54.6	8.6	1.2
NSA C6	46.0	49.8	51.3	5.3	1.5
CP-1	43.0	52.0	52.5	9.5	0.6
CP-2	59.0	56.9	61.1	2.1	0.6

a/ The existing ambient sound levels shown are the lowest reported levels at project NSAs near the standardized NSAs. See table 4.13.3-5 for the data source.

Construction – Vessel Traffic

During construction of the three LNG projects, the area would experience an increase in noise due to marine traffic delivering construction supplies. The Texas LNG Project is not anticipated to contribute significantly to the cumulative noise impact because only a small amount of the anticipated construction supplies would arrive via barges or ships (109 deliveries over the 5-year construction period). Rio Grande LNG estimates that barges would make 880 marine deliveries to the Project site during construction. Marine deliveries to the Rio Grande LNG site would occur about 15 times per month during the first 5 years of construction; no deliveries are currently anticipated during the remainder of the construction period, though sporadic deliveries could occur as needed. Annova estimates that a total of 24 to 36 barge deliveries to the project site per year would be required during construction. If these construction periods overlap, the total expected construction barge traffic is approximately 20 visits a month, or one barge visit every 1.5 days. This is only slightly more than the one barge visit every 2 days estimated for the Rio Grande LNG Project, and the cumulative effects would not be significant.

Construction – Underwater Noise

Underwater noise would be produced by construction activities including in-water pile driving and dredging, and increased vessel traffic associated with equipment delivery. Cumulative impacts for underwater construction noise would be limited due to the large distance between the various project marine facilities.

The marine facilities closest to each other are the proposed Texas LNG and Rio Grande LNG facilities, with a center to center distance of about 4,400 feet. As an example of the distance effects, underwater pile driving sound levels would be expected to decrease by 32 decibels re 1 μPa at a distance of 4,400 feet compared to reference levels at 32 feet. The LNG sites are so far apart that pile driving activities at any single facility would have a limited cumulative effect on underwater noise at locations close to either of the other construction areas.

Due to the short impulsive nature of pile driving noises, it is very unlikely that the peak sound pressure levels from multiple pile drivers would occur at exactly the same instant, so there would be no increase in the predicted pile driving peak sound pressure levels. Rather, the number of pile driving events would increase due to the multiple active construction areas.

At locations midway between two active pile driving projects, the sound exposure levels would be expected to increase during simultaneous pile driving activities. The threshold distances for permanent and temporary injury for marine mammals, fish, and sea turtles would not be expected to increase significantly in size. However, during simultaneous pile driving at the three projects, the behavioral disturbance area for most species would increase. In some cases, the behavioral disturbance distances for some marine wildlife and fish for the projects would overlap and would likely encompass much of the BSC and increase the total continuous behavioral disturbance areas. Cumulative impacts on aquatic resources as a result of underwater noise are discussed further in sections 4.13.3.4 and 4.13.3.5.

As a mitigating factor, the expected durations of the marine pile-driving activities for the three projects are limited. Annova LNG expects to perform in-water pile driving over the course of 5 days. Texas LNG plans to drive only 12 piles in-water. Rio Grande LNG expects that marine pile-driving would be required for sheet piling, which is anticipated to occur over 25 days and for installation of four in-water piles, which would take 4 days. Due to the long construction schedules for the projects, and the limited duration of in-water pile driving, it is unlikely that there would be significant overlap in the in-water pile driving schedules. Even with complete overlap in pile-driving activity schedules, there could possibly be only 4 days in which all three projects would be driving (non-sheet) piles.

Dredging activities at all three projects would have the potential to produce underwater noise. The proposed dredging activities would be far enough apart that generally there would be no cumulative impacts expected for underwater dredging noise for species other than mid-frequency cetaceans. However, the BSC is an active waterway that already has ongoing and regular maintenance dredging activities. The additional construction dredging activities associated with the projects is not expected to be significantly different than the existing maintenance dredging and is not expected to cause a significant cumulative underwater noise impact in the BSC.

Operations – Airborne Noise

To consistently analyze the potential cumulative impact of airborne operational noise from the three proposed LNG projects, the noise models for each project were used to predict the sound levels due to facility operation at the standardized NSAs and at the three CPs located close to points of interest. The methodology behind the noise model development for the Annova LNG Project is presented in section 4.11.2 of this EIS. The methodology for the other two LNG projects is described in their FERC Applications. Generally, each project used three-dimensional environmental noise modeling software to predict the sound levels from the respective project equipment. To combine the sound level predictions for operational noise, each project submitted the noise model results in a standardized grid format as outlined in the August 10, 2017 Environmental Information Request issued for the Annova LNG Project. The standardized grid results used the same spacing and nominally the same boundaries. The grid maps were overlaid and logarithmically summed and the overall cumulative impact of operations noise from the three projects was calculated. Figure 4.13.3-2 shows the predicted sound levels as 24-hour L_{dn} values for the three projects in simultaneous operation at full project completion. In addition to the grid map results, predicted operations sound levels were calculated by each project for the cumulative NSAs and CP locations described in table 4.13.3-4. The predicted sound levels were logarithmically summed for the cumulative NSAs and for CPs 1 and 2.

Each project also reported predicted sound levels at the location in the LANWR closest to the project, with these unique CPs labeled as CP-TX, CP-RG, and CP-AN, for the Texas LNG, Rio Grande LNG, and Annova LNG, projects respectively. These project specific calculation points were used to evaluate the highest predicted individual project sound level in the LANWR. Cumulative sound levels were not calculated for these points as the levels were predicted by each project for only that respective project CP.

Table 4.13.3-7 presents a summary of the predicted operation sound levels at the cumulative NSA and CP locations for each of the individual LNG projects. As shown in this table, the expected increases in the sound levels at the standardized NSA locations range from 0.3 to 1.5 dB. These are very small increases and would be considered imperceptible to most listeners. The small difference in the overall cumulative increases and those increases predicted for each separate project is due to the large distances between the noise generating equipment at the project sites, and the small impact of the more distant projects to the overall sound levels at each NSA location.

Sound levels at CP-1, representing the Palmito Ranch Battlefield NHL are predicted to have a cumulative increase of 1.3 dB, which would be imperceptible for most listeners. At CP-2 in the LANWR, the sound level impact is somewhat higher, with a predicted cumulative increase of 4.8 decibels and an overall cumulative sound level of 62 dBA L_{dn}. As shown on figure 4.13.3-2, there would be areas in the LANWR in which the cumulative sound levels exceed 55 dBA L_{dn}. The predicted sound levels in the LANWR are generally dominated by contributions from the Rio Grande LNG facility.

TABLE 4.13.3-7

Cumulative Operational Noise Impacts from LNG Facilities

	Predicted Sound Level Contributions, dBA L_{dn}							
Location	Annova LNG	Rio Grande LNG	Texas LNG	Cumulative LNG	Existing Ambient	Ambient Data a/	Combined Ambient plus Cumulative LNG	Predicted Increase over Ambient
NSA C1	31.4	41.9	40.2	44.4	56.0	AN NSA 1	56.3	0.3
NSA C2	30.4	40.2	44.8	46.2	50.2	TX NSAs 1 & 2	51.7	1.5
NSA C3	30.4	39.7	44.4	45.8	50.2	TX NSA 3	51.5	1.3
NSA C4	31.4	38.7	34.7	40.7	46.0	AN NSA 2	47.1	1.1
NSA C5	39.4	41.0	32.2	43.6	46.0	AN NSA 2	61.4	0.1
NSA C6	34.4	37.3	28.7	39.5	46.0	AN NSA 2	46.9	0.9
CP 1	33.4	36.1	28.5	38.4	43.0	AN NSA 4	44.3	1.3
CP 2	46.4	61.8	41.0	62.0	59.0	TX	63.8	4.8

a/ The existing ambient sound levels shown are the lowest reported levels at project NSAs near the standardized NSAs.

The sound levels at the project-specific CPs during operation were an Annova LNG contribution of 55.4 dBA L_{dn} at CP-AN, a Rio Grande LNG contribution of 69.7 dBA L_{dn} at CP-RG, and a Texas LNG contribution of 52.9 dBA L_{dn} at CP-TX. This demonstrates that operational sound levels in the LANWR would be dominated by contributions from the Rio Grande LNG Project, due to its proximity to the LANWR. Cumulative impacts resulting from increased noise on wildlife is further discussed in section 4.13.2.3.

Flaring

There would be flaring noise associated with all three projects. However, all three projects report that flaring would not be part of standard operations. The maximum sound levels predicted for flaring were 59 dBA, 52 dBA, and 43 dBA for Rio Grande LNG, Annova LNG, and Texas LNG Projects, respectively, at the worst-case NSAs for each project. Although possible, it is unlikely that flaring would occur simultaneously at all three projects. In the event of simultaneous flaring at all three projects, the highest predicted sound levels would be at cumulative NSA C1, with a predicted cumulative flaring sound level of 59.6 dBA, or 0.6 dBA higher than the individual impact of the Rio Grande LNG flare operating alone. This is not a noticeable difference indicating that the cumulative impact of flaring events would be minimal. However, with three facilities in operation, the frequency of occurrence of flaring events would be approximately tripled, so flaring events would occur more often, though the overall sound level from each flaring event would be similar or lower than predicted by each project.

Maintenance Dredging

Occasional maintenance dredging would be required during the operational lifespan of the three LNG projects to maintain the channel, turning basin, and other marine facilities associated with the projects. Generally, the projects anticipate that maintenance dredging would be necessary every few years. Maintenance dredging activities would be substantially quieter than the sound levels reported with construction sound level predictions, as the predicted construction levels also include pile-driving, general construction, and dredging activities. The BSC is an active waterway that already has ongoing and regular maintenance dredging. The additional maintenance dredging activities associated with the projects are not expected to cause a significant cumulative airborne noise impact at the NSAs.

Noise Conclusions

For simultaneous construction activities at all of the three LNG projects, the predicted sound level increase over the existing ambient ranges from 2.2 to 9.8 dBA L_{dn} at the NSAs and sound levels of slightly over 55 dBA L_{dn} are predicted for NSAs C2, C3, and C5. These noise level increases range between less than noticeable increases in ambient noise to a doubling of noise at specific NSAs. For construction activities that are not simultaneous but incremental, the predicted sound level increase ranges from 1.0 to 8.6 dBA L_{dn} at the NSAs. These increases would be minor to moderate; however, all levels would be below the FERC criterion of 55 dBA L_{dn}. For CP-1, the predicted cumulative construction increase was 10.1 dBA L_{dn} over the existing ambient which could result in periods of perceived doubling of noise. At CP-2 in the Laguna Atascosa NWR there is a higher ambient sound level so the predicted increase due to cumulative construction noise would be 2.7 dBA L_{dn}, which would be a less than noticeable increase.

The predicted sound level impacts for simultaneous operation of all three LNG projects are much lower than construction impacts, with potential increases over the existing ambient sound level between 0.3 and 1.5 dBA L_{dn} at NSAs, resulting in a negligible to minor impact. Construction and operation of the pipeline facilities would not contribute to significant cumulative noise impacts on nearby NSAs. Operational impacts are slightly higher at CP-1 and CP-2, with possible increases in sound levels due to operations of between 1.3 and 4.8 dBA L_{dn}. This is generally considered barely noticeable to minor long-term impact. Construction and operation of the pipeline facilities would not contribute to significant cumulative noise impacts on nearby NSAs.

4.13.3.10 Safety

We considered the geographic scope for safety to be the area adjacent to and in the vicinity of the Annova LNG Project site. Annova would minimize negative impacts on public safety through the implementation of applicable federal, state, and local rules and regulations as described in section 4.12. Those rules and regulations would ensure that the applicable design and engineering standards are implemented to protect the public and avoid or minimize the potential for accidents and failures. Because the Project would require an increase in the number of LNG carriers transiting the Brazos Santiago Pass and the BSC, it would add to the public safety risk associated with vessel traffic in these waterways.

Emergency response time is a key aspect of public health and safety. In accordance with our regulations, Annova would prepare a comprehensive plan that identifies the cost-sharing mechanisms for funding emergency response costs. This plan would minimize the potential for a cumulative public safety impact associated with the Project.

