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Draft Environmental Assessment
Wyoming CarbonSAFE Phase IV Project

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Location: Gillette, Wyoming

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Abstract: The United States Department of Energy (DOE) National Energy Technology Laboratory (NETL) prepared this Environmental Assessment (EA) to analyze the potential environmental, cultural, and social impacts of partially funding Phase IV of the Wyoming Carbon Storage Assurance Facility Enterprise (CarbonSAFE) Project (Project). The CarbonSAFE Project entails construction and operation of a commercial-scale Integrated Commercial Carbon Capture and Storage facility that would capture, compress, and transport carbon dioxide (CO2) to injection wells and inject it several thousand feet below ground. The proposed Project would be designed, constructed, and operated by Basin Electric Power Cooperative in (BEPC) in coordination with the University of Wyoming (UW) and would be located at the Dry Fork Station near Gillette, Wyoming.

DOE's proposed action is to provide cost-shared financial assistance to the UW. Based on the best available projections, the Phase IV cost is estimated to be approximately $77 million, and the DOE share would be approximately $38.5 million. Exact costs are not available, since UW has not yet been selected to receive DOE funding under CarbonSAFE Phase IV. DOE funding of Phase IV would include only the construction of the CO_2 storage facility and its infrastructure; however, since the project cannot proceed without the capture facility, and operation of the storage facility can reasonably be expected to occur after the construction is completed, the impacts these connected actions are included in the analysis of the proposed Project's impacts for the purposes of the EA. UW and the project partners are required to obtain funding for the remaining project cost. The funding will be used to construct the project but would not include the operation of the CO_2 injection and storage facility.

Availability: This EA is being released for public review and comment. Hard copies of the EA are being distributed to Tribal agencies and the Campbell County Public Library in Gillette, with electronic copies sent to the project mailing list and others who requested an electronic copy. The public is invited to provide written or e-mail comments to DOE on the EA during the comment period, from January 20 through February 20, 2024. Comments should be provided to the National Energy Technology Laboratory, Cochran Mill Rd, Pittsburgh, PA 15236-0940, Attention: Pierina Fayish or Pierina.Fayish@NETL.DOE.GOV. Comments received after February 20, 2024 will be considered to the extent possible.

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LIST OF ACRONYMS

°C	Degrees Celsius
°F	Degrees Fahrenheit
AOI	Area of Influence
AOR	Area of Review
APD	Application for Permit to Drill
AST	Aboveground Storage Tank
BEPC	Basin Electric Power Cooperative
BGEPA	Bald and Golden Eagle Protection Act
bgs	below ground surface
BLM	Bureau of Land Management
BMPs	Best Management Practices
BNSF	Burlington Northern Santa Fe
CAA	Clean Air Act
CarbonSAFE	Wyoming Carbon Storage Assurance Facility Enterprise
CBNG	Coalbed Natural Gas
CCUS	Carbon Capture, Utilization, and Storage
CEQ	President's Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CH_4	Methane
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2-eq	Carbon Dioxide Equivalents
Construction	CarbonSAFE Phase IV
CWA	Clean Water Act
CX	Categorical Exclusion
DCC	Direct Contact Cooler
DFM	Dry Fork Mine
DFS	Dry Fork Station
DOE	United States Department of Energy
EA	Environmental Assessment
EO 11988	Floodplain Management
EO 11990	Protection of Wetlands
EO 12898	Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations

LIST OF ACRONYMS (cont.)

EOR	Enhanced Oil Recovery
Eos	Executive Orders
EPA	US Environmental Protection Agency
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FLPMA	Federal Land Policy and Management Act
FOA	Funding Opportunity Announcement
GHG	Greenhouse Gas
H_20	Water Vapor
H_2S	Hydrogen Sulfide
HAPs	Hazardous Air Pollutants
HDD	Horizontal Directional Drilling
HLPSA	Hazardous Liquid Pipeline Safety Act
HWY	Highway
IEPA	Illinois EPA
IpaC	Information for Planning and Consultation
KM CDR	Kansai Mitsubishi Carbon Dioxide Recovery
kw	Kilowatts
M#	Moment Magnitude Scale
MBTA	Migratory Bird Treaty Act
mD	Millidarcy(s)
MMT	Million Metric Tons
MTR	Membrane and Technology Research, Inc.
MVA	Monitoring Verification and Accountability
MW	Megawatt
N_2	Nitrogen Gas
N_2O	Nitrous Oxide
NAAQS	National Ambient Air Quality Standards
NaOH	Sodium Hydroxide
NCA	Noise Control Act of 1972
NEPA	National Environmental Policy Act
NETL	National Energy Technology Laboratory
NHPA	National Historic Preservation Act
NI	Intent to abandon
NO_2	Nitrogen Dioxide

LIST OF ACRONYMS (cont.)

NREX	Natural Resource Energy Explorer
NRHP	National Register of Historic Places
O&M	Operation and Maintenance
O_2	Oxygen Gas
O_3	Ozone
OSHA	Occupational Safety and Health Act
PHMSA	Pipeline and Hazardous Materials Safety Administration
PM_X	Particulate matter with an aerodynamic diameter of X microns or less
PPA	Pollution Prevention Act of 1990
ppm	Parts per Million
ppmv	Parts per Million by Volume
PRB	Powder River Basin
PSD	Prevention of Significant Deterioration
RCRA	Resource Conservation and Recovery Act
ROW	Right-of-ways
SC-GHG	Social Cost of Greenhouse Gases
SO_2	Sulfur Dioxide
SO_3	Suspended Sulfites
SR	State Route
SWPPP	Stormwater Pollution Prevention Plan
TMDLs	Total Maximum Daily Loads
TSCA	Toxic Substances Control Act
UIC	Underground Injection Control
USDW	Underground Source of Drinking Water
USFWS	United States Fish and Wildlife Service
UW	University of Wyoming
WAAQS	Wyoming Ambient Air Quality Standards
WDEQ	Wyoming Department of Environmental Quality
WGFD	Wyoming Game and Fish Department
WOGCC	Wyoming Oil and Gas Conservation Corporation
WSE	Wyoming State Engineer
WYDOT	Wyoming Department of Transportation
WYSHPO	Wyoming State Historic Preservation Office

1.0 INTRODUCTION/PURPOSE AND NEED

1.1 Introduction

The United States Department of Energy (DOE) National Energy Technology Laboratory (NETL) prepared this Environmental Assessment (EA) under the National Environmental Policy Act (NEPA) to analyze potential environmental, cultural, and social impacts of partially funding Phase IV of the Wyoming Carbon Storage Assurance Facility Enterprise (CarbonSAFE) Project (Project). The CarbonSAFE Project entails construction and operation of a commercial-scale Integrated Commercial Carbon Capture and Storage facility that would capture, compress, and transport carbon dioxide (CO_2) to injection wells and inject it several thousand feet below ground. The proposed Project would be designed, constructed, and operated by Basin Electric Power Cooperative (BEPC) in coordination with the University of Wyoming (UW) and would be located at the Dry Fork Station (DFS) near Gillette, Wyoming.

1.2 Background

In 2016, Congress directed the DOE's Office of Fossil Energy and Carbon Management to test, mature, and prove Carbon Capture, Utilization and Storage (CCUS) technologies at commercial-scale. DOE developed the CarbonSAFE Initiative to fulfill the need for research into safe, efficient, and effective characterization and permitting of commercial-scale CCUS projects. CarbonSAFE projects include storage complexes capable of safely and efficiently storing commercial volumes of CO_2. Storage complexes are geologic reservoirs with permeability and porosity that allow injection and storage of CO_2, as well as one or more low-permeability seals, which enclose the target storage reservoir(s) and serve as barriers preventing migration of CO_2 out of the reservoir(s). Project sites include both the surface footprint and subsurface storage complex that encompasses the entire area of subsurface impacted by injection. All projects are required to include monitoring of the target storage reservoir and the surrounding area, including the groundwater resources within the storage complex, throughout the project's injection and post-injection phases.

To implement the CarbonSAFE Initiative, DOE established sequential phases of development: Phase I – Integrated CCS Pre-Feasibility; Phase II – Storage Complex Feasibility; Phase III – Site Characterization and Permitting; and Phase IV –Site Construction. DOE recently added a Phase III.5 in order to accommodate projects that have completed some of the requirements of Phase III prior to applying for DOE funding. DOE issued Funding Opportunity Announcement (FOA) DE-FOA-0001584 (Phase I) in 2016 and DE-FOA-0001450 (Phase II) in 2017. In 2019, DOE issued DE-FOA-0001999 to request proposals for CarbonSAFE Phase III. DOE conducted a competitive merit review of the proposals and selected projects for Phase III in 2020.

During Phase III, each project team would complete the acquisition, analysis, and development of information to fully characterize a storage complex capable of storing commercial volumes of CO_2 (a minimum of 50 million metric tons of (MMT) CO_2 within a 30-year period). In addition, Phase III requires the identification and characterization of the target storage reservoir(s) and associated confining formations within the storage complex, as well as the preparation and submission of the US Environmental Protection Agency's (EPA's) Underground Injection Control (UIC) Class VI Permit to Construct for each proposed injection well at the site(s). Once the UIC Class VI Permit(s) to Construct are submitted, any additional activities would include working with the regulators to satisfy their requirements until construction authorization is granted. Finally, Phase III would

address pore/surface rights, right-of-way(s) (ROWs), and all other permitting processes and requirements, liability relief, and finance agreements in support of the business model for eventual commercial operations, as needed. Phase III project participants awarded under DE-FOA-0001999 are required to complete NEPA reviews for a potential Phase IV project, which would include construction of the injection well(s) and obtaining authorization to proceed with commercial-scale injection via an Operating Permit from the EPA's UIC's Class VI Permitting Process. DOE prepared this EA in response to the requirement to complete the NEPA process as part of the Phase III project. This project has not yet been selected for a CarbonSAFE Phase IV (Construction) project.

The "Wyoming CarbonSAFE" Project was selected under Phase III and must complete the NEPA process for a potential Phase IV project. DOE assessed this Project, as required by NEPA implementing procedures and regulations, and issued Categorical Exclusions (CXs) to the project prior to the separate, but related, projects in Phases I, II, and III for work conducted in those phases. Copies of all CXs for the previous phases of the proposed project are included in Appendix A: Previous NEPA Actions. CX documents are also available online at https://netl.doe.gov/nepa.

1.3 Purpose and Need

The purpose and need for this DOE action is to advance the commercial readiness of CCUS by constructing a commercial-scale geologic storage complex and associated CO_2 transport infrastructure. Successful implementation of the CarbonSAFE Initiative, including this proposed Project, would encourage the rapid growth of an emerging, geographically widespread industry for secure geologic carbon storage by reducing risks and costs for future projects and bringing more storage resources into commercial classifications. Further, this commercial-scale secure geologic storage infrastructure is needed to support the President's goals of 50-52 percent reduction in greenhouse gas (GHG) emissions from 2005 levels by 2030, a carbon-pollution free power sector by 2035, and achieving a net-zero GHG emissions economy by 2050.

UW proposed this project in Campbell County, Wyoming because a fully-characterized storage complex: (1) is able to receive and safely store CO_2 in sufficient quantities to meet the DOE goals of 50 MMT over a 30-year period; (2) is located in proximity to one or more CO_2 sources that can supply those quantities; and (3) can be connected to the sources by a transport system that can be built and operated economically.

The Bureau of Land Management (BLM) as a cooperating agency is participating in the analysis of the effects of the proposed project. BLM has responsibility to manage ROW grants to occupy and use federal pore space under Title V of the Federal Land Policy and Management Act of 1976 (FLPMA), as amended (43 United States Code [U.S.C.] § 1761 et seq.) and in accordance with the 43 CFR § 2800 regulations. BLM may use this NEPA analysis to support decision making on any future applications from the project proponent to occupy and use BLM-administered federal lands or pore space.

1.4 Regulatory Requirements and Permits Needed

1.4.1 NEPA and Related Procedures

DOE prepared this EA in accordance with NEPA, as amended (42 United States Code [U.S.C.] 4321), the President's Council on Environmental Quality (CEQ) regulations for implementing NEPA

(40 Code of Federal Regulations [CFR] 1500-1508), and DOE's implementing procedures for compliance with NEPA (10 CFR 1021). This statute and the implementing regulations require that DOE, as a federal agency:

- Assess the environmental impacts of its proposed action;
- Identify any adverse environmental effects that cannot be avoided, should the proposed action be implemented;
- Propose mitigation measures for adverse environmental effects, if appropriate;
- Evaluate alternatives to the proposed action, including a no action alternative; and
- Describe the cumulative impacts of the proposed action together with other past, present, and reasonably foreseeable future actions.

These provisions must be addressed before a final decision is made to proceed with any proposed federal action that has the potential to cause impacts to the natural or human environment, including providing federal funding to a project. This EA is intended to meet DOE's regulatory requirements under NEPA and provide DOE with the information needed to make an informed decision about providing financial assistance. In accordance with the above-listed regulations, this EA allows for public input into the federal decision-making process; provides federal decision-makers with an understanding of potential environmental effects of their decisions; and documents the NEPA process.

1.4.2 Laws, Regulations, and Executive Orders

The following federal laws, regulations, and Executive Orders (Eos) were also considered in the evaluation of the CarbonSAFE Project.

- Clean Air Act (CAA)
- Clean Water Act (CWA)
- Protection of Wetlands (EO 11990)
- Floodplain Management (EO 11988)
- Endangered Species Act (ESA)
- Migratory Bird Treaty Act (MBTA)
- Bald and Golden Eagle Protection Act (BGEPA)
- The Noise Control Act (NCA) of 1972, as amended
- Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (EO 12898)
- National Historic Preservation Act (NHPA)
- Pollution Prevention Act (PPA) of 1990
- Resource Conservation and Recovery Act (RCRA)
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
- Toxic Substances Control Act (TSCA)
- Occupational Safety and Health Act (OSHA)

1.4.3 State and Local Regulations and Requirements

To implement the proposed CarbonSAFE Project, the following permits or licenses would likely be required from state and local agencies.

- Wyoming Department of Environmental Quality (WDEQ) – Class VI Underground Injection Control (UIC) Permit
- WDEQ – Wyoming Air Quality Permit
- WDEQ – General Permit to Discharge Stormwater Associated with Large Construction Activity
- WDEQ – Industrial Siting Permits
- WDEQ – General Permit to Discharge Stormwater Associated with Industrial Activity
- WDEQ – Temporary Turbidity Waiver
- WDEQ – General Permit for Temporary Discharges
- WDEQ – CWA Section 401 Certification
- Wyoming Department of Transportation (WYDOT) – Transport Permits
- WYDOT – M-54 License
- Wyoming Oil and Gas Conservation Commission (WOGCC) – Application for Permit to Drill (APD)
- WOGCC – Unitization Order for Use of Pore Space
- Wyoming Office of State Lands and Investments – Authorization of activities on state land
- Wyoming State Engineer (WSE) – Water Agreement for Temporary Use of Water
- WSE – Application for Permit to Appropriate Groundwater
- WSE – SEO Chapter 5 Surface Water Reservoir Permit
- Wyoming State Historic Preservation Office (WYSHPO) – Letter of Concurrence

1.5 Organization of EA

The DOE has prepared this EA in compliance with NEPA and other relevant federal and state laws and regulations. This EA discloses the direct, indirect, and cumulative environmental effects that would result from the proposed action and alternatives. The document is organized into five parts:

- Chapter 1: Introduction – This chapter includes information on the purpose of and need for the Project, the agency's proposal for achieving that purpose and need, applicable laws and regulations, and other permits that may be required.
- Chapter 2: Proposed Action and Alternatives – This chapter provides a more detailed description of the agency's proposed action and evaluates the no action alternative. Alternatives considered by the applicant are also discussed in this chapter.
- Chapter 3: Affected Environment and Environmental Consequences – This chapter contains a description of current resource conditions in the Project area and the environmental effects of the proposed action and no action alternatives.
- Chapter 4: Consultation and Coordination – This chapter provides a detailed discussion of the consultation and coordination that has occurred for the EA. The chapter also includes a list of preparers for the EA.

- Chapter 5: References – This chapter provides references for literature and data cited throughout the document.
- Appendices: The appendices provide information on previous NEPA actions, consultation efforts, and other information to support the analyses presented in the EA.

2.0 PROPOSED ACTION AND ALTERNATIVES

This chapter provides a more detailed description of the Wyoming CarbonSAFE Project and sets the stage for consideration of the affected environment and environmental consequences discussions.

2.1 Proposed Action

DOE's proposed action is to provide cost-shared financial assistance to the UW. Based on the best available projections, Phase IV cost is estimated to be approximately $77 million, and the DOE share would be approximately $38.5 million. It is important to note that the costs are estimates, based on DOE's knowledge of the cost of construction for CCUS projects. Exact costs are not available since UW has not yet been selected to receive DOE funding under CarbonSAFE Phase IV. DOE funding of Phase IV would include only the construction of the CO_2 storage facility and its infrastructure; however, since the Project cannot proceed without the capture facility, and operation of the storage facility can reasonably be expected to occur after the construction is completed, the impacts of these connected actions are included in the analysis of the proposed Project's impacts for the purposes of the EA.

2.2 No Action Alternative

Under the No Action Alternative, DOE would not provide cost-shared funding to the proposed Project. The Project may be delayed if UW opts to search for other funding sources. More likely, the commercial-scale CCUS project would not be constructed. DOE assumes, for the purposes of NEPA, that the recipient would not pursue the Project. Consequently, the commercial-scale geologic storage complex would not be constructed, and the risks would not be reduced for future storage complexes. Further, the President's goals of 50-52 percent reduction in GHG emissions from 2005 levels by 2030, a carbon-pollution free power sector by 2035, and achieving a net-zero GHG emissions economy by 2050 would not be advanced by the Project. Additionally, ROW access and utilization for BLM subsurface pore space would not be requested or required.

2.3 Alternatives Considered but Dismissed

NEPA requires DOE to assess the range of reasonable alternatives to the proposed action. Because DOE's proposed action is limited to providing financial assistance in cost-sharing arrangements to selected applicants in response to a competitive funding opportunity, DOE's decision is limited to either accepting or rejecting the Project as proposed by the proponent, including its proposed technology and selected sites. The Project alternatives would consist of the projects available for selection to CarbonSAFE Phase IV, and would not be known until DOE receives applications for project funding under DE-FOA-0002711 for Phase IV (Construction). There are four other projects currently completing the NEPA process in Phase III:

- DOE/EA-2196: Establishing an Early CO_2 Storage Complex in Kemper County, Mississippi: Project ECO_2S
- DOE/EA-2197 North Dakota CarbonSAFE: Project Tundra
- TBD: San Juan Basin CarbonSAFE
- TBD: One Earth Sequestration- Carbon Capture and Storage Project

Those projects will be analyzed for potential impacts separately and will not be discussed further in this EA. DOE's consideration of reasonable alternatives to this project under NEPA is therefore limited to the No-Action Alternative.

2.4 Project Description

The Wyoming CarbonSAFE Project (Project) would construct approximately 27 linear miles of 10-inch subsurface pipeline in northeastern Wyoming as part of a proposed carbon capture and storage (CCS) project. The Project would capture and compress CO_2 and convey the CO_2 to five injection sites with 2 wells each (for a total of 10 wells) at which the CO_2 would be injected deep into subsurface geologic formations. The targeted geologic formations (the Minnelusa and Sundance formations) would then contain the CO_2 until it mineralizes. Approximately 57.5 MMT of CO_2 would be transported through the pipeline from a starting location at Dry Fork Station (DFS) and injected into subsurface pore space over a period of 30 years. The Project would involve the use of BLM-administered federal pore space within approximately 240 acres of public lands; there are no other Project facilities or operations proposed on BLM-administered public lands.

2.4.1 Location and Setting

The Project would be located approximately 6.5 miles north of Gillette, Wyoming, within undeveloped areas of the Powder River Basin (PRB) in Campbell County, Wyoming (Figure 1). The carbon capture plant component of the Project would be located adjacent to Basin Electric Power Cooperative's (BEPC) existing DFS facility (Figure 2). The proposed pipeline component would extend west, originating from the carbon capture plant, along state route (SR) 59 before branching north along United States (US) Highway (HWY) 14/16. Along the proposed alignment, the pipeline branches toward the east and west in three locations ending at five injection sites. Four of the injection sites would be located northwest of DFS and one injection site would be located approximately 3,000 feet south of DFS. Figure 1: Project Vicinity Map depicts all Project components and their proposed locations within Campbell County. Additional information about each Project component is included in Section 2.4.5 Project Construction Methods

The Project would utilize one of two different methods of carbon capture further described in Section 2.4.3 MTR CO2 Capture Plant and Section 2.4.4. Amine-based CO2 Capture Plant Description.

2.4.2 Dry Fork Station

BEPC's 405 megawatt (MW) DFS coal-powered electric generation facility outside of Gillette, Wyoming, has been in operation since 2011. Sub-bituminous coal fuel, coal with a low heating value primarily used for electricity generation (United States Geological Survey [USGS] 2023a, Britannica 2019), is obtained from the adjacent Dry Fork Mine (DFM) through an approximately one-mile-long conveyor system. Once obtained, DFS utilizes pulverized coal technology and the latest generation of pollution control technologies during the coal combustion process to reduce the volume of emissions (BEPC 2023). Through the combustion of coal, DFS converts the produced heat into usable electricity.

2.4.3 MTR CO_2 Capture Plant Description

The Membrane and Technology Research, Inc. (MTR) CO_2 Capture method is the preferred and probable method and would require construction of one carbon capture plant located immediately adjacent to DFS (Figure 3). Through the MTR CO_2 Capture method, flue gas (exhaust gas from the stacks with residual substances) is directed to the capture plant from an interconnection immediately upstream of the DFS existing stack (Figure 4). The flue gas first passes through a direct contact cooler (DCC), which cools it to approximately 30 degrees Celsius (°C). A dedicated

cooling system provides the necessary cooling duty for the DCC and balance of plant intercoolers and aftercoolers. The DCC is a two-stage unit. The first-stage provides the cooling function and the second-stage provides a sulfur dioxide (SO_2) polishing function and uses a sodium hydroxide (NaOH) solution to reduce the SO_2 in the flue gas from 37 parts per million by volume (ppmv) leaving the flue-gas desulfurization (FGD) at less than 5 ppmv. After the DCC, the flue gas passes through a flue gas blower to the first-stage membrane system.

As the flue gas passes through the membrane module, a partial vacuum condition is generated on the permeate-side of the membrane driving the separation of CO_2 from flue gas. The partially decarbonized flue gas streams exit the first-stage membrane module containers, and are recombined into a single stream, which then leaves the capture process through the DFS flue gas stack. The first permeate stream contains approximately 60 percent CO_2.

The first-stage permeate stream then enters the second-stage membrane. Here, the membrane further concentrates the CO_2 to approximately 87 percent CO_2 concentration in the second-stage permeate. The second-stage residue gas stream is combined with the flue gas downstream of the DCC, prior to entry to the first-stage membrane. The permeate from the second-stage is then compressed in multiple stages of compression, intercooling and water knockout. After reaching a pressure of 25 bar, the gas is chilled to near freezing to condense out as much water vapor (H_2O) as possible. Next, the gas is then sent through a mol sieve drier to achieve bone dry conditions.

This dry gas is passed to a low temperature condensation step then fractional distillation unit to flash off nitrogen gas (N_2) and oxygen gas (O_2) to the column overhead. The cold and high-pressure overhead stream still contains a significant fraction of CO_2 (50 percent) and so it is passed through a small vent membrane unit of spiral-wound Polaris membrane modules for additional recovery. The 80 percent CO_2 rich permeate is recycled back into the second-stage permeate compression train. Overall, the process results in a high purity, high pressure CO_2 product stream that is then ready for pipeline transportation to the injection wells (Figure 5). The process is designed to meet Enhanced Oil Recovery (EOR) specifications for SO_2 (5 parts per million [ppm]) and O_2 (10 ppmv). The MTR membrane-based CO_2 capture technology is currently being pilot tested at DFS (DE-FE0031587) and is the CO_2 capture technology the project team envisions using for the full-scale commercial buildout. If selected as the CO_2 capture technology, a new commercial-scale capture plant would be constructed adjacent to DFS.

2.4.4 Amine-based CO_2 Capture Plant Description

The second alternative CO_2 capture method option proposed for the Project is an amine-based CO_2 capture approach such as the Kansai Mitsubishi Carbon Dioxide Recovery (KM CDR) process. The KM CDR process has been applied previously at various sites (MHI 2021). Initially, flue gas is pretreated with caustic soda to remove SO_2 in the quencher. Then, in the CO_2 recovery step, cooled flue gas is transported upward through the absorber where it contacts solvent (on the surface of packing material) and 95 percent of the CO_2 in the flue gas is absorbed by the amine-based solvent. The flue gas then enters a washing stage where it contacts circulating water to reduce any carryover amine emitted from the top of the absorber. The cool CO_2-rich solvent exiting the bottom of the absorber is heated via a heat exchanger with hot CO_2-poor solvent and is transported to the top of the regenerator column. Here, it contacts stripping steam, releases the CO_2, and gets regenerated and recycled to the absorber. CO_2-rich vapor exiting the regenerator is

cooled. The condensed liquid is returned to the system. Finally, the CO_2 is compressed and then pretreated as necessary (oxygen removal, dehydration) for transport via pipeline, and storage (DOE 2020).

The amine alternative would require thermal energy, primarily in the form of steam, to separate the CO_2 from other flue gas components. The water supply requirements would be greater for the amine alternative and would require installation of a new groundwater supply well within DFS. BEPC would coordinate with state and local agencies prior to installation of a new supply well. Exact water usage volume requirements for operation of the amine facility would be determined and approved by agencies prior to construction of the Project.

2.4.5 Project Construction Methods

Upon completion of the Project's final engineering, construction activities would begin and require a construction window of at least two years. Prior to Project construction, all permits and authorizations required by federal, state, and local agencies would be obtained. A list of anticipated permits and authorizations anticipated for the Project is included in Section 1.4 Regulatory Requirements and Permits Needed. Anticipated construction methods are described in the following subsections.

Access

Each injection site selected contains existing unpaved access roads providing vehicle access to each of the five locations. While these roads are pre-existing, repairs, regrading, and additional road improvements may be required to provide suitable access for construction and drilling equipment. The anticipated maximum total length of road repair would be approximately 6.5 miles. None of the planned access roads are located on BLM-administered public lands.

Grading

Each access road may require repairs or regrading to provide suitable conditions for construction and drilling equipment. Grading would level out the roadway and return any eroded areas to a flat, smooth surface for vehicle use. Grading activities would require a single crew and is estimated to take several weeks to complete.

CO_2 Capture Plant

The Project carbon capture plant would be located on non-federal lands within the existing, pre-graded, DFS yard (Figure 2). Construction of the carbon capture plant would require a footprint of approximately 7 acres. Once completed, an attachment between the existing DFS emission stacks and the carbon capture plant would be constructed to direct flue gas into the carbon capture system (Figure 3).

The MTR CO_2 Capture method would also require construction of a new pond to account for seasonal imbalances in water generation and need associated with the membrane-based capture technology. This pond would be sized so that the carbon capture plant would be water-neutral overall. Final siting of the pond has not been determined but would be located in the immediate vicinity of the carbon capture plant, with an estimated maximum surface area of approximately 12 acres and a maximum total capacity of approximately 240 acre-feet.

The amine alternative CO_2 Capture method would not require construction and installation of the pond but would require installation of a new water supply well. Additional water extraction

permits would be acquired if water supply requirements for the amine alternative would be greater than the water extraction allowances for DFS.

Pipeline

The Project would construct approximately 27 miles of subsurface 10-inch diameter pipeline. The longest continuous pipeline would extend approximately 16.5 miles. Three pipelines would extend out from the longest pipeline and lead to different injection point locations where CO_2 gas would be injected into subsurface pore space. At injection site locations, pipeline connections to the injection wells would be constructed aboveground. Concrete footings would be installed to stabilize the aboveground portions of the pipeline. The pipeline would require acquisition of a 50-foot ROW along the entire alignment for future operation and maintenance (O&M) activities. None of the planned pipelines are located within BLM-administered public lands.

Pipeline materials would be delivered to the existing DFS, which would serve as the temporary work area. Each pipeline segment would be welded to another pipeline segment of the same diameter to construct one continuous pipeline complex. Upon completion, the pipeline would be pressure tested to monitor the structural integrity and identify any leaks prior to operation. Existing US HWY 14/16, SR 59, and unpaved access roads would provide sufficient access along the proposed ROW for Project construction and future O&M activities. As stated in previous sections, road upgrades and maintenance may be required to provide adequate conditions for construction and drilling equipment, but no new access roads would be constructed. Additional information about each construction method is provided in the following subsections.

Welding

Construction of the 27-mile subsurface pipeline would require welding together multiple sections of pipeline. At locations where the pipeline would connect to the carbon capture plant and the injection wells, the pipeline and associated connectors would be welded together, and pressure tested to monitor integrity. Welding activities would require several trained professionals and would occur on-site within the established ROW. In the instance that leaks are detected during a pressure test, additional welding may be required to restore pipeline integrity in those areas.

Trenching and Excavation

The Project pipeline construction would require trenching along the entire pipeline alignment. Following federal guidance outlined by the Pipeline and Hazardous Materials Safety Administration (PHMSA), the pipeline alignment would be installed approximately 5 feet below ground surface (bgs) (49 CFR Subtitle B Chapter I Subchapter D Part 195, PHMSA 2017). Excavation along the trench would extend to a depth of between 5- and 6-feet. Each concrete footing would require an excavation of up to one cubic yard of material. Upon installation of the pipeline and concrete footings, the excavated native material would be backfilled and repacked into the remaining excavated area and the disturbed area would be returned to natural grade. Total excavation and trenching for the Project would disturb approximately 1,296,000 cubic feet of native material. The pipeline would displace a volume of approximately 129,000 cubic feet. Further information is provided in Section 3.11 Solid and Hazardous Waste of this Environmental Assessment.