The Rio Grande LNG and Texas LNG projects each would also have to prepare and implement a similar comprehensive plan to provide emergency services. In addition, we anticipate that the other major project proponents in the area would include emergency services within their facilities and have emergency response plans developed with the appropriate agencies. Emergency responses at any of those facilities could temporarily stress emergency services in the area, but we would not expect them to result in a long-term adverse impact on those services. In the unlikely event of major emergencies at several of the facilities at the same time, there could be a short-term but significant cumulative impact on emergency services within Cameron County; that impact could be mitigated by assistance from emergency service providers from surrounding areas.

The risk associated with the pipeline facilities would be small. Although operation of the pipelines would incrementally increase the risk of a pipeline accident, the increase would be minor. As a result, the cumulative impact and risks associated with constructing or operating the third-party owned pipeline facilities would be negligible.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 SUMMARY OF THE ENVIRONMENTAL ANALYSIS

The conclusions and recommendations presented in this section are those of the FERC environmental and engineering staff. Our conclusions and recommendations are based on input from the COE, Coast Guard, DOE, DOT, and EPA as cooperating agencies in the preparation of this draft EIS. However, the cooperating agencies will present their own conclusions and recommendations in their respective Records of Decision and determinations, and can adopt this draft EIS consistent with 40 CFR 1501.3 if, after an independent review of the document, they conclude that their requirements have been satisfied. Otherwise, they may elect to conduct their own supplemental environmental analysis.

We conclude that construction and operation of the Annova Project would result in temporary and short-term impacts on numerous resources. However, the Project would result in permanent impacts on geological conditions, soils, wetlands, and visual resources; and long-term impacts on air quality. As part of our analysis, we developed specific mitigation measures that are practical, appropriate, and reasonable for construction and operation of the Project. We are, therefore, recommending that these mitigation measures be attached as conditions to any authorization issued by the Commission. Implementation of the mitigation proposed by Annova and our recommended mitigation would ensure that impacts in the Project area would be avoided or minimized and would not be significant. A summary of the Project impacts and our conclusions are presented below by resource.

5.1.1 Geologic Resources

The Project site would be graded to the extent necessary to construct Project facilities, and, as a result, the LNG facilities would permanently alter the existing surface conditions at the site. The final Project site would include asphalt- and gravel-surfaced roads, general gravel surfacing, and application of top soil, seed, and mulch for planned vegetated areas. Construction and operation of the Project would not significantly affect mineral resources. Blasting is not anticipated during Project construction.

Based on Annova's proposal, and in consideration of its proposed mitigation and design criteria, we conclude that potential impacts on geological conditions would be adequately minimized and would not be significant.

5.1.2 Soils

Project site soils would be permanently impacted by Project facilities, paved or gravel roads, stormwater retention and evaporation ponds, or other impervious surfaces. Construction at the Project site would involve grading and raising the site elevation with fill material, excavating for building foundations, compacting soils, creating impermeable surfaces, and trenching to install necessary piping and utilities. Clearing, grading, and construction activities associated with the Project could cause a temporary loss of soil structure, and increase the potential for erosion, compaction, and mixing of topsoil. Annova would adhere to the BMPs contained in its *Plan and Procedures*, as well as the preliminary draft Construction SPCC Plan, which were developed in accordance with applicable regulations and permit requirements to minimize soil impacts.

Adherence to these measures would minimize soil impacts during construction and operation through sedimentation control and workspace restoration. Annova would also develop and implement a separate Operation SPCC Plan. We have included a recommendation that, prior to construction, Annova file its final *Spill Prevention and Response Procedures, Construction SPCC Plan,* and the *Operation SPCC Plan* for review and written approval by the Director of OEP.

There are no known contaminated soils in either the Project site or the BSC and it is not expected that contaminated sediments would be found during construction based on the on-site soil investigation results and previous studies. Dredging does, however, have the potential to expose unidentified contaminated soils. Annova has developed a *Dredged Area Sampling and Analysis Plan* for dredging activities as part of the COE permit application and would implement the proposed plan following COE guidance for dredged material sampling and testing to minimize the potential for the release of contaminated soils.

Based on Annova's proposal, and in consideration of its proposed mitigation measures and design criteria, we conclude that the Project would have a permanent effect on soils within the terminal site but that potential impacts would be minimized to the extent practical and would not result in significant soil impacts.

5.1.3 Water Resources

No potable water supply wells are located within the Project site or within 150 feet of Project. The nearest domestic water supply well is located over 4 miles north of the Project. The majority of Project-related excavation would occur adjacent to the BSC where groundwater is located near the surface. Excavation, the addition of fill, and the installation of foundations and underground utilities would have localized and short-term effects on the groundwater during construction with effects to local water table elevations. The shallow aquifer could sustain minor, temporary indirect impacts from changes in overland water flow and recharge caused by clearing and grading of the work areas. Implementation of mitigation measures included in Annova's *Plan* would reduce the potential for groundwater contamination. Annova would not use or withdraw groundwater during construction or operation of the Project. Because of the temporary localized effects of construction on groundwater, implementation of mitigation, and the relatively large distance between the Project site and any water supply wells, we conclude that the potential impacts on groundwater resources due to Project-related construction activities would be minimal.

Dredging during construction and maintenance dredging during Project operation, as well as vessel traffic, site modification and stormwater runoff, and hydrostatic testing, would result in decreased water quality of the BSC within the vicinity of the site. The majority of the excavation during construction would occur on land, thereby minimizing suspension of sediment and turbidity impacts on water quality that could occur due to direct dredging within the BSC. Impacts on water quality from dredging would be further reduced by the use of a hydraulic cutter suction dredge, which suctions excavated material into a pipeline, minimizing the loss of material and resuspension of sediments into the water column. Periodic maintenance dredging would occur only in areas previously disturbed during Project construction, with impacts further minimized by the use of hydraulic cutter suction dredges. Annova would prepare a *Dredging Water Quality Monitoring Plan* that would outline the use of BMPs during dredging and disposal activities, and require monitoring of turbidity, flow rate, pH, and TSS at locations near dredging operations. In addition, dredging activities would be permitted by the COE and required to comply with applicable permit conditions.

The potential for shoreline erosion would be unlikely to increase significantly from LNG vessel traffic for the Project, provided the LNG carriers avoid shoreline erosion from propeller scour when traveling to and from Project facilities. In addition, rock rip-rap protection would be placed along the terminal shoreline at the Project facilities to prevent erosion due to vessel propellers or bow thrusters. Entrainment of non-consolidated substrate would result in a short-term, but minor, impact on water quality as LNG carriers transit the BSC.

Ballast water discharged by LNG carriers docked at the marine berth would have minimal effect on the salinity regime, dissolved oxygen levels, water temperature, or pH in the BSC. Federal oversight and the applicable Coast Guard regulatory requirements that govern ballast water discharges into U.S. waters would apply to all LNG carriers calling at the Project site. Cooling water intake and discharge by LNG vessels would have temporary and minor effects on water quality in the vicinity of the vessel.

Through implementation of NPDES regulations, Annova's SPCC Plan, and its *Plan and Procedures*, potential impacts resulting from stormwater runoff would be adequately minimized or avoided. Annova would obtain an EPA Hydrostatic Test Water Discharge Permit and an RRC permit to discharge the water that would be used for hydrostatic testing of pipes and LNG storage tanks during construction. Discharge of hydrostatic test water may cause localized, short-term turbidity in the BSC.

Surface water impacts resulting from the construction and operation of the Project could result from site grading activities, fill activities, dredging and construction activities associated with the marine facilities, vessel traffic, hydrostatic testing, and spills or leaks of hazardous materials. With implementation of the mitigation measures identified for each of the proposed activities, we have determined that construction and operation of the Project would result in primarily temporary and less than significant impacts on surface waters.

5.1.4 Wetlands

Construction and operation of the Project would result in the disturbance of 57.7 acres of wetlands, with 52.8 acres of permanent wetland loss. This includes disturbance to 53.0 acres of vegetated wetlands and 4.7 acres of non-vegetated tidal flats and open water, with permanent loss of 50.8 acres of vegetated wetlands and 2.0 acres of non-vegetated tidal flats and open water. The entirety of impact on vegetated wetlands would occur to estuarine emergent marsh wetlands.

Annova is consulting with the COE and other relevant agencies regarding impacts on wetlands and non-wetland waters of the U.S. In addition, Annova has prepared a draft *Conceptual Mitigation Plan* that has identified preliminary Project mitigation requirements and proposed compensation for the Project's impacts on wetlands and waters under the COE's jurisdiction. The acceptability of any proposed compensatory mitigation measures would be determined by the COE prior to construction. Annova is still refining the mitigation plan, which has not yet been approved by the COE.

Adherence to measures contained in Annova's *Procedures* would adequately address wetlands that are only temporarily affected by Project construction, such that impacts on temporally affected wetlands would be less than significant. Construction of the Project would result in the permanent loss of 50.8 acres of emergent vegetated wetlands and 2 acres of unvegetated open water and tidal flat. This loss of nearly 53 acres of wetland would be a permanent impact. Annova is working with the COE to finalize required mitigation for permanent wetland impacts. We anticipate that if the COE issues a Section 404/Section 10 permit for the Project, it would be conditioned upon Project-related adverse impacts on waters of the U.S. being effectively offset by mitigation similar to what Annova has identified in its draft *Conceptual Mitigation Plan;* therefore, the permanent impacts on wetlands would be reduced to less than significant levels.

5.1.5 Vegetation

Construction of the Project would temporarily impact approximately 462 acres of vegetation, with approximately 409 acres permanently impacted during Project operation. The majority of these impacts would be to the following vegetative communities: South Texas Loma Evergreen Shrubland, Gulf Coast Salty Prairie, South Texas Loma Grassland/Shrubland, and Coastal Sea Ox-eye Daisy Flats. No state-designated vegetation communities of special concern (including rare, threatened, or endangered plants) occur in the Project area.

At the request of the FWS, Annova has modified the original Project layout to minimize clearing of South Texas Loma Evergreen Shrubland and South Texas Loma Grassland/Shrubland. The current site layout reduces Project impacts on these vegetation communities on the western and eastern boundaries of the Project site. Additionally, Annova would comply with any Project-specific recommendations and mitigation requirements associated with the Section 404 and Section 10 permits issued by the COE, which would be expected to include implementation of compensatory wetland mitigation similar to what Annova has identified in a draft *Compensatory Mitigation Plan*.

Although approximately 409 acres of vegetation communities would be permanently lost, the region contains large quantities of similar vegetation communities. Therefore, we have determined that construction and operation of the Project would not significantly impact vegetation. Annova is also evaluating off-site lands for conservation, either through purchase or conservation easement, to compensate for loss of loma vegetation and wildlife habitat.

5.1.6 Wildlife and Aquatic Resources

Construction and operation of the Project would result in the removal and/or conversion of wildlife habitats at the site, with the permanent conversion of open land to industrial land. Although construction would permanently remove wildlife habitat, diverse and ample undisturbed habitat is available in the vicinity of the Project site. Temporary workspaces would be temporarily disturbed during construction, then planted with native grasses with the goal of restoring a grassland/herbaceous wildlife habitat. Annova would also minimize impacts on wildlife through implementation of some TPWD recommendations during construction and restoration, as well as through use of measures designed to reduce nuisance lighting, and development and implementation of a *Facility Lighting Plan* for operation of the LNG terminal. Because Annova has not yet developed the *Facility Lighting Plan* we recommend that, prior to construction, Annova file its *Facility Lighting Plan* for operation of the LNG terminal with the Secretary for review and written approval by the OEP. At the request of the FWS we recommend that the *Facility Lighting Plan* also address construction and commissioning.

Construction and operation of the Project could affect migratory bird species through permanent and temporary removal of habitat and Project lighting. In accordance with FWS recommendations, Annova would attempt to limit clearing on the Project site to between September 1 through and February 28 to avoid impacts on migratory bird nesting. If construction during the nesting season cannot be avoided, Annova would follow the FWS recommendation to identify and avoid active nests prior to and during the clearing activity. The MBTA is under the jurisdiction of the FWS. Therefore, we recommend that prior to construction, Annova consult with the FWS to develop a Project-specific *Migratory Bird Plan* that includes measures to avoid and minimize impacts on migratory birds, including details from the *Facility Lighting Plan* that are intended to reduce impacts on wildlife and birds. The occasional use of warm/cold gas flares could impact some migratory birds if present during the flaring event but is not expected to substantially impact migratory bird populations.

Constructing the Project would temporarily and permanently impact pollinator habitat (vegetation). Milkweed is the primary plant species monarch butterflies use for foraging and for reproduction and impacts and range-wide loss of this plant species has had a potential population effect on monarch butterflies. Vegetation surveys performed at the Project site indicated that no milkweed species were present within the Project site; therefore, construction and operation of the Project is not anticipated to impact the primary habitat for the monarch butterfly.

Construction and operation activities with the potential to affect aquatic resources include excavation and dredging of the marine berth, hydrostatic testing of the LNG tanks, additional vessel traffic in the BSC, discharge of ballast water, cooling water intake and discharge, increased noise levels, stormwater runoff or spills, and lighting. Construction of the marine facilities would permanently alter the shoreline and adjacent uplands, resulting in more open water habitats in the BSC as well as modify existing benthic areas encompassed by the turning basin.

Construction of the Project would result in minor effects on aquatic resources, including managed species and EFH, due to temporary degradation of water quality and direct mortality of some immobile individuals during dredging. Further, noise from limited in-water pile-driving would result in temporary and minor impacts on fish. In addition, spills of hazardous materials could affect water quality and affect aquatic organisms during construction and operations; however, implementation of measures in Annova's SPCC Plans and Project-specific *Plan and Procedures* would minimize potential effects. During operation, the Project would have minor effects on aquatic resources, including managed species and EFH, due to maintenance dredging and increased vessel traffic. Permanent effects on aquatic habitat would occur where open water would be converted to commercial/industrial land within the BSC; however, the permanent reduction in aquatic habitat within the Project area is not expected to result in significant adverse effects on marine resources, including managed species and EFH.

5.1.7 Special Status Species

Based on information obtained from the FWS and NOAA Fisheries, 21 federally listed, proposed, and candidate threatened and endangered species could potentially be impacted by the Project. This total includes 18 federally listed, two proposed, and one candidate species. Of the federally listed species, we have determined that construction and operation of the Project: would have *no effect* on 2 of the federally listed species (South Texas ambrosia and Texas ayenia). We have determined that the Project *may affect, but* is *not likely to adversely affect* 14 of the federally listed species (blue whale, fin whale, sei whale, sperm whale, West Indian manatee, northern aplomado falcon, piping plover, red knot, whooping crane, green sea turtle, Kemp's ridley sea turtle, loggerhead sea turtle, hawksbill sea turtle, and leatherback sea turtle), or the two proposed species (Gulf of Mexico Bryde's whale and Eastern black rail). We also determined that the Project *would not contribute to a trend toward federal listing* for the identified candidate species (red-crowned parrot). Finally, we have determined that the Project *may affect, and is likely to adversely affect* 2 of the federally listed species (ocelot and Gulf Coast jaguarondi). Potentially suitable habitat is present in the Project area for 45 of the 54 state-listed species in Cameron County.

The potential exists for listed species to be affected by pile driving. Disturbances from pile driving would be short term (approximately five days) and localized. Annova would reduce impacts on listed species from pile driving by implementing a series of pile driving protocols that would include visual monitoring and not starting pile driving during nighttime hours.

Measures proposed by Annova to minimize impacts on federally and state-listed species include implementation of conservation measures and SPCC plans. Measures also include providing LNG carrier captains with a NOAA-issued guidance document that outlines collision avoidance measures to be implemented in order to minimize impacts on marine mammals and sea turtles. Consultation with NOAA Fisheries and the FWS is ongoing; therefore, we recommend that Annova should not begin construction until the FERC staff completes section 7 consultation with the FWS and NOAA Fisheries.

5.1.8 Land Use, Recreation, and Visual Resources

Construction of the Project would result in temporary impacts on 491 acres, with 412 acres of this total permanently affected during operation. Lands permanently affected during operation would either contain permanent facilities or be permanently maintained as concrete, paved, or gravel surfaces, or maintained in an herbaceous state. The Project site is located entirely on land owned by the BND and designated for heavy industrial development. Following the completion of construction, the site would shift from undeveloped to industrial land use. Construction and operation of the Project is not expected to affect existing or planned residential or commercial land uses. Construction and operation of the Project is also not expected to restrict land use on adjacent properties or displace any residences or businesses. The Project is not expected to affect the proposed SpaceX vertical launch area that would be located approximately 6.3 miles east-southeast of the Project. To ensure compliance with the CZMA, we are recommending that Annova not begin construction until it files with the Secretary a determination from the Coastal Coordination Advisory Committee that the Project is consistent with the laws and regulations of the state's Coastal Zone Management Program.

The lands surrounding the Project site are largely undeveloped providing a variety of dispersed outdoor recreational activities, including fishing and bird/wildlife watching. There are also designated recreation sites and facilities located in the Project vicinity. Increases in dust, noise, and traffic during construction would likely affect some recreationists, but would be short-term and temporary. Project construction and operation would not permanently affect access to the majority of regional fishing locations in the waters in the vicinity of the Project site. The increase in the number of large vessels transiting the BSC during Project operation with the addition of LNG carriers navigating to and from the Project site, could potentially result in additional delays for other traffic within the BSC, but is not expected to substantially affect recreational fishing in the ship channel.

The most prominent visual features at the Project site would be the two 186-feet-high domed, cylindrical LNG tanks, and the 160-foot-high flare stack. Materials would be colored and treated to blend in with the surrounding landscape and reduce glare, and the Project's lighting would be designed to minimize contrast with the night sky. Viewer sensitivity in the Project area is generally considered to be high because a large proportion of the viewers in the area are there for recreation and leisure activities.

Annova's Visual Impact Assessment evaluated 10 KOPs at representative visually sensitive areas, including areas used for recreation and wildlife viewing, key travel routes, and other public gathering areas. Potential visual impacts occurred at all KOPs and ranged from low to moderate at most locations. However, the visual impacts at KOP 8 at the State Highway 48 pull-off near Bahia Grande Channel would be moderately high. Based on our analysis, Project construction and operation would not result in significant impacts on current land use and recreation, or overall visual resources.

5.1.9 Socioeconomics

Construction of the Project is expected to be completed over a 48-month period, with an average of 700 workers employed on-site during this period. A total of 1,200 workers would be employed during peak construction, which is expected to last 6 months starting mid-way through the second year. An average of 253 non-local workers are expected to be employed to perform the specialized jobs needed to complete the Project. During peak construction, up to 780 non-local workers may temporarily relocate to the region. Project construction would result in a short-term, moderate increase to the local population, and Project operation would result in a negligible, long-term increase to the local population.

Construction and operation of the Project would generate local and state tax revenues from sales and payroll taxes, and support some local employment. Construction and operation of the Project would not be expected to have high and adverse human health or environmental effects on any nearby communities. The Project site is entirely located on property owned by the BND and designated for industrial use. The closest residences to the Project site boundary are located approximately 2.3 miles to the south, on County Road 199, off of SH 4.

Potential land transportation impacts were assessed by evaluating how construction and operation of the Project would likely affect traffic volumes, circulation patterns, and LOS on roadways within the Project area. Preliminary analysis indicated that the addition of 1,000 Project-related vehicles during morning and evening peak hours would cause failing conditions at the intersections nearest to the Project access road. Subsequent analysis assumed that construction shifts would be staggered, with half the workforce (500 vehicles) arriving and departing during peak hours and the other half arriving and departing one hour later. With this assumption in place, additional mitigation measures were identified for 3 of 10 affected intersections. In addition, Annova proposes to transport construction workers to and from the construction site from a centralized location via passenger buses, which would further reduce potential impacts on one or more intersections, as well as reduce potential delays at the Border Patrol checkpoint on SH 4 (Boca Chica Boulevard). Because Annova has not yet identified the off-site centralized location, we recommend that prior to the end of the draft EIS comment period, Annova should file the specific location(s) of any off-site centralized parking sites, and for each location identify: the existing environment and land use at those locations; an evaluation of potential impacts that would result from Project use; and a description of how the use of these sites would mitigate the impacts identified in its construction traffic analysis.

Construction and operation of the Project would result in an increase in marine traffic in the area. During operation, Annova anticipates that on average, 2-6 LNG carriers per month would visit the Project once fully operational, up to a maximum of 80 visits per year. LNG carriers would require a moving safety and security zone that would limit deep draft traffic while LNG carriers are in the channel. Large ocean-going commercial vessels currently call at the Port of Brownsville at an average rate of six per week, or 312 per year. The addition of approximately two-six LNG carriers per month with 2-hour transits in each direction per carrier is not expected to create adverse impacts on inbound and outbound transits of large vessels, which are already accustomed to queues and early scheduling requirements. Smaller vessels heading in the opposite direction to a LNG carrier could experience delays of a few minutes to 1.5 hours, depending on the position of the smaller vessel relative to the LNG carrier. The total estimated annual delay for small vessels could range from 1.8 to 5.5 percent of daylight hours.

Although the demographics indicate that potential environmental justice communities are present within the census blocks near the Project site, there is no evidence that these communities would be disproportionately affected by the Project or that impacts on these communities would appreciably exceed impacts on the general population. It is not anticipated that the Project would cause significant adverse health or environmental harm to any community with a disproportionate number of minority or low-income populations. We conclude that the Project would not have disproportionate adverse effects on minority and low-income residents in the area.

5.1.10 Cultural Resources

Cultural resource surveys were conducted for the Project APE. The investigations were under Antiquities Permit No. 7040, in compliance with SOI professional standards and in accordance with federal and THC standards and guidelines. The surveys covered both archaeological and architectural (non-archaeological) resources. The archaeological report (Sanchez et al. 2015) and architectural report (Wallisch and Russo 2015) were submitted to the FERC and the THC. In addition, a bathymetric survey was also conducted for the Project and a report detailing the results was submitted to FERC and the THC (iLinks Geosolutions LLC 2015). In a letter dated October 1, 2015, the Executive Director of the THC agreed that sites 41CF49, 41CF50, 41CF87, 41CF102, 41CF219, 41CF220, 41CF221, and 41CF222 are not eligible for listing on the NRHP or as State Antiquities Landmarks.

The SHPO also determined that the area around site 41CF48 is considered unevaluated due to the inability to survey the area. Therefore, the eligibility of site 41CF48 is considered undetermined. If the Project is approved, we recommend that Annova survey the area prior to construction. If this site cannot be avoided, SHPO must be consulted and a survey plan for this area will be implemented prior to construction in order to ascertain the eligibly of site 41CF48.

Annova contacted several Native American tribes to identify properties of traditional, religious, or cultural importance that may be affected by the proposed Project in March 2015, with follow-up calls in July 2015; additional tribes were notified in December 2015. To date, only two tribes have responded: the Tonkawa Tribe of Oklahoma responded on April 17, 2015 that they have no historical or cultural interest in the Project, and on July 9, 2015, the Lipan Apache Tribe of Texas responded that the tribe does not have any sacred sites in the Project area. The *Unanticipated Discovery Plan* for the Project has been submitted to the tribes. To date, no additional responses have been received.

Annova prepared a visual impact assessment for three historic resources in the vicinity of the site: the Palmito Ranch Battlefield NHL, the Palo Alto Battlefield NHL, and the NRHP-listed Brazos Santiago Depot. We used this assessment to evaluate potential visual effects on the viewshed from these three properties. We conclude that the Project would not affect the essential features of the Palmito Ranch Battlefield for the period of significance (the Civil War) or the Palo Alto Battlefield for the period of significance (the Mexican War), and the overall integrity of these properties would remain intact. While the Project may be visible from the location of the Brazos Santiago Depot, construction and operation would not affect the site's potential to provide information about its period of significance or to yield information about the past.