Hydrostatic Testing

During Project construction, hydrostatic testing of the pipeline may be utilized as a form of pressure testing to monitor pipeline integrity prior to operation. This process would require high-pressure injection of water through the pipeline, to pipeline capacity, for a period of 24 hours**.**

While water is moving through the pipeline, Project engineers and monitoring staff would be observing and monitoring the integrity of the pipeline and each weld seam to determine any weak areas or any leak spots. The Project would use reclaimed water to the extent practicable or would obtain water from local municipal sources.

Horizontal Directional Drilling

Construction of subsurface pipeline components may be located within or proximate to surface water and/or cultural resources, as described in Section 3 Affected Environment and Environmental Consequences. To avoid impacts to resources, Project construction may utilize horizontal directional drilling (HDD) techniques. HDD is a trenchless method of installing subsurface pipelines in a shallow underground arc. A tunnel is drilled under a waterway or other sensitive area, and a pipeline is pulled through the drilled underground tunnel to the other side. Throughout the drilling process, the tunnel is kept open and lubricated by circulating a mud-slurry mixture, typically around 95 percent clay and 5 percent bentonite clay. Water to create this slurry mixture would be obtained from on-site groundwater wells authorized by the Wyoming State Engineer's Office (WSEO) or municipal sources.

Injection Locations

The Project would utilize five injection sites at various locations surrounding the existing DFS (Figure 1). Each injection site would contain two independent injection wells. As part of a pilot testing program, two injection wells (PRB-1 and PRB-2) have already been constructed and would not require further drilling (Figure 5). Each of the five injection sites would require a temporary disturbance of approximately 1.84 acres with a permanent disturbance of approximately one acre. None of the existing or planned injection sites are located on BLM-administered public lands.

Staging Areas

The Project would require approximately 30 acres of temporary staging area for use during construction. Construction activities for the CO_2 capture and storage facility would occur adjacent to the existing DFS and would not require any additional storage areas or temporary staging yards. In the instance that the area at DFS is insufficient for Project activities and more space is required, additional staging would be located at BEPC allied or associated properties (not including BLM-administered public lands). Identified staging areas may require additional grading for adequate materials and vehicle storage.

Construction Schedule

Project construction is anticipated to begin March 2025, pending acquisition of all required permits. Construction of the Project would be phased; the first phase would consist of drilling 8 wells while the second phase would construct the pipeline and connect all Project components. Construction would take approximately 2 years to complete.

Operation and Maintenance Activities

Construction of the Project is anticipated to be completed in March 2027 and would subsequently begin the process of capturing flue gas released by the existing DFS, extracting CO_2 from the flue gas, transferring the CO_2 through the newly constructed pipeline, and injecting the CO_2 into subsurface pore space proximate to each of the five injection sites. Each injection site is anticipated to have a subsurface footprint with a 3-mile radius (the maximum extent of the modeled CO_2 plume), totaling approximately 141.4 sq miles of pressure-altered subsurface. The 141.4 sq mile Area of Review (AOR) identifies the furthest anticipated extent of potential subsurface impacts resulting from O&M of the Project. O&M activities would include, but would

not be limited to, periodic inspection of each Project component, integrity monitoring of the pipeline, excavation of pipeline sections to perform required repairs and upgrades to Project components, access road maintenance, corrosion preventative maintenance, and Monitoring Verification and Accountability (MVA) studies. O&M activities would be conducted using existing access roads or on foot. The AOR includes BLM-administered federal pore space.

Monitoring Verification and Accountability Studies

Active and passive seismic reflection techniques would be used in the MVA studies at each of the injection well locations to monitor subsurface conditions within the AOR. The MVA studies would provide data indicating any changes to the subsurface condition as a result of Project operation.

The active techniques would use thumper trucks to produce energy waves. The energy waves would travel through the subsurface, reflecting from various existing rock formations. A series of probes would be installed within the AOR and would record characteristics of returning energy waves, producing an image of the subsurface condition that would be compared to pre-Project conditions.

During the active seismic investigation, thumper trucks would be driven over each site in a 3-mile by 3-mile grid (3x3-mile grid) pattern every 5 years throughout the 30-year life of the Project, and would zig sag in 300 foot intervals. Along the mapped path, the thumper trucks would periodically stop, and vibrators attached to the vehicles would produce a force strong enough to be measured by installed seismic sensors. By measuring the seismic waves, the investigator would create a 3D seismic representation of the subsurface and quantify the changes since the earlier 5-year recordings. Exact force drive emitted by the vibrators would be determined at a site-by-site basis to minimize impacts to surrounding resources. Prior to utilization of the thumper trucks, resource specialists and agencies would identify avoidance areas or areas of environmental concern that would be avoided during the MVA study to minimize impacts to surface and subsurface environmental resources. Each 3x3-mile grid would require approximately two weeks to complete. Small, 4-wheel drive vehicles would lay out the receivers and identify any potential hazards prior to beginning thumper truck runs. A crew of approximately 20 would be required. Site access agreements for all properties within the 3x3-mile grid area would be obtained by the licensed seismic provider, contracted to conduct the MVA study, prior to commencement of the MVA study.

Passive seismic techniques would not utilize man-made energy sources to create seismic waves but instead record acoustic waves created by the fracturing and property changes of existing rock formations within the AOR. Recording acoustic, micro seismic events across a wide spatial array of sensors, the location and magnitude of each fracture or property altering event can be delineated and a potential cause identified. Records of these and similar historical events within the AOR would provide an understanding of the changes in the subsurface as a result of Project operation or natural conditions and addressed as needed.

During the passive seismic investigation small sensors would be installed by digging a shallow hole and backfilling with the removed material and would record data for a period up to one month. Larger sensors would record data for a period up to six months. A five-by-five array of both small and large sensors would be placed around each injection site to triangulate any seismic activity proximate to the injection well.

BLM review and approval of a permit or authorization to allow the seismic studies would be required prior to operations conducted on the BLM-administered surface within the AOR. The BLM would ensure NEPA compliance upon receipt of a proposal for conducting geophysical investigations and before authorizing these operations on BLM-administered surface. If authorized, the BLM would include appropriate terms and conditions to reduce potential impacts to surface resources.

3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1 Introduction

This section provides relevant environmental, cultural, and socioeconomic baseline information, and identifies and evaluates the individual or cumulative environmental and socioeconomic changes likely to result from constructing and operating the Project. The region of influence for this EA includes the Project and the immediately surrounding areas north of Gillette in Campbell County, Wyoming.

CEQ regulations encourage NEPA analyses to be as concise and focused as possible, consistent with 40 CFR Part 1500.1(b). Consistent with the NEPA and CEQ Regulations, this EA focuses on those resources and conditions potentially subject to effects.

The methodology used to identify the existing conditions and to evaluate potential impacts on the physical and human environment involved the following: review of documentation and Project information provided by UW and their consultants, searches of various environmental and agency databases, and agency consultations.

Wherever possible, the analyses presented in this chapter quantify the potential impacts associated with the Proposed Action and No Action Alternative. Where it is not possible to quantify impacts, the analyses present a qualitative assessment of the potential impacts. The subsections presented throughout the remainder of this chapter provide a concise summary of the current affected environment within the region of influence, and an analysis of the potential effects to each resource area considered from implementation of the Proposed Action and No Action Alternative.

3.1.1 Resource Areas Excluded from Detailed Analysis

Section 3.12 Resource Areas Dismissed from Further Review and the associated subsections describe the resources that DOE has determined would not be affected or would sustain negligible impacts from the Proposed Action and would not require further NEPA evaluation. The resource areas dismissed from further analysis are Infrastructure and Utilities, Transportation, Noise, and Visual resources.

3.1.2 No-Action Alternative – Environmental Consequences

Under the No Action Alternative, the Proposed Action would not occur and funds for the commercial-scale CCUS project would not be provided by DOE. With implementation of the No Action Alternative, construction of the Project would not be funded by DOE and likely would not be constructed. As a result, 57.5 MMT of CO_2 would not be removed from flue gas emissions of the active DFS and captured for geologic storage. There would be no environmental consequences associated with Project construction and no effect on the existing local government. BEPC would continue to operate the DFS facility under normal operating conditions. DOE assumes, for the purposes of NEPA, that the recipient would not pursue the Project with implementation of the No Action Alternative.

Table 3.1-1 summarizes the anticipated environmental consequences of the No-Action Alternative.

Table 3.1-1. No-Action Alternative – Environmental Consequences

Resource Category	Resource Impacts Under the No Action Alternative
Land Use	No land use changes, including ground disturbance or new impervious surfaces, would occur.
Atmospheric Conditions and Air Quality	DFS would continue normal operations and CO_2 emissions would not be captured or reduced. There would be no new impacts to air quality or additional emissions resulting from the No Action Alternative.
Geologic and Soil Conditions	Ongoing oil and gas exploration activities would continue to occur; however, no additional impacts related to regional geology or soil resources would occur under the No Action Alternative.
Hydrologic Conditions and Water Quality	There would be no changes to the Project site. Surface waters, floodplains, water quality, hydrogeology, and wetlands within the AOR would not be impacted as a result of implementation of the No Action Alternative.
Vegetation and Wildlife Resources	There would be no changes to the Project site and nearby aquatic, wildlife, or vegetation resource would not be impacted.
Socioeconomic Conditions	The Project would not be constructed or operated and there would be no local spending for materials or supplies, and no employment during construction, operations, or decommissioning. No change would occur in the employment and demographics for the area; therefore, there would be no impacts to socioeconomic conditions.
Environmental Justice	There would be no change to minority, low income, or disadvantaged populations resulting from implementation of the No Action Alternative.
Historical and Cultural Resources	Implementation of the No Action Alternative would not require ground disturbance. DFS would continue ongoing operations and no impacts to historical or cultural resources would occur.
Human Health and Safety	Construction of the Project would not occur. Therefore, there would be no increased potential for adverse impacts to public or employee health and safety from Project construction, operation, or decommissioning.
Solid and Hazardous Waste	The Project would not be constructed and the flue gas from the existing DFS would continue to be released into the atmosphere. Implementation of the No Action Alternative would result in no increase to the generation of solid waste or hazardous waste from the existing DFS. BEPC's DFS would continue to operate under existing conditions and would continue to adhere to BEPC's existing solid and hazardous waste practices, procedures, and applicable standards.
Greenhouse Gases and Climate Change	The Project would not be implemented as a result of the No Action Alternative. DFS would continue ongoing operations and flue gas emissions would not be treated. CO_2 emissions would not be reduced as a result of ongoing operations.
Cumulative Impacts	The Project would not be constructed and would not contribute to cumulative impacts within the Project area or Campbell County.

3.2 Land Use

3.2.1 Affected Environment

Land use refers to the surface use by humans and include the economic and cultural activities that affect the area. The Project is proposed in a rural area within Campbell County that is not zoned and where coal and clinker mining is the predominant land use. Secondary land uses include agriculture, ranching, farming, transportation, wildlife habitat, and oil and gas development (Campbell County 2022). DFS is located approximately 6.5 miles north of Interstate 90. Other major transportation access in the immediate vicinity of DFS includes SR 59 to the west, US HWY 14/16, and Burlington Northern Santa Fe (BNSF) rail lines to the south and east. Northeast Wyoming Regional Airport is approximately 5 miles southwest of DFS. The Wyoming Natural Resource Energy Explorer (NREX), an online geographic information tool for accessing state and federally maintained data, indicates that there are several pipelines in the broader vicinity of DFS, with the nearest being crude oil pipelines approximately 3 miles to the south and east, and natural gas pipelines approximately 4 miles to the west. NREX shows several transmission lines branching away from DFS to the north, west and east, and indicates other transmission lines approximately 6.5 miles south of DFS and approximately 7.5 miles west of DFS (NREX 2023).

The offsite footprint of the commercial-scale buildout would encompass a broad area to the northwest of DFS, which includes the pipeline network and four injection sites (Figure 1). Surface ownership within the footprint of the pipeline network consists of approximately 1,027 acres of private surface, approximately 306 acres of state surface, and approximately 26 acres of local government surface (Figure 6). The injection well pads would be sited and constructed on state-owned land, except for PRB-1 and PRB-2 which are on privately owned land adjacent to DFS. Therefore, the indicated areas of private and local government surface ownership are areas crossed by the proposed pipelines. There are small parcels of BLM land within the AOR approximately three miles to the west of the Project footprint, but the footprint does not intersect any of these parcels. Similarly, there is a portion of Medicine Bow-Routt National Forest approximately 20 miles northeast of DFS, and the nearest state park (Keyhole State Park) is approximately 30 miles east of DFS in Crook County, but the Project footprint does not go through these areas.

3.2.2 Proposed Action Impact

Campbell County's Natural Resource Land Use Plan (Land Use Plan, Campbell County 2022) provides a framework and recommendations to guide decision makers on land management uses within the County. The Land Use Plan identifies objectives related to infrastructure development and emphasizes development within existing utility corridors or easements. The capture plant would be co-located near DFS on private land primarily used for coal mining and processing. Build out of the capture plant would be consistent with existing facilities at and near DFS and would not alter or affect existing land uses in the area including ongoing coal mining and processing activities as well as peripheral agriculture, ranching, and farming activities. The pipeline network would largely follow existing roadways and be buried within a ROW. Injection wells would be constructed on state land either adjacent to mining operations or in undeveloped areas. Development of the Project is consistent with the County's Land Use Plan and would not require a change in zoning or affect existing or future land uses.

Project construction would avoid federal lands including small parcels of BLM land that are within the Project AOR. However, underground storage of CO_2 is estimated to occupy approximately a three-mile subsurface radius from each injection well and would likely overlap with federally managed minerals and pore space under BLM jurisdiction. Coordination with the BLM would be required prior to CO_2 injection within these areas, and a ROW grant would be required prior to injection to BLM-managed federal pore space. Additionally, UIC Class VI permitting requirements would preclude adverse impacts to mineral recovery within areas of federal jurisdiction, which is discussed further in Section 3.4 Geologic and Soil Conditions. Implementation of the Project would not require a change in surface zoning or land use but would require utilization of federally managed subsurface pore space. The Project generally would not result in significant impacts to existing and future land uses; however, there is a potential for previously abandoned oil and gas fields to become candidates for future CO_2 injection sites, which would result in a minor change in future land uses.

3.3 Atmospheric Conditions and Air Quality

3.3.1 Affected Environment

Regional Climate

The Project area is in the high plains in northeastern Wyoming. The area experiences a wide range of temperatures: summers are hot, with rain, thunderstorms, and hail; winters are cold, with strong winds. Generally, the climate has low humidity and plentiful sun (WRCC 2023). May is typically the wettest month, with an average precipitation of 3.27 inches. February receives the most snowfall, with an average of 9 inches. Overall, the area receives an average of 17.59 inches per year of precipitation. The coldest month is January, with an average low temperature of 16 degrees Fahrenheit (°F); the warmest month is July, with an average high temperature of 86°F (NWS 2023). Wind speeds are strongest in the winter when the winds tend to come from the southwest. In the summer, the winds tend to come from the south (WSCO 2023). The topography in the region is mostly flat, with a north-south oriented mountain range about 75 miles to the west.

Regulatory Status

The US EPA established National Ambient Air Quality Standards (NAAQS) to protect public health and welfare in 40 CFR 50 as part of the CAA. NAAQS are required to be met and maintained through control of air pollution emission sources by the individual states. Criteria air pollutants-nitrogen dioxide (NO_2), carbon monoxide (CO), SO_2, particulate matter with an aerodynamic diameter of 10 microns or less (PM_{10}), particulate matter with an aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$), ozone (O_3), and lead are regulated with maximum acceptable concentrations (EPA 2023a). The state of Wyoming Ambient Air Quality Standards (WAAQS) are equivalent to, or more stringent than, the NAAQS (Table 3.3-1). Air quality is assessed by comparing the criteria pollutant ambient concentrations to the WAAQS. In addition to specifying standards for criteria air pollutants for Wyoming, the WAAQS also include standards (not shown) for hydrogen sulfide (H_2S), suspended sulfites (SO_3), and fluorides.

Air pollutant concentrations must be kept below WAAQS/NAAQS to protect public health, including the health of sensitive populations such as asthmatics, children, and the elderly (WDEQ 2018). The CAA requires that all areas of a state be designated as having air quality conditions that are in attainment, maintenance, nonattainment, or unclassifiable with respect to the WAAQS/NAAQS.

Established under the CAA [Section 176(c)(4)], the General Conformity Rule plays an important role in helping states and tribes improve air quality in those areas that do not meet the NAAQS (i.e., nonattainment areas). Under the General Conformity Rule, federal agencies must work with state, tribal, and local governments in nonattainment or maintenance areas to ensure that federal actions conform to the air quality plans established in the applicable state or tribal implementation plan.

Table 3.3-1. Federal and State Ambient Air Quality Standards

Pollutant	Averaging Period	NAAQS	WAAQS	Form
CO	8-hour	9 ppm	9 ppm	Not to be exceeded more than once per year
	1-hour	35 ppm	35 ppm	Not to be exceeded more than once per year
NO_2	Annual	53 ppb	53 ppb	Annual mean
	1-hour	100 ppb	100 ppb	98th percentile of the annual distribution of the maximum daily 1-hour concentrations averaged over 3 years
$PM_{2.5}$	Annual	12 µg/m^3	12 µg/m^3	Annual mean, averaged over 3 years
	24-hour	35 µg/m^3	35 µg/m^3	98th percentile, averaged over 3 years
PM_{10}	Annual		50 µg/m^3	Annual mean
	24-hour	150 µg/m^3	150 µg/m^3	Not to be exceeded more than once per year on average over 3 years
SO_2	1-hour	75 ppb	75 ppb	99th percentile of the annual distribution of the maximum daily 1-hour concentrations averaged over 3 years
O_3	8-hour	0.070 ppm	0.070 ppm	3-year average of the fourth-highest daily maximum of the 8-hour average concentration
H_2S	½ hour		70 mg	Not to be exceeded more than twice per year
	½ hour		40 mg	Not to be exceeded more than 2 times in any five consecutive days
SO_3	Daily		0.25 mg per	Maximum annual average
	Daily		0.50 mg per	30-day maximum

Sources: EPA 2023a, WDEQ 2018a

cm^2 = square centimeter
CO = carbon monoxide
H_2S = hydrogen sulfide
mg = milligram
µg/m^3 = micrograms per cubic meter
NAAQS = National Ambient Air Quality Standards
NO_2 = nitrogen dioxide
$PM_{2.5}$ = particulate matter with an aerodynamic diameter of 2.5 microns or less
PM_{10} = particulate matter with an aerodynamic diameter of 10 microns or less
ppm = parts per million
ppb = parts per billion
SO_2 = sulfur dioxide
SO_3 = suspended sulfites
WAAQS = Wyoming Ambient Air Quality Standards

The Project area is in a county defined as an attainment and/or unclassifiable area for all pollutants, so a general conformity analysis is not required (EPA 2023b). The closest nonattainment area is for PM_{10} in Sheridan, Wyoming, which is more than 100 miles northwest of the Project area. The nearest nonattainment areas for O_3 include Upper Green River Basin, Wyoming (approximately 330 miles from the Project area) and the Fort Collins-Denver-Boulder-Greeley-Loveland, Colorado area (more than 220 miles from the Project area).

Along with regulating criteria pollutants, the EPA and local governments also regulate hazardous air pollutants (HAPs) such as asbestos, benzene, naphthalene, toluene, and xylenes. EPA regulates 188 HAPs that are known or suspected to cause health effects in small doses (EPA 2022).

GHGs are compounds that trap heat in the portion of the earth's atmosphere closest to the surface, causing heating at the surface of the earth. The main long-lived anthropogenic GHGs are CO_2, methane (CH_4), nitrous oxide (N_2O), and fluorinated gases. CO_2 and other GHGs are emitted from combustion of fuel by stationary and mobile sources, and from certain manufacturing industries and activities, including leaked and vented gas (EPA 2023d). GHG emissions are discussed further in Section 3.15.2 Greenhouse Gases and Climate Change.

Air Quality Monitoring

Several air quality monitors are located in Campbell County; most are associated with mines in the central and southeast part of the county. PM_{10} monitors monitor the particulate emissions near mines, with several located near the DFS and the Project area. Unpaved road dust is the largest single source of PM_{10} emissions in Campbell County and is likely due to vehicle activity associated with oil and gas development and, to a lesser extent, mining. Based on the County's review of the air monitoring data from 2011 to 2020 and the emission inventories collected from the EPA, the air quality in Campbell County is in compliance with federal or state standards or regulations. However, the levels associated with PM_{10} were close to violating both state and federal ambient air quality standards (Campbell County 2022).

Minor New Source Review

The minor New Source Review permitting program regulates pollutants from sources that do not require prevention of significant deterioration (PSD) or Nonattainment New Source Review permits. The purpose of minor New Source Review permits is to prevent the construction of sources that would interfere with attainment or maintenance of a NAAQS or violate the control strategy in nonattainment areas. Also, minor New Source Review permits often contain permit conditions that limit the source emissions to avoid the need for PSD analysis or Nonattainment New Source Review. The Wyoming minor source permitting program does not include de minimis emission levels below which facilities or projects are exempted from permitting. If the proposed action is approved, it is anticipated that the Project would require a minor source permit because the emissions are not expected to reach the major source permit threshold.

3.3.2 Proposed Action Impact

Construction of the Project including the capture plant would be partially located in an area that already has numerous mining or oil and gas-related pipeline infrastructure; however, other components of the Project including the CO_2 pipelines and injection sites would require new disturbance to vegetation and soils. Temporary construction related activities associated with the

Project would result in direct criteria air pollutant emissions from fuel combustion for operation of construction equipment and indirect criteria air pollutant emissions from consumption of electricity during the construction period. Construction of the Project would result in fugitive particulate emissions (PM_{10} and $PM_{2.5}$) from site clearing and excavation, installation of pilings and concrete, and other construction activities. Project construction activities are not expected to exceed air quality monitoring thresholds or ambient air quality standards in offsite areas.

Operation of the MTR CO_2 capture system would utilize membrane-based technology to isolate flue gas components and remove specific pollutants from DFS emissions. SO_2 and NO_x would permeate the membrane and be removed from flue gas prior to isolation and capture of CO_2. CO_2 capture utilizing this methodology would not create or exacerbate new or ongoing air pollutant emissions from DFS operations.

Operation of the amine-based CO_2 capture system would have the potential to release air emissions into the atmosphere (which is not the case with the membrane-based capture system). Emissions would include nitrogen oxides, organic acids, amides, cyclic compounds, aldehydes, and amines (Hasan et al. 2021) and nitrosamines (Dautzenberg and Bruhn 2013; DOE 2020). Use of an amine solvent CO_2 capture system would likely require a New Source Review under the Wyoming Air Quality Division operating permit. Typically, these systems can be designed to remove 90-99 percent of the CO_2 in flue gas. Emissions produced by operation of the amine-based CO_2 capture system would not exceed air quality monitoring thresholds or ambient air quality standards in offsite areas. Further, recent studies on the co-benefits of carbon capture technologies, specifically amine-based carbon systems, have found positive health benefits from reducing air pollutants including NO_x, SO_2 and $PM_{2.5}$. These benefits include reduction in adult and infant mortality and asthma exacerbations (Great Plains Institute 2023).

Impacts to air quality during proposed Project construction and O&M would be minor and temporary. The impacts would be minimized by using best practices during construction and O&M activities, including, but not limited to the use of water for dust suppression and the use of construction equipment with appropriate emission controls. Completion and subsequent O&M of the Project would result in an overall reduction in CO_2 and other emissions from the DFS contributing to an improvement in ambient air quality and reduction of greenhouse gases. Additional information regarding greenhouse gases and emissions reduction is discussed further in Section 3.15.2 Greenhouse Gases and Climate Change.

3.4 Geologic and Soil Conditions

3.4.1 Affected Environment

Geology

Location and Structure

The Project is within the PRB, a north-northwest trending geologic basin spanning portions of northeast Wyoming and southeast Montana. The expanse of the PRB covers approximately 19,500 square miles (Figure 7). The PRB is an asymmetric synclinal basin with a steeply dipping western flank and more gently dipping eastern flank. The axis of the basin is on the west side, trending north-northwest (Figure 7). Regional dip on the western flank is approximately 500 feet

per mile and dips on the eastern flank are approximately 100 feet per mile (Anna 2010). The DFS is located on the eastern, gently dipping flank of the basin.

Geologic Overview

Sedimentary rock formations in the basin have been formed over each Phanerozoic geologic period and achieve a maximum thickness of 17,000 feet in the deepest parts of the basin (Anna 2010). The Project would target the Mesozoic Lakota formation and Hulett Sandstone Member of the lower Sundance Group (Storage Unit 1) and the Paleozoic Minnelusa Formation for CO_2 injection (Storage Unit 2). Primary targets would be the lower Sundance Group and the Minnelusa Formation, with the Minnelusa Formation providing more storage capacity. These geologic formations are located approximately 8,000 to 10,000 feet bgs. The Mesozoic Lakota formation consists of discontinuous sandstones, siltstones, and mudstones deposited in a broad delta system (Meyers et al. 1992; Anna 2010). The Hulett Sandstone Member of the lower Sundance Group is composed primarily of silty sandstone and shale interbeds (Rautman 1978). In the northern part of the basin, the Minnelusa formation is comprised of mostly eolian, or windblown, sandstones interbedded with evaporites and lower porosity carbonates (Figure 8). The target depth for injection into the Minnelusa formation is approximately 9,340 to 9,600 feet bgs (McLaughlin et al. 2023)

Porosity is a measure of the open spaces present in a rock formation (units in percent); permeability is the measure of how well those open spaces are connected (units in millidarcys [mD], which is a measure of flow capacity across an area). The measure of each of these can predict the anticipated pathway for air or fluid transport through a particular formation. Based on the core measurements collected at PRB-1, the porosity of the target Minnelusa Formation ranges from 1-19 percent and horizontal permeability ranges from 0.001-459 mD. Vertical permeability is typically between one-tenth and one-hundredth of horizontal permeability meaning that fluid transport through a formation generally moves horizontally, following the path of least resistance (Quillinan 2017). The porosity ranges for the Hulett sandstone ranges from 5-17 percent and horizontal permeability ranges from 0.0015-20 mD. Porosity values in the Lakota range from 11-14 percent and horizontal permeability values range from 4-53 mD.

The Opeche Shale formation, located directly above the Minnelusa, acts as an approximately 140-foot-thick seal (also referred to as confining unit, sealing unit, or caprock) for the Minnelusa formation. A seal is a relatively impermeable formation that acts as a barrier to upward fluid flow from lower formations. The Opeche Shale has low porosities ranging from 3-4 percent and low horizontal permeabilities ranging from 0.0001-0.001 mD. Between the Minnelusa Formation and the Sundance Group, there are 1,000 feet of sealing formations, including the Opeche Shale. The Sundance Group is approximately 40-50 feet thick and is 8,170 to 8,390 feet bgs. The Redwater Shale Member in the upper Sundance Formation is a thick, continuous shale present across most of Wyoming; it acts as the seal for the Sundance Group (Rautman 1978). The sealing unit for the Lakota formation is the Skull Creek shale. The Skull Creek shale is a deep water, dark grey to black shale, and an excellent seal (Anna 2010). The shale overlies the lowermost Cretaceous deposits and is hundreds of feet thick (Craddock et al. 2012). The deepest underground source of drinking water (USDW) in the PRB is the Fox Hills Sandstone, separated from the Skull Creek shale by 4,500 feet of sealing rock (McLaughlin et al. 2023). The Project area is underlain by the Fort Union and Wasatch aquifers which are stratigraphically above the Fox Hills Sandstone.

Mining Activities

Coal Resources

The PRB has extensive coal resources and is currently the largest coal producing region in the US, producing approximately 40 percent of the nation's coal annually. Coal operations in the PRB began in the 1970s but the PRB did not become the leading coal producer in the US until an amendment of the CAA was passed in the 1990s. The amendment requires power plants use coal with lower sulfur concentrations than what had previously been used. Most coal in the PRB is low-sulfur, subbituminous coal and thus became the dominant fuel for power plants, raising production demand (Luppens et. al. 2015). Coal resources in the PRB are estimated at 1.16 trillion tons.

Many of the coal resources are in the Tertiary sedimentary section of the PRB, primarily in the Eocene Wasatch and Paleocene Fort Union formations (Figure 8). The Wasatch Formation contains coal in thicknesses ranging from 15-50 feet and is present in the Project area, though most of the coal resource is located and mined from the Fort Union Formation (Luppens et. al. 2015).

The three coal mines in the vicinity of the Project area are the Dry Fork Mine, the Rawhide Mine, and the Buckskin Mine. All three open pit mines are extracting coal from the Fort Union Formation.

Oil and Gas Resources

Oil and gas resources are abundant in the PRB and operators have explored for petroleum in the region for over 100 years. The first oil well was drilled in 1889 just north of Salt Creek Field, located in the southwestern portion of the PRB. Exploration continued to the north and commercial oil and gas development began in the 1940s with the biggest discovery occurring in 1956 at Raven Creek field.

The closest active field is the Kitty field to the southwest which targets the Muddy formation and exploratory wells to the southeast which mostly consist of abandoned oil wells. The Kitty field was discovered in 1965 and to date has produced 23 million barrels of oil and 131 million cubic feet of gas, mostly out of the Mowry and Muddy formations, which are stratigraphically above the Lakota, Sundance, and Minnelusa formations (Wyoming Oil and Gas Conservation Corporation (WOGCC 2023a).

The group of exploration wells to the east have been producing since the 1930s mostly from the Muddy, Skull Creek, and Minnelusa formations. The Mill-Gillette field further to the east was discovered in 1969 and to date has produced 4 million barrels of oil and 10 million cubic feet of gas out of the Muddy and Skull Creek formations (WOGCC 2023a).

The Minnelusa formation, Sundance group, and Lakota formation have been targets for oil and gas extraction in the PRB. The Minnelusa has been one of the PRBs most prolific oil reservoirs, particularly on the east/northeast portion of the basin (WOGCC 2023b). The Sundance and Lakota has provided very little resource relative to other formations in the basin (WOGCC 2023b and Anna 2010). Minnelusa fields are generally small typically consisting of around four oil wells. These fields average 3.7 million barrels of oil total and are considered very productive (Anna 2010).