Compliance with Section 106 of the National Historic Preservation Act is not complete for the Project. Therefore, we recommend that Annova file all outstanding reports and agency comments with the FERC and that FERC staff complete the Section 106 consultation process before construction may begin.

5.1.11 Air Quality and Noise

Air quality impacts associated with construction of the Project would include emissions from fossil-fueled construction equipment and fugitive dust. During construction the Project would result in short-term, localized impacts on air quality. These impacts would transition to permanent operational-phase emissions after commissioning and initial start-up. Annova would incorporate fugitive dust control measures during construction to minimize emissions. Emissions from off-road construction equipment would be minimized by implementing idling restrictions, using newer-tier engines, when available, and installing add-on pollution controls on temporary stationary construction equipment. Vehicle emissions would be further reduced through the use of ultra-low-sulfur diesel and compliance with 30 TAC Chapter 114 – Control of Air Pollution from Motor Vehicles.

Operation of the Project would result in permanent air quality impacts. Annova would minimize operation emissions through implementation of BACT, as required by Annova's operating air permits. Annova would apply for all applicable air permits and would comply with all air permit requirements for the Project. Air dispersion modeling that included both the Project's stationary sources and emissions from the marine vessels that would operate as part of the Project's activities demonstrated that the stationary sources plus mobile source emissions would not cause or contribute to an exceedance of a NAAQS.

With the exception of pile-driving activities, the maximum noise levels attributable to Project construction would be equal or similar to existing noise levels. No structural effects to structures are anticipated from vibration during construction. To ensure that the noise resulting from pile driving is not significant, we recommend that Annova monitor pile-driving activities and file weekly noise data. If measured noise impacts at the nearest noise-sensitive areas are greater than 10 dBA over the L_{eq} ambient levels, we recommend that Annova cease pile driving and implement noise mitigation measures, and not resume pile-driving activities until receipt of written notification from the Director of OEP.

Operation of the LNG terminal would produce noise on a continual basis. Operational sound levels at all NSAs would be equal to existing noise levels (NSA1) and/or below the 55 dBA L_{dn} FERC criterion (at NSA2, NSA3, and NSA4). Operation and maintenance of the Project would not cause significant noise impacts although certain short-term activities such as flaring would be distinctly noticeable to residents or the public in the vicinity of the Project. To ensure that noise resulting from operation of the Project is not significant, we recommend that Annova file a noise survey with the FERC no later than 60 days after placing each liquefaction unit and the entire Project in service. With the inclusion of our recommended pile-driving noise measures and terminal noise surveys, we conclude that Project noise would not result in a significant impact on any nearby noise sensitive areas.

5.1.12 Reliability and Safety

We assessed the potential impact on the human environment in terms of safety and whether the Project would operate safely, reliably, and securely. As a cooperating agency, the DOT assisted the FERC staff by determining whether Annova's proposed design would meet the DOT's 49 CFR 193 Subpart B siting requirements. The DOT will provide a LOD on the Project's compliance with 49 CFR 193 Subpart B prior to the final EIS. This determination will be provided to the Commission as further consideration to the Commission on its decision to authorize or deny the Project. If the Project is authorized and constructed, the facility would be subject to the DOT's inspection and enforcement program; final determination of whether a facility is in compliance with the requirements of 49 CFR 193 would be made by the DOT staff.

As a cooperating agency, the Coast Guard also assisted the FERC staff by reviewing the proposed LNG terminal and the associated LNG marine vessel traffic. The Coast Guard reviewed a WSA submitted by Annova that focused on the navigation safety and maritime security aspects of LNG marine vessel transits along the affected waterway. On February 13, 2018, the Coast Guard issued an LOR that recommended that the BSC be considered suitable for accommodating the type and frequency of LNG marine traffic for the Project based on the WSA and in accordance with the guidance in the Coast Guard's NVIC 01-11. If the Project is authorized and constructed, the facilities would be subject to the Coast Guard's inspection and enforcement program to ensure compliance with the requirements of 33 CFR 105 and 33 CFR 127.

As a cooperating agency, the FAA assisted FERC staff in evaluating impacts on and from the SpaceX rocket launch facility in Cameron County. We are including specific recommendations to address potential impacts from rocket launch failures on the Project. However, the extent of impacts on SpaceX operations, the National Space Program, and to the federal government would not fully be known until SpaceX submits an application with the FAA requesting to launch and whether the LNG terminal is under construction or in operation at that time.

We conducted a preliminary engineering and technical review of the Annova design, including potential external impacts based on the site location. Based on this review, we recommend a number of mitigation measures, to ensure continuous oversight prior to initial site preparation, prior to construction of final design, prior to commissioning, prior to introduction of hazardous fluids, prior to commencement of service, and throughout life of the facility, in order to enhance the reliability and safety of the facility to mitigate the risk of impact on the public. With the incorporation of these mitigation measures and oversight, we conclude that Annova's terminal design would include acceptable layers of protection or safeguards that would reduce the risk of a potentially hazardous scenario from developing into an event that could impact the offsite public.

5.1.13 Cumulative Impacts

We considered the contributions of the proposed Project in conjunction with other projects in the Project area to determine the potential for cumulative impact on the resources affected by the Project. As part of that assessment, we identified existing projects, projects under construction, projects that are proposed or planned, and reasonably foreseeable future projects – including proposed LNG terminals, currently operating and future oil and gas projects, land transportation projects, commercial and industrial developments, and dredging projects. Reasonably foreseeable projects that might cause cumulative impacts in combination with the proposed Project include the Rio Grande LNG Project and the Texas LNG Project. Many of the identified cumulative impacts would be temporary and minor. Cumulative impacts have the potential to be more substantial for water resources, protected wildlife, visual resources, noise, and transportation, as discussed below.

The greatest potential for cumulative impacts associated with surface water resources would be during dredging activities, as well as during operation. Concurrent dredging of the maneuvering basin for the proposed Project as well as the Rio Grande LNG, Texas LNG, Bahia Grande Estuary Channel Widening/Restoration, and Brazos Island Harbor Channel Improvement Project would result in increased turbidity and sedimentation, resulting in short-term impacts on water quality. The Brazos Island Harbor Channel Improvement project is not expected to result in sediment accumulation during dredging as the purpose of the project is to deepen the main channel and any accumulated sediments would likely be accounted for with the allowed over-dredge depth to achieve the final design depth. While the BSC is a routinely maintained, manmade channel, concurrent dredging activities and other impacts on surface water resources during construction activities, as described above, are anticipated to be temporary and moderate.

The operation of all three proposed Brownsville LNG projects would also result in a substantial increase in the number of large, ocean-going vessels transiting the BSC (estimated to be about 467 LNG carriers per year combined). During operation, increased vessel traffic would result in a cumulative impact on surface water resources from increases in turbidity and shoreline erosion. Each of the three LNG projects has designed its respective facilities to minimize shoreline erosion through placement of rock riprap along the shoreline, or similar measures. Cumulative impacts on surface water quality during operation would be permanent and moderate to significant due to the persistent transit of LNG carriers and other large vessels within the BSC resulting in the potential increased erosion of the shoreline along unarmored portions of the BSC.

The proposed Project, Rio Grande LNG, and Texas LNG Projects, as well as the pipeline projects proposed in the area, are anticipated to have the greatest cumulative impacts on ocelot habitat through removal and conversion to industrial uses and fragmentation, respectively. In addition, these projects along with several of the transportation projects could result in increased road traffic and/or additional roads for transiting ocelots and jaguarundis to cross, thus increasing the potential for vehicle strikes. The current remaining habitat corridor in the region to connect U.S. and Mexico populations of these federally listed species is within and adjacent to the proposed Annova Project site on the south side of the BSC, and adjacent to and within the proposed Rio Grande LNG and Texas LNG Project sites north of the BSC. Other impacts, such as those associated with noise, would be minimized by the projects to the extent practicable; however, due to the proximity of the proposed Annova Project and Rio Grande LNG Project to the wildlife corridors, facility-generated noise during construction and operation would still be audible to ocelots and jaguarundis utilizing the wildlife corridor. Impulsive noise, like pile driving and intermittent construction noise, is especially disruptive to members of the Family Felidae. Due to the past, present, and proposed future development throughout the geographic scope for assessing cumulative impacts on ocelots and jaguarundis, as well as the associated increases in road traffic, light, and noise, we have determined that cumulative impacts on ocelots and jaguarundis would be permanent and significant.

Projects with permanent aboveground components, such as the Texas LNG and Rio Grande LNG terminals, have the most potential to contribute, along with the proposed Project, to cumulative impacts on visual resources. In particular, motorists on State Highway 48 and visitors to the nearby recreation areas where two or three LNG terminals would be visible (including the NWRs, Loma Ecological Preserve, and South Bay Coastal Preserve and South Bay Paddling Trail) would experience a permanent change in the existing viewshed during construction and operation of the projects. The proposed Annova Project would have a low to moderate impact on visual resources in the area. However, due to the proximity of the Rio Grande LNG and Texas LNG Projects to the same visual receptors as the Annova LNG Project, significant cumulative impacts on visual resources are anticipated.

Cumulative noise impacts would primarily occur as a result of the concurrent construction and operation of the Annova LNG Project, and the Texas LNG and Rio Grande LNG Projects. For simultaneous construction activities at all three LNG projects, the predicted sound level increase over the existing ambient ranges from 2.2 to 9.8 dBA L_{dn} at the noise sensitive areas and sound levels of slightly over 55 dBA L_{dn} are predicted for several noise sensitive areas, and range from less than noticeable increases in ambient noise to a doubling of noise at specific noise sensitive areas. For construction activities that are not simultaneous but incremental, the predicted sound level increase ranges from 1.0 to 8.6 dBA L_{dn} at the noise sensitive areas. These increases would result in a minor to moderate impact; however, all levels would be below 55 dBA L_{dn}. For the Palmito Ranch Battlefield National Historic Landmark, the predicted cumulative construction increase was 10.1 dBA L_{dn} over the existing ambient, which could result in periods of perceived doubling of noise. At the Laguna Atascosa NWR there is a higher ambient sound level so the predicted increase due to cumulative construction noise would be 2.7 dBA L_{dn}, resulting in a minor impact.

For operational noise with all three projects fully operational, the predicted sound level impacts are much lower than construction impacts, with potential increases over the existing ambient of between 0.3 and 1.5 dBA L_{dn} at noise sensitive areas, resulting in minor impacts. Operational impacts would be slightly higher at the Palmito Ranch Battlefield National Historic Landmark and the Laguna Atascosa NWR, with possible increases in sound levels due to operation of all three LNG projects of between 1.3 and 4.8 dBA L_{dn}. This is generally considered a minor to moderate long-term impact.

If the three LNG projects were constructed concurrently, the combined impact of construction traffic would be approximately 14,624 daily trips during active construction, with the Annova Project accounting for approximately 14 percent of this total. This cumulative impact would result in increased wait times and congestion on local roadways during construction. If all three proposed LNG projects were authorized and go into operation, and the other identified dredging projects also occur, there would be a substantial increase of large and ocean-going vessel traffic on the BSC. The three LNG projects combined would support an estimated 467 LNG carrier trips per year, with periodic channel maintenance dredging activities, on average, contributing about 420 vessel trips per year. This cumulative impact would represent a substantial increase in the number of large and ocean-going vessels in the BSC, and small vessels and recreational boaters attempting to access South Bay and the BSC would likely experience delays, ranging from 11 to 32 percent of daylight hours per year.

5.1.14 Alternatives

In accordance with NEPA and our policies, we evaluated alternatives to the Project to determine whether an alternative would be environmentally preferable, reasonable, and/or technically and economically feasible. As part of the alternatives analysis we considered: a no action alternative; system alternatives; alternative sites; site layout alternatives; access road alternatives; process alternatives; and marine berth excavation and dredging alternatives. Using the evaluation criteria stated above and subsequent environmental comparisons, we considered each alternative to the point where it was clear that the alternative could not meet the Project's objectives, offered no significant environmental advantage over the proposed action, or was not reasonable from a technical or economic standpoint.