Coalbed Natural Gas

Coalbed natural gas (CBNG) is also present in the Project area. CBNG is a form of gas extraction where water is extracted from the CBNG target, allowing the methane gas to desorb from the surface of the coal, releasing gas and making it available for production. CBNG development near the Project area is concentrated in the Paleocene and Eocene stratigraphy, targeting similar formations as coal extraction. Specifically, the main target of CBNG production is the Paleocene Fort Union formation (Figure 8). CBNG production began in the 1950s and was further developed into the early 2000s. The gas produced in CBNG wells is typically produced through bacterial activity, where the methane exhibits a biogenic isotopic signature. Produced water from CBNG development is fresh with low total dissolved solids concentrations between 400-2000 ppm (Flores 2004). Most of the CBGN wells are no longer in production since they are not economical compared to horizontally produced deep gas wells and many have been reclaimed.

Faulting and Seismicity

The PRB is considered a low seismic risk region (Algermissen and Perkins 1976). Two earthquakes, magnitude M2.5 (moment magnitude scale) or greater, have been recorded within 50 miles of Gillette, WY since 2000. There have been numerous mining explosions that have registered over 2.5 magnitude since 2000 near the Project site (USGS 2023b). There have not been any documented instances of induced seismicity in the PRB from oil and gas development or CBNG development.

Campbell County is in Seismic Zones 0 and 1 of the Uniform Building Code, a document prepared by the International Conference of Building Officials. The Seismic Zone ratings are a guide to building code regulations and are defined by the probability of intensity of ground shaking. Seismic Zone ratings range from 0 to 4 with 0 indicating weakest potential motion and 4 indicating the strongest. Calculating the peak ground acceleration (PGA) using the USGS Unified Hazard Tool (USGS 2023c), the proposed well site at PRB-1 and PRB-2. The calculations did not indicate the need for earthquake resistant construction components, nor did they indicate that ground movement would indicate a breach of the confining zone. Though this was calculated for the PRB-1 and PRB-2 locations, the seismic risk is similar across the PRB and similar results are expected for well locations PRB-3 through PRB-10.

The nearest identified (mapped) faults to the proposed well are located greater than 15 miles to the west and north-northwest in the Twentymile Butte and Truman Draw quadrangles (Bohor et al., 1979; Robinson et al., 1964; Kent et al., 1977; Boyd et al., 1999; Hallberg et al., 2002; Denson, N.M. et al. 1992; Denson and Pierson 1991). The faults are likely extensional, meaning they stretch the earth's crust extending it horizontally. The extensional fault sets are generally subparallel or sub-perpendicular to bedding with minor offsets, and characteristic of near-surface faults that form to accommodate regional basin flexure/settling (Bohor et al., 1979; Kent et al., 1977). These faults disrupt Tertiary strata but are not shown to interrupt Quaternary units. According to the quaternary fault map compiled by the Wyoming Geological Survey, there are no surface expressions of active quaternary faults in the Project area (Machette et al. 2001). Overall, major faulting in the area exhibits relatively small offsets.

Soils

Most of the soils in this area of the PRB and on pad sites are classified by the United States Department of Agriculture Natural Resource Conservation Service Web Soil Survey (USDA NRCS

WSS) as deep and moderately-to-well-drained Mollisols. This soil order is characteristic of floodplains and terraces, similar to those located within the PRB. Mollisols and similar soil classes are formed through alluvial and eolian sediment deposition or degradation of existing sedimentary rock. Depending on the slope and aspect, there can be wide variation in soil type and subclass, each with differing minerology and characteristics. Some other soil orders in this area include, Alfisols, Aridisols, Entisols, Inceptisols, which are often formed in arid, cooler climates. Most of these soil orders are not susceptible to wind erodibility according to available wind erodibility index values. There are no mapped hydric soils within the Project area. Section 3.5 Hydrologic Conditions and Water Quality provides information regarding wetland resources and hydric conditions within the Project area.

3.4.2 Proposed Action Impact

Construction

Construction of the Project would require drilling and installation of well casings for eight CO_2 injection wells, construction of a carbon capture facility within the existing DFS, and installation of an approximately 27-mile subsurface pipeline within the PRB. No major improvements or construction would be needed for the existing PRB-1 and PRB-2 wells, though they would need to be re-permitted from a Class I injection well to a Class VI CO_2 injection well and fitted with injection equipment such as tubing. Construction would require trenching and excavation extending approximately 6 feet in depth for the subsurface pipeline within lands owned or leased by BEPC. Trenching and excavation activities may temporarily impact ongoing agricultural activities within the Project area but would not permanently impact agricultural use of the Project area. Construction of the carbon capture facility including the pond would be contained within the previously disturbed DFS footprint and would not require disturbance of undisturbed geological or soil resources. Injection wells would be drilled to a depth between 8,000 and 10,000 feet bgs. Drilling and installation of the injection wells would follow guidance published by the Wyoming Department of Environmental Quality (WDEQ), WSEO, and other state or local agencies as applicable. Therefore, impacts to geologic or soil resources as a result of Project construction would be minimal.

Operation and Maintenance

Injection Wells

The Project proposes to inject approximately 57.5 MMT of CO_2 into the subsurface geology, specifically the Minnelusa and Sundance formations, over a 30-year period. The injection of CO_2 into these subsurface formations could result in a sudden unplanned or uncontrolled release of CO_2 to the surface through the disturbed geologic material adjacent to the injection well. However, current well construction standards required for modern injection wells and the continuous operational and monitoring technologies that would be required throughout the life of the Project would significantly reduce potential for unplanned or uncontrolled release. Additionally, lateral continuity, substantial thickness, and low vertical permeability of the sealing units and lack of fractures/faults that go through the primary confining unit, or primary seal, would minimize the potential release of CO_2 through undisturbed geologic materials. The confining unit would sequester and trap the injected CO_2 underground for thousands of years; in other areas of the PRB it has contained buoyant hydrocarbons in-place for millions of years. If a release were to occur at or from the injection well, such an event would have minimal impacts on the geological and soil resources surrounding the well.

The storage formations and pad locations were specifically placed in reservoirs that do not hold economic reserves of petroleum and are distanced from active production. There are nearby fields and some of these fields would be within the overall storage complex, but oil and gas reservoirs are stratigraphically above, and sufficiently separated from, the targeted injection zones. Exploration in the area has been extensive, and empirical data has shown that this portion of the reservoir is not charged with petroleum; most of those exploratory wells resulted in dry holes in the targeted storage formations. These injection wells are sufficiently separated by both distance, and stratigraphically, by confining units such that injected CO_2 would not damage producing fields, nor would the CO_2 enhance any oil or gas production.

A risk assessment examined if injection would disrupt or impact mineral resources in the area and found no significant impacts. Additionally, by regulation, CO_2 wells cannot have a deleterious effect on mineral rights and mineral resources. Further, required monitoring surrounding the storage complex would show impacts, if any.

Technical risk factors related to injectivity, storage capacity, containment (including a variety of specific CO_2 migration scenarios), and induced seismicity (meaning seismicity created by injecting into the targeted geologic CO_2 storage complex) were analyzed as part of the Project's Feasibility Study. These risk factors were assessed by simulating CO_2 injection and storage over a 30-year operating period in relation to existing wellbores that penetrate the sealing formations and intersect one of the two targeted storage units, water wells producing from the lowermost USDW, and a variety of surface features. Simulations also included a 50-year post-operation monitoring period. While most of the analyzed risk factors were determined to have low criticality (a combination of risk probability and impact), the following is a list of higher-criticality risks that could affect the surrounding landscape, mineral resources, and drinking water resources (McLaughlin et al. 2023):

- Subsurface pressure impacts reach beyond the permitted AOR for an injection well's storage unit. The storage unit is defined as the area of reservoir rock that is expected to contain the injected CO_2.
- CO_2 or formation brine, water containing a high concentration of dissolved salts, migrates laterally within the storage unit, intercepts existing wells, and results in vertical migration to the surface or impacts to mineral resources.
- CO_2 or formation brine migrates laterally within the storage unit, intercepts existing wells, and results in vertical migration to the lowermost USDW.
- Abandoned orphan wells that penetrate the storage complexes and are unidentified prior to injection fail, resulting in vertical migration of CO_2 or formation brine to the lowermost USDW, surface, or surface water bodies.

The highest risk potentially impacting USDW is identified as CO_2 leakage along existing wellbores, either legacy hydrocarbon wellbores or the Project's carbon storage wells. If cement or casings failed, these could provide a conduit from injection targets to USDW. Individual wellbore risk levels have been categorized based on depth, completion and plugging techniques, distribution relative to the area of review, and other relevant variables. This risk categorization guides existing monitoring activities and would be used to develop a long-term monitoring strategy throughout Project implementation. The second highest risk potentially impacting USDW is the potential for

structural risks. A 3D seismic survey was developed to characterize geologic structure and to identify the location of paleo-karst collapse features and minor folding and fracturing. The last principal risk that may impact USDW is the competency of sealing lithologies to contain the CO_2. Core and fluid studies demonstrate that the site contains numerous competent seals that offer protection. With the depth of injection, existence of confining units above the injection zone, and implementation of a long-term monitoring strategy, impacts to the surrounding environment resulting from potential CO_2 transport through geologic formations would be less than significant.

Induced seismicity can be a concern in areas where a large amount of fluid is injected into the subsurface at high rates and/or near large faults (Keranen and Weingarten 2018). Induced seismicity has not been documented in this part of the PRB and there are no known large faults in the Project area. Therefore, impacts to or resulting from seismic activity would be unlikely to occur as a result of the Project.

Surrounding Wells

Existing deep wells within the AOR were evaluated to determine whether they would have the potential to intercept the modeled CO_2 plume and potentially contribute to CO_2 leakage (Figure 9). Wells that penetrate the Minnelusa, Sundance, or Madison formations would have a greater potential to intercept the modeled CO_2 plume, whereas the wells that terminate above the targeted injection depths and formations would not intercept the CO_2 plume and have a lower likelihood of contributing to leaking wellbores. The wells that terminate at a depth above the targeted injection zone which have been included in Figure 9 penetrate sealing formations for the Project's injection zone. While there would be less potential for CO_2 leakage from these wellbores, they would create a potential pathway through the seal through which CO_2 may escape. Any well that penetrates the Minnelusa must also penetrate the Sundance formation. Figure 9 depicts all wells within the AOR which penetrate the Project's injection zones.

There are four wells in the AOR that penetrate the Madison formation, which is stratigraphically below the Minnelusa and Sundance formations (Figure 9). These four wells fully penetrate both the sealing formations and the proposed injection zones and could be a potential pathway for CO_2 leakage to occur. There are 57 wells that penetrate the Minnelusa and Sundance Formations; 90 percent of these wells are permanently abandoned.

There are 239 wells in the AOR that penetrate a major sealing formation – either the Mowry or the Skull Creek shales. Though these sealing formations are penetrated, they pose a smaller risk of wellbore leakage because they would not encounter the modeled CO_2 plume.

There are two wastewater injection wells on the east side of PRB-5 and PRB-6 and one on the east side of PRB-1 and PRB-2. Some of the wells were originally oil producers that were later converted to injection wells. All three wells inject into the upper Minnelusa formation. One injection well is on confidential status and not reporting injection rates and two do not have available injection data (WOGCC 2023b). O&M of the Project would require development and implementation of a long-term monitoring strategy and a MVA study to identify any potential change to the subsurface environment as a result of Project activities. With the implementation of the monitoring strategy, potential leaks of CO_2 from the injection zone into the atmosphere originating from existing deep wells would be identified and addressed as soon as detected to

minimize impacts to geological resources and surrounding communities as a result of implementation of the Project.

Monitoring and Leak Detection

Effects on USDW from CO_2 have been widely studied in both the laboratory and in the field at analog sites that contain naturally occurring CO_2 in reservoirs and natural gas storage sites. Studies from natural analogs have demonstrated that introducing CO_2 into an USDW can alter the chemistry, but in most cases did not affect the potability of the water source (Lewicki et al. 2006). Regular monitoring of the USDW for changes in chemistry would quickly detect potential leaks. Regular monitoring is required by the Class VI permit issued by the WDEQ. The required monitoring activities would detect changes in baseline conditions in a variety of ways including downhole pressure, geochemistry, and soil gas CO_2 concentrations throughout the injection and post-injection periods.

Monitoring instrumentation is currently used within the AOR at plugged and abandoned wells that represent the largest risk of leakage. Monitoring of these wells would continue throughout the life of the Project and allow for early warnings to quantify leakage and further inform necessary corrective actions.

Relatively slow leakage from the well bores due to casing and/or cement problems would be detected ahead of time by mechanical integrity testing to be conducted as part of the monitoring requirement under the UIC Class VI permit. If a subsurface release were to occur, such an event would not be expected to reach or have adverse impacts on the surface soils or near surface geologic units due to the presence of additional confining units within the overlying 9,000 feet of vertical distance from the injection zone. The nearest aquifer, in vertical depth, to the injection formations within the PRB would be separated by approximately 4,500 feet of vertical distance from the nearest injection zone. Aquifer resources within the Project area are located at an even greater vertical distance from the Project's injection zone. If the CO_2 did reach USDW or near surface soils, the released CO_2 would continue to react geochemically with the carbonate materials and most likely be geochemically converted and dissolved within the formation fluids via solubility and mineral trapping prior to atmospheric release.

Appropriate siting of the wells and underlying geologic formations have been evaluated extensively for site suitability and determined that minimal risks or impacts to the geology would result from the construction and operation of the project. Additionally, the Project would be subject to rigorous UIC Class VI permit requirements and frequent monitoring, allowing for early detection of any issues. Based on the aforementioned discussion, it is anticipated that impacts to geology and soils resulting from the construction or operation of the project would be minimal.

3.5 Hydrologic Conditions and Water Quality

3.5.1 Affected Environment

Surface Waters, Surface Water Quality, and Floodplains

Surface Waters

Surface water resources in the Project area include rivers, streams, creeks, lakes, ponds, reservoirs, and wetlands. Surface water features within the Project area are maintained by

precipitation. Evaporation, seepage into the ground, and use by plants and animals all contribute to natural reduction of surface water resources within the Project area. Surface water resources within the PRB are utilized by surrounding communities for drinking water, public supply, irrigation, agriculture, thermoelectric generation, mining, and other industrial uses.

The Project is located within the Little Powder watershed, Hydrologic Unit Code (8-digit) 10090208, within the Powder/Tongue River Basin (WSGS 2023). This watershed spans approximately 1,297,045 acres and includes approximately 6,470,180 linear feet of streams and approximately 377 acres of other surface waters (Campbell County Conservation District 2023).

The WDEQ assigns classes to surface waters as indications of the water systems beneficial use and status. Four classes have been established with Class 1 waters provide the most beneficial uses (e.g. drinking water, fish for consumption, etc.) while Class 4 waters provide the least beneficial uses (e.g. recreation, industry, scenic value, etc.). Four named surface waters cross the Project area: Little Rawhide Creek, Rawhide Creek, Hay Creek, and Jamison Prong Wildcat Creek. Appendix B: Waters Assessment Memo contains specific information regarding each of the four main surface waters which cross the Project area. North Wildcat Creek is located proximate to the Project area but does not cross the proposed alignment. All five of these named surface waters are Class 3 waters, designated for aquatic life other than fish, recreation, agriculture, industry, wildlife, and scenic value uses. Wyoming Water Quality Rules, Chapter 1, Wyoming Surface Water Quality Standards (Wyoming Surface Water Quality Standards) describe the numeric and narrative water quality criteria applicable to these designated uses, along with the applicable antidegradation provisions.

Wetlands

Wyoming Water Quality Rules and Wyoming Surface Water Quality Standards expand the Classification for surface waters to adjacent wetlands. Wetlands adjacent to surface waters are assigned the same classification as the adjacent water. As defined by Wyoming Surface Water Quality Standards ENV-WAT-1 § 2, adjacent wetlands are 'wetlands that are connected by a defined channel to a surface tributary system or are within the 100-year flood plain of a river or stream, or occupy the fringe of any still water body which is connected by a defined channel to a surface tributary system.' The USFWS National Wetland Inventory (NWI) mapper identifies multiple wetlands within the Project's AOI, some of which would be considered adjacent wetlands and therefore protected under Wyoming regulations.

Water Quality

The CWA Section 303(d) requires states to develop lists of impaired surface waters, or waters that do not meet surface water quality standards established by state agencies. The CWA requires each state to establish priority rankings for surface waters on the list and develop total maximum daily loads (TMDLs) for surface water pollutants. The WDEQ is the authority on the water quality of Wyoming's surface water resources. The 2020 WDEQ Integrated 305(b) and 303(d) Report is the most current published list (WDEQ 2020) and does not identify any 303(d) listed waters proximate to the Project site. (WDEQ 2018b, WDEQ 2020).

Floodplains

The Project area is located within several delineated floodplains or areas susceptible to inundation from adjacent surface waters (44 CFR 59.1). Floodplains provide natural flood and erosion control, enhance biological productivity, and a variety of socioeconomic benefits and functions. Due to

natural flood susceptibility, structures constructed within floodplains are at a higher risk of flood damage.

Under the National Flood Insurance Program, the Federal Emergency Management Agency (FEMA) develops Flood Insurance Rate Maps which delineate specific flood hazard areas for each mapped surface waterbody. Through this program, FEMA maps anticipated 100-year floodplains, or areas that have a 1 percent annual chance of flooding, and 500-year floodplains, or areas that have a 0.2 percent annual chance of flooding, based on the available climate and local flood study data.

Portions of the Project's subsurface pipeline would be located within a FEMA-mapped Flood Hazard Zone A (no base flood elevation determined) (FEMA 2022). Zone A areas are subject to rising waters and are usually near a lake, river, stream, or other body of water. Potential flooding would be associated with Little Rawhide Creek or Dry Fork Little Powder River which flow south to north crossing the Project area. Hay Creek and Rawhide Creek may also contribute to potential flooding in FEMA delineated areas of the Project, both of these surface waters flow west to east.

Groundwater

The Project is underlain by the Wasatch Aquifer, Fort Union aquifer, and a Quaternary alluvial aquifer, three classified sandstone aquifers, all of which have been disturbed by mining activities throughout the PRB (USGS 2003, 2023d, WSGS 2022, 2023, UW Water Resources Research Institute 1981, WSGS 2022, 2023) (Figure 10). Alluvial and shallow bedrock aquifers recharge naturally through rainfall and snowmelt and none of these aquifers are designated by the US EPA as a sole-source aquifer (WSGS 2023, EPA 2020). In reclaimed areas that were mined below the water table, the water-bearing rock layers have been removed and groundwater moves through unconsolidated pit backfill materials. The backfill includes rock of varying sizes, which are placed back in the open pit without compaction, except by equipment moving over the surface to grade the material. Because of the unconsolidated nature of pit backfill, groundwater moves through this material faster than the native rock aquifers and may pool in the former mine pits.

More than 75 percent of the Wyoming state population relies on groundwater resources for part, or all, of their drinking supply relying on over 90,000 supply wells throughout the state (WDEQ 2023). Approximately 682 groundwater wells are located within the Project's AOR, of which 360 are monitoring wells and 71 are designated domestic wells (WSEO 2023b) (Figure 10). Using monitoring well data available through the WSEO, groundwater resources within the AOR would be located, on average, approximately 60 feet bgs.

3.5.2 Proposed Action Impact

Construction

Surface Water, Surface Water Quality, and Floodplains

The Project would be located within mapped surface waters and floodplains and trenching, backfilling, HDD, and vegetation clearing would occur within these resources. Approximately 1,392 linear feet of the Project's pipeline alignment would be located within a FEMA mapped Flood Hazard Zone (FEMA 2022). Subsurface pipeline installation would utilize HDD technology where feasible to reduce potential floodplain impacts resulting from Project construction. Four named surface waters cross the Project area. Attachment B: Waters Assessment Memo provides specific information about each surface water. All five of the Project injection sites and the carbon capture

plant would be located outside of FEMA mapped Flood Hazard Zones. The erosion and transport of sediment due to construction could result in localized water quality degradation of Little Rawhide Creek, Rawhide Creek, Jamison Prong Wildcat Creek, and Hay Creek due to their proximity to the Project. Each of the four surface waters serve as tributaries to the Little Powder River, an interstate water, and degradation to one or more of the tributaries may affect the Little Powder River. Table 3.5-1: Main Surface Water Crossings of the Project Area lists each of the four main surface waters and their crossing locations.

Table 3.5-1. Main Surface Water Crossings of the Project Area

Surface Water Name	Approximate Length of Pipeline Crossing (Feet)	Crossing Location (Latitude, Longitude)	Stream Type (Perennial/Intermittent)
Little Rawhide Creek	19.5	44.39579522, -105.5156719	Perennial
Rawhide Creek	22.4	44.43447762, -105.5370418	Intermittent
	20.7	44.43191335, -105.5539057	Intermittent
	22.2	44.42608235, -105.5609862	Intermittent
	23.4	44.42287247, -105.5583753	Intermittent
Hay Creek	19.9	44.47784883, -105.5165438	Intermittent
Jamison Prong Wildcat Creek	20.4	44.49285498, -105.6162605	Intermittent
	19.1	44.50197342, -105.6091039	Perennial

Source USFWS 2023a

Sediment deposition into surface waters can increase turbidity and adversely affect aquatic species and habitats by increasing water temperatures and decreasing dissolved oxygen levels. Sediment deposition into surface waters may also increase pollutant and nutrient levels which may adversely affect water quality conditions.

An approximately 12-acre storage pond would be constructed within BEPC's existing DFS to provide water resources and storage for future operation of the carbon capture facility. This stock pond would be located completely within the existing DFS fence line and would be constructed away from any mapped or otherwise identified surface water resources.

Use of construction equipment within the Project area could result in accidental spills or leaks of petrochemicals that could reach surface waters if not contained and cleaned up. Vehicle leaks observed during Project construction would be immediately cleaned and any contaminated soil or other material removed from the site following the Project specific Solid and Hazardous Waste Management Plan, further described in Section 3.11 Solid and Hazardous Waste. Project construction would require the development of a Stormwater Pollution Prevention Plan (SWPPP) which would contain best management practices (BMPs) and site-specific measures to avoid and minimize erosion and sediment transportation to surface waters in proximity to the Project, as well as measures to contain and clean up accidental spills. Any potential impacts to surface waters would be mitigated through the use of site-specific measures and BMPs as identified in the Project SWPPP. Where feasible, HDD methods or aboveground pipeline water crossings would be utilized to reduce impacts to surface water channels and riparian habitat. Construction locations within FEMA Flood Hazard Zones would have the potential to experience seasonal flooding.

Implementation of a Project SWPPP, associated BMPs, and approved dewatering techniques and subsequent water treatment would reduce risk of impacts to proximate surface waters as a result of on-site flooding. If infeasible, the Project would acquire all necessary permits from the US Army Corps of Engineers (USACE) and WDEQ prior to project construction. All measures would be designed for water quality protection and to ensure water quality standards of nearby surface waters would not be exceeded. Therefore, impacts to surface water resources as a result of Project construction would be minor and temporary.

Wetlands

The USFWS NWI mapper identifies multiple wetlands within the Project's AOI, some of which would be considered adjacent wetlands and therefore protected under Wyoming regulations. Within the proposed subsurface pipeline alignment, several surface waters and adjacent wetlands occur. Injection sites and associated infrastructure would be sited to avoid surface waters and wetland resources. Project construction would have the potential to impact wetland resources in the vicinity. With implementation of HDD construction practices and a Project SWPPP, impacts to proximate wetlands would be reduced. Prior to construction, the Project would obtain applicable permits from WDEQ and other agencies to identify potential mitigation requirements for impacts to surface waters. Impacts to wetland resources resulting from Project construction would occur during subsurface pipeline construction and would be temporary and intermittent.

Groundwater

There are 360 mapped groundwater monitoring wells within the Project's AOR (Figure 10). Specific depth to groundwater within the AOR varies with an average monitoring well depth to

groundwater measurement of approximately 60 feet bgs (WSEO 2023a). During construction, trenching would be required to construct and install the subsurface pipeline and would extend to a depth between 4 and 6 feet bgs. The pipeline alignment excavation would not be anticipated to encounter groundwater resources. If groundwater is encountered during trenching, dewatering activities would be conducted following recommendations and procedures outlined in the Project SWPPP and the Project's construction dewatering plan. BMPs would be put into place before construction and would continue throughout Project operation to manage stormwater runoff and capture and contain any spills and leaks. These BMPs would be designed to avoid contamination of groundwater. The containment and disposal of wastewater and wastes from the operations would provide further protection for groundwater.

Construction and installation of the amine carbon capture plant alternative would require additional supply water for operation of the CO_2 capture process. One new groundwater supply well would be constructed within the existing DFS utilizing guidance from the WSEO and WDEQ. All permits required for construction and installation of the new supply well would be obtained prior to Project construction. Coordination with public water supply (PWS) would occur prior to initiation of the Project to minimize potential impacts to PWS wells proximate to the construction area. Construction of the MTR carbon capture plant alternative would not require construction and installation of any new groundwater supply wells.

Construction of the injection well component for the Project would likely encounter groundwater. All well drilling activities would follow guidance published by the WSEO, and WDEQ's Class VI permit program, and would reduce levels of groundwater intrusion into the well bore during construction. These provisions would be met by following the long-standing requirements for well drilling and completion necessitated by the WSEO and Wyoming Oil and Gas Commission, including those requirements that protect surface sections and groundwater resources. Upon completion of well drilling, the well casing would be installed and prevent further groundwater intrusion into the well bore. The well completion program would satisfy Class VI well permitting requirements, which include a double barrier (i.e., casing) between drinking water reservoirs and the production string, CO_2 resistant casing, tubing and cement, cementation to surface in all completion strings, and rigorous mechanical and cementation tests post-installation to prove full separation prior to any injection activities. This would prevent CO_2 injection from interacting with groundwater resources and subsequent contamination minimizing impacts to groundwater resources as a result of Project construction.

Operation and Maintenance

Surface Water, Surface Water Quality, and Floodplains

Operation and maintenance of the Project would require periodic repairs within or proximate to FEMA mapped floodplains and Little Rawhide Creek. Maintenance of the Project pipeline component would require excavation of portions of the pipeline alignment. Excavated material would be stockpiled following site-specific measures and BMPs to reduce potential impacts to proximate surface waters.

Operation of the amine carbon capture plant alternative would require the use of an aqueous solvent and water as part of the carbon capture process. Spent solvent (liquid waste) would be stored on-site proximate to the carbon capture plant.

To support the MTR carbon capture plant alternative, an approximately 12-acre storage pond would be constructed to contain water used for gas cooling to contain potential contaminants and would operate as a closed system, storing and providing water resources for use. Implementation of this storage pond would ultimately provide all water resources required for operation of the MTR carbon capture plant alternative and would not permanently increase BEPC's dependency on proximate surface and groundwater supplies. This storage pond would be engineered following all current, applicable EPA and WDEQ guidelines to protect surface and groundwater resources from contaminants associated with O&M of the Project.

Project design components would assist in control of stormwater runoff to divert rainwater away from the testing facility equipment and on-site contaminants. Spill containment for on-site contaminant storage would include a secondary containment system surrounding liquid storage tanks adequately sized to contain 110 percent volume of the largest volume liquid storage tank within the secondary containment area, and to account for the anticipated rainfall volume following climate data and projected precipitation conditions in the Project area. Wastewater and spent solvent generated from the carbon capture plant would be disposed of and treated following existing DFS procedures, further described in Section 3.11 Solid and Hazardous Waste.

Operation and maintenance of the Project would include a MVA study over the 30-year period. This study would include the use of thumper trucks for several weeks every five years. The trucks would be driven at specified intervals over a 3x3-mile grid around each of the injection wells to monitor subsurface impacts as a result of CO_2 injection. Prior to thumper truck usage, environmental professionals would identify sensitive resources within the 3x3-mile grid and would exclude areas of environmental significance, including surface water resources. Surface water resources would be avoided during this study and no impacts as a result of thumper truck use would be anticipated. Therefore, impacts resulting from O&M of the Project would be minor.

Wetlands

O&M Of the Project would require intermittent repairs to subsurface pipeline components. Repairs may include integrity testing, pipeline replacement, and trenching activities for pipeline access. Impacts to wetlands would be avoided to the extent practicable and any actions to disturb wetlands would be permitted through the WDEQ prior to construction. Therefore, impacts as a result of Project O&M would be reduced and would be temporary and intermittent.

Groundwater

As described in Section 3.4 Geologic and Soil Conditions, Project operation would require injection of approximately 57.5 MMT of CO_2 into several subsurface geologic formations over a period of 30 years. Subsurface injection of CO_2 would occur through injection wells installed during the Project's construction. Using subsurface modeling and study of the stratigraphy of these formations prior to selection, the formations were selected based on the presence of specific characteristics which would contain and fully sequester the injected CO_2. These formation characteristics would prevent the release of the stored gas to surrounding formations and aquifers. Injection of CO_2 would be conducted at a target depth of greater than 8,000 feet bgs. Currently, active groundwater wells within the Project's AOR extend to a maximum depth of 1,200 feet bgs and the aquifers extend to a maximum depth of approximately 4,000 feet bgs (WSEO 2023b, Tisherman 2022).

Operation of the amine carbon capture plant alternative would require additional water supply for both steam production and the cooling process during CO_2 capture. Upon installation of a new supply well, BEPC would begin extracting groundwater from the new well following existing groundwater extraction limits. No additional groundwater extraction permits or authorizations would be anticipated. In the event that additional groundwater supply volumes would be required for operation of the amine carbon capture plant, BEPC would obtain any additional permits from authorizing agencies prior to extracting additional groundwater. Operation of the amine carbon capture plant alternative would not increase DFS's current groundwater use and, therefore, would not impact groundwater supplies for other existing wells proximate to the Project.

Operation of the MTR carbon capture plant alternative would not require extraction of groundwater resources and would not impact groundwater supplies.

During operation, BEPC and UW would continue analyzing subsurface impacts over the 30-year period to identify any impacts to each formation's structural integrity, injection and pipeline integrity, and groundwater quality. If impacts to formation integrity are identified which would have the potential to impact groundwater resources, operation of the Project would be halted, and further study would begin to identify further action. Seventy-one (71) domestic supply wells would be located within the AOR and would potentially be the first domestic wells affected in the instance of a CO_2 leakage. However, because the depth of the carbon storage plumes would be much deeper than groundwater resources and active groundwater supply wells, minimal impacts to groundwater aquifers and supply would result from Project operation.