While the no action alternative would avoid the environmental impacts identified in this EIS, the objectives of the Project would not be met. Further, any need for the import and export of natural gas could potentially be met by LNG export and import projects developed elsewhere, which would result in similar or greater impacts at other locations. It is also possible that industrial or commercial development would occur on the proposed Project site whether or not Annova constructs the Project, with other industrial or commercial development potentially resulting in similar types of environmental impacts. For these reasons, the no action alternative is not preferable to and does not provide a significant environmental advantage over the proposed action.

Energy conservation and alternative energy sources have been proposed by commenters as a replacement for the Project. However, energy conservation and alternative energy technology would not meet the Project's purpose to prepare natural gas for export to overseas markets, and would, therefore, not be a reasonable alternative to the proposed action.

System alternatives considered in this analysis are those alternatives to the proposed action that would make use of other existing, modified, or proposed facilities to meet the stated purpose and need of the proposed action. To be considered a viable system alternative, the existing or proposed project would need to be located in the Texas Gulf Coast region and provide LNG send-out capacities similar to Annova's proposal, in addition to current or planned expansion capacities for the other terminals. Our evaluation of potential system alternatives did not identify any existing, proposed, or planned LNG export facilities in the region that could be considered a viable system alternative.

We received comments from the public and other federal agencies during the scoping period regarding the need for an evaluation of alternative sites such as industrial areas that are not in proximity to communities and important wildlife habitat. Based in part on the information provided by Annova, we evaluated alternative sites that may also meet the stated objectives of the Annova Project. We applied screening criteria to identify sites that would be reasonable and most likely to provide some environmental advantage over the proposed terminal site. Based on this analysis, we conclude that the proposed site represents an acceptable site for the proposed LNG terminal, and that the alternative sites are either not feasible or are not environmentally preferable to the proposed site.

Based on scoping comments, Annova (in consultation with the FWS) identified two alternatives to its proposed access road from SH 4 to the Project site. The two alternative routes (Access Road Alternatives 1 and 3) reflect possible modifications to minimize potential impacts on wildlife movement through the area. Based on a detailed evaluation of the three access road locations (the proposed access road and two alternatives), we conclude that the proposed access road location is the environmentally preferable alternative. However, use of the proposed access road would require an appropriateness determination and a compatibility determination from the FWS. Annova has stated it is in discussion with the FWS regarding the appropriateness determination for use of the proposed access road. Annova states that it would construct and operate its access road on the route identified as Access Road Alternative 1 in the event the FWS' regulatory process precludes use of the proposed access road.

At our request, Annova evaluated process and design alternatives that include an on-site power plant versus grid-supplied power as proposed, gas-fired compressors versus electric compressors as proposed, and several flare design alternatives. We conclude that neither an on-site power plant alternative or gas-fired compressors would provide a significant environmental advantage over the proposed design when comparing local air quality impacts. We conclude that a Totally Enclosed Ground Flare design would not result in an environmental advantage over the proposed combined warm/cold flare stack.

Annova proposes to use the existing DMPA 5A located along the BSC just west of the Project site for placement of dredged material not used as fill on site. Annova's proposed *Dredged Material Transport Plan* includes evaluation of three alternative placement area also located along the BSC which we summarize in our EIS. We conclude that none of the three alternative placement areas would provide an environmental advantage over the proposed placement area.

5.2 FERC STAFF'S RECOMMENDED MITIGATION

If the Commission authorizes the Project, we are recommending that the following measures be included as specific conditions in the Commission's Order. These measures would further mitigate the environmental impacts associated with the construction and operation of the proposed Project. We have included some recommendations that require Annova to provide updated information and/or documents prior to the end of the draft EIS comment period. We do not expect that Annova's responses would materially change any of the conclusions presented in this draft EIS; instead, the information requested is primarily related to ensuring that our final EIS provides up-to-date information on Annova's ongoing efforts to minimize the impacts of the Project in compliance with FERC regulations. The section number in parentheses at the end of a condition corresponds to the section number in which the measure and related resource impact analysis appears in the EIS.

1. Annova shall follow the construction procedures and mitigation measures described in its applications and supplemental filings (including responses to staff data requests), and as identified in the EIS, unless modified by the Order. Annova must:
    a. request any modification to these procedures, measures, or conditions in a filing with the Secretary;
    b. justify each modification relative to site-specific conditions;
    c. explain how that modification provides an equal or greater level of environmental protection than the original measure; and
    d. receive approval in writing from the Director of OEP **before using that modification**.
2. The Director of OEP, or the Director's designee, has delegated authority to address any requests for approvals or authorizations necessary to carry out the conditions of the Order, and take whatever steps are necessary to ensure the protection of life, health, property, and the environment during construction and operation of the Terminal. This authority shall include:
    a. the modification of conditions of the Order;
    b. stop-work authority and authority to cease operation; and
    c. the imposition of any additional measures deemed necessary to ensure continued compliance with the intent of the conditions of the Order as well as the avoidance or mitigation of unforeseen adverse environmental impact resulting from project construction and operation.
3. **Prior to any construction,** Annova shall file an affirmative statement with the Secretary, certified by a senior company official, that all company personnel, EIs, and contractor personnel will be informed of the EI's authority and have been or will be trained on the implementation of the environmental mitigation measures appropriate to their jobs **before** becoming involved with construction and restoration activities.
4. The authorized facility location shall be as shown in the EIS, as supplemented by filed site plans. **As soon as they are available, and before the start of construction,** Annova shall file with the Secretary any revised detailed site plan drawings for all facilities approved by the Order. All requests for modifications of environmental conditions of the Order or site-specific clearances must be written and must reference locations designated on these site plan drawings.

5. Annova shall file with the Secretary detailed site plan drawings identifying all changes in site plan layout and staging areas, and other areas that would be used or disturbed and have not been previously identified in filings with the Secretary. Approval for each of these areas must be explicitly requested in writing. For each area, the request must include a description of the existing land use/cover type, documentation of landowner approval, whether any cultural resources or federally listed threatened or endangered species would be affected, and whether any other environmentally sensitive areas are within or abutting the area. All areas shall be clearly identified on the maps/sheets/aerial photographs. Each area must be approved in writing by the Director of OEP **before construction in or near that area.**

   Examples of alterations requiring approval include all facility location changes resulting from:

   a. implementation of cultural resources mitigation measures;
   b. implementation of endangered, threatened, or special concern species mitigation measures;
   c. recommendations by state regulatory authorities; and
   d. agreements with individual landowners that affect other landowners or could affect sensitive environmental areas.

6. **Within 60 days of the acceptance of the Authorization and before construction begins**, Annova shall file an Implementation Plan with the Secretary for review and written approval by the Director of OEP. Annova must file revisions to the plan as schedules change. The plan shall identify:

   a. how Annova will implement the construction procedures and mitigation measures described in its application and supplements (including responses to staff data requests), identified in the EIS, and required by the Order;
   b. how Annova will incorporate these requirements into the contract bid documents, construction contracts (especially penalty clauses and specifications), and construction drawings so that the mitigation required at each site is clear to onsite construction and inspection personnel;
   c. the number of EIs assigned, and how the company will ensure that sufficient personnel are available to implement the environmental mitigation;
   d. company personnel, including EIs and contractors, who will receive copies of the appropriate material;
   e. the location and dates of the environmental compliance training and instructions Annova will give to all personnel involved with construction and restoration (initial and refresher training as the Project progresses and personnel change), with the opportunity for OEP staff to participate in the training session(s);
   f. the company personnel (if known) and specific portion of Annova's organization having responsibility for compliance;

g. the procedures (including use of contract penalties) Annova will follow if noncompliance occurs; and

h. for each discrete facility, a Gantt or PERT chart (or similar Project scheduling diagram), and dates for:

i. the completion of all required surveys and reports;

ii. the environmental compliance training of onsite personnel;

iii. the start of construction; and

iv. the start and completion of restoration.

7. Annova shall at least one EI for the Project. The EIs shall be:

a. responsible for monitoring and ensuring compliance with all mitigation measures required by the Order and other grants, permits, certificates, or authorizing documents;

b. responsible for evaluating the construction contractor's implementation of the environmental mitigation measures required in the contract (see condition 6 above) and any other authorizing document;

c. empowered to order correction of acts that violate the environmental conditions of the Order, and any other authorizing document;

d. a full-time position separate from all other activity inspectors;

e. responsible for documenting compliance with the environmental conditions of the Order, as well as any environmental conditions/permit requirements imposed by other federal, state, or local agencies; and

f. responsible for maintaining status reports.

8. Beginning with the filing of its Implementation Plan, Annova shall file updated status reports with the Secretary on a **monthly** basis until all construction and restoration activities are complete. Problems of a significant magnitude shall be reported to the FERC **within 24 hours.** On request, these status reports will also be provided to other federal and state agencies with permitting responsibilities. Status reports shall include:

a. an update on Annova's efforts to obtain the necessary federal authorizations;

b. Project schedule, including current construction status of the Project and work planned for the following reporting period;

c. a listing of all problems encountered, contractor nonconformance/deficiency logs, and each instance of noncompliance observed by the EI during the reporting period (both for the conditions imposed by the Commission and any environmental conditions/permit requirements imposed by other federal, state, or local agencies);

d. a description of the corrective and remedial actions implemented in response to all instances of noncompliance, nonconformance, or deficiency;

e. the effectiveness of all corrective and remedial actions implemented;

f. a description of any landowner/resident complaints which may relate to compliance with the requirements of the order, and the measures taken to satisfy their concerns; and

g. copies of any correspondence received by Annova from other federal, state, or local permitting agencies concerning instances of noncompliance, and Annova's response.

9. Annova must receive written authorization from the Director of OEP **before commencing construction of any Project facilities.** To obtain such authorization, Annova must file with the Secretary documentation that it has received all applicable authorizations required under federal law (or evidence of waiver thereof).

10. Annova must receive written authorization from the Director of OEP **prior to introducing hazardous fluids into the Project facilities**. Instrumentation and controls, hazard detection, hazard control, and security components/systems necessary for the safe introduction of such fluids shall be installed and functional.

11. Annova must receive written authorization from the Director of OEP **before placing the Project into service**. Such authorization will only be granted following a determination that the facilities have been constructed in accordance with the FERC approval, can be expected to operate safely as designed, and the rehabilitation and restoration of the areas affected by the Project are proceeding satisfactorily.

12. **Within 30 days of placing the authorized facilities in service**, Annova shall file an affirmative statement with the Secretary, certified by a senior company official:

a. that the facilities have been constructed in compliance with all applicable conditions, and that continuing activities will be consistent with all applicable conditions; or

b. identifying which of the conditions of the Order Annova has complied with or will comply with. This statement shall also identify any areas affected by the Project where compliance measures were not properly implemented, if not previously identified in filed status reports, and the reason for noncompliance.

13. **Prior to construction,** Annova shall file with the Secretary, for review and written approval by the Director of the OEP, its final *Spill Prevention and Response Procedures* and *Construction SPCC Plan*, and the *Operation SPCC Plan*. *(section 4.2.3)*

14. **Prior to construction,** Annova shall file with the Secretary, for review and written approval by the Director of OEP, its *Facility Lighting Plan* for operation of the LNG terminal. In addition, Annova shall include in its *Facility Lighting Plan* measures to reduce the effects of light during construction and commissioning of the Project. *(section 4.6.1)*

15. **Prior to construction**, Annova shall consult with the FWS to develop a Project-specific *Migratory Bird Plan* that includes measures to avoid and minimize impacts on migratory birds, including details from the *Facility Lighting Plan* that are intended to reduce impacts on wildlife and birds. Annova shall file the *Migratory Bird Plan* and evidence of consultation with the FWS with the Secretary. *(section 4.6.1)*

16. Annova **shall not begin construction activities until**:

a. the FERC staff receives comments from the FWS and NOAA Fisheries regarding the proposed action;

b. the FERC staff completes Section 7 ESA consultation with the FWS and NOAA Fisheries; and

c. Annova has received written notification from the Director of OEP that construction or use of mitigation may begin. *(section 4.7.3)*

17. **Prior to construction**, Annova shall file with the Secretary a determination from the Texas Coastal Coordination Advisory Committee that the Project is consistent with the laws and regulations of the state's Coastal Zone Management Program. *(section 4.8.6)*

18. **Prior to the end of the draft EIS comment period**, Annova shall file the specific location(s) of any off-site centralized parking sites that would be used for the construction work force. For each location, Annova shall identify: the existing environment and land use at those locations; an evaluation of potential impacts that would result from use as an off-site parking and staging facility; and a description of how the use of these sites would mitigate the impacts at Intersections 1-4, identified in the Traffic Impact Group 2015 report. (*section 4.9.10.1*)

19. Annova shall **not begin** construction of facilities and/or use of staging, storage, or temporary work areas and new or to-be-improved access roads **until**:

a. Annova files with the Secretary:

i. remaining cultural resources survey report(s);

ii. site evaluation report(s) and avoidance/treatment plan(s), as required; and

iii. comments on all cultural resources reports and plans from the Texas State Historic Preservation Office.

b. the Advisory Council on Historic Preservation is afforded an opportunity to comment if historic properties would be adversely affected; and

c. the FERC staff reviews and the Director of OEP approves the cultural resources reports and plans, and notifies Annova in writing that treatment plans/mitigation measures (including archaeological data recovery) may be implemented and/or construction may proceed.

All materials filed with the Commission containing **location, character, and ownership** information about cultural resources must have the cover and any relevant pages therein clearly labeled in bold lettering: **CUI/PRIV "CONTAINS PRIVILEGED INFORMATION - DO NOT RELEASE."** (*section 4.10.4*)

20. Annova shall monitor pile-driving activities, and file **weekly** noise data with the Secretary **following the start of pile-driving activities** that identify the noise impact on the nearest NSAs. If any measured noise impacts (L_{max}) at the nearest NSAs are greater than 10 dBA over the L_{eq} ambient levels, Annova shall:

a. cease pile-driving activities and implement noise mitigation measures;

b. file with the Secretary evidence of noise mitigation installation and request written notification from the Director of OEP that pile driving may resume. (*section 4.11.2)*

21. Annova shall file a full power load noise survey with the Secretary for the LNG terminal **no later than 60 days** after each liquefaction train is placed into service. If the noise attributable to operation of the equipment at the LNG terminal exceeds an L_{dn} of 55 dBA at the nearest NSA, **within 60 days** Annova shall modify operation of the liquefaction facilities or install additional noise controls until a noise level below an L_{dn} of 55 dBA at the NSA is achieved. Annova shall confirm compliance with the above requirement by filing a second noise survey with the Secretary **no later than 60 days** after it installs the additional noise controls. (*section 4.11.2)*

22. Annova shall file a noise survey with the Secretary **no later than 60 days** after placing the entire LNG terminal into service. If a full load condition noise survey is not possible, Annova shall provide an interim survey at the maximum possible horsepower load **within 60 days** of placing the LNG terminal into service and provide the full load survey **within 6 months**. If the noise attributable to operation of the equipment at the LNG terminal exceeds an L_{dn} of 55 dBA at the nearest NSA under interim or full horsepower load conditions, Annova shall file a report on what changes are needed and shall install the additional noise controls to meet the level **within 1 year** of the in-service date. Annova shall confirm compliance with the above requirement by filing an additional noise survey with the Secretary **no later than 60 days** after it installs the additional noise controls. (*section 4.11.2)*

23. **Prior to the end of the draft EIS comment period**, Annova shall determine if the heights of the LNG marine vessels would be higher than other objects that traverse the waterway and if applicable, file for an Aeronautical Study under 14 CFR 77 for LNG marine vessels that may exceed the height requirements in 14 CFR 77.9. *(section 4.12.6)*

24. **Prior to the end of the draft EIS comment period**, Annova shall consult with DOT PHMSA on whether using normally-closed valves as a stormwater removal device on curbed areas would meet the requirements of 49 CFR 193. *(section 4.12.6)*

25. **Prior to the end of the draft EIS comment period**, Annova shall clarify how liquid releases in each heavies handling train area (consisting of the stabilizer, stabilizer reboiler, and the LNG expander) would be contained. *(section 4.12.6)*

26. **Prior to the end of the draft EIS comment period**, Annova shall file with the Secretary a plan to conduct a comprehensive supplemental geotechnical field investigation and geotechnical report at the proposed locations for the new LNG facilities and a date by which the investigation and report are expected to be completed by. *(section 4.12.6)*

27. **Prior to the end of the draft EIS comment period**, Annova shall file with the Secretary a wave overtopping analysis for a 500-year storm and include a discussion on the impacts to the public and surrounding LNG facilities. The overtopping analysis shall also include a more detailed storm surge study to determine the flood elevation associated with a 500-year event, including 500-year SWEL, sea level rise, subsidence, wave effects, and potential run up. *(section 4.12.6)*

28. **Prior to initial site preparation**, Annova shall file with the Secretary documentation demonstrating LNG marine vessels will be no higher than existing ship traffic or it has received a determination of no hazard (with or without conditions) by FAA for mobile objects that exceed the height requirements in 14 CFR 77.9. *(section 4.12.6)*

29. **Prior to construction of final design**, Annova shall file with the Secretary the following information, stamped and sealed by the professional engineer-of-record registered in Texas:

    a. site preparation drawings and specifications;

    b. LNG terminal structures and foundation design drawings and calculations (including prefabricated and field constructed structures);

    c. seismic specifications for procured equipment; and

    d. quality control procedures to be used for civil/structural design and construction.

    In addition, Annova shall file, in its Implementation Plan, the schedule for producing this information. *(section 4.12.6)*

30. **Prior to construction of final design**, Annova shall file with the Secretary a monitoring and maintenance plan, stamped and sealed by the professional engineer-of-record registered in Texas, to ensure the site is maintained at a minimum elevation of 16.5 feet NAVD 88 and the crest elevation of the earthen berm around each LNG storage tank is maintained at a minimum crest of 21 feet NAVD 88 **for the life of the facility** considering settlement, subsidence, and sea level rise.

Conditions 31 through 120 shall apply to the Annova LNG terminal facilities. Information pertaining to these specific conditions shall be filed with the Secretary for review and written approval by the Director of OEP, or the Director's designee, within the timeframe indicated by each condition. Specific engineering, vulnerability, or detailed design information meeting the criteria specified in Order No. 833 (Docket No. RM16-15-000), including security information, shall be submitted as critical energy infrastructure information pursuant to 18 CFR 388.113. See Critical Electric Infrastructure Security and Amending Critical Energy Infrastructure Information, Order No. 833, 81 Fed. Reg. 93,732 (December 21, 2016), FERC Stats. & Regs. 31,389 (2016). Information pertaining to items such as offsite emergency response, procedures for public notification and evacuation, and construction and operating reporting requirements would be subject to public disclosure. All information shall be filed a minimum of 30 days before approval to proceed is requested.

31. **Prior to initial site preparation**, Annova shall file an overall project schedule, which includes the proposed stages of the commissioning plan. *(section 4.12.6)*

32. **Prior to initial site preparation**, Annova shall file quality assurance and quality control procedures for construction activities. *(section 4.12.6)*

33. **Prior to initial site preparation**, Annova shall file procedures for controlling access during construction. *(section 4.12.6)*

34. **Prior to initial site preparation**, Annova shall develop, file, and implement procedures to position construction crews outside of areas that could be impacted by rocket debris of a

failed launch from the SpaceX facility during initial moments of rocket launch activity. *(section 4.12.6)*

35. **Prior to initial site preparation**, Annova shall conduct and provide results of a minimum of five equally distributed borings, cone penetration tests, and/or seismic cone penetration tests to a depth of at least 100 feet or refusal underneath the revised locations of each LNG storage tank to affirm or better characterize underlying conditions. *(section 4.12.6)*

36. **Prior to initial site preparation**, Annova shall develop an Emergency Response Plan (including evacuation) and coordinate procedures with the Coast Guard; state, county, and local emergency planning groups; fire departments; state and local law enforcement; and appropriate federal agencies. This plan shall include at a minimum:

    a. designated contacts with state and local emergency response agencies;

    b. scalable procedures for the prompt notification of appropriate local officials and emergency response agencies based on the level and severity of potential incidents;

    c. procedures for notifying residents and recreational users within areas of potential hazard;

    d. evacuation routes/methods for residents and public use areas that are within any transient hazard areas along the route of the LNG marine transit;

    e. locations of permanent sirens and other warning devices; and

    f. an "emergency coordinator" on each LNG marine vessel to activate sirens and other warning devices.

    Annova shall notify the FERC staff of all planning meetings in advance and shall report progress on the development of its Emergency Response Plan at **3-month intervals**. *(section 4.12.6)*

37. **Prior to initial site preparation**, Annova shall file a Cost-Sharing Plan identifying the mechanisms for funding all Project-specific security/emergency management costs that would be imposed on state and local agencies. This comprehensive plan shall include funding mechanisms for the capital costs associated with any necessary security/emergency management equipment and personnel base. Annova shall notify FERC staff of all planning meetings in advance and shall report progress on the development of its Cost Sharing Plan at **3-month intervals**. *(section 4.12.6)*

38. **Prior to construction of final design**, Annova shall file change logs that list and explain any changes made from the front end engineering design provided in Annova's application and filings. A list of all changes with an explanation for the design alteration shall be provided and all changes shall be clearly indicated on all diagrams and drawings. *(section 4.12.6)*

39. **Prior to construction of final design**, Annova shall file information/revisions pertaining to its response to numbers 4, 5, 6, 10 11, 14, 17, 18, 19, 20, 21, 22, 24, 25, 26, 27, 28, 29, 31, 33, 34, 35, 36, 38, 43, and 49 of the February 14, 2017 data request and to its response to numbers 11, 12, 13, 17, 18a, 18e, 19, and 21f of the October 19, 2018 data request, which indicated features to be included or considered in the final design. *(section 4.12.6)*

40. **Prior to construction of final design**, Annova shall file a plot plan of the final design showing all major equipment, structures, buildings, and impoundment systems. *(section 4.12.6)*

41. **Prior to construction of final design**, Annova shall file three-dimensional plant drawings to confirm plant layout for maintenance, access, egress, and congestion. *(section 4.12.6)*

42. **Prior to construction of final design**, Annova shall file an up-to-date equipment list, process and mechanical data sheets, and specifications. The specifications shall include:

    a. building specifications (e.g., control buildings, electrical buildings, compressor buildings, storage buildings, pressurized buildings, ventilated buildings, blast resistant buildings);

    b. mechanical specifications (e.g., piping, valve, insulation, rotating equipment, heat exchanger, storage tank and vessel, other specialized equipment);

    c. electrical and instrumentation specifications (e.g., power system, control system, safety instrument system [SIS], cable, other electrical and instrumentation); and

    d. security and fire safety specifications (e.g., security, passive protection, hazard detection, hazard control, firewater). *(section 4.12.6)*

43. **Prior to construction of final design**, Annova shall file a summary of all codes and standards referenced in the final specifications. *(section 4.12.6)*

44. **Prior to construction of final design**, Annova shall file a complete LNG storage tank specification and design drawings. The specification shall define the battery limits (i.e., engineering design, structural design, supports, piping components, piping connections, electrical power, control, and utilities) of the LNG storage tank. *(section 4.12.6)*

45. **Prior to construction of final design**, the LNG storage tank specification shall clearly define the roof top load requirements for the LNG pump platform as well as other laydown areas required for maintenance activities. *(section 4.12.6)*

46. **Prior to construction of final design**, Annova shall file drawings of the storage tank piping support structure and support of horizontal piping at grade including pump columns, relief valves, pipe penetrations, instrumentation, and appurtenances. *(section 4.12.6)*

47. **Prior to construction of final design**, Annova shall provide process data sheets that specify the start-up, operating, and shutdown conditions for the BOG Compressors. *(section 4.12.6)*