3.6 Vegetation and Wildlife Resources

3.6.1 Affected Environment

The PRB is characterized by short grass plains, mixed grass prairies, and intermixed sagebrush steppe and foothill transition juniper woodlands (Knight 1994). The Project area falls primarily within the sagebrush steppe and grasslands regions, with the northern and western pipeline branches on the border of the foothill transition sparce juniper woodlands (Knight 1994). Vegetation species throughout this area include Wyoming big sagebrush (*Artemisia tridentata*), needle-and-thread grass (*Hesperostipa comata*), western wheatgrass (*Pascopyrum smithii*), prairie junegrass (*Koeleria macrantha*), Indian ricegrass (*Achnatherum hymenoides*), blue grama (*Bouteloua gracilis*), Plains prickly pear cactus (*Opuntia polyacantha*), fringed sagewort (*Artemisia frigida*), cheatgrass (*Bromus tectorum*), and various species of milkvetch (*Astragalus spp.*) (Knight 1994). Approximately 75 percent of the Project area is located within previously disturbed areas and contains some non-native vegetation, particularly in the vicinity of established roads and highways.

Vegetation communities in the vicinity of the Project area support a wide variety of wildlife species, including prairie rattlesnake, greater short-horned lizard, golden eagle, prairie falcon, Swainson's hawk, sharp-tailed grouse, lark bunting, horned lark, western meadowlark, Brewer's sparrow, lark and vesper sparrow, chestnut collared longspur, American badger, coyote, desert cottontail, black-tailed jackrabbit, kangaroo rat, mule deer, pronghorn, white-tailed deer, and black-tailed prairie dog, among others (Campbell County 2016). The Project area does not fall

within a designated greater sage-grouse (*Centrocercus urophasianus*) core area pursuant to State of Wyoming Executive Order 2019-3, nor does it overlap the Public Land Survey System (PLSS) townships known to contain greater sage-grouse leks. Similarly, the Project area does not fall within approved wildlife migration corridors recognized by the Wyoming Game and Fish Department (WGFD).

To evaluate the potential occurrence of species listed under the ESA in the vicinity of the Project area, the United States Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) system was queried (Appendix C: USFWS Section 7 Consultation Memo). IPaC identified one listed species that could occur within the area: Ute ladies'-tresses (*Spiranthes diluvialis*). Ute ladies'-tresses is an orchid that inhabits low, flat floodplain terraces or abandoned oxbows that are seasonally flooded and remain moist into the summer (Heidel 2007). Wyoming populations occur at elevations ranging from 4,650 to 5,420 feet (Heidel 2007). Although the Project area falls within the USFWS Area of Influence (AOI) for this species, there are no known occurrences within Campbell County (Heidel 2007). Additionally, previous environmental analysis at DFS entailed surveys for Ute ladies'-tresses in areas of potentially suitable habitat in the vicinity of DFS, and the species was not observed (MTR 2019). The nearest known occurrence of Ute ladies'-tresses is to the southwest of the Project area over 70 miles away in Converse County (Heidel 2007; Andersen et al. 2016).

The northern long-eared bat (*Myotis septentrionalis*) is listed as endangered and are primarily located in the eastern US; however, the western most extent of their range extends to northeastern Wyoming, which is near the proposed project area. During the summer, the northern long-eared bat typically roosts in cavities, underneath bark, crevices, or hollows of both live and dead trees and/or snags, which are not present within the project area. The closest known hibernation sites and resident population are in the South Dakota Black Hills.

3.6.2 Proposed Action Impact

Construction and O&M of the Project would disturb vegetation within the Project ROW and at injection sites. Initial construction would affect mixed grassland and shrubland habitat along the pipeline corridor and at the injection well pads and the carbon capture site. O&M activities would periodically affect smaller, more localized areas of the Project. Assuming that Project-related surface disturbance would be mitigated by re-seeding with appropriate native plant species or similar at the landowner's discretion, Project-related impacts on vegetation would be temporary and would attenuate through time as vegetation recovers. Some portions of the Project, namely injection sites, would likely involve longer-term vegetation removal impacts. However, recognizing the small footprint of injection sites, these impacts would be minimal. Additionally, given the pronounced footprint of existing mining and industrial activity within the Project area, these impacts would represent an incremental increase in ground disturbance within the Project area.

Construction and O&M of the Project may displace wildlife in the vicinity of the disturbed areas through localized habitat alteration, noise disturbance, the production of fugitive dust, or other potential deterrents. However, Project-related impacts to wildlife arising from avoidance of construction or maintenance equipment would be temporary. Assuming successful re-seeding of the disturbance footprint, Project-related impacts to wildlife would further attenuate through time

with the recovery of vegetation and wildlife habitat within disturbed areas. Moreover, given that the Project would use an underground pipeline network, the pipeline is not expected to inhibit wildlife movement at the landscape scale or result in habitat fragmentation. As such, Project-related impacts on vegetation and wildlife resources would be less than significant.

The Project is not expected to impact any ESA-listed species. Although IPaC identified one listed species with potential to occur within the Project area, the nearest known occurrence of Ute ladies'-tresses is in neighboring Converse County (Heidel 2007; Andersen et al. 2016). As such, this species is not expected to occur within the Project area. Moreover, the nearest known occurrence of Ute ladies'-tresses is far enough from the Project area that it would not be affected by the Project. This determination is consistent with previous surveys for Ute ladies'-tresses in the vicinity of DFS, which did not document any individuals of the species (MTR 2019). Additionally, while the Project is on the edge of the USFWS AOI for the northern long-eared bat, there is no suitable habitat present within the Project area and the Project would have no effect on this species.

3.7 Socioeconomic Conditions

3.7.1 Affected Environment

The Project is located approximately 6.5 miles north of Gillette, Wyoming, within undeveloped areas of the PRB in Campbell County, Wyoming. Gillette is the county seat and the most populous city in Campbell County with a population of 33,407. There are also small unincorporated towns southeast of Gillette, including Antelope Valley-Crestview (population 1,658) and Sleepy Hollow (population 1,308). The area to the north of DFS is sparsely populated, as is the general area through which the conceptual commercial-scale buildout would pass. As of 2021, the total population of Campbell County was 46,758 (USDC 2021a). The largest employers in Campbell County are the mining, quarrying, and oil & gas extraction industries, retail, and educational services (Data USA 2023).

Table 3.7-1 presents a comparison of basic socioeconomic metrics between the City of Gillette, Campbell County, the State of Wyoming, and the United States in 2021. As shown in Table 3.7-1, both the City of Gillette and Campbell County have markedly higher median household income than the State of Wyoming and the United States. As a proportion of household income, housing is more affordable for homeowners in Gillette and Campbell County compared to Wyoming and the United States, as fewer homeowners in Gillette and Campbell County expend more than 30 percent of household income on mortgages. In contrast, more renters in Gillette, Campbell County, and the State of Wyoming expend more than 30 percent of household income on rent. Similar to other places in the US, Gillette is currently experiencing a housing shortage (Gillette News Record 2023).

Employment in Gillette is dominated by extractive industries. In 2021, 19.9 percent of working-age individuals in Gillette and 24.1 percent of working-age individuals in Campbell County were employed in agriculture, forestry, fishing/hunting, or mining (Table 3.7-2). Most of these jobs are likely related to the fossil fuel industry. This represents markedly higher employment in this sector compared to the State of Wyoming overall (10.1 percent) as well as the United States (1.4 percent).

Table 3.7-1. Socioeconomic Conditions Metrics, 2021

Population Metric	City of Gillette	Campbell County	State of Wyoming	United States
Total Population	33,047	46,758	576,641	329,725,481
Median Household Income	$83,193	$87,547	$68,002	$69,021
Median Home Value[1]	$224,000	$230,400	$237,900	$244,900
Median Mortgage Cost (Monthly)[1]	$1,630	$1,648	$1,536	$1,697
Median Rent (Monthly)[1]	$836	$867	$878	$1,163

Source: USDC 2021a, 2021b.

Notes:

[1] Values in 2021 dollars.

[2] Values should be interpreted with caution (coefficients of variation, the extent of variability in relation to the mean of the population, are between 12 percent and 40 percent).

Table 3.7-2. Employment by Industry, 2021

Industries	City of Gillette	Campbell County	State of Wyoming	United States
Agriculture, forestry, fishing/hunting, and mining	3,303 (19.9%)	5,793 (24.1%)	28,906 (10%)	2,138,149 (1.4%)
Construction	1,580 (9.5%)[1]	2,539 (10.6%)[1]	23,675 (8.3%)	10,717,186 (6.8%)
Manufacturing	803 (4.8%)[1]	972 (4.0%)[1]	11,895 (4.2%)	15,786,008 (10%)
Wholesale trade	295 (1.8%)[1]	399 (1.7%)[1]	5,053 (1.8%)	3,916,817 (2.5%)
Retail trade	1,838 (11.0%)[1]	2,320 (9.7%)[1]	32,184 (11.3%)	17,253,259 (11.0%)
Transport, warehousing, and utilities	976 (5.9%)[1]	1,318 (5.5%)[1]	17,598 (6.2%)	8,905,978 (5.7%)
Information	130 (0.8%)[1]	172 (0.7%)[1]	4,271 (1.5%)	3,031,263 (1.9%)
Finance, insurance, and real estate	586 (3.5%)[1]	832 (3.5%)[1]	13,159 (4.6%)	10,483,270 (6.7%)
Professional, management, administration, and waste management	634 (3.8%)[1]	972 (4.0%)[1]	18,933 (6.6%)	18,817,926 (11.9%)
Education, healthcare, and social assistance	3,431 (20.6%)	4,480 (18.6%)	70,553 (24.8%)	36,753,702 (23.3%)
Art, entertainment, recreation, accommodation, and food	1,547 (9.3%)[1]	1,915 (8.0%)[1]	27,317 (9.6%)	14,346,635 (9.1%)
Other services, except publica administration	620 (3.7%)[1]	964 (4.0%)[1]	13,521 (4.7%)	7,485,169 (4.8%)
Public administration	893 (5.4%)[1]	1,348 (5.6%)[1]	17,869 (6.3%)	7,399,660 (4.7%)

Source: USDC 2021a, 2021b.

Note:

[1] Values should be interpreted with caution (coefficients of variation, the extent of variability in relation to the mean of the population, are between 12 percent and 40 percent).

The population in Gillette is tied to fluctuations in the fossil fuel industry. A fossil fuel boom period resulted in 39.3 percent population growth between 2000 and 2010. The end of the mining boom has resulted in a notable reduction in fossil-fuel-related employment since the mid-2010s (Richards 2018; Baragona 2019). Diversification of the employment sector in Gillette and Campbell County is key to long-term economic viability of the area (Baragona 2019).

3.7.2 Proposed Action Impact

Under the proposed action, coal mining in the area would continue and there would be no direct impacts related to the coal mining industry. Approximately 10 percent of the employment industry within Gillette is related to construction. The Project would diversify job opportunities in the region and project-related construction and operation activities would increase demand for skilled labor in construction, piping, excavation, and electrical, positively contributing to the economic activity in Gillette and Campbell County during the Project timeframe (approximately 30 years). The increased demand for additional skilled labor would be the highest during the initial Project construction phase, where workers would be sourced locally, within the region, as well as throughout the country. The total number of workers would vary from as a little as a few dozen to several hundred, depending on the Project phase and need for various forms of specialized labor. This would further increase the demand for hotels, restaurants, and other consumer goods. Following Project build-out, there would be a need for ongoing maintenance of the facility which would require permanent, full-time workers (likely sourced locally) as well as temporary, more specialized workers (likely sourced locally and elsewhere). The total number of workers during the O&M phase would be much less than the initial build-out phase. Therefore, the Project would be expected to have a minor, short-term, and beneficial impact on the economy.

3.8 Environmental Justice

3.8.1 Affected Environment

Environmental justice is the fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, requires all federal agencies to identify and address disproportionately high and adverse human health or environmental effects of their programs and policies on minorities and low-income populations and communities. Following this executive order, the CEQ issued guidance for considering environmental justice within the NEPA process (CEQ 1997). This guidance defines minorities as individuals who identify as being one or more of the following population groups: American Indian or Alaska Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic. The guidance further defines a minority population as follows: "Minority populations should be identified where either: (a) the minority population of the affected area exceeds 50 percent or (b) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis" (CEQ 1997). The CEQ guidance does not define the term "meaningfully greater." Additionally, pursuant to the Justice40 Initiative established by Executive Order 14008, which made it a goal that 40 percent of the overall benefits of certain federal investments will flow towards disadvantaged communities, CEQ recognizes "disadvantaged communities" as those that are marginalized, underserved, and overburdened by pollution and underinvestment.

Relevant 2021 population metrics for the City of Gillette, Campbell County, Wyoming, and the United States are presented in Table 3.8-1.

Table 3.8-1. Minority and Low-Income Populations Metrics, 2021

Population Metric	City of Gillette	Campbell County	State of Wyoming	United States
White (including Hispanic ethnicity)	95%[1]	95.3%[1]	93.3%[1]	77.8%
Hispanic ethnicity	10.1%[1]	8.6%	10.3%	18.4%
Non-Hispanic ethnicity	89.9%[1]	91.4%[1]	89.7%	81.6%
All other races	5.2%[1]	4.6%[1]	6.9%	22.2%
People in poverty	10.1%[1]	11%[1]	10.7%	12.6%
People in poverty over 65	1.04%[1]	1.33%[1]	0.81%	1.10%
Families in poverty	9.2%[1]	9.2%[1]	6.8%	8.9%
Households receiving Supplemental Security Income	3.3%[1]	2.6%[1]	3.4%	5.2%
Households receiving cash public assistance income	0.9%[1]	0.7%[1]	1.6%	2.6%
Households receiving food stamps/SNAP	5.0%[1]	4.5%[1]	5.2%	11.4%
People between 16 and 64 years in age who did not work	16.8%[1]	18.4%[1]	17.6%	22.7%
Households with mortgage costing >30% of household income	18.2%	18.4%	23.8%	27.0%
Rental households with mortgage costing >30% of household income	39.3%[1]	37.2%[1]	38.5%	46.0%

Source: USDC 2021a, 2021b.

Note:

[1] Values should be interpreted with caution (coefficients of variation, the extent of variability in relation to the mean of the population, are between 12 percent and 40 percent).

In 2021, Gillette had a slightly higher proportion than the greater Campbell County and the state of Wyoming of the following population metric: rental households with rent greater than 30 percent of household income; all other metrics were equal to or less than Campbell County or the state of Wyoming. All these values are lower than the average for the entire United States except for families in poverty which is slightly higher. A slightly higher proportion of Black/African American, Native American, and other non-White, non-Hispanic ethnicity individuals live in Gillette than in Campbell County as a whole, though the percentage of all non-White, non-Hispanic individuals is lower than in Wyoming and much lower than in the rest of the United States. However, most of these comparisons rely on data values that should be interpreted with caution (i.e., coefficients of variation, the extent of variability in relation to the mean of the population, are between 12 and 40 percent); therefore, no strong conclusions can be drawn about the presence of low-income or minority populations in the City of Gillette. Per the Climate and Economic Justice Screening Tool (CJEST; CEQ 2023), there are no disadvantaged communities within Campbell County.

3.8.2 Proposed Action Impact

The Project would be sited in a rural, undeveloped portion of the county, approximately 6.5 miles from the City of Gillette. The closest occupied structure (a single-family home) is more than 1.8 miles from the site, specifically the pipeline corridor. As described in the other resource area analyses, the proposed Project is not expected to have significant adverse impacts on any resource, including air quality, water quality or human health and safety. Additionally, the proposed Project would be compatible with the existing industry in the area which is coal mining. Given the distance of the proposed Project location from Gillette and nearby residences, and the low to negligible level of adverse impacts from construction and operation outside the immediate Project area, no disproportionate adverse impacts on low-income or minority populations are anticipated. The Project would have no effect on disadvantaged communities.

3.9 Historical and Cultural Resources

3.9.1 Affected Environment

The Project is in area that has been heavily disturbed by coal mining operations and has been subject to numerous cultural resources and historic property surveys that were previously completed. A search was conducted through the Wyoming State Historic Preservation Office (WYSHPO) WyoTrack application to identify previously documented cultural resources and previous cultural resource studies in the proposed Project area. Many of the sites in the region are prehistoric lithic scatters of unknown age or cultural affiliation. They often produce subsurface cultural materials, though these tend to be sparse and inorganic. Most lithic scatters are located along ridge tops and areas near large and reliable water sources. The same is true of prehistoric cairns and stone circles, though these are less common near the Project.

Historic resources in the area almost exclusively date to the Expansion period (circa 1890-1919). These are dominated by debris scatters, though homesteads are also common. These are not usually National Register of Historic Places (NRHP)-eligible. Historic transportation routes are also common, including trails, railroads, and highways. These often contributed to the settlement of the region and, by and large, are considered eligible under Criterion A.

Known resource density within and adjacent to the Project area is high. Site density averages about five sites per square mile. The area has been subjected to abundant Class III inventory, so site density is accurately reflected. According to WyoTrack, these inventories occurred between 1973 and 2013. Most were related to coal mine development and expansion in the 1980s, though large swaths were also surveyed in the 2000s for coal bed methane development. Most of these projects are over 20 years old and no longer qualify as adequate inventory.

Recorded sites located near the Project area include prehistoric lithic scatters, open camps, and historic material scatters. Historic ranches and prehistoric stone feature sites are also common. Other resources within the vicinity include historic road infrastructure sheepherder's cairns, and rural schoolhouses. Several resources were previously determined eligible for the NRHP, most of which are prehistoric lithic scatters.

3.9.2 Proposed Action Impact

Section 106 of the NHPA requires consultation with the State Historic Preservation Officer (SHPO). The WYSHPO was consulted on the potential for cultural resources in the proposed Project area. Due to previous disturbance from county roads, highways, coal mining, and oil and gas development, the proposed subsurface pipeline and injection wells sites contain little potential for undiscovered cultural resources. A Class 1 cultural resources survey was conducted in compliance with Section 106 of the NHPA and determined that the proposed pipeline would potentially intersect several cultural resources. The majority of historic resources near the proposed Project represent homesteading and ranching activities dating from about 1890 to 1940. Most of these represent an explosion in homesteading that occurred in the aftermath of World War I (Cassity 2002). Several of these were determined ineligible for the NRHP and require no further work. However, the Black and Yellow Trail, which was one of the first interstate highway systems in the country, was determined eligible for the NRHP under Criteria A and C. The Black and Yellow Trail provides a historically significant example of early transportation in the American West. Previous recordings have provided an exhaustive history of the trail and provide comprehensive maps.

The proposed subsurface pipeline alignment potentially crosses a contributing segment in two places; therefore, the Project has a potential to physically impact the Black and Yellow Trail. The Project proposes to optimize use of existing ROW to avoid any impacts to the trail segments. If use of ROW or design cannot avoid the trail, then HDD and/or trenching techniques would be employed to avoid all impacts to the trail. Installation of the highways have already impacted the trail in these areas, and the development of the pipeline would not constitute an adverse effect. The WYSHPO concurred that no historic properties would be adversely affected (Appendix D).

Operation and maintenance of the Project pipeline alignment and CO_2 capture facility may require additional excavation to conduct repair work, but no disturbance to areas not previously disturbed by historic mining activities are proposed. Operation and maintenance of the Project includes annual data collection for the ongoing MVA study to measure the subsurface condition of pore space impacted by injection of CO_2. As part of the MVA study as described in Section 2.4 Project Description, thumper trucks would be driven over the pressure-altered subsurface proximate to each injection site in a 3x3-mile grid pattern every 5 years throughout the 30-year life of the Project, and zig zag at 300-foot intervals. Prior to utilization of the thumper trucks, resource specialists and agencies would identify avoidance areas or areas of environmental concern that

would be avoided during the MVA study to minimize impacts to surface and subsurface environmental resources. Prior to the BLM's authorization of seismic investigations on BLM-administered lands, cultural resource surveys would be required, and appropriate avoidance measures or other mitigation measures would be taken.

On February 2, 2019, the Wyoming Legislature passed WS-7-4-106 Archaeological Human Burial Sites. The Statute requires that archaeological human remains discovered on private and state lands in Wyoming be recovered by the State Archaeologist, ensuring respectful treatment and prompt disinterment. As part of the Statute, protocols outlining the process of reporting, recovery, analysis, and reinterment were developed through consultation between the Eastern Shoshone, Northern Arapaho, Wyoming's Coroner's association, State Archaeologist, State Historic Preservation Officer, and members of the Wyoming State Legislation. If any cultural materials are discovered during construction, work in the area should halt immediately. The County Corner shall be contacted, and the *Protocol for Consultation, Repatriation, and Reinterment of Human Remains Originating from State and Private Lands in Wyoming as Required per W2-7-4-106* (WYSHPO 2020) shall be implemented. In addition, the DOE and WYSHPO staff should be contacted, and the materials should be evaluated by an archaeologist or historian meeting the Secretary of the Interior's Professional Qualification Standards (48 Federal Register 22716, September 1983).

3.10 Human Health and Safety

3.10.1 Affected Environment

The affected environment for health and safety includes the proposed Project construction and operations personnel, BEPC employees at the DFS, and members of the public that could be exposed to health and safety impacts of the proposed Project. The existing DFS is a coal-fired power plant with industrial activities occurring 24-hours a day, 365 days a year. Workforce health and safety are governed by the OSHA regulations. Current activities at the DFS are also governed by policies and procedures of BEPC. These policies require all contractors to follow the same safety standards that BEPC employees follow.

The Project is located in a rural area approximately 6.5 miles north of Gillette with the closest residence approximately 3 miles from DFS, 0.7 miles from the nearest injection site, and 0.5 miles from the pipeline corridor. Rawhide Elementary School is approximately 1.3 miles from the nearest segment of the pipeline corridor, approximately 1.5 miles from the nearest injection site, and approximately 4 miles from DFS. Northeast Wyoming Regional Airport is approximately 0.5 miles from the nearest segment of the pipeline corridor, approximately 1.8 miles from the nearest injection site, and approximately 5 miles from DFS.

3.10.2 Proposed Action Impact

The Project and the removal of CO_2 could have a positive effect on climate change and result in a number of benefits to human health and safety. Human populations are sensitive to shifting and unpredictable weather patterns, which can result in heat waves, flooding, droughts, and fires. Indirectly, human health may be damaged by ecological disruptions brought on by climate change including crop failures and shifting patterns of disease vectors as well as other social impacts such as the displacement of communities (IPCC 2023). Additionally, recent studies on the co-benefits of carbon capture technologies, specifically amine-based carbon systems, have found positive health

benefits from reducing air pollutants including NO_x, SO_2 and $PM_{2.5}$. These benefits include reduction in adult and infant ailments and asthma related illnesses (Great Plains Institute 2023).

Construction and operation of the Project would result in the potential for health and safety impacts to workers at the Project site, workers at the DFS, and members of the public. Occupational hazards related to Project construction and operation entail those commonly encountered on construction or industrial sites, including eye hazards, repetitive motion, working in awkward positions, exposure to paints, solvents, or other chemicals, heat stress, exposure to ultraviolet radiation, use of hand tools, power tools, and heavy equipment, vibration hazards from tools and equipment, slip, trip and fall hazards, ambient noise, odor and heat, and excavation hazards. Construction and operation activities for the Project would be conducted in accordance with applicable health and safety regulations and guidelines, including applicable OSHA regulations.

Operations of the Project could involve the use of hazardous materials (if amine-based CO_2 capture is selected) including amine-based solvent and sodium hydroxide (NaOH, caustic). Amine-based solvent would be used as a process fluid to capture the CO_2 from the power plant flue gas. This would involve the transport and onsite storage of fresh (unused) and spent (used) solvent in above-ground storage tanks. While amine itself is not considered to be particularly dangerous, the unintentional emissions of amines into the atmosphere can lead to a variety of environmental side effects including the formation of aerosol particles that can present a risk to human health. Additionally, the waste from spent amine solvent is considered hazardous. Transport, storage, and handling of fresh and spent amine solvent would be conducted in accordance with solvent handling guidance developed by BEPC.

The transportation of hazardous materials including CO_2 is regulated by the Department of Transportation's PHMSA pursuant to the Hazardous Liquid Pipeline Safety Act of 1979 (HLPSA). Therefore, 49 CFR 195 (Transportation of Hazardous Liquids by Pipeline) would control construction and operation of the pipeline. Wyoming has accepted responsibility for enforcement of HLPSA requirements and has obtained Certification pursuant to Section 60105(a). In addition to HLPSA requirements, Wyoming's Department of Transportation mandates specific casing and siting requirements for hazardous liquid pipelines facilities within the state highway system ROW.

CO_2 would be transported to five injection sites and injected several thousand feet below ground, which requires an UIC Carbon Sequestration Class VI Permit issued by the WDEQ's Water Quality Division (who has been delegated primacy for administering the Class VI UIC program in Wyoming by the US EPA). Class VI wells are subject to extensive site characterization requirements to ensure appropriate siting, construction, and operation of the wells. These requirements are designed to protect underground sources of drinking water and to minimize the risks associated with CO_2 leakage or release. Compliance with Class VI permit requirements including scheduled monitoring and testing of the wells would minimize potential public health and safety risks associated with underground CO_2 injection and long-term storage, minimizing potential impacts to human health and safety as a result of Project implementation.

3.11 Solid and Hazardous Waste

3.11.1 Affected Environment

Portions of the Project are located within the existing DFS and other lands owned and operated by BEPC, with the pipeline alignment located within other private or publicly owned lands within the PRB. Sources of hazardous and solid wastes within the PRB include spilled, leaked, or dumped hazardous substances, petroleum products, and solid waste associated with oil and gas exploration, oil and gas development, BNSF rail lines, utility installation and maintenance, or agricultural activities. The DFS generates solid and hazardous wastes from its existing operations, including coal combustion solids, spent solvents, waste oil, flue gas, municipal solid waste, and other solid and hazardous wastes associated with coal combustion and electric generation process. All wastes produced by operations at DFS are managed in accordance with BEPC's Waste Disposal Program and in accordance with applicable state and local standards for waste management. Municipal solid waste from DFS is transported off-site to local municipal solid waste landfills for disposal. Waste oil, spent solvents, and other solid and hazardous wastes are transported off site for disposal to licensed treatment and disposal facilities. Currently, DFS utilizes the Campbell County Landfill outside of Gillette, located along SR 59.

3.11.2 Proposed Action Impact

Construction

Construction of the Project would generate solid wastes including construction and demolition debris from site clearing and grading, pipeline corridor and foundation excavation, and Project construction. Waste oils, spent solvents, and other solid waste would be produced during construction activities. Solid and hazardous wastes generated from construction activities would be managed by BEPC and the construction contractor and would be transported offsite for disposal at licensed facilities following state and local guidelines. Construction debris and solid waste generated during construction would be transported to the local landfill. Drilling mud produced by construction of the injection wells would be handled using a closed-loop system in which drilling mud would be contained, stored, and disposed of following BEPC DFS solid and hazardous waste management procedures.

The MTR or amine carbon capture plant would be constructed adjacent to the existing BEPC DFS and would require the use of construction liquids and solvents including paints, concrete, petroleum and other fuels, amine solvent, glues, and other industrial materials.

Construction of the Project would have the potential to generate hazardous wastes through spills or leaks of vehicle fuels and carbon capture facility construction solvents. Any on-site spills would be addressed following guidance outlined in the site-specific SWPPP and utilizing on-site spill kits. Hazardous materials spills during construction would be reported following state and local guidelines. All solid wastes produced during Project construction would be disposed of following BEPC DFS solid and hazardous waste management procedures, minimizing impacts resulting from solid and hazardous waste produced by Project construction.

Operation and Maintenance

O&M of the Project would generate solid and hazardous wastes. The BEPC DFS would continue to operate following BEPC solid and hazardous waste disposal guidelines. With construction of the

Project, DFS operations would release less flue gas into the atmosphere instead redirecting the flue gas and other carbon combustion gases into the newly constructed carbon capture plant for processing. During the carbon capture process, CO_2 is separated from other gases including O_2, N_2, and SO_2. The CO_2 would be directed through the Project pipeline components to each of the five injection sites and pumped into subsurface pore space to be sequestered. The other gases would continue to be released into the atmosphere in accordance with existing permits and state regulations and/or thresholds.

Operation of the Project would involve the use of activated carbon to remove surface-active contaminants and dissolved or emulsified high molecular organic compounds. Spent activated carbon would be stored on site and disposed of following BEPC's DFS solid and hazardous waste management procedures. Spent activated carbon would be reused at DFS for combustion and electricity generation.

The US EPA has conditionally excluded CO_2 streams from hazardous waste management provisions under Resource Conservation and Recovery Act (RCRA), provided that the CO_2 is captured from emission sources (e.g., flue gas) and injected into UIC Class VI wells (79 CFR 350-364). Project injection wells and injection sites would be permitted as Class VI wells and all Project-related CO_2 injection activity would be covered by this conditional exclusion. The CO_2 stream would be monitored for impurities that might render the injectate a hazardous waste, per anticipated conditions of the UIC permits. Additional solid and hazardous waste generation produced by the carbon capture plant would be dependent on which carbon capture technology is selected for the Project. Anticipated waste generation for each technology is described in the following subsections.

MTR Carbon Capture Plant

The Project MTR Carbon Capture Plant component would utilize several rounds of cooling and filtration of the captured flue gas to isolate CO_2 for subsequent transport and injection into subsurface pore space. The process would produce wastewaters concentrated with ash from DFS. The ash and other particulates would be filtered out of the wastewaters and the wastewaters returned to the approximately 12-acre retention pond. Filtered wastewaters would be reused for the carbon capture process, reducing MTR carbon capture plant water supply requirements. Lube oil, filters, and spent membranes utilized for the carbon capture process would require periodic replacement following manufacturer guidelines. Spent membrane technology would be returned to the manufacturer upon replacement for proper disposal. No additional hazardous substances would be produced from O&M of the MTR Carbon Capture Plant.

Amine Carbon Capture Plant

The Project Amine Carbon Capture Plant component would require the use of amine solvent and other process materials for the CO_2 capture process. The use of amine solvent and other process materials would result in the generation of solid and hazardous waste during operation of the carbon capture plant, where amine solvent would be delivered to the Project site prior to commencement of operation. Throughout the anticipated 30 years of operation, additional amine solvent would be required to continue operations at the carbon capture plant. Spent solvent would be collected and stored in an aboveground storage tank (AST) on site during Project operations. Removal and disposal of the spent solvent would follow BEPC hazardous waste disposal procedures and be conducted by a vendor to a licensed hazardous waste disposal facility.

It is anticipated that the Project would be categorized as a RCRA hazardous waste large-quantity generator based on the types and quantities of hazardous wastes anticipated to be generated by Project operations. It is anticipated that the Project would obtain a separate RCRA hazardous waste generator number from the WDEQ's Solid & Hazardous Waste Division and would not operate under BEPC's DFS hazardous waste generator number. RCRA large-quantity generators are required to remove hazardous waste from the site within 90 days for the date of waste generation. It is anticipated that the Project would qualify as an episodic event under RCRA regulation 40 CFR 262 subpart L and may be categorized as a small quantity generator rather than a large-quantity generator by the WDEQ.

As part of the carbon capture process, filter cartridges would be used in the mechanical filter process to remove particulate matter from the amine solvent. The frequency of replacement of filter cartridges would be minimized through the design and size of the carbon capture plant filter, with an estimated life of six months per filter cartridge. Off-site transport and disposal of the spent filter cartridges would be conducted by a vendor, to a licensed off-site hazardous waste treatment and disposal facility.

Off-site disposal locations and vendors for off-site transport of solid and hazardous waste would be used following ongoing procedures used at BEPC's DFS in accordance with BEPC solid and hazardous waste disposal procedures. Solid and hazardous wastes produced during O&M of the Project would not exceed current or anticipated capacities at both the local landfill and licensed hazardous waste disposal facilities. Production of solid and hazardous waste during O&M would be comparable to solid and hazardous waste production at the existing DFS and would not significantly increase volumes of waste materials.

3.12 Resource Areas Dismissed from Further Review

3.12.1 Infrastructure and Utilities

The Project is located adjacent to, and within, the existing BEPC DFS. DFS and the proximate Dry Fork Mine is rated at 405 MW of electricity (BEPC 2023). The Project would be constructed to address GHG emissions from the DFS as part of the current electric generation process and a new pipeline would be constructed within an established BEPC ROW. No impacts to existing or future infrastructure and utilities within the Project area would be anticipated.

3.12.2 Transportation

The Project is located north of Gillette, Wyoming, and outside of the WYDOT State Significant Corridor System (WYDOT 2010). No scenic byways or heavily trafficked tourist destinations are located in proximity to the Project which would increase vehicle use of SR 59 and HWY 14/16. Construction of the Project would not impact traffic flow or access to emergency services due to lane or road closures. As the Project would not impact traffic conditions, no impact to transportation or traffic patterns within the Project area would occur.

3.12.3 Noise

The Project pipeline alignment is located approximately 0.3 miles northeast from the nearest sensitive receptor, Rawhide Elementary School. Construction of the Project would be constrained to the eastern side of HWY 14/16 and the northern side of SR 59. Construction would not impact

commuters and would not permanently impact operations at Rawhide Elementary School. No other sensitive receptors are located within 1 mile of the Project. O&M would require intermittent construction to maintain pipeline integrity but would not significantly increase noise levels over the sound of daily vehicle traffic on HWY 14/16. Therefore, no impact to the community as a result of Project noise would be anticipated to occur.

3.12.4 Visual Resources

The Project is located within the PRB in an area characterized by ongoing mining activities. The Project pipeline alignment would be constructed subsurface and would not be visible upon completion of construction. The carbon capture plant would be located within the existing BEPC DFS and would remain consistent with the character of the existing viewshed. Injection well locations would generally be located away from public view, apart from PRB-3 and PRB-4. PRB-3 and PRB-4 would be located adjacent to HWY 14/16 proximate to pre-existing utility infrastructure. As the Project would remain in character with the existing viewshed, no impact to visual resources would occur.

3.13 Irreversible and Irretrievable Commitment of Resources

Section 102(2)(C) of NEPA and Section 1502.16 of the CEQ regulations for implementing NEPA require that the discussion of environmental consequences include a description of irreversible and irretrievable commitment of resources because of implementation of the Project.

Construction of the Project pipeline component would have potentially irretrievable and potentially irreversible effects on vegetation, wildlife, aquatic resources, and mapped cultural resources. Construction of injection sites and the CO_2 capture facility would potentially affect these resources as well as mineral and geologic resources. O&M of the Project would require injection of CO_2 into subsurface pore space. As discussed in Section 3.4.1, CO_2 injection wells cannot damage or have a deleterious effect on mineral rights. The injected CO_2 would eventually solidify over thousands of years, causing an irreversible effect on pore space availability.

3.14 Unavoidable Adverse Impacts

Section 1021 of NEPA mandates disclosure of any adverse or environmental effects which cannot be avoided should the Project be implemented. These are impacts for which there are no mitigation measures or impacts that would remain, even after mitigation measures are implemented. Implementing this Project would result in unavoidable adverse impacts to some natural resources. These impacts are described in detail in prior sections and summarized in this section.

Construction and O&M of the Project would result in unavoidable and adverse impacts including, soil compaction and erosion, temporary loss of vegetated cover, impacts to floodplains and aquatic resources, reduction of available subsurface pore space, disturbance to and potential displacement of wildlife, and potential loss of cultural or paleontological resources.

3.15 Cumulative Impacts

As defined by the CEQ, cumulative effects are "effects on the environment that result from the incremental effects of the [Proposed] Action when added to the effects of other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or [individual] person undertakes such other actions" [40 CFR 1508.1(g)]. Cumulative effects analysis

identifies and captures the effects that result from the Proposed Action in combination with the effects of other actions taken during the duration of the Proposed Action at the same time and place. Cumulative effects may be accrued over time and/or in conjunction with other pre-existing effects from other activities in the area (40 CFR 1508.25); therefore, pre-existing impacts and multiple smaller impacts should also be considered. Overall, assessing cumulative effects involves defining the scope of the other actions and their interrelationship with the Proposed Action to determine if they overlap in space and time.

3.15.1 Proposed Action

The NEPA and CEQ regulations require the analysis of cumulative environmental effects of a Proposed Action on resources that may often manifest only at the cumulative level. Cumulative effects can result from individually minor, but collectively significant actions taking place at the same time, over time. As noted above, cumulative effects are most likely to arise when a Proposed Action is related to other actions that could occur in the same location and at a similar time. Following this assumption, Table 3.15-1 Cumulative Activities within 5 miles of the Project identifies additional projects and construction activities occurring within 5 miles of the Proposed Action which would contribute to cumulative impacts on natural resources.

Table 3.15-1. Cumulative Activities within 5 miles of the Project

Project Name	Project Summary/Description of Activities	Location	Project Managing Agency or Private Company	Nearest Project Component	Distance from Project (miles)	Current Project Stage	Anticipated Project Completion
Kawasaki Heavy Industries (KHI) CO_2 Capture Demonstration	Demonstration of the KHI CO_2 capture technology at the 0.5 MW scale.	Integrated Test Center located at DFS	KHI, Wyoming Infrastructure Authority	CO_2 carbon capture facility	0	Under Construction	2024
MTR Co_2 Capture Demonstration	Demonstration of MTR system ability to capture 90 percent of the CO_2 from a 10 MW equivalent flue gas stream.	Integrated Test Center located at DFS	MTR, Wyoming Infrastructure Authority	CO_2 carbon capture facility	0	Under Construction	2024
MTR Full Scale Front End Engineering and Design (FEED) Study	Study conducted by MTR of CO_2 capture from the full output of DFS (405 MW) at 70 percent capture. Dependent upon the outcome of a DOE FOA, MTR may amend the study assuming 90 percent CO_2 capture.	DFS	MTR and Sargent & Lundy	CO_2 carbon capture facility	0	Feed study for 70 percent capture completed summer 2022. Amended study for 90 percent capture not yet started	2024
Denbury Storage	Development of a CO_2 storage site by Denbury Resources	North and Northwest of DFS	Denbury Resources	Pipeline alignment	0	Planning	--

3.15.2 Greenhouse Gases and Climate Change

Climate change is an inherently cumulative effect caused by releases of greenhouse gases from human activities and natural processes around the world. GHGs are chemical compounds in the atmosphere which absorb and emit radiation, trapping heat (longwave radiation) and causing what is known as the greenhouse effect. The greenhouse effect causes the Earth's atmosphere to warm and thereby create changes in the planet's climate systems. The primary GHGs in the Earth's atmosphere are H_2O, CO_2, CH_4, N_2O, and O_3. GHGs are often quantified and analyzed using the common unit of CO_2-equivalents (CO_2-eq), which is based on the global warming potential of each greenhouse gas. CO_2-eq signifies the functionally equivalent amount or concentration of CO_2 that would have the equivalent global warming impact.

GHG emissions would result from construction of the Project. Direct GHG emissions including CO_2, CH_4, and N_2O would result from diesel fuel and gasoline consumption for operation of construction equipment and vehicles. Indirect GHG emissions would result from electricity consumption for the carbon capture plant and pipeline construction.

During operations, the carbon capture plant and pipeline operation would result in indirect GHG emissions including CO_2, CH_4, and N_2O from electricity consumption and fuel combustion utilizing sub-bituminous coal obtained from DFM. Electricity required for the CCS process would be produced by BEPC's existing DFS.

The carbon capture plant is designed to capture GHG emissions from DFS and isolate CO_2. Once isolated, the CO_2 would be transferred through the newly constructed pipeline, injected into the subsurface pore space, and sequestered indefinitely thereby reducing overall CO_2 emissions from the DFS. All other GHGs captured by the carbon capture plant would subsequently be reintroduced into the DFS and emitted into the atmosphere. In total, the Project would result in an overall decrease in GHG emissions into the atmosphere at DFS as further quantified in the following Social Cost of Carbon subsection.

As climate change is considered a cumulative global phenomenon, it is generally accepted that any successful strategy to address climate change must rest on a global approach to controlling GHG emissions. As discussed in Chapters 1 and 2 of this EA, the purpose and need of the Project is an overall reduction of CO_2 emissions and mid-scale testing of CCS process and infrastructure to continue to reduce GHG emissions.

Social Cost of Carbon

The social cost of GHGs (SC-GHG) are monetized estimates of the damages associated with incremental increases in GHG each year. It includes the estimated value of all climate change impacts, including but not limited to, public health effects, changes in net agricultural productivity, property damage from increased flood risk, natural disasters, disruption of energy systems, risk of conflict, environmental migration, and the value of ecosystem services. (Interagency Working Group on the Social Cost of Greenhouse Gases [IWG] 2021). Put simply, the SC-GHG is a monetary estimate calculated by each ton of GHG that is released into the atmosphere. Without significant global mitigation efforts, these essential resources will be disrupted and cause considerable damage to infrastructure, property, labor productivity, and vitality of our

communities. By using the SC-GHG as a cost-benefit analysis tool, it allows federal agencies to take an unbiased approach to account for the costs of GHGs when performing these analyses.

For federal agencies, the best currently available estimates of the SC-GHG are the interim estimates of the social cost of CO_2, CH_4, and N_2O developed by the IWG in accordance with EO 13990 on the SC-GHG. Select estimates are published in the IWG's technical support document (IWG 2021) and the complete set of annual estimates are available on the Office of Management and Budget's website. The IWG's SC-GHG estimates are based on complex models describing how GHG emissions affect global temperatures, sea level rise, and other biophysical processes; how these changes affect society through, for example, agricultural, health, or other effects; and monetary estimates of the market and nonmarket values of these effects. One key parameter in the models is the discount rate, which is used to estimate the present value of the stream of future damages associated with emissions in a particular year. A higher discount rate assumes that future benefits or costs are more heavily discounted than benefits or costs occurring in the present (that is, future benefits or costs are a less significant factor in present-day decisions). The current set of interim estimates of SC-GHG have been developed using three different annual discount rates: 5 percent, 3 percent, and 2.5 percent (IWG 2021).

The commercial-scale MTR CO_2 carbon capture system is designed to capture 5,855 tons of CO_2 per day. Assuming a 90 percent annual capacity factor, this equates to approximately 1.923 MMT of CO_2 captured per year. As such, over a 30-year operational period, the Project is ultimately expected to result in the storage of approximately 57.5 MMT of CO_2 that would otherwise be emitted from DFS, which is approximately equivalent to the amount of CO_2 that would be emitted by 418,000 passenger vehicles over the same operational period. Relative to the average annual CO_2 emissions baseline as reported in the prefeasibility study (Moore 2017), this represents a reduction in annual CO_2 emissions of approximately 60 percent. Using this information and the IWG's current draft guidance, the expected social benefits can be calculated for the duration of the Project. Using a 5 percent, 3 percent, and 2.5 percent average discount rate, the Project is expected to result in a cost benefit of $0.667 billion, $2.58 billion, and $3.91 billion, respectively (Appendix F – Social Cost of Carbon Calculations). This estimation uses the expected costs of carbon per ton and how that is expected to change over the course of the 30-year operational period of the Project. Using the 95th percentile with a 3 percent discount rate, the total social benefit of GHGs from the Project is expected to be $7.85 billion (in 2020 dollars). The 95th percentile refers to the amount of simulations where the cost of carbon per ton exceeds 95 percent of all other simulations. . This outcome is in line with federal goals of achieving a net-zero emissions economy by 2050.

4.0 CONSULTATION AND COORDINATION

4.1 Public Involvement, Agency Coordination, and Tribal Consultation

DOE coordinated with the following agencies, tribes, and nongovernmental agencies through agency consultation letters and/or notification of the availability of the EA.

- Federal, state, and local government agencies:
  - Bureau of Land Management (BLM) – EA Cooperating Agency
  - US Army Corps of Engineers (USACE) – CWA Permitting Strategy
  - United States Department of Fish and Wildlife (USFWS) – Section 7 Consultation
  - Wyoming State Historic Preservation Office (WYSHPO) – Section 106 Consultation
  - Wyoming Department of Environmental Quality (WDEQ) – UIC Class VI Permitting
- Tribal Governments:
  - Apache Tribe of Oklahoma
  - Cheyenne River Sioux Tribe of the Cheyenne River Reservation, South Dakota
  - Cheyenne and Arapaho Tribes, Oklahoma
  - Crow Creek Sioux Tribe of the Crow Creek Reservation, South Dakota
  - Crow Tribe of Montana
  - Eastern Shoshone Tribe
  - Fort Belknap Indian Community of the Fort Belknap Reservation of Montana
  - Lower Brule Sioux Tribe of the Lower Brule Reservation, South Dakota
  - Northern Arapaho Tribe
  - Oglala Sioux Tribe
  - Rosebud Sioux Tribe of the Rosebud Indian Reservation, South Dakota
  - Santee Sioux Nation, Nebraska
  - Standing Rock Sioux Tribe of North & South Dakota
  - Three Affiliated Tribes of the Fort Berthold Reservation, North Dakota
- Nongovernmental Organizations
  - Basin Electric Power Cooperative (BEPC)
  - University of Wyoming (UW)
  - Membrane Technology and Research, Inc. (MTR)

4.2 List of Preparers

4.2.1 United States Department of Energy

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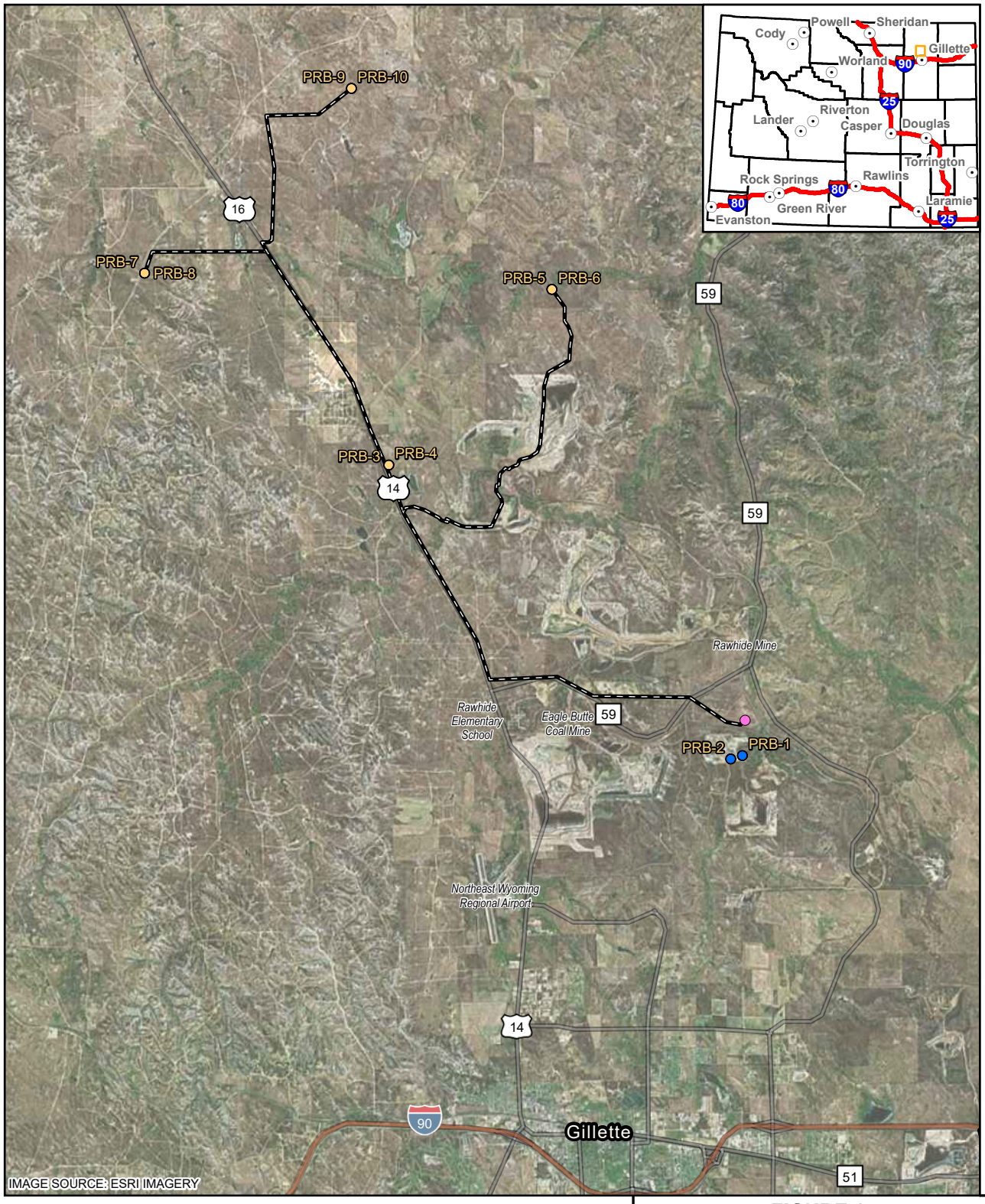
FIGURES



EXPLANATION

- INJECTION POINT
- PRE-EXISTING INJECTION POINT
- DRY FORK STATION AND CCS SITE
- PIPELINE
- PROJECT LOCATION

N

0 12,500'

FIGURE 1

VICINITY MAP

ENVIRONMENTAL ASSESSMENT
WYOMING CARBONSAFE
GILLETTE, WY

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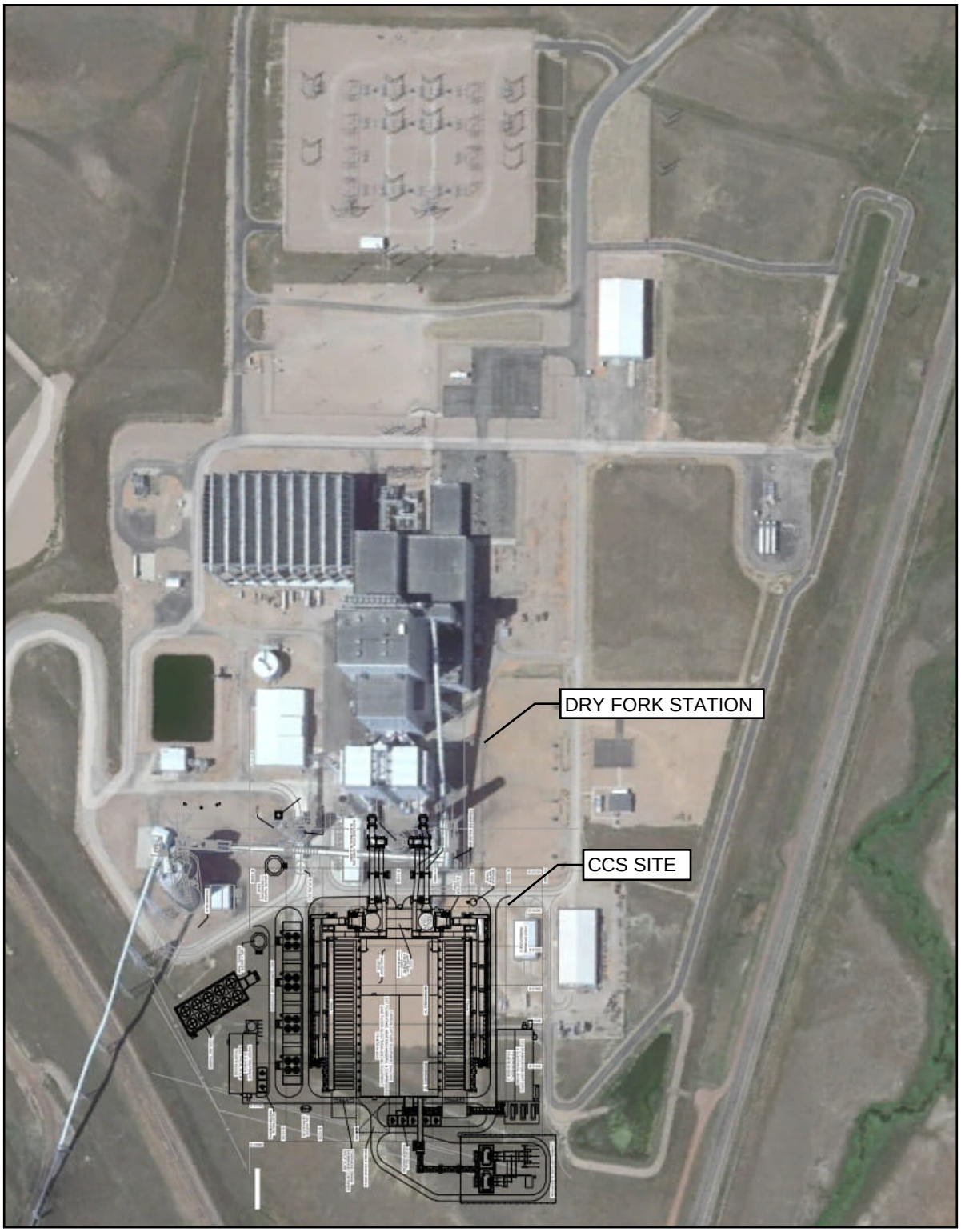


Source: MTR 2022. Dry Fork Station Unit 1: Full Scale Carbon Capture FEED Study

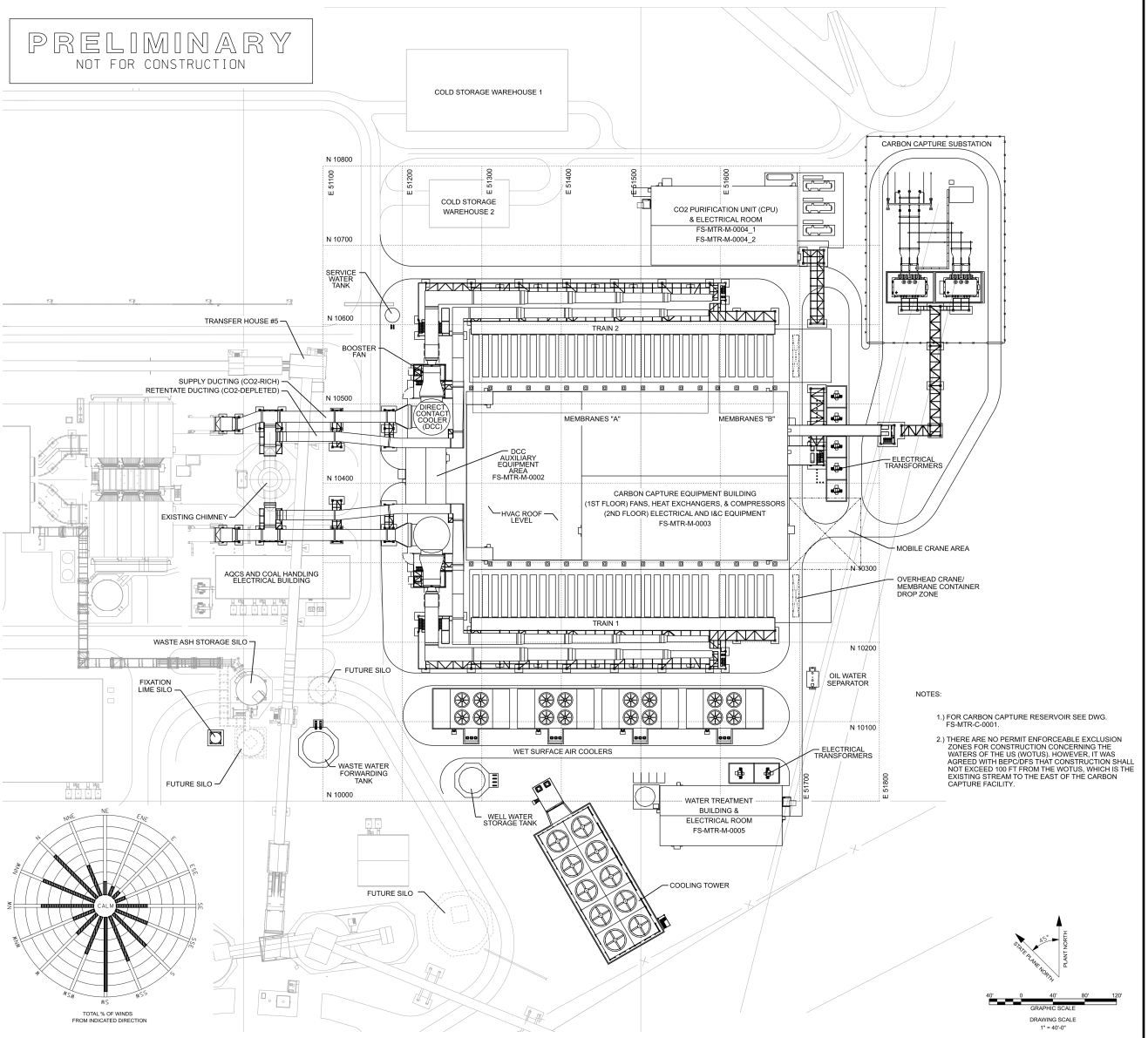
N

0 500'