48. **Prior to construction of final design**, Annova shall file up-to-date process flow diagrams (PFDs) that demonstrate the peak liquefaction rate of 6.95 mtpa is achievable and piping and instrument diagrams (P&IDs). The PFDs shall include heat and material balances. The P&IDs shall include the following information:

    a. equipment tag number, name, size, duty, capacity, and design conditions;

    b. equipment insulation type and thickness;

    c. storage tank pipe penetration size and nozzle schedule;

    d. valve high pressure side and internal and external vent locations;

e. piping with line number, piping class specification, size, and insulation type and thickness;

f. piping specification breaks and insulation limits;

g. all control and manual valves numbered;

h. relief valves with size and set points; and

i. drawing revision number and date. *(section 4.12.6)*

49. **Prior to construction of final design**, Annova shall file P&IDs, specifications, and procedures that clearly show and specify the tie-in details required to safely connect subsequently constructed facilities with the operational facilities. *(section 4.12.6)*

50. **Prior to construction of final design**, Annova shall file a car seal philosophy and a list of all car-sealed and locked valves consistent with the P&IDs. *(section 4.12.6)*

51. **Prior to construction of final design**, Annova shall file a hazard and operability review prior to issuing the P&IDs for construction. A copy of the review, a list of the recommendations, and actions taken on the recommendations shall be filed. *(section 4.12.6)*

52. **Prior to construction of final design**, Annova shall provide specifications and piping and instrumentation diagrams of the Refrigerant Compressor motor cooling system. *(section 4.12.6)*

53. **Prior to construction of final design**, Annova shall file the safe operating limits (upper and lower), alarm and shutdown set points for all instrumentation (i.e., temperature, pressures, flows, and compositions). *(section 4.12.6)*

54. **Prior to construction of final design**, Annova shall file cause-and-effect matrices for the process instrumentation, fire and gas detection system, and emergency shutdown system for review and approval. The cause-and-effect matrices shall include alarms and shutdown functions, details of the voting and shutdown logic, and set points. *(section 4.12.6)*

55. **Prior to construction of final design**, Annova shall file an evaluation of emergency shutdown valve closure times. The evaluation shall account for the time to detect an upset or hazardous condition, notify plant personnel, and close the emergency shutdown valve. *(section 4.12.6)*

56. **Prior to construction of final design**, Annova shall file an evaluation of dynamic pressure surge effects from valve opening and closure times and pump startup and shutdown operations. *(section 4.12.6)*

57. **Prior to construction of final design**, Annova shall demonstrate that, for hazardous fluids, piping and piping nipples 2 inches or less in diameter are designed to withstand external loads, including vibrational loads in the vicinity of rotating equipment and operator live loads in areas accessible by operators. *(section 4.12.6)*

58. **Prior to construction of final design**, Annova shall file electrical area classification drawings. *(section 4.12.6)*

59. **Prior to construction of final design**, Annova shall file drawings and details of how process seals or isolations installed at the interface between a flammable fluid system and

an electrical conduit or wiring system meet the requirements of NFPA 59A (2001). *(section 4.12.6)*

60. **Prior to construction of final design**, Annova shall file details of an air gap or vent installed downstream of process seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system. Each air gap shall vent to a safe location and be equipped with a leak detection device that shall continuously monitor for the presence of a flammable fluid, alarm the hazardous condition, and shut down the appropriate systems. *(section 4.12.6)*

61. **Prior to construction of final design**, Annova shall include layout and design specifications of the pig trap, inlet separation and liquid disposal, inlet/send-out meter station, and pressure control. *(section 4.12.6)*

62. **Prior to construction of final design**, Annova shall include LNG storage tank fill flow measurement with high flow alarm. *(section 4.12.6)*

63. **Prior to construction of final design**, Annova shall include BOG flow measurement from each LNG storage tank. *(section 4.12.6)*

64. **Prior to construction of final design**, Annova shall specify how each LNG storage tank dome's vent valve HV-0014/HV-0054 will be isolated with administrative controls in the event that the vent valve cannot be closed or requires maintenance work. *(section 4.12.6)*

65. **Prior to construction of final design**, Annova shall file the sizing basis and capacity for the final design of the flares and/or vent stacks as well as the pressure and vacuum relief valves for major process equipment, vessels, and storage tanks. *(section 4.12.6)*

66. **Prior to construction of final design**, Annova shall provide the Refrigerant Surge Drum, Ethylene Make-up Drum, Propane Make-up Drum, and Iso-pentane Make-up Drum with dual full capacity relief valves that allow the isolation with administrative controls of individual pressure relief valves while providing full relief capacity during pressure relief valve maintenance or testing. *(section 4.12.6)*

67. **Prior to construction of final design**, Annova shall file a drawing showing the location of the emergency shutdown buttons. Emergency shutdown buttons shall be easily accessible, conspicuously labeled, and located in an area which would be accessible during an emergency. *(section 4.12.6)*

68. **Prior to construction of final design**, Annova shall specify that all ESD valves are to be equipped with open and closed position switches connected to the Distributed Control System/Safety Instrumented System. *(section 4.12.6)*

69. **Prior to construction of final design**, Annova shall specify how the BOG system will prevent pipeline gas from back flowing into the BOG Metering Skid. *(section 4.12.6)*

70. **Prior to construction of final design**, Annova shall specify how the Heat Medium Expansion Drum pressure indicator, 1090-PI-0241, will notify operators of excessive venting through pressure regulator, 1090-PCV-0240. *(section 4.12.6)*

71. **Prior to construction of final design**, Annova shall file drawings and specifications for vehicle barriers at each facility entrance for access control. *(section 4.12.6)*

72. **Prior to construction of final design**, Annova shall file drawings of the security fence. The fencing shall extend around the pigging and metering equipment. The fencing drawings shall provide details of fencing that demonstrates it would restrict and deter access around the entire facility and has a setback from exterior features (e.g., power lines, trees, etc.) and from interior features (e.g., piping, equipment, buildings, etc.) that does not allow the fence to be overcome. *(section 4.12.6)*

73. **Prior to construction of final design**, Annova shall file drawings of internal road vehicle protections, such as guard rails, barriers, and bollards to protect transfer piping, pumps, and compressors, etc. to ensure that they are located away from roadway or protected from inadvertent damage from vehicles. *(section 4.12.6)*

74. **Prior to construction of final design**, Annova shall file security camera and intrusion detection drawings. The security camera drawings shall show the locations, areas covered, and features of each camera (e.g., fixed, tilt/pan/zoom, motion detection alerts, low light, mounting height, etc.) to verify coverage of the entire perimeter with redundancies for cameras interior to the facility to enable rapid monitoring of the facility. The intrusion detection drawings shall show or note the location of the intrusion detection to verify coverage of the entire perimeter of the facility. *(section 4.12.6)*

75. **Prior to construction of final design**, Annova shall file lighting drawings. The lighting drawings shall show the location, elevation, type of light fixture, and lux levels of the lighting system and shall cover the entire perimeter of the facility, process equipment, and along paths/roads of access and egress. *(section 4.12.6)*

76. **Prior to construction of final design**, Annova shall file an updated fire protection evaluation of the proposed facilities. A copy of the evaluation, a list of recommendations and supporting justifications, and actions taken on the recommendations shall be filed. *(section 4.12.6)*

77. **Prior to construction of final design**, Annova shall file spill containment system drawings with dimensions and slopes of curbing, trenches, impoundments, and capacity calculations considering any foundations and equipment within impoundments, as well as the sizing and design of the down-comer that would transfer spills from the tank top to the ground-level impoundment system. The spill containment drawings shall show containment for all hazardous fluids, including all liquids handled above their flashpoint, from the largest flow from a single line for 10 minutes, including de-inventory, or the maximum liquid from the largest vessel (or total of impounded vessels) or otherwise demonstrate that providing spill containment would not significantly reduce the flammable vapor dispersion or radiant heat consequences of a spill. In addition, Annova shall demonstrate that the stainless steel piping spill trays at each LNG storage tank will withstand the force and shock of a sudden cryogenic release. *(section 4.12.6)*

78. **Prior to construction of final design**, Annova shall specify how residual water within each spill basin will be removed after the stormwater removal pumps shut down on low water level. *(section 4.12.6)*

79. **Prior to construction of final design**, Annova shall review each Process Area Impoundment Basin stormwater removal system. If applicable, each stormwater removal

pump shall be equipped with an interlock to prevent inadvertent discharge of warm refrigerant, heavy hydrocarbon, or hot oil releases. *(section 4.12.6)*

80. **Prior to construction of final design**, Annova shall file complete drawings and a list of the hazard detection equipment. The drawings shall clearly show the location and elevation of all detection equipment. The list shall include the instrument tag number, type and location, alarm indication locations, and shutdown functions of the hazard detection equipment. *(section 4.12.6)*

81. **Prior to construction of final design**, Annova shall file a list of alarm and shutdown set points for all hazard detectors that account for the calibration gas of the hazard detectors when determining the lower flammable limit set points for methane, propane, ethylene, pentane, and condensate. *(section 4.12.6)*

82. **Prior to construction of final design**, Annova shall file a list of alarm and shutdown set points for all hazard detectors that account for the calibration gas of hazard detectors when determining the set points for toxic components such as aqueous ammonia, natural gas liquids and hydrogen sulfide. *(section 4.12.6)*

83. **Prior to construction of final design**, Annova shall file a technical review of facility design that:

    a. identifies all combustion/ventilation air intake equipment and the distances to any possible flammable gas or toxic release; and

    b. demonstrates that these areas are adequately covered by hazard detection devices and indicates how these devices would isolate or shutdown any combustion or heating ventilation and air conditioning equipment whose continued operation could add to or sustain an emergency. *(section 4.12.6)*

84. **Prior to construction of final design**, Annova shall file a design that includes hazard detection suitable to detect high temperatures and smoldering combustion products in electrical buildings and control room buildings. *(section 4.12.6)*

85. **Prior to construction of final design**, Annova shall provide low oxygen detectors to notify operators of liquid nitrogen releases. *(section 4.12.6)*

86. **Prior to construction of final design**, Annova shall file an evaluation of the voting logic and voting degradation for hazard detectors. *(section 4.12.6)*

87. **Prior to construction of final design**, Annova shall file facility plan drawings and a list of the fixed and wheeled dry-chemical, hand-held fire extinguishers, and other hazard control equipment. Plan drawings shall clearly show the location and elevation by tag number of all fixed dry chemical systems in accordance with NFPA 17, and wheeled and hand-held extinguishers location travel distances are along normal paths of access and egress in accordance with NFPA 10. The list shall include the equipment tag number, type, capacity, equipment covered, discharge rate, and automatic and manual remote signals initiating discharge of the units. *(section 4.12.6)*

88. **Prior to construction of final design**, Annova shall file a design that includes clean agent systems in the instrumentation buildings. *(section 4.12.6)*

89. **Prior to construction of final design**, Annova shall file facility plan drawings showing the proposed location of the firewater and any foam systems. Plan drawings shall clearly show the location of firewater and foam piping, post indicator valves, and the location and area covered by, each monitor, hydrant, hose, water curtain, deluge system, foam system, water-mist system, and sprinkler. The drawings shall also include piping and instrumentation diagrams of the firewater and foam systems.