FIGURE 2

DRY FORK STATION AND CCS SITE

ENVIRONMENTAL ASSESSMENT WYOMING CARBONSAFE GILLETTE, WY

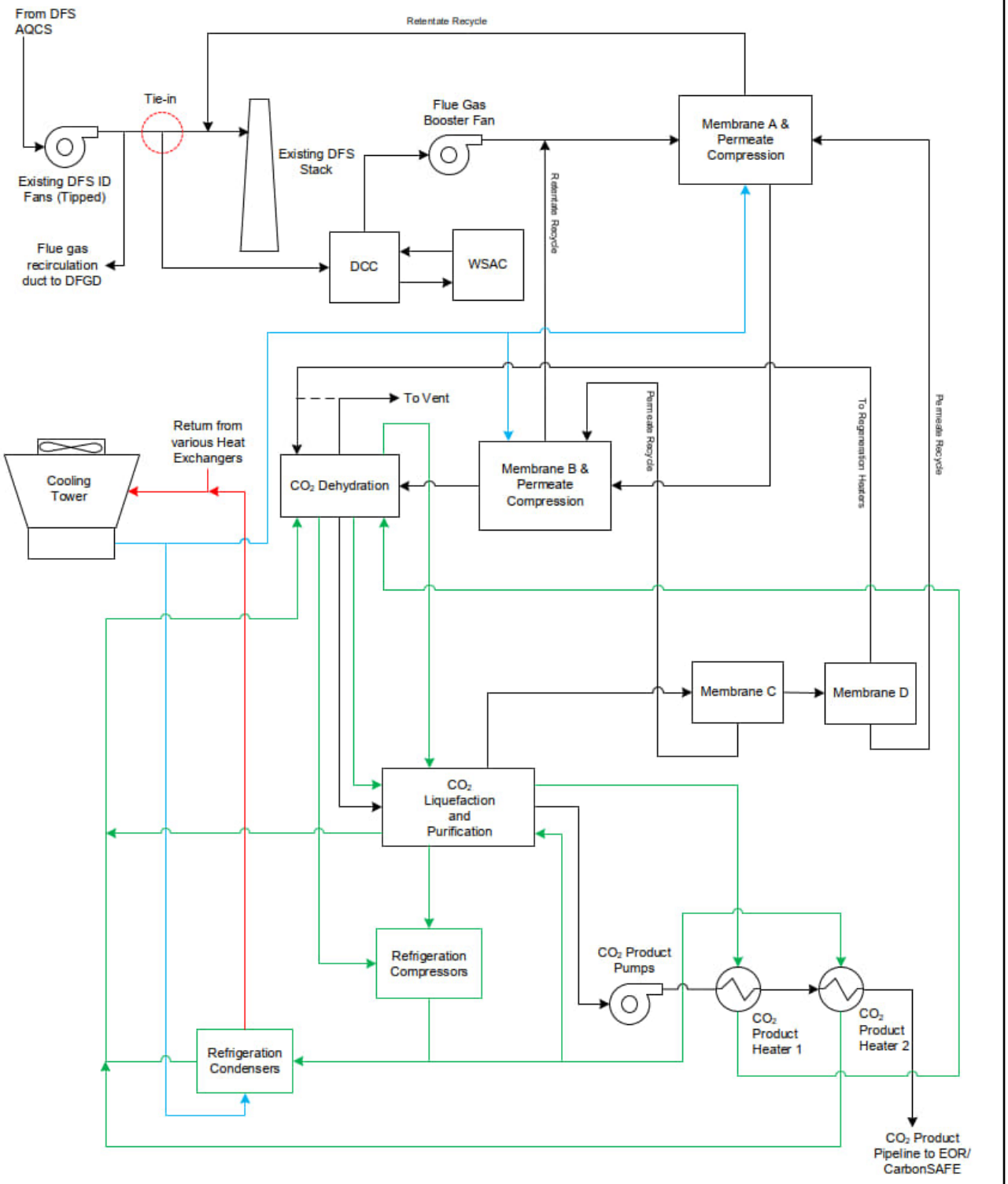


Source: MTR 2022. Dry Fork Station Unit 1: Full Scale Carbon Capture FEED Study

FIGURE 3

CCS SITE PLAN

ENVIRONMENTAL ASSESSMENT
WYOMING CARBONSAFE
GILLETTE, WY



Source: MTR 2022. Dry Fork Station Unit 1: Full Scale Carbon Capture FEED Study

FIGURE 4

CCS FLOW DIAGRAM

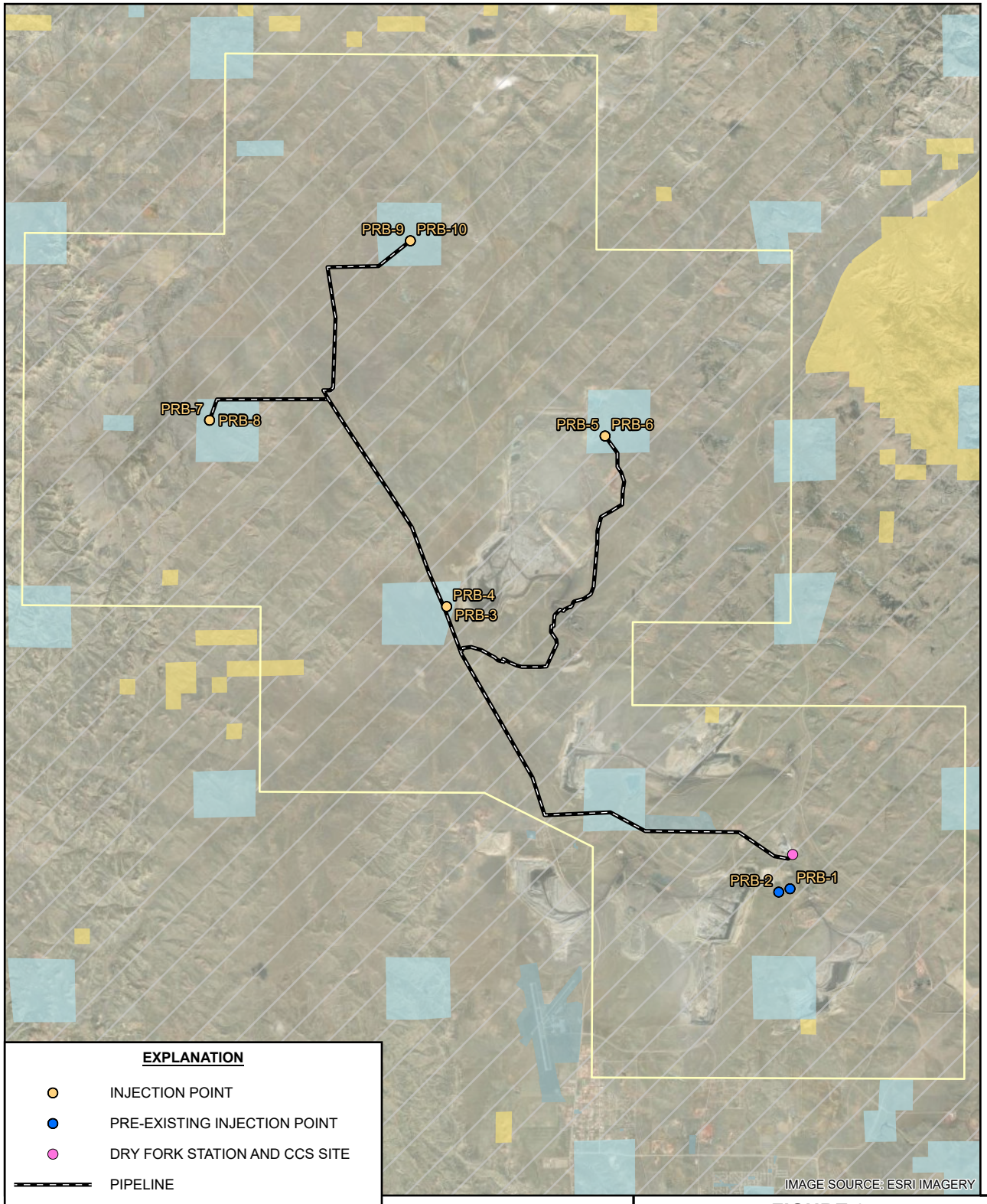
ENVIRONMENTAL ASSESSMENT WYOMING CARBONSAFE GILLETTE, WY

Source: Trihydro Corporation 2023. PRB Well 1 at DFS.

FIGURE 5

CCS INJECTION WELL

**ENVIRONMENTAL ASSESSMENT
WYOMING CARBONSAFE
GILLETTE, WY**



EXPLANATION

- INJECTION POINT
- PRE-EXISTING INJECTION POINT
- DRY FORK STATION AND CCS SITE
- PIPELINE
- AREA OF REVIEW

LAND OWNERSHIP - SURFACE MANAGEMENT AGENCY

- BUREAU OF LAND MANAGEMENT
- LOCAL GOVERNMENT
- STATE
- PRIVATE

N

0 12,500'

FIGURE 6

LAND USE AND OWNERSHIP

**ENVIRONMENTAL ASSESSMENT
WYOMING CARBONSAFE
GILLETTE, WY**

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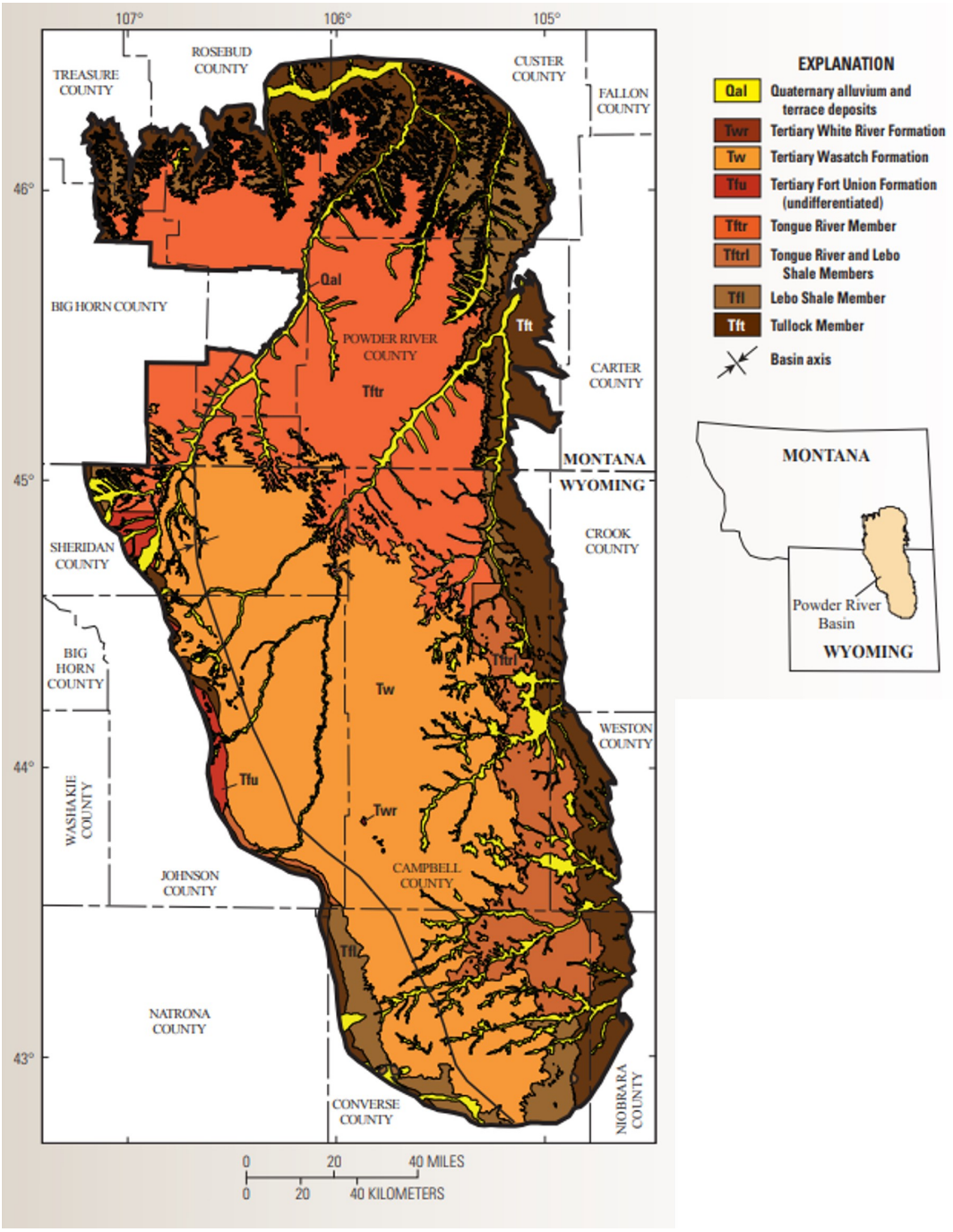
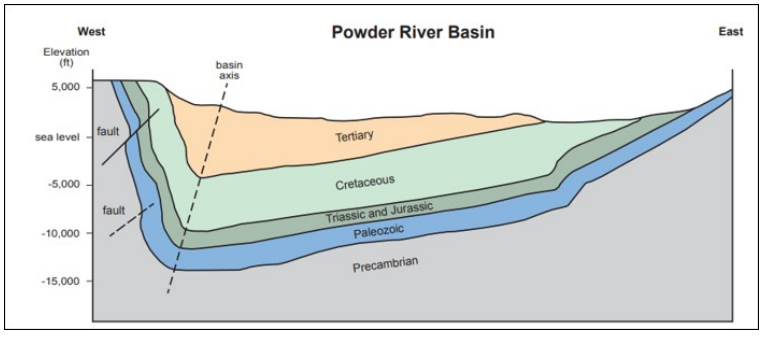


Source: USGS 2013. Generalized bedrock geology of the Powder River Basin, Wyoming and Montana.

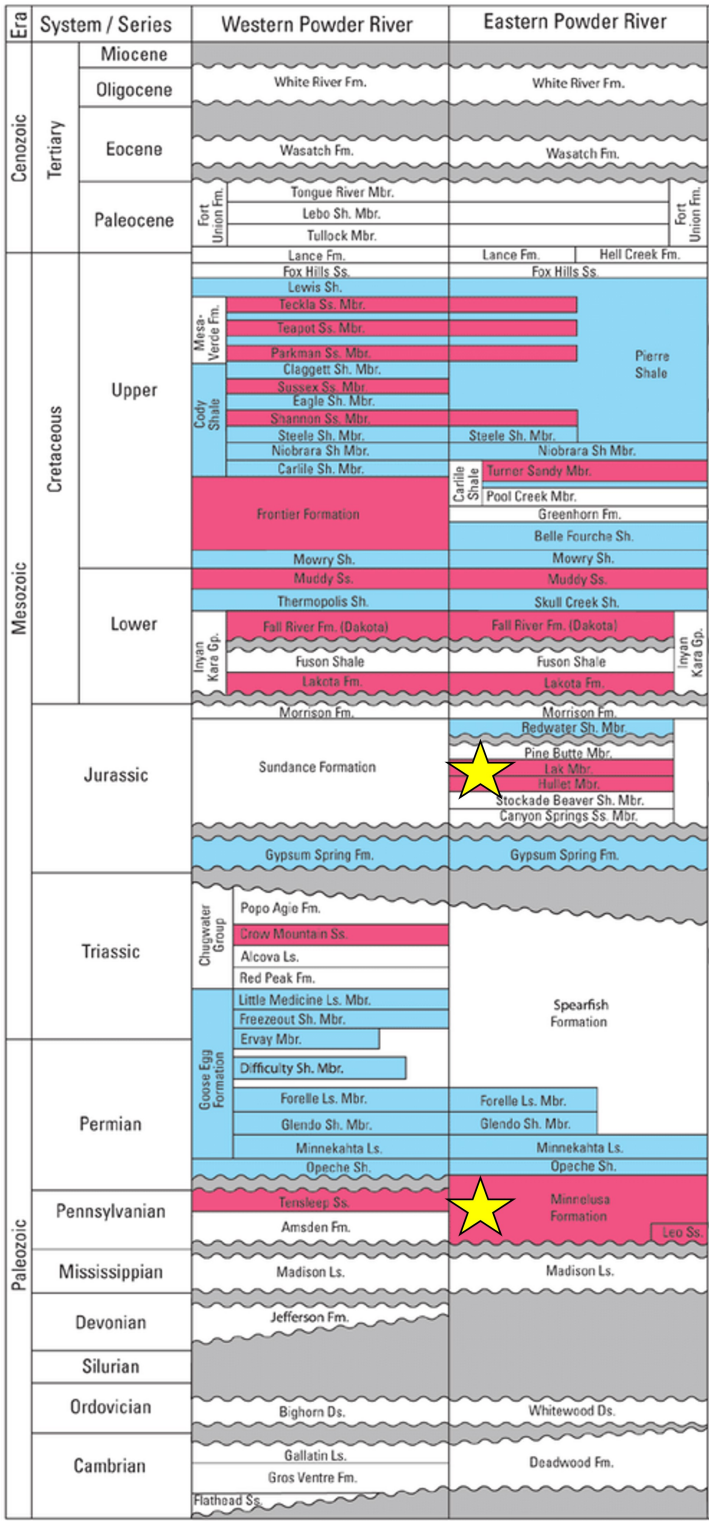


Source: Anna 2010. Powder River Basin generalized cross-section

FIGURE 7

POWDER RIVER BASIN GEOLOGY

ENVIRONMENTAL ASSESSMENT WYOMING CARBONSAFE GILLETTE, WY

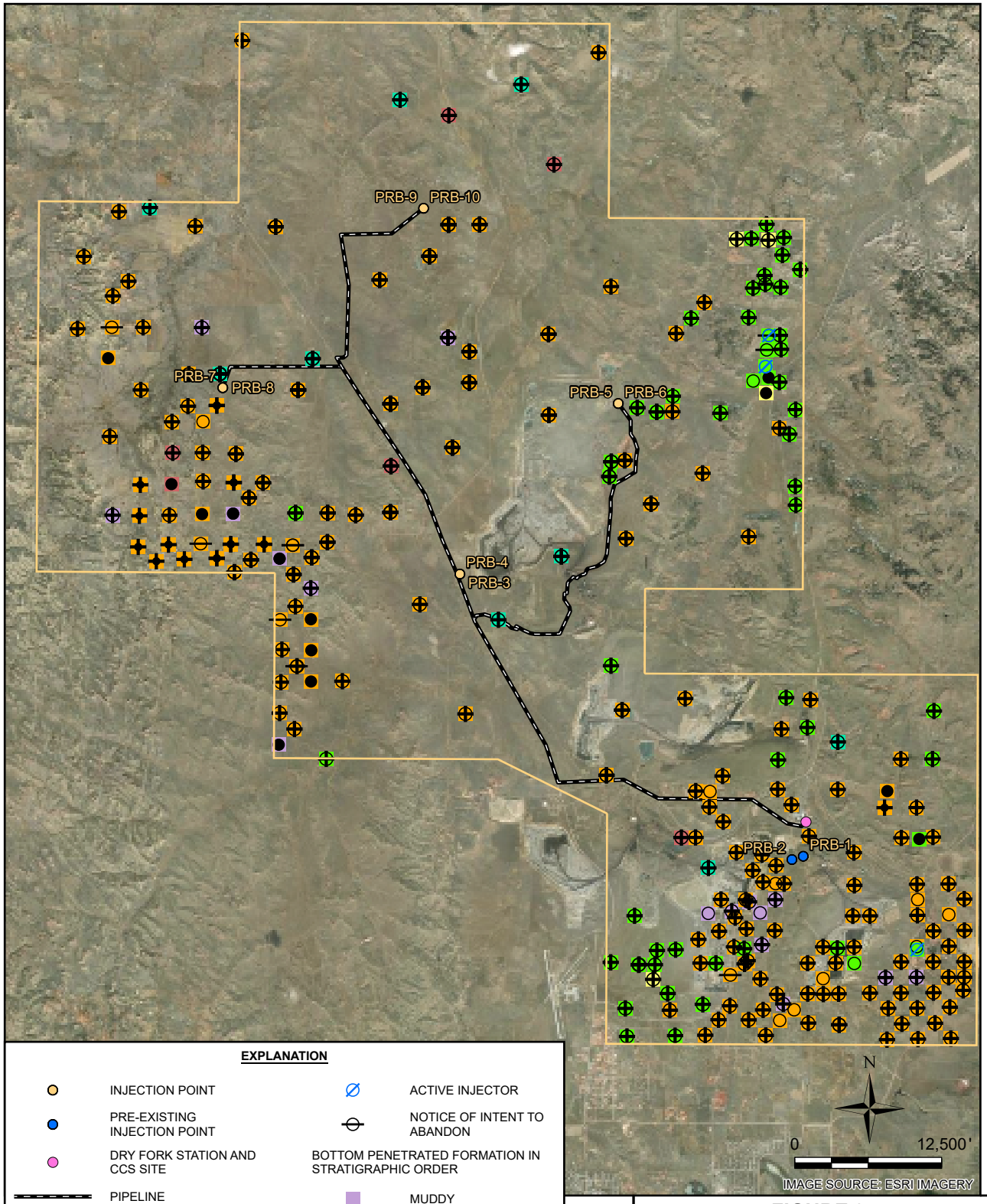


Source: Craddock, et al., 2012. Stratigraphic section of the geology in the Powder River Basin. Sealing units are blue, reservoir units are red. Stars indicate targets for CO_2 sequestration. Ss., sandstone; Sh. Shale; Ls., Limestone; Dol., Dolomite; Gp., Group; Fm., Formation; Mbr., Member.

FIGURE 8

POWDER RIVER BASIN STRATIGRAPHY

ENVIRONMENTAL ASSESSMENT WYOMING CARBONSAFE GILLETTE, WY



EXPLANATION

- INJECTION POINT
- PRE-EXISTING INJECTION POINT
- DRY FORK STATION AND CCS SITE
- PIPELINE
- AREA OF REVIEW

WELL STATUS

- PERMANENTLY ABANDONED
- PRODUCING OIL WELL
- SHUT-IN
- SUBSEQUENT REPORT OF ABANDONMENT
- ACTIVE INJECTOR
- NOTICE OF INTENT TO ABANDON

BOTTOM PENETRATED FORMATION IN STRATIGRAPHIC ORDER

- MUDDY
- SKULL CREEK
- DAKOTA/LAKOTA
- MORRISON
- MINNELUSA
- MADISON

FIGURE 9

EXISTING DEEP WELL MAP

ENVIRONMENTAL ASSESSMENT
WYOMING CARBONSAFE
GILLETTE, WY

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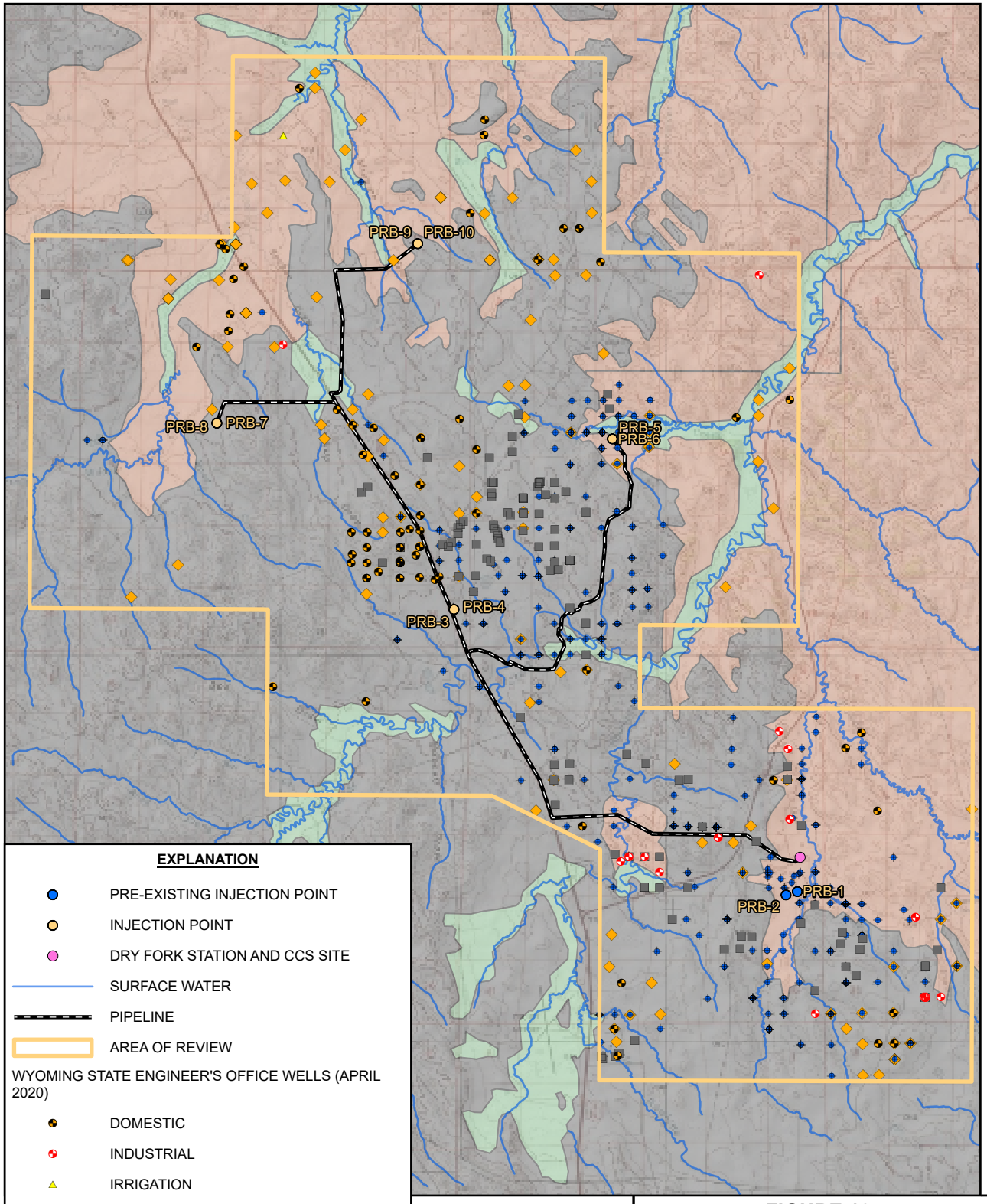

FIGURE 10

AQUIFER UNITS
IN PROXIMITY TO THE PROJECT

ENVIRONMENTAL ASSESSMENT
WYOMING CARBONSAFE
GILLETTE, WY

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APPENDIX A
Previous NEPA Actions

NETL F 451.1-1/1
Revised: 11/24/2014
Reviewed: 11/24/2014
(Previous Editions Obsolete)

U.S. DEPARTMENT OF ENERGY - NETL

CATEGORICAL EXCLUSION (CX) DESIGNATION FORM

Project No.: DE-FE0029375 Recipient Name: University of Wyoming Project Location: Laramie, WY

Sub-recipient(s) and Locations:

Energy and Environmental Research Center - Grand Forks, ND; Advanced Resources International - Arlington, VA; Schlumberger Carbon Services - Denver, CO

NETL Sponsoring Org.: FE/TDIC/Coal/Carbon Storage Team NETL Contact: Erik Albenze

Brief Title of Proposed Action: Integrated Commercial CCS Prefeasibility Study at Dry Fork Station

Brief Description of Activities:

Planned activities include literature review, computer modeling and simulation, data analysis, report writing, presentation of results, outreach, and establishment of partnerships/collaborations.

THE PROPOSED ACTION FALLS WITHIN THE FOLLOWING CATEGORICAL EXCLUSION(S) FROM APPENDICES A AND B TO SUBPART D OF DOE NEPA IMPLEMENTING PROCEDURES (10 CFR 1021):

General Administration/Management
- ☐ A1 – Routine business actions
- ☒ A9 – Info gathering, analysis, documentation, dissemination, and training
- ☒ A11 – Technical advice and planning assistance

Facility Operations
- ☐ B1.3 – Routine maintenance and custodial services
- ☐ B1.7 – Communication system and data processing equipment acquisition, installation, operation, removal
- ☐ B1.15 – Support building or structure, non-waste storage, construction/ operation

Safety and Health
- ☐ B2.1 – Modifications to enhance workplace habitability
- ☐ B2.2 – Installation/improvement of building/equipment instrumentation
- ☐ B2.3 – Installation of equipment for personnel safety and health

General Research
- ☒ B3.1 – Site characterization/environmental monitoring
- ☐ B3.6 – R&D or pilot facility construction/operation/decommissioning
- ☐ B3.7 – New infill exploratory, experimental oil/gas/geothermal well construction and/or operation
- ☐ B3.9 – Certain CCT demonstration activities, emissions unchanged
- ☐ B3.11 – Outdoor tests, experiments on materials and equipment components

Electrical Power and Transmission
- ☐ B4.4 – Power management activities (storage, load shaping, and balancing)
- ☐ B4.6 – Transmission support addition/modifications at developed facility site
- ☐ B4.11 – Construction of power substations and interconnection facilities
- ☐ B4.13 – Upgrading and rebuilding existing power lines (< 20 miles)

Conservation, Fossil, and Renewable Energy Activities
- ☐ B5.1 – Actions to conserve energy, no indoor air quality degradation
- ☐ B5.3 – Modification/abandonment of wells
- ☐ B5.5 – Short crude oil/gas/steam/geothermal/carbon dioxide pipeline const/oper within an existing right-of-way (< 20 miles) between existing facilities
- ☐ B5.13 – Experimental wells for injection of small quantities of carbon dioxide (< 500,000 tons)
- ☐ B5.15 – Small scale renewable energy research/development/pilot projects
- ☐ B5.22 – Alternative fuel vehicle fueling stations
- ☐ B5.23 – Electric vehicle charging stations

Other
- ☐ Specify category:
- ☐ Specify category:
- ☐ Specify category:

This action (1) would not present any extraordinary circumstances such that the action might have a significant impact upon the human environment; (2) is not connected to other actions with potentially significant impacts; (3) is not related to other actions with cumulatively significant impacts; and (4) is not inconsistent with 10 CFR 1021.211 - Interim Actions or 40 CFR 1506.1 - Limitations during the NEPA process.

SELECT ONE OF THE FOLLOWING:
- ☒ This Categorical Exclusion includes all tasks and phases in the Statement of Work or Statement of Project Objectives for this project.
- ☐ This Categorical Exclusion is only valid for the following tasks/phases _____. The DOE initiator acknowledges the responsibility to obtain a NEPA determination prior to initiating any activities outside the scope of this Categorical Exclusion.

SELECT ONE OF THE FOLLOWING:
- ☒ This Categorical Exclusion includes all locations and activities for this project.
- ☐ Additional sites, sub-recipients, or activities cannot be identified at this time. The DOE initiator acknowledges the responsibility to obtain a NEPA determination prior to initiating any activities outside the scope of this Categorical Exclusion.

NOTE: ANY CHANGE(S) TO THE PROJECT SCOPE OR LOCATIONS MAY REQUIRE A NEW NEPA DETERMINATION.

DOE Initiator Signature: ERIK ALBENZE Digitally signed by ERIK ALBENZE Date: 2016.12.07 15:46:36 -05'00' Date: 12 (month) / 7 (day) / 2016 (year)

NEPA Compliance Officer: FRED POZZUTO Digitally signed by FRED POZZUTO Date: 2016.12.08 15:37:27 -05'00' Date: 12 (month) / 8 (day) / 2016 (year)

The following special condition is provided for the consideration of the Contracting Officer:

NCO's NOTE: All field work to be conducted at existing wells/facilities.

NETL F 451.1-1/1
Revised: 11/24/2014
Reviewed: 11/24/2014
(Previous Editions Obsolete)

U.S. DEPARTMENT OF ENERGY - NETL

CATEGORICAL EXCLUSION (CX) DESIGNATION FORM

Project No.: DE-FE0031624 Recipient Name: University of Wyoming Project Location: Laramie, WY

Sub-recipient(s) and Locations:

Advanced Resources International - Arlington, VA; Carbon GeoCycle, Inc. - Laramie, WY;
Energy & Environmental Research Center - Grand Forks, ND; Basin Electric Power Cooperative - Gillette, WY

NETL Sponsoring Org.: FE/TDIC/Coal/Carbon Storage Team NETL Contact: Erik Albenze

Brief Title of Proposed Action: Commercial-Scale Carbon Storage Complex Feasibility Study at Dry Fork Station

Brief Description of Activities:

Drilling of stratigraphic test well near Dry Forks Station; Lab work including rock analysis, cutting analysis, fluid analysis, and coreflooding experiments; Data analysis and report writing.

THE PROPOSED ACTION FALLS WITHIN THE FOLLOWING CATEGORICAL EXCLUSION(S) FROM APPENDICES A AND B TO SUBPART D OF DOE NEPA IMPLEMENTING PROCEDURES (10 CFR 1021):

General Administration/Management
- ☐ A1 – Routine business actions
- ☒ A9 – Info gathering, analysis, documentation, dissemination, and training
- ☐ A11 – Technical advice and planning assistance

Facility Operations
- ☐ B1.3 – Routine maintenance and custodial services
- ☐ B1.7 – Communication system and data processing equipment acquisition, installation, operation, removal
- ☐ B1.15 – Support building or structure, non-waste storage, construction/ operation

Safety and Health
- ☐ B2.1 – Modifications to enhance workplace habitability
- ☐ B2.2 – Installation/improvement of building/equipment instrumentation
- ☐ B2.3 – Installation of equipment for personnel safety and health

General Research
- ☒ B3.1 – Site characterization/environmental monitoring
- ☒ B3.6 – R&D or pilot facility construction/operation/decommissioning
- ☒ B3.7 – New infill exploratory, experimental oil/gas/geothermal well construction and/or operation
- ☐ B3.9 – Certain CCT demonstration activities, emissions unchanged
- ☐ B3.11 – Outdoor tests, experiments on materials and equipment components

Electrical Power and Transmission
- ☐ B4.4 – Power management activities (storage, load shaping, and balancing)
- ☐ B4.6 – Transmission support addition/modifications at developed facility site
- ☐ B4.11 – Construction of power substations and interconnection facilities
- ☐ B4.13 – Upgrading and rebuilding existing power lines (< 20 miles)

Conservation, Fossil, and Renewable Energy Activities
- ☐ B5.1 – Actions to conserve energy, no indoor air quality degradation
- ☐ B5.3 – Modification/abandonment of wells
- ☐ B5.5 – Short crude oil/gas/steam/geothermal/carbon dioxide pipeline const/oper within an existing right-of-way (< 20 miles) between existing facilities
- ☐ B5.13 – Experimental wells for injection of small quantities of carbon dioxide (< 500,000 tons)
- ☐ B5.15 – Small scale renewable energy research/development/pilot projects
- ☐ B5.22 – Alternative fuel vehicle fueling stations
- ☐ B5.23 – Electric vehicle charging stations

Other
- ☐ Specify category:
- ☐ Specify category:
- ☐ Specify category:

This action (1) would not present any extraordinary circumstances such that the action might have a significant impact upon the human environment; (2) is not connected to other actions with potentially significant impacts; (3) is not related to other actions with cumulatively significant impacts; and (4) is not inconsistent with 10 CFR 1021.211 - Interim Actions or 40 CFR 1506.1 - Limitations during the NEPA process.

SELECT ONE OF THE FOLLOWING:
- ☒ This Categorical Exclusion includes all tasks and phases in the Statement of Work or Statement of Project Objectives for this project.
- ☐ This Categorical Exclusion is only valid for the following tasks/phases _____. The DOE initiator acknowledges the responsibility to obtain a NEPA determination prior to initiating any activities outside the scope of this Categorical Exclusion.

SELECT ONE OF THE FOLLOWING:
- ☒ This Categorical Exclusion includes all locations and activities for this project.
- ☐ Additional sites, sub-recipients, or activities cannot be identified at this time. The DOE initiator acknowledges the responsibility to obtain a NEPA determination prior to initiating any activities outside the scope of this Categorical Exclusion.

NOTE: ANY CHANGE(S) TO THE PROJECT SCOPE OR LOCATIONS MAY REQUIRE A NEW NEPA DETERMINATION.

DOE Initiator Signature: ERIK ALBENZE Digitally signed by ERIK ALBENZE Date: 2018.06.14 13:33:38 -04'00' Date: 6 (month) / 14 (day) / 2018 (year)

NEPA Compliance Officer: Jesse Garcia Digitally signed by Jesse Garcia Date: 2018.06.20 16:39:50 -07'00' Date: 06 (month) / 20 (day) / 2018 (year)

The following special condition is provided for the consideration of the Contracting Officer:

CX covers activities to be conducted on existing industrial site and lab/office sites. The test well will be drilled within industrial boundary with existing roads and graded area. Seismic surveys will also be completed.

NETL F 451.1-1/1
Revised: 11/24/2014
Reviewed: 11/24/2014
(Previous Editions Obsolete)

U.S. DEPARTMENT OF ENERGY - NETL

CATEGORICAL EXCLUSION (CX) DESIGNATION FORM

Project No.: DE-FE0031891 Recipient Name: University of Wyoming Project Location: Laramie, WY

Sub-recipient(s) and Locations:

ARI-Knoxville, TN; BEPC-Bismarck, ND; CGC-Laramie, WY; Denbury Resources-Plano, TX; EERC-Grand Forks, ND; EORI-Casper, WY; LANL-Los Alamos, NM; MTR-Newark, CA; Dry Fork Station-Campbell County, WY; Western Fuels-Gillette, WY

NETL Sponsoring Org.: FE/TDIC/Coal/Carbon Storage Team NETL Contact: Kyle Smith

Brief Title of Proposed Action: WY CarbonSAFE: Accelerating CCUS Commercialization & Deployment at DFS & WY ITC

Brief Description of Activities:

Cont. char. of DFS CO2 storage complex: drill new well,reenter existing well, subsurface char. (core, log, H2O injection tests, crosswell/passive seismic), UIC Class VI permit to construct,Phase IV NEPA.

THE PROPOSED ACTION FALLS WITHIN THE FOLLOWING CATEGORICAL EXCLUSION(S) FROM APPENDICES A AND B TO SUBPART D OF DOE NEPA IMPLEMENTING PROCEDURES (10 CFR 1021):

General Administration/Management
- ☐ A1 – Routine business actions
- ☒ A9 – Info gathering, analysis, documentation, dissemination, and training
- ☐ A11 – Technical advice and planning assistance

Facility Operations
- ☐ B1.3 – Routine maintenance and custodial services
- ☐ B1.7 – Communication system and data processing equipment acquisition, installation, operation, removal
- ☐ B1.15 – Support building or structure, non-waste storage, construction/ operation

Safety and Health
- ☐ B2.1 – Modifications to enhance workplace habitability
- ☐ B2.2 – Installation/improvement of building/equipment instrumentation
- ☐ B2.3 – Installation of equipment for personnel safety and health

General Research
- ☒ B3.1 – Site characterization/environmental monitoring
- ☐ B3.6 – R&D or pilot facility construction/operation/decommissioning
- ☒ B3.7 – New infill exploratory, experimental oil/gas/geothermal well construction and/or operation
- ☐ B3.9 – Certain CCT demonstration activities, emissions unchanged
- ☐ B3.11 – Outdoor tests, experiments on materials and equipment components

Electrical Power and Transmission
- ☐ B4.4 – Power management activities (storage, load shaping, and balancing)
- ☐ B4.6 – Transmission support addition/modifications at developed facility site
- ☐ B4.11 – Construction of power substations and interconnection facilities
- ☐ B4.13 – Upgrading and rebuilding existing power lines (< 20 miles)

Conservation, Fossil, and Renewable Energy Activities
- ☐ B5.1 – Actions to conserve energy, no indoor air quality degradation
- ☐ B5.3 – Modification/abandonment of wells
- ☐ B5.5 – Short crude oil/gas/steam/geothermal/carbon dioxide pipeline const/oper within an existing right-of-way (< 20 miles) between existing facilities
- ☐ B5.13 – Experimental wells for injection of small quantities of carbon dioxide (< 500,000 tons)
- ☐ B5.15 – Small scale renewable energy research/development/pilot projects
- ☐ B5.22 – Alternative fuel vehicle fueling stations
- ☐ B5.23 – Electric vehicle charging stations

Other
- ☐ Specify category:
- ☐ Specify category:
- ☐ Specify category:

This action (1) would not present any extraordinary circumstances such that the action might have a significant impact upon the human environment; (2) is not connected to other actions with potentially significant impacts; (3) is not related to other actions with cumulatively significant impacts; and (4) is not inconsistent with 10 CFR 1021.211 - Interim Actions or 40 CFR 1506.1 - Limitations during the NEPA process.

SELECT ONE OF THE FOLLOWING:
- ☒ This Categorical Exclusion includes all tasks and phases in the Statement of Work or Statement of Project Objectives for this project.
- ☐ This Categorical Exclusion is only valid for the following tasks/phases _____. The DOE initiator acknowledges the responsibility to obtain a NEPA determination prior to initiating any activities outside the scope of this Categorical Exclusion.

SELECT ONE OF THE FOLLOWING:
- ☒ This Categorical Exclusion includes all locations and activities for this project.
- ☐ Additional sites, sub-recipients, or activities cannot be identified at this time. The DOE initiator acknowledges the responsibility to obtain a NEPA determination prior to initiating any activities outside the scope of this Categorical Exclusion.

NOTE: ANY CHANGE(S) TO THE PROJECT SCOPE OR LOCATIONS MAY REQUIRE A NEW NEPA DETERMINATION.

DOE Initiator Signature: KYLE SMITH Digitally signed by KYLE SMITH Date: 2020.06.16 08:46:21 -04'00' Date: 06 (month) / 16 (day) / 2020 (year)

NEPA Compliance Officer: Mark Lusk Digitally signed by Mark Lusk Date: 2020.06.25 09:43:35 -04'00' Date: 06 (month) / 25 (day) / 2020 (year)

The following special condition is provided for the consideration of the Contracting Officer:

NETL F 451.1-1/1
Revised: 11/24/2014
Reviewed: 11/24/2014
(Previous Editions Obsolete)

U.S. DEPARTMENT OF ENERGY - NETL

CATEGORICAL EXCLUSION (CX) DESIGNATION FORM

Project No.: DE-FE0031891 Recipient Name: University of Wyoming Project Location: Laramie, WY

Sub-recipient(s) and Locations:

Oxy Low Carbon Ventures (OLCV) - Houston, TX (Prime recipient has been previously approved - this CX approval is for the sub-recipient, OLCV).

NETL Sponsoring Org.: FE/TDIC/Coal/Carbon Storage Team NETL Contact: Kyle Smith

Brief Title of Proposed Action: WY CarbonSAFE: Accelerating CCUS Commercialization & Deployment at DFS & WY ITC

Brief Description of Activities:

OLCV will provide technical analysis and advisory support for the project. All work will take place at its facility in Houston, TX.

THE PROPOSED ACTION FALLS WITHIN THE FOLLOWING CATEGORICAL EXCLUSION(S) FROM APPENDICES A AND B TO SUBPART D OF DOE NEPA IMPLEMENTING PROCEDURES (10 CFR 1021):

General Administration/Management
- ☐ A1 – Routine business actions
- ☒ A9 – Info gathering, analysis, documentation, dissemination, and training
- ☒ A11 – Technical advice and planning assistance

Facility Operations
- ☐ B1.3 – Routine maintenance and custodial services
- ☐ B1.7 – Communication system and data processing equipment acquisition, installation, operation, removal
- ☐ B1.15 – Support building or structure, non-waste storage, construction/ operation

Safety and Health
- ☐ B2.1 – Modifications to enhance workplace habitability
- ☐ B2.2 – Installation/improvement of building/equipment instrumentation
- ☐ B2.3 – Installation of equipment for personnel safety and health

General Research
- ☐ B3.1 – Site characterization/environmental monitoring
- ☐ B3.6 – R&D or pilot facility construction/operation/decommissioning
- ☐ B3.7 – New infill exploratory, experimental oil/gas/geothermal well construction and/or operation
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Electrical Power and Transmission
- ☐ B4.4 – Power management activities (storage, load shaping, and balancing)
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Conservation, Fossil, and Renewable Energy Activities
- ☐ B5.1 – Actions to conserve energy, no indoor air quality degradation
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- ☐ B5.22 – Alternative fuel vehicle fueling stations
- ☐ B5.23 – Electric vehicle charging stations

Other
- ☐ Specify category:
- ☐ Specify category:
- ☐ Specify category:

This action (1) would not present any extraordinary circumstances such that the action might have a significant impact upon the human environment; (2) is not connected to other actions with potentially significant impacts; (3) is not related to other actions with cumulatively significant impacts; and (4) is not inconsistent with 10 CFR 1021.211 - Interim Actions or 40 CFR 1506.1 - Limitations during the NEPA process.

SELECT ONE OF THE FOLLOWING:
- ☒ This Categorical Exclusion includes all tasks and phases in the Statement of Work or Statement of Project Objectives for this project.
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SELECT ONE OF THE FOLLOWING:
- ☐ This Categorical Exclusion includes all locations and activities for this project.
- ☒ Additional sites, sub-recipients, or activities cannot be identified at this time. The DOE initiator acknowledges the responsibility to obtain a NEPA determination prior to initiating any activities outside the scope of this Categorical Exclusion.

NOTE: ANY CHANGE(S) TO THE PROJECT SCOPE OR LOCATIONS MAY REQUIRE A NEW NEPA DETERMINATION.

DOE Initiator Signature: KYLE SMITH Digitally signed by KYLE SMITH Date: 2020.07.22 11:59:43 -04'00' Date: 07 (month) / 22 (day) / 2020 (year)

NEPA Compliance Officer: PIERINA FAYISH Digitally signed by PIERINA FAYISH Date: 2020.08.04 09:04:28 -04'00' Date: 08 (month) / 04 (day) / 2020 (year)

The following special condition is provided for the consideration of the Contracting Officer:

NCO Note: New subcontractor for this project. This CX applies to work at this location only. A previous CX for this project remains in effect.

APPENDIX B

USACE Coordination and Waters Assessment Memo

October 11, 2023

U.S. Army Corps of Engineers
Wyoming Regulatory Office
2232 Dell Range Blvd STE 210
Cheyenne, WY 82009

Re: U.S. Army Corps of Engineers coordination for a proposed CarbonSAFE Project in Gillette, Wyoming

Dear Sir or Ma'am:

The U.S. Department of Energy (DOE) is preparing an Environmental Assessment (EA) for DOE's proposed action of providing cost-shared financial assistance to the University of Wyoming (UW) for the "Wyoming CarbonSAFE Phase IV Project". The EA is being prepared to fulfill DOE's obligation under the National Environmental Policy Act (NEPA), the Council on Environmental Quality's NEPA regulations, and DOE's NEPA implementing procedures.

DOE's proposed action is to provide cost-shared financial assistance to UW. Based on the best available projections, the Phase IV cost is estimated to be approximately $77 million, and the DOE share would be approximately $38.5 million. The Wyoming CarbonSAFE Project would construct approximately 27 linear miles of 10-inch subsurface pipeline throughout northeastern Wyoming as part of a proposed carbon capture and sequestration project. The Project would capture and compress carbon dioxide gas (CO_2) and convey the CO_2 to five injection well pads at which the CO_2 would be injected deep into subsurface geologic formations. The targeted geologic formations would then contain the CO_2 until it mineralizes. Approximately 57.5 million metric tons (MMT) of CO_2 would be transported through the pipeline from Dry Fork Station and injected into subsurface pore space over a period of 30 years.

If selected for funding, UW would pursue permitting under Section 404 of the Clean Water Act independent of the NEPA review process; however, DOE would like to seek input on any environmental issues or concerns the U.S. Army Corps of Engineers may have on the proposed Project as it relates to WOTUS prior to completing the EA. We respectfully ask that you provide any information or comments within 30 days to enable us to complete the EA within the scheduled timeframe.

A waters assessment was completed by Trihydro Corporation for the Project on July 24, 2023. The assessment consisted of a comprehensive desktop analysis utilizing aerial imagery and public databases with a field work element to verify and document the presence of surface waters proximate to the proposed Project. The waters assessment was conducted following implementation of the 2023 Regulatory Definition (2023 definition) of Waters of the United States (WOTUS) and the subsequent May 25, 2023, *Sackett vs. EPA* United States Supreme Court decision. Publicly available digital resources reviewed

626 Cochran Mill Road, Pittsburgh, PA 15236
Pierina.Fayish@netl.doe.gov Phone (412) 386-5428 www.netl.doe.gov

as part of the waters assessment include data from the United States Geological Survey (USGS), National Wetlands Inventory (NWI), Wyoming Department of Environmental Quality (WYDEQ), Wyoming Fish and Game Department (WYFGD), and the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Web Soil Survey (WSS).

Topographic data indicates variable topography with a high elevation of approximately 4,500 feet above sea level (ft asl) and low areas of approximately 3,000 ft asl. NWI data delineates many riverine and freshwater emergent wetlands within the Project area. The USDA NRCS WSS identifies soils within the Project area as 'well drained' and no classified hydric soils are recorded. The majority of the Project area is located within previously mined or actively mined parcels. As much of the soil surface has been historically disturbed by mining activities, and a full wetland delineation was not required, no soil pits were dug as part of this waters assessment to verify the presence of hydric indicators in the soil.

Vegetation and hydrology were evaluated at wetland and waters locations mapped in the NWI to verify the presence of surface water resources in those locations. Attachment A: Surface Waters within the Project Area Map depicts the NWI delineated surface water features within the Project Area.

The following named waterways cross the Project area in one or more locations:

- **Little Rawhide Creek**, classified within the Project area as a Freshwater Emergent Wetland on NWI, crosses the Project area at (44.39579522, -105.5156719°). This feature is fed by tributaries to the southwest and southeast of the creek until its outlet at Raw Hide Reservoir which, in turn, feeds Rawhide Creek.
- **Rawhide Creek**, classified within the Project area as a Freshwater Emergent Wetland on NWI, intersects the Project area at (44.43447762, -105.5370418°), (44.43191335, -105.5539057°), (44.42608235, -105.5609862°), and (44.42287247, -105.5583753°). This feature is fed by tributaries to the west of the Project area and flows northeast.
- **Hay Creek** crosses the northern most point of the southern branch at (44.47784883, -105.5165438°). Classified as a Freshwater Emergent Wetland on NWI, this feature flows eastward until its outlet at the Little Powder River.
- **Jamison Prong Wildcat Creek** and its tributaries intersect the western and northern branches of the Project area at (44.49285498, -105.6162605°) and (44.50197342, -105.6091039°). This feature flows northeast to its outlet at Wildcat Creek which, in turn, flows into Horse Creek, a tributary to Little Powder River, an interstate water. While a tributary to a class (a)(3) WOTUS, Jamison Prong Wildcat Creek would not be considered a WOTUS following section (c) guidelines in the 2023 definition.

Numerous unnamed tributaries also cross the Project area and have a direct surface connection to one or more of the listed surface waters. All surface waters and their

tributaries which cross the Project area are tributaries to Little Powder River, an interstate water. As the Little Powder River is defined as a class (a)(1) WOTUS, the tributaries may also be considered WOTUS following section (a)(3) guidelines in the 2023 definition.

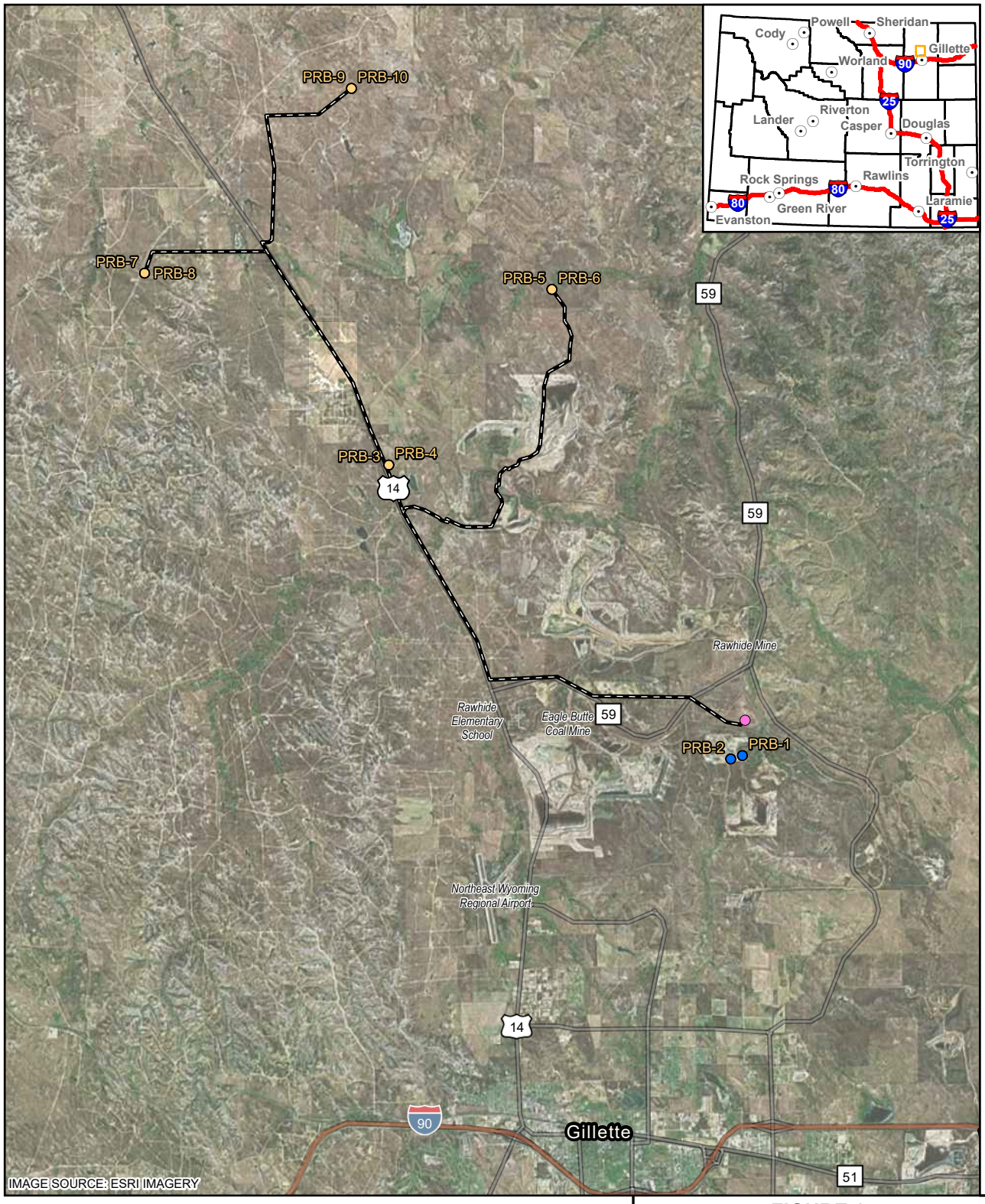
Please send any questions or comments to:

Pierina Fayish
National Energy Technology Laboratory
626 Cochran Mill Rd
Pittsburgh PA 15236
Pierina.Fayish@netl.doe.gov
(412) 386-5428

Thank you for your assistance.

Sincerely,

Pierina N. Fayish



EXPLANATION

- INJECTION POINT
- PRE-EXISTING INJECTION POINT
- DRY FORK STATION AND CCS SITE
- PIPELINE
- PROJECT LOCATION

N

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FIGURE 1

VICINITY MAP

ENVIRONMENTAL ASSESSMENT
WYOMING CARBONSAFE
GILLETTE, WY

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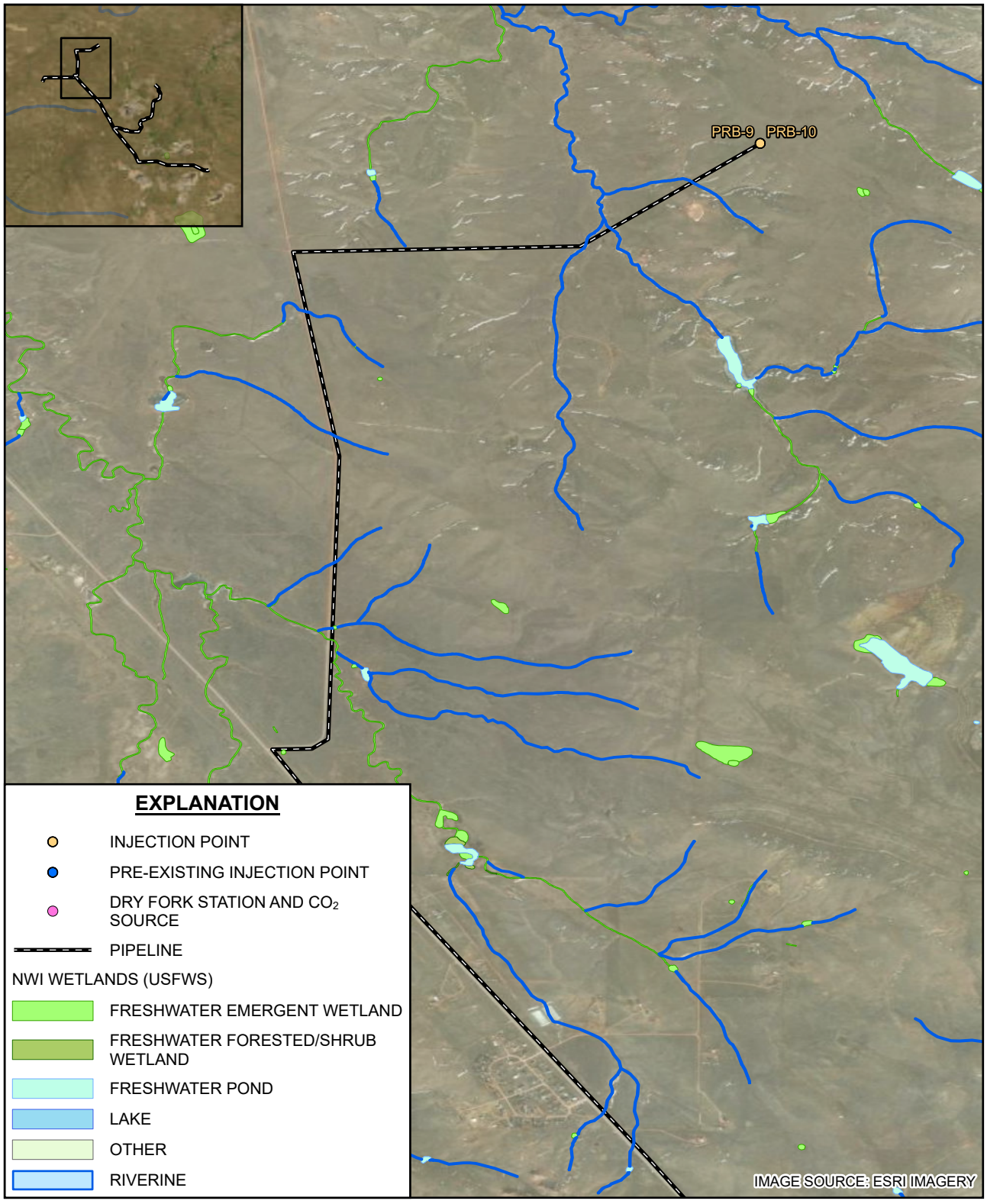

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Trihydro CORPORATION
1252 Commerce Drive
Laramie, WY 82070
www.trihydro.com
(P) 307/745.7474 (F) 307/745.7729

FIGURE 1

WATERS ASSESSMENT MEMO

ENVIRONMENTAL ASSESSMENT
WYOMING CARBONSAFE
GILLETTE, WYOMING

Drawn By: NM	Checked By: MC	Scale: 1" = 3,091'	Date: 9/20/23	File: UW_CS_WatersAsses

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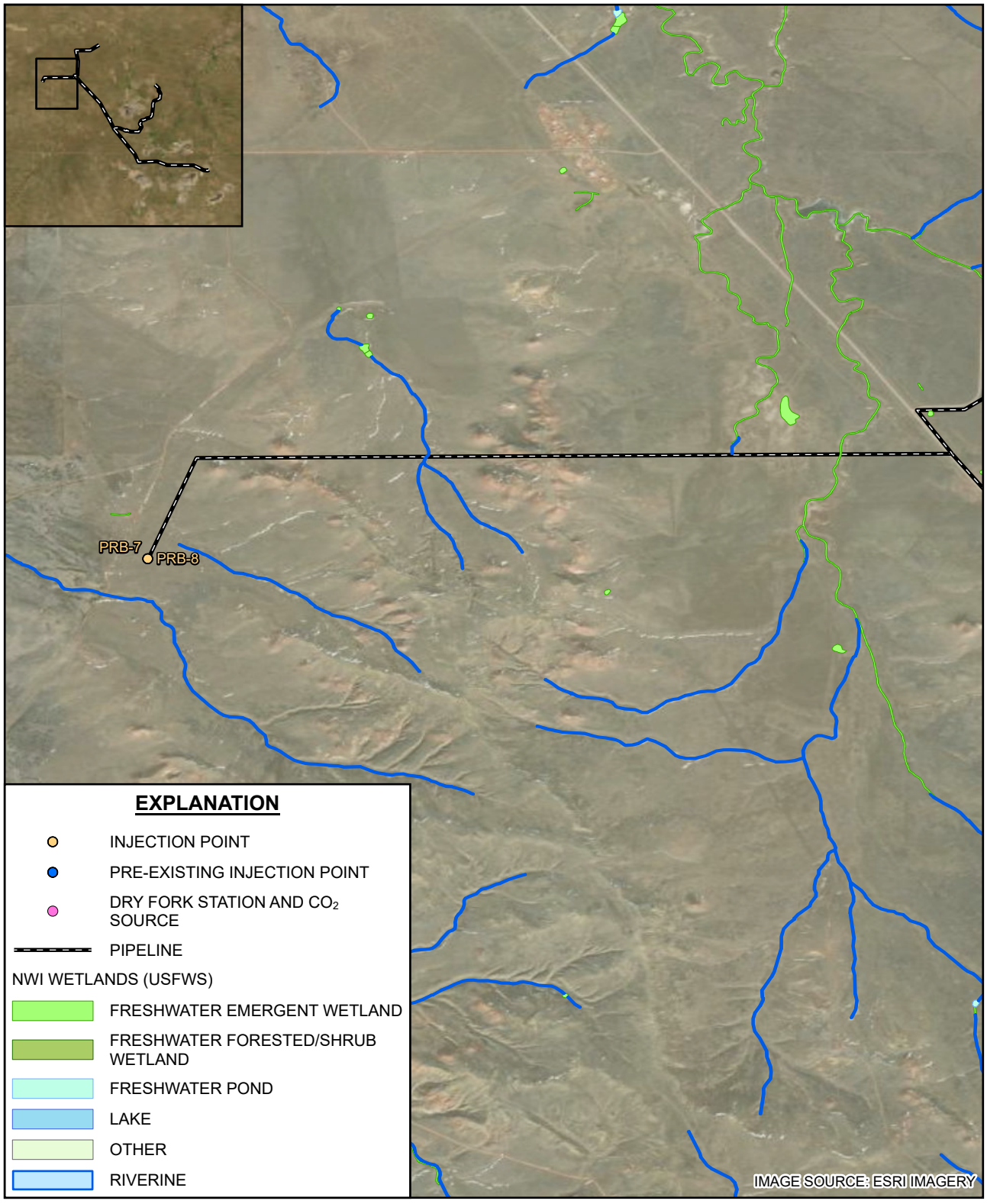