90. **Prior to construction of final design**, Annova shall specify two firewater jockey pumps and appurtenances that can operate simultaneously in the event that the primary jockey pump cannot maintain system pressure. The flow rate capacity from the jockey pumps shall be supported with calculations. *(section 4.12.6)*

91. **Prior to construction of final design**, Annova shall include or demonstrate the firewater storage volume for its facilities has minimum reserved capacity for its most demanding firewater scenario plus 1,000 gpm for no less than 2 hours. The firewater storage shall also demonstrate compliance with NFPA 22 or demonstrate how API 650 provides an equivalent or better level of safety. *(section 4.12.6)*

92. **Prior to construction of final design**, Annova shall consider additional options for firewater pump flow test metering. The design shall include a flow transmitter and pressure transmitter connected to the DCS to maintain a historical record of pump performance tests. *(section 4.12.6)*

93. **Prior to construction of final design**, Annova shall file detailed calculations to confirm that the final fire water volumes would be accounted for when evaluating the capacity of the impoundment system during a spill and fire scenario. *(section 4.12.6)*

94. **Prior to construction of final design**, Annova shall specify that both freshwater pump shelter and the firewater intake and pumps shelter are designed to remove the largest firewater pump or other component for maintenance with an overhead or external crane. *(section 4.12.6)*

95. **Prior to construction of final design**, Annova shall file drawings and specifications for the structural passive protection systems to protect equipment and supports from cryogenic releases. *(section 4.12.6)*

96. **Prior to construction of final design**, Annova shall file a detailed quantitative analysis to demonstrate that adequate thermal mitigation would be provided for each significant component within the 4,000 BTU/ft^2-hr zone from an impoundment (including amine sump pit and condensate storage tank berm), or provide an analysis to assess the consequence of pressure vessel bursts and boiling liquid expanding vapor explosions. Trucks at the truck loading/unloading areas shall be included in the analysis. Passive mitigation shall be supported by calculations for the thickness limiting temperature rise and active mitigation shall be supported by calculations demonstrating flow rates and durations of any cooling water would mitigate the heat absorbed by the vessel. *(section 4.12.6)*

97. **Prior to construction of final design**, Annova shall file a projectile analysis that demonstrates whether each LNG storage tank would withstand wind-borne projectiles, or demonstrate whether protective measures are in place to ensure the structural integrity of each LNG storage tank. If the analysis demonstrates the tank would be penetrated, Annova

shall file an analysis indicating the containment dikes would sufficiently contain an LNG spill. *(section 4.12.6)*

98. **Prior to construction of final design**, Annova shall file an analysis demonstrating that each LNG storage tank's water deluge system would provide adequate thermal mitigation to withstand the radiant heat from an adjacent LNG storage tank dike fire. *(section 4.12.6)*

99. **Prior to construction of final design**, Annova shall specify how cascading damage to the condensate storage tank would be mitigated from a pool fire in the Heat Medium Impoundment Basin. Alternatively, Annova shall reposition the condensate storage tank or the Heat Medium Impoundment Basin to prevent high radiant heat zones over the condensate storage tank. *(section 4.12.6)*

100. **Prior to construction of final design**, Annova shall provide an evaluation of impacts from any size jetting releases from each LNG storage tank platform, marine dock and trestle, and the ethylene make-up drum area. As applicable, the evaluation shall demonstrate that adequate mitigation would be provided to prevent cascading damage. *(section 4.12.6)*

101. **Prior to commissioning**, Annova shall file a detailed schedule for commissioning through equipment startup. The schedule shall include milestones for all procedures and tests to be completed: prior to introduction of hazardous fluids and during commissioning and startup. Annova shall file documentation certifying that each of these milestones has been completed before authorization to commence the next phase of commissioning and startup will be issued. *(section 4.12.6)*

102. **Prior to commissioning**, Annova shall file detailed plans and procedures for: testing the integrity of onsite mechanical installation; functional tests; introduction of hazardous fluids; operational tests; and placing the equipment into service. *(section 4.12.6)*

103. **Prior to commissioning**, Annova shall file a plan for clean-out, dry-out, purging, and tightness testing. This plan shall address the requirements of the American Gas Association's Purging Principles and Practice, and shall provide justification if not using an inert or non-flammable gas for clean-out, dry-out, purging, and tightness testing. *(section 4.12.6)*

104. **Prior to commissioning**, Annova shall file the procedures for pressure/leak tests which address the requirements of ASME VIII and ASME B31.3. The procedures shall include a line list of pneumatic and hydrostatic test pressures. *(section 4.12.6)*

105. **Prior to commissioning**, Annova shall file the settlement results from hydrostatic testing of the LNG storage containers as well as a routine monitoring program to ensure settlements are as expected and do not exceed applicable criteria in API 620, 625, and 653. *(section 4.12.6)*

106. **Prior to commissioning**, Annova shall equip the LNG storage tank and adjacent piping and supports with permanent settlement monitors to allow personnel to observe and record the relative settlement between the LNG storage tank and adjacent piping. The settlement record shall be reported in the semi-annual operational reports. *(section 4.12.6)*

107. **Prior to commissioning**, Annova shall file the operation and maintenance procedures and manuals, as well as safety procedures, hot work procedures and permits, abnormal

operating conditions reporting procedures, simultaneous operations procedures, and management of change procedures and forms. *(section 4.12.6)*

108. **Prior to commissioning**, Annova shall tag all equipment, instrumentation, and valves in the field, including drain valves, vent valves, main valves, and car-sealed or locked valves. *(section 4.12.6)*

109. **Prior to commissioning**, Annova shall file a plan and maintain a detailed training log to demonstrate that operating, maintenance, and emergency response staff has completed the required training.

110. **Prior to introduction of hazardous fluids**, Annova shall complete and document all pertinent tests (Factory Acceptance Tests, Site Acceptance Tests, Site Integration Tests) associated with the DCS and SIS that demonstrates full functionality and operability of the system. *(section 4.12.6)*

111. **Prior to introduction of hazardous fluids**, Annova shall develop and implement an alarm management program to reduce alarm complacency and maximize the effectiveness of operator response to alarms. *(section 4.12.6)*

112. **Prior to introduction of hazardous fluids**, Annova shall develop and implement procedures for plant personnel to monitor all rocket launches and shut down operating equipment in the event of a rocket launch failure. *(section 4.12.6)*

113. **Prior to introduction of hazardous fluids**, Annova shall complete and document a firewater pump acceptance test and firewater monitor and hydrant coverage test. The actual coverage area from each monitor and hydrant shall be shown on facility plot plan(s). *(section 4.12.6)*

114. **Prior to introduction of hazardous fluids**, Annova shall complete and document a pre-startup safety review to ensure that installed equipment meets the design and operating intent of the facility. The pre-startup safety review shall include any changes since the last hazard review, operating procedures, and operator training. A copy of the review with a list of recommendations, and actions taken on each recommendation, shall be filed. *(section 4.12.6)*

115. Annova shall file a request for written authorization from the Director of OEP **prior to unloading or loading the first LNG commissioning cargo**. After production of first LNG, Annova shall file **weekly** reports on the commissioning of the proposed systems that detail the progress toward demonstrating the facilities can safely and reliably operate at or near the design production rate. The reports shall include a summary of activities, problems encountered, and remedial actions taken. The weekly reports shall also include the latest commissioning schedule, including projected and actual LNG production by each liquefaction train, LNG storage inventories in each storage tank, and the number of anticipated and actual LNG commissioning cargoes, along with the associated volumes loaded or unloaded. Further, the weekly reports shall include a status and list of all planned and completed safety and reliability tests, work authorizations, and punch list items. Problems of significant magnitude shall be reported to the FERC **within 24 hours**. *(section 4.12.6)*

116. **Prior to commencement of service**, Annova shall label piping with fluid service and direction of flow in the field, in addition to the pipe labeling requirements of NFPA 59A (2001). *(section 4.12.6)*

117. **Prior to commencement of service**, Annova shall provide plans for any preventative and predictive maintenance program that performs periodic or continuous equipment condition monitoring. *(section 4.12.6)*

118. **Prior to commencement of service**, Annova shall develop procedures for handling offsite contractors including responsibilities, restrictions, and limitations and for supervision of these contractors by Annova staff. *(section 4.12.6)*

119. **Prior to commencement of service**, Annova shall notify the FERC staff of any proposed revisions to the security plan and physical security of the plant. *(section 4.12.6)*

120. **Prior to commencement of service**, Annova shall file a request for written authorization from the Director of OEP. Such authorization would only be granted following a determination by the Coast Guard, under its authorities under the Ports and Waterways Safety Act, the Magnuson Act, the MTSA of 2002, and the Security and Accountability For Every Port Act, that appropriate measures to ensure the safety and security of the facility and the waterway have been put into place by Annova or other appropriate parties. *(section 4.12.6)*

In addition, conditions 121 through 124 shall apply **throughout the life of the Annova LNG terminal**.

121. The facility shall be subject to regular FERC staff technical reviews and site inspections on at least an **annual basis** or more frequently as circumstances indicate. Prior to each FERC staff technical review and site inspection, Annova shall respond to a specific data request including information relating to possible design and operating conditions that may have been imposed by other agencies or organizations. Up-to-date detailed P&IDs reflecting facility modifications and provision of other pertinent information not included in the semi-annual reports described below, including facility events that have taken place since the previously submitted semi-annual report, shall be submitted. *(section 4.12.6)*

122. **Semi-annual** operational reports shall be filed with the Secretary to identify changes in facility design and operating conditions; abnormal operating experiences; activities (e.g., ship arrivals, quantity and composition of imported and exported LNG, liquefied and vaporized quantities, boil off/flash gas); and plant modifications, including future plans and progress thereof. Abnormalities shall include, but not be limited to, unloading/loading/shipping problems, potential hazardous conditions from offsite vessels, storage tank stratification or rollover, geysering, storage tank pressure excursions, cold spots on the storage tanks, storage tank vibrations and/or vibrations in associated cryogenic piping, storage tank settlement, significant equipment or instrumentation malfunctions or failures, non-scheduled maintenance or repair (and reasons therefore), relative movement of storage tank inner vessels, hazardous fluids releases, fires involving hazardous fluids and/or from other sources, negative pressure (vacuum) within a storage tank, and higher than predicted boil off rates. Adverse weather conditions and the effect on the facility also shall be reported. Reports shall be submitted **within 45 days after each period ending June 30 and December 31**. In addition to the above items, a section entitled "Significant

Plant Modifications Proposed for the Next 12 Months (dates)" shall be included in the semi-annual operational reports. Such information would provide the FERC staff with early notice of anticipated future construction/maintenance at the LNG facilities. *(section 4.12.6)*

123. In the event the temperature of any region of the LNG storage container becomes less than the minimum specified operating temperature for the material, the Commission shall be notified **within 24 hours** and procedures for corrective action shall be specified. *(section 4.12.6)*

124. Significant non-scheduled events, including safety-related incidents (e.g., LNG, condensate, refrigerant, or natural gas releases; fires; explosions; mechanical failures; unusual over pressurization; and major injuries) and security-related incidents (e.g., attempts to enter site, suspicious activities) shall be reported to the FERC staff. In the event that an abnormality is of significant magnitude to threaten public or employee safety, cause significant property damage, or interrupt service, notification shall be made **immediately**, without unduly interfering with any necessary or appropriate emergency repair, alarm, or other emergency procedure. In all instances, notification shall be made to the FERC staff **within 24 hours**. This notification practice shall be incorporated into the LNG terminal's emergency plan. Examples of reportable hazardous fluids-related incidents include:

a. fire;

b. explosion;

c. estimated property damage of $50,000 or more;

d. death or personal injury necessitating in-patient hospitalization;

e. release of hazardous fluids for 5 minutes or more;

f. unintended movement or abnormal loading by environmental causes, such as an earthquake, landslide, or flood, that impairs the serviceability, structural integrity, or reliability of a facility that contains, controls, or processes hazardous fluids;

g. any crack or other material defect that impairs the structural integrity or reliability of a facility that contains, controls, or processes hazardous fluids;

h. any malfunction or operating error that causes the pressure of a pipeline or facility that contains or processes hazardous fluids to rise above its maximum allowable operating pressure (or working pressure for LNG facilities) plus the build-up allowed for operation of pressure-limiting or control devices;

i. a leak in a facility that contains or processes hazardous fluids that constitutes an emergency;

j. inner tank leakage, ineffective insulation, or frost heave that impairs the structural integrity of an LNG storage tank;

k. any safety-related condition that could lead to an imminent hazard and cause (either directly or indirectly by remedial action of the operator), for purposes other than abandonment, a 20 percent reduction in operating pressure or shutdown of operation of a pipeline or a facility that contains or processes hazardous fluids;

l. safety-related incidents from hazardous fluids transportation occurring at or en route to and from the facility; or

m. an event that is significant in the judgment of the operator and/or management even though it did not meet the above criteria or the guidelines set forth in an LNG terminal's incident management plan.

In the event of an incident, the Director of OEP has delegated authority to take whatever steps are necessary to ensure operational reliability and to protect human life, health, property, or the environment, including authority to direct the LNG terminal to cease operations. Following the initial company notification, the FERC staff would determine the need for a separate follow-up report or follow up in the upcoming semi-annual operational report. All company follow-up reports shall include investigation results and recommendations to minimize a reoccurrence of the incident.