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0 3,100'

Trihydro CORPORATION

1252 Commerce Drive
Laramie, WY 82070
www.trihydro.com
(P) 307/745.7474 (F) 307/745.7729

FIGURE 2

WATERS ASSESSMENT MEMO

ENVIRONMENTAL ASSESSMENT
WYOMING CARBONSAFE
GILLETTE, WYOMING

Drawn By: NM	Checked By: MC	Scale: 1" = 2,576'	Date: 9/20/23	File: UW_CS_WatersAsses

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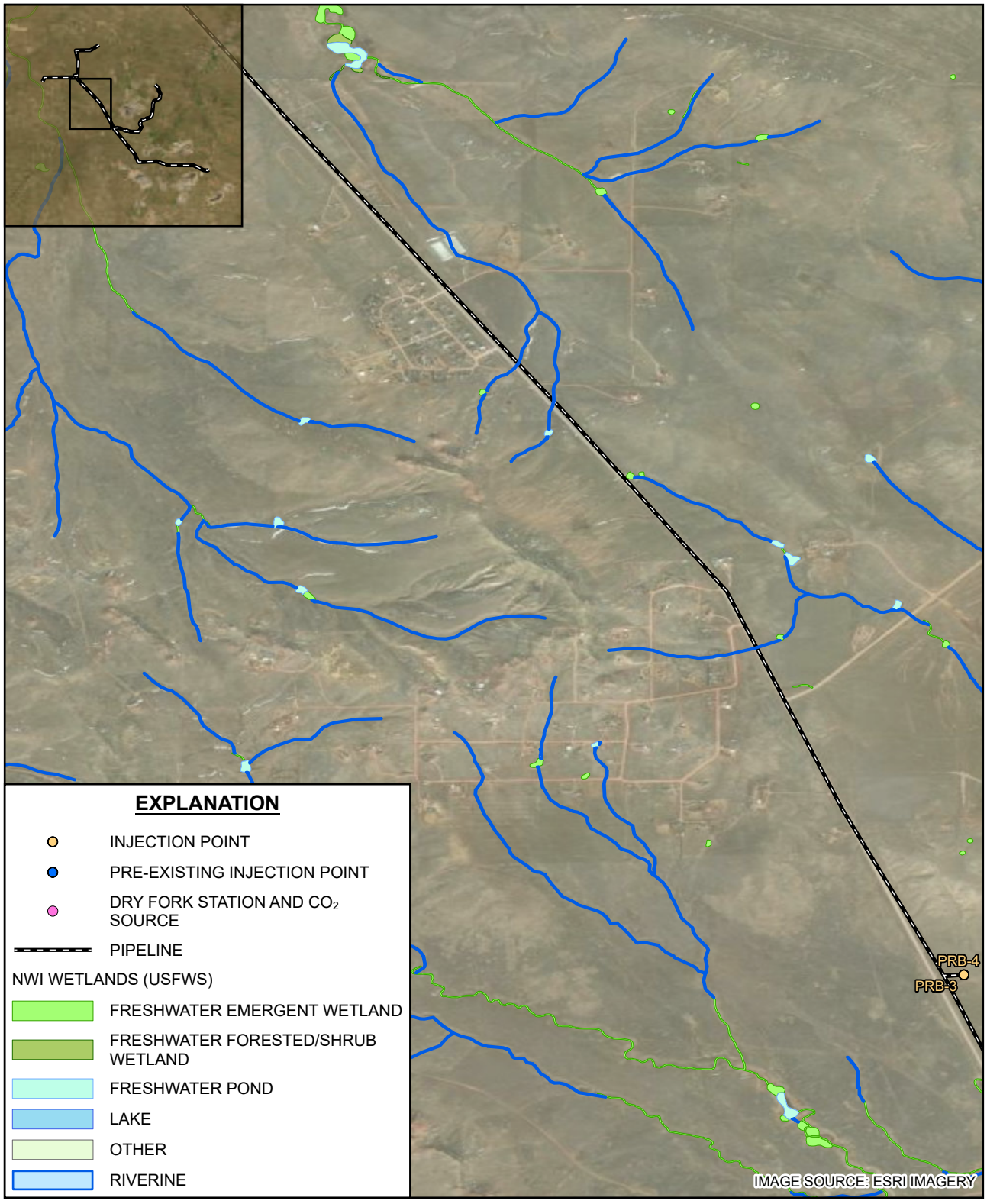

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0 3,100'

Trihydro CORPORATION
1252 Commerce Drive
Laramie, WY 82070
www.trihydro.com
(P) 307/745.7474 (F) 307/745.7729

FIGURE 3

WATERS ASSESSMENT MEMO

ENVIRONMENTAL ASSESSMENT
WYOMING CARBONSAFE
GILLETTE, WYOMING

Drawn By: NM	Checked By: MC	Scale: 1" = 2,576'	Date: 9/20/23	File: UW_CS_WatersAsses

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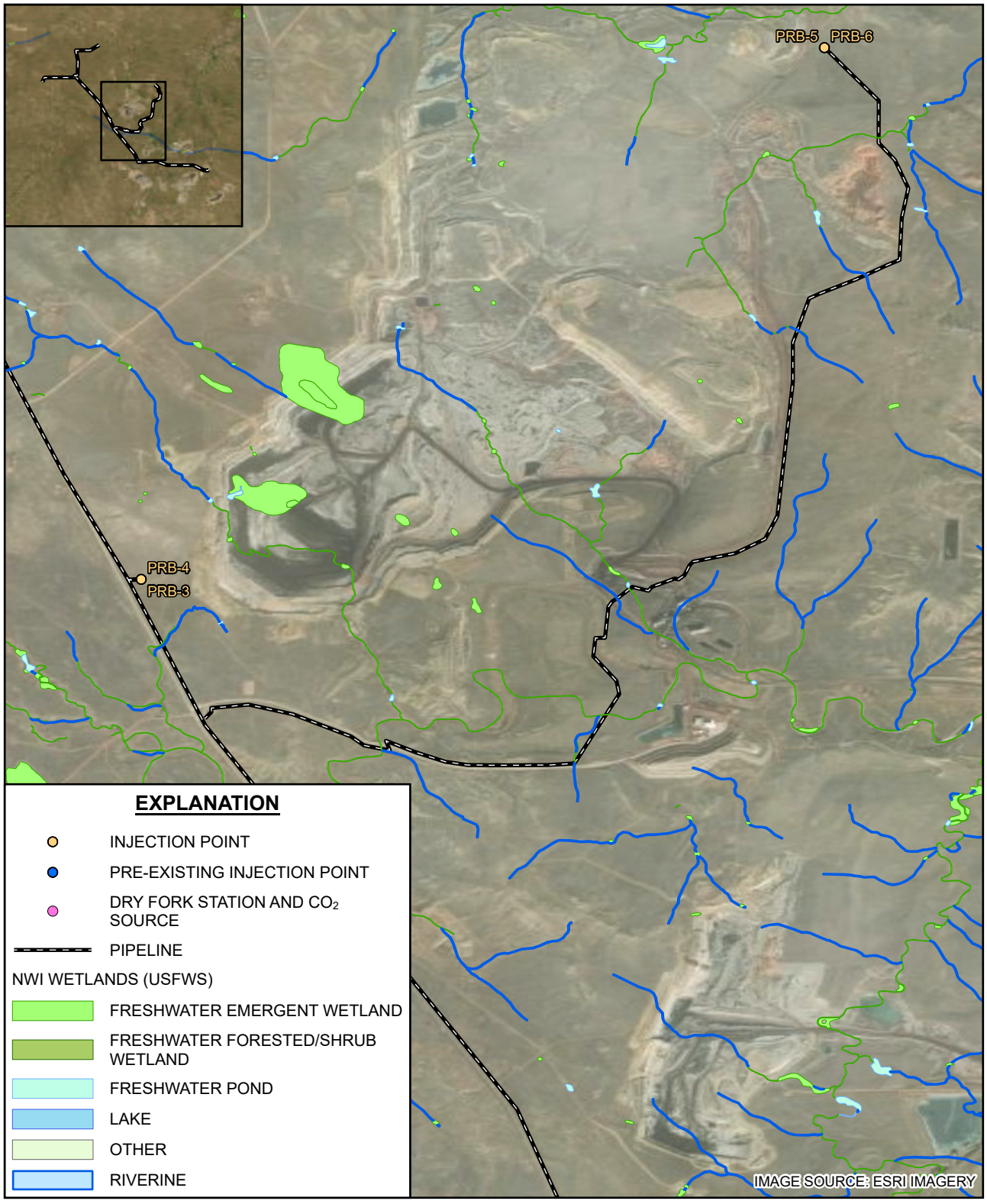

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Trihydro CORPORATION

1252 Commerce Drive
Laramie, WY 82070
www.trihydro.com
(P) 307/745.7474 (F) 307/745.7729

FIGURE 4

WATERS ASSESSMENT MEMO

**ENVIRONMENTAL ASSESSMENT
WYOMING CARBONSAFE
GILLETTE, WYOMING**

Drawn By: NM	Checked By: MC	Scale: 1" = 4,024'	Date: 9/20/23	File: UW_CS_WatersAsses

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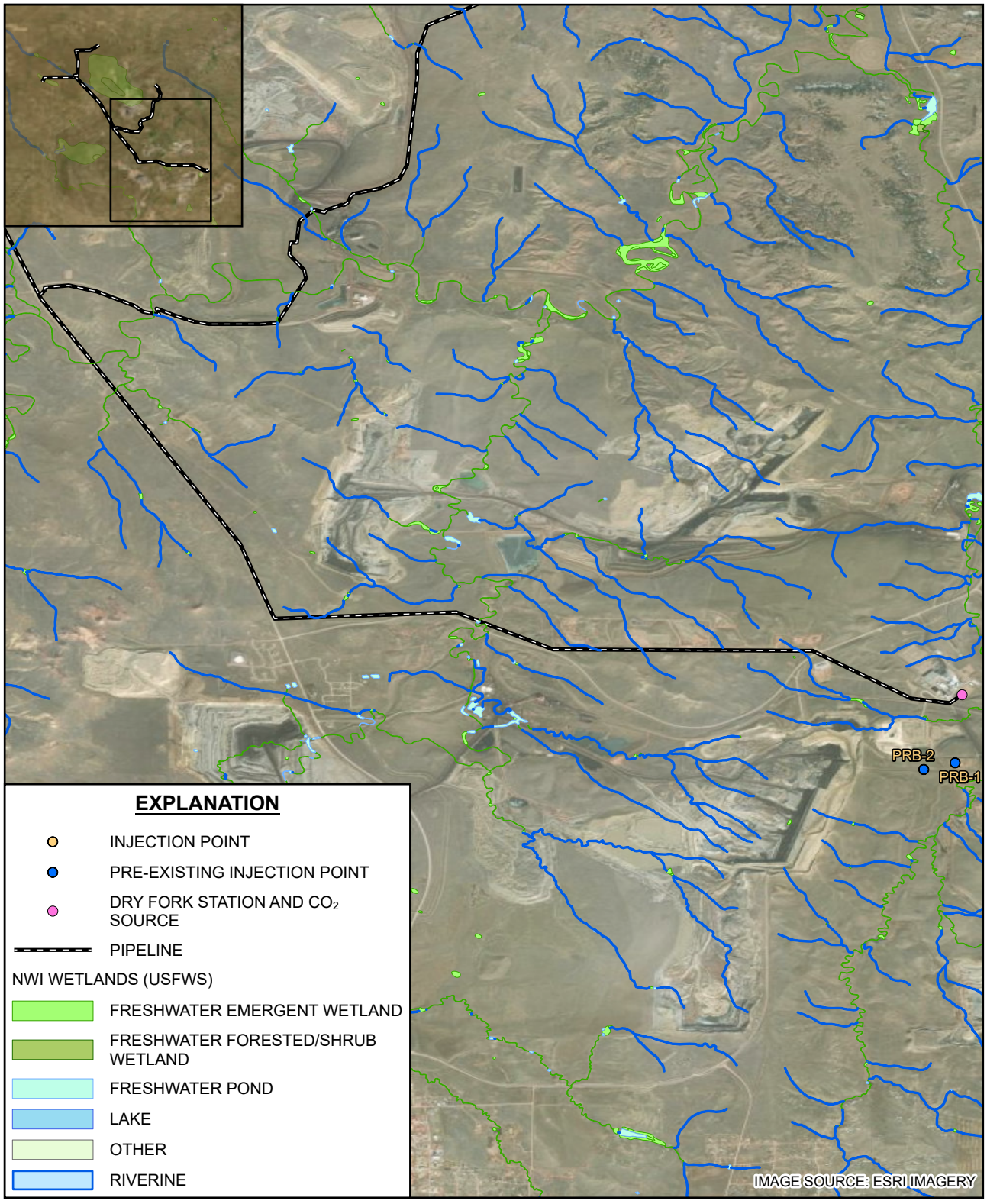

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Trihydro CORPORATION
1252 Commerce Drive
Laramie, WY 82070
www.trihydro.com
(P) 307/745.7474 (F) 307/745.7729

FIGURE 5

WATERS ASSESSMENT MEMO

**ENVIRONMENTAL ASSESSMENT
WYOMING CARBONSAFE
GILLETTE, WYOMING**

Drawn By: NM	Checked By: MC	Scale: 1" = 6,288'	Date: 9/20/23	File: UW_CS_WatersAsses

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APPENDIX C

USFWS Section 7 Consultation Memo

August 10, 2023

Tyler Abbott, Wyoming Field Supervisor
U. S. Fish and Wildlife Service
Wyoming Ecological Services Field Office
334 Parsley Boulevard
Cheyenne, WY 82007-4178

Re: Consultation Under Section 7 of the ESA for a Proposed Project in Gillette, Wyoming

Dear Mr. Abbott:

The U.S. Department of Energy (DOE) is preparing an Environmental Assessment (EA) for DOE's proposed action of providing cost-shared financial assistance to the University of Wyoming (UW) for the "Wyoming CarbonSAFE Phase IV Project". The EA is being prepared to fulfill DOE's obligation under the National Environmental Policy Act (NEPA), as amended, the Council on Environmental Quality's NEPA regulations, and DOE's NEPA implementing procedures.

DOE's proposed action is to provide cost-shared financial assistance to UW. Based on the best available projections, the Phase IV cost is estimated to be approximately $77 million, and the DOE share would be approximately $38.5 million.

UW's proposed project would capture carbon dioxide (CO_2) from Basin Electric's Dry Fork Station in Gillette, Wyoming, and transport it via pipeline to several EPA Class VI Underground Injection Control (UIC) permitted injection wells for permanent geologic storage. The project would construct approximately 27 linear miles of 10-inch subsurface pipeline throughout northeastern Wyoming to transport the CO_2 to five injection well pads. Approximately 57.5 million metric tons (MMT) of CO_2 would be transported through the pipeline from a starting location at Dry Fork Station and injected into subsurface pore space over a period of 30 years.

DOE evaluated the potential occurrence of species listed under the Endangered Species Act (ESA) within the vicinity of the Project area using the USFWS Information for Planning and Consultation (IPaC) system and through a field verified habitat assessment conducted on from May 22-24, 2023. IPaC identified one listed species that could occur within the area: Ute ladies'-tresses (*Spiranthes diluvialis*). Ute ladies'-tresses is an orchid that inhabits low, flat floodplain terraces or abandoned oxbows that are seasonally flooded and remain moist into the summer. Wyoming populations occur at elevations ranging from 4,650 to 5,420 feet. Although the Project area falls within the USFWS area of influence for this species, there are no known occurrences within Campbell County, Wyoming. Additionally, previous environmental analysis prepared as part of project planning entailed surveys for Ute ladies'-tresses in areas of potentially suitable habitat in the vicinity of Dry Fork Station, and the species was not observed. The nearest known

626 Cochran Mill Road, Pittsburgh, PA 15236
Pierina.Fayish@netl.doe.gov Phone (412) 386-5428 www.netl.doe.gov

occurrence of Ute ladies'-tresses is to the southwest of the impact area in Converse County. Therefore, the project would have no effect on this species.

The northern long-eared bat (*Myotis septentriolnalis*) is listed as endangered and are primarily located in the eastern US; however, the western most extent of their range extends to northeastern Wyoming, which is near the proposed project area. During the summer, the northern long-eared bat typically roosts in cavities, underneath bark, crevices, or hollows of both live and dead trees and/or snags, which are not present within the project area. The closest known hibernation sites and resident population are in the South Dakota Black Hills. Based on the lack of suitable summer and winter habitat within or near the project area, the proposed project would have no effect on this species.

DOE does not anticipate any adverse effects on federal or state-listed wildlife species based on the proposed construction and operation of the carbon capture and storage facility. As part of the NEPA process, we are seeking your input on any environmental issues or concerns your agency may have on the Proposed Action and the potentially affected areas as described above. We respectfully ask that you provide any information or comments within 30 days to enable us to complete this phase of the project within the scheduled timeframe.

If you have any questions or comments, please contact Ms. Pierina Fayish at:

National Energy Technology Laboratory M/S: 921-227
626 Cochran Mill Rd
Pittsburgh, PA 15236-0940
Pierina.Fayish@netl.doe.gov
(412) 386-5428

Thank you for your assistance with this matter.

Sincerely,

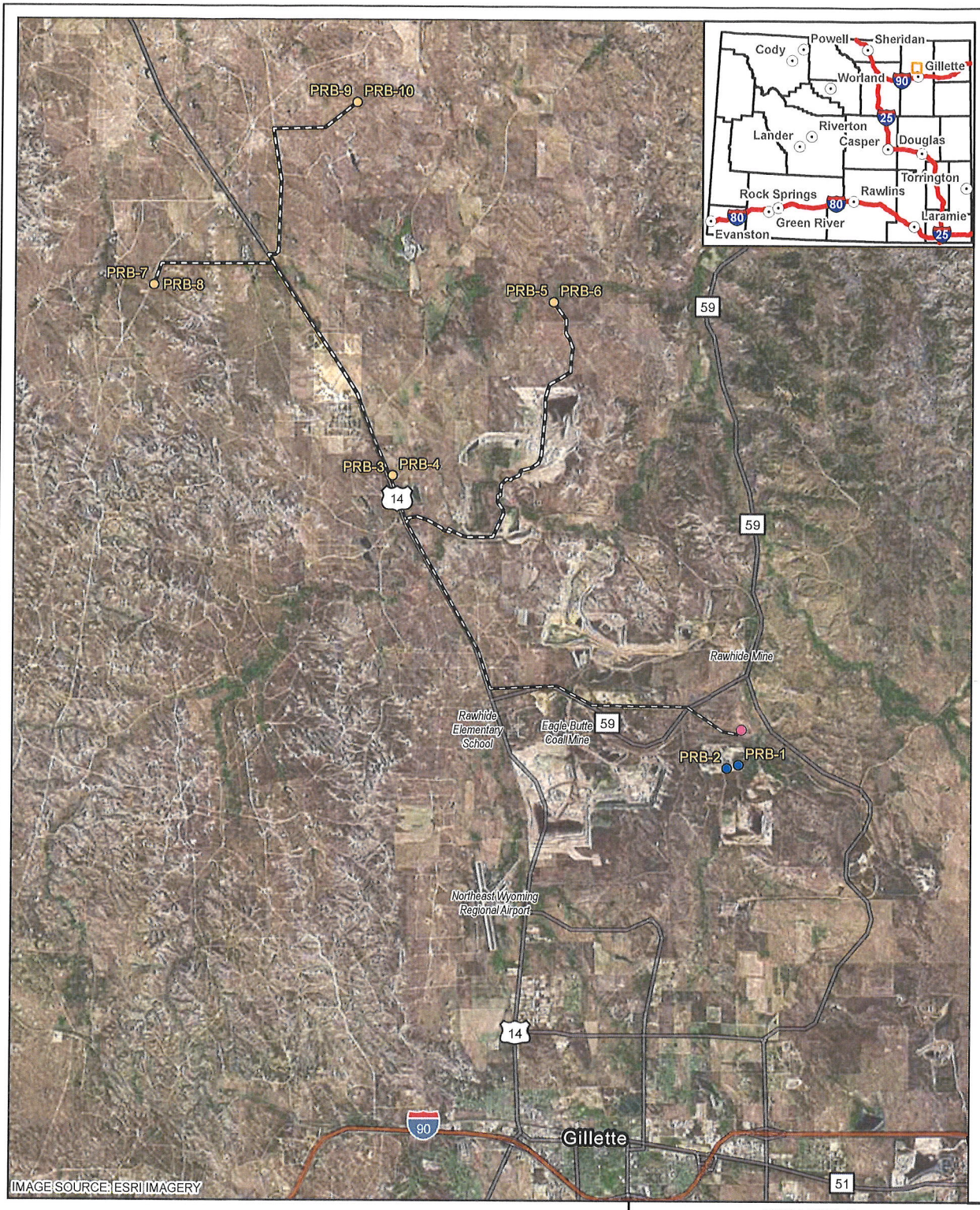
Pierina N. Fayish

U.S. Fish and Wildlife Service

Based on the information provided, you may consider this project to be in compliance with the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.). The project should be reanalyzed by our office if any new information indicates there may be effects to protected species or their habitats.

JENNIFER HILL Digitally signed by JENNIFER HILL
Date: 2023.10.18 13:42:43 -06'00'

for Field Supervisor, U.S. Fish and Wildlife Service, Wyoming Field Office, 334 Parsley Boulevard, Cheyenne, WY 82007



EXPLANATION

- INJECTION POINT
- PRE-EXISTING INJECTION POINT
- DRY FORK STATION AND CCS SITE
- PIPELINE
- PROJECT LOCATION

N

0 12,500'

FIGURE 1

VICINITY MAP

ENVIRONMENTAL ASSESSMENT
WYOMING CARBONSAFE
GILLETTE, WY

L:\UW - DOCUMENTS\CARBONSAFE_EA\GIS\MAPPING\UW_CARBONSAFE_EA\UW_CARBONSAFE_EA_062723.APRX

Overview of habitat for mapped alignment between highway & DFS.

Representative vegetation conditions along pipeline alignment.

Siting of future injection well site.

Existing injection well and DFS.

FIGURE 2

PHOTO LOG -
JULY 24, 2023

ENVIRONMENTAL ASSESSMENT
WYOMING CARBONSAFE
GILLETTE, WY

APPENDIX D

WYSHPO Section 106 Concurrence Letter and Tribal Notifications

WYOMING STATE Historic Preservation OFFICE

June 30, 2023

Department of Energy

Re: DBI_WY_2023_295, DBPR_WY_2023_311 Wyoming CarbonSAFE Carbon Sequestration Project

Dear Department of Energy:

Thank you for consulting with the Wyoming State Historic Preservation Office (SHPO) regarding the above referenced undertaking. We have reviewed the associated report and find the documentation meets the Secretary of the Interior's Standards for Archaeology and Historic Preservation (48 FR 44716-42). We concur with your finding that no historic properties, as defined in 36 CFR § 800.16(l)(1), will be adversely affected by the undertaking as planned.

We concur with your finding that the following sites are not eligible for listing in the National Register of Historic Places (NRHP) and no further work or protective measures are necessary;

Smithsonian Number	Site Name	Current Eligibility	Effect
CA 308		Not Eligible	Not Applicable
CA 1837	HPC-82-6220-14	Not Eligible	Not Applicable
CA 4698	PA-03-187-1	Not Eligible	Not Applicable

We concur that the following sites are eligible for listing in the NRHP but will not be adversely affected by the undertaking as planned;

Smithsonian Number	Site Name	Current Eligibility	Effect
CA 2785_1	BLACK AND YELLOW TR.	Eligible	No Adverse Effect

We recommend the Department of Energy allow the undertaking to proceed in accordance with state and federal laws subject to the following stipulations: If any cultural materials are discovered during construction, work in the area shall halt immediately, the federal agency must be contacted, and the materials evaluated by an archaeologist or historian meeting the Secretary of the Interior's Professional Qualification Standards (48 FR 22716, Sept. 1983).

This letter should be retained in your files as documentation of a SHPO concurrence with your finding of no historic properties adversely affected. We look forward to continuing to work with your office on this undertaking. Please refer to SHPO project DBI_WY_2023_295 on any future correspondence regarding this undertaking.

If you have any questions, please contact me at 307-777-8793.

Sincerely,

Joseph Daniele

August 11, 2023

Tribe
Tribe Point of Contact
Tribe Point of Contact Title
Tribe Address

Re: Consultation Under NHPA Section 106 for a Proposed Project in Gillette, Wyoming

Dear Tribe Point of Contact Title:

The U.S. Department of Energy (DOE) is preparing an Environmental Assessment (EA) for DOE's proposed action of providing cost-shared financial assistance to the University of Wyoming (UW) for the "Wyoming CarbonSAFE Phase IV Project". The EA is being prepared to fulfill DOE's obligation under the National Environmental Policy Act (NEPA), as amended, the Council on Environmental Quality's NEPA regulations, and DOE's NEPA implementing procedures.

The undertaking and its effects are also being considered under Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, and implementing regulations at 36 CFR Part 800. As part of compliance with Section 106, DOE is writing to seek your comments on any issues or concerns for traditional cultural properties, sacred sites, or site of traditional religious or cultural importance in the area that might be affected by the proposed project and would like to know if you wish to receive a copy of the draft EA. We respectfully ask that you provide any information or comments within 30 days to enable us to complete this phase of the project within the scheduled timeframe.

DOE's proposed action is to provide cost-shared financial assistance to UW. Based on the best available projections, the Phase IV cost is estimated to be approximately $77 million, and the DOE share would be approximately $38.5 million.

UW's proposed project would capture carbon dioxide (CO_2) from Basin Electric's Dry Fork Station in Gillette, Wyoming, and transport it via pipeline to several EPA Class VI Underground Injection Control (UIC) permitted injection wells for permanent geologic storage. The project would construct approximately 27 linear miles of 10-inch subsurface pipeline throughout northeastern Wyoming to transport the CO_2 to five injection well pads. Approximately 57.5 million metric tons (MMT) of CO_2 would be transported through the pipeline from a starting location at Dry Fork Station and injected into subsurface pore space over a period of 30 years. Please see the attached map for the proposed project locations and pipeline routing.

If you have any questions or comments, please contact Ms. Pierina Fayish at:

National Energy Technology Laboratory M/S: 921-227
626 Cochran Mill Rd
Pittsburgh, PA 15236-0940

Pierina.Fayish@netl.doe.gov
(412) 386-5428

Thank you for your assistance with this matter.

Sincerely,

Pierina N. Fayish

From: Clare Johnson <clare.johnson@northernarapaho.com>
Sent: Friday, August 25, 2023 12:21 PM
To: Fayish, Pierina M. <Pierina.Fayish@NETL.DOE.GOV>
Subject: [EXTERNAL] Letter to Northern Arapaho Tribe

Good Morning,
I am writing to let you know that the Northern Arapaho Business Council has received your letter in regard to consultation under NHPA SEction 106 for a proposed project in Gillete, Wyoming. I have also forwarded the letter to the Northern Arapaho Tribe's Tribal Historic Preservation Office. I also wanted to inform you that the current Chairman of the Tribe is Chairman Lloyd Goggles and ask that you please address future correspondence to him
Thank you.
L. Clare Johnson
Counsel, Northern Arapaho Tribe
Clare.johnson@northernarapaho.com
307-349-9422

APPENDIX E
WDEQ Coordination Memo

October 11, 2023

Wyoming Department of Environmental Quality
Water Quality Division
200 West 17th Street
Cheyenne, WY 82002

Re: Wyoming Department of Environmental Quality coordination for a proposed CarbonSAFE Project in Gillette, Wyoming

Dear Sir or Ma'am:

The U.S. Department of Energy (DOE) is preparing an Environmental Assessment (EA) for DOE's proposed action of providing cost-shared financial assistance to the University of Wyoming (UW) for the "Wyoming CarbonSAFE Phase IV Project". The EA is being prepared to fulfill DOE's obligation under the National Environmental Policy Act (NEPA), the Council on Environmental Quality's NEPA regulations, and DOE's NEPA implementing procedures.

DOE's proposed action is to provide cost-shared financial assistance to UW. Based on the best available projections, the Phase IV cost is estimated to be approximately $77 million, and the DOE share would be approximately $38.5 million. The Wyoming CarbonSAFE Project would construct approximately 27 linear miles of 10-inch subsurface pipeline throughout northeastern Wyoming as part of a proposed carbon capture and sequestration project. The Project would capture and compress carbon dioxide gas (CO_2) and convey the CO_2 to five injection well pads at which the CO_2 would be injected deep into subsurface geologic formations. The targeted geologic formations would then contain the CO_2 until it mineralizes. Approximately 57.5 million metric tons (MMT) of CO_2 would be transported through the pipeline from Dry Fork Station and injected into subsurface pore space over a period of 30 years.

Injection of the CO_2 would be subject to permit requirements by the Wyoming Department of Environmental Quality (WDEQ) Water Quality Division Class VI Underground Injection Control (UIC) Program. If selected for funding, UW would pursue UIC Class VI permits independent of the NEPA review process; however, DOE would like to seek input on any environmental issues or concerns the WDEQ may have on the proposed Project as it relates to the protection of Underground Sources of Drinking Water (USDW) and other state water resources prior to completing the EA. We respectfully ask that you provide any information or comments within 30 days in order to incorporate your feedback into the EA within the scheduled timeframe.

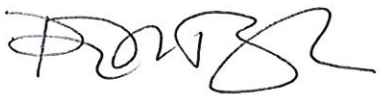
Please send any questions or comments to:

626 Cochran Mill Road, Pittsburgh, PA 15236
Pierina.Fayish@netl.doe.gov Phone (412) 386-5428 www.netl.doe.gov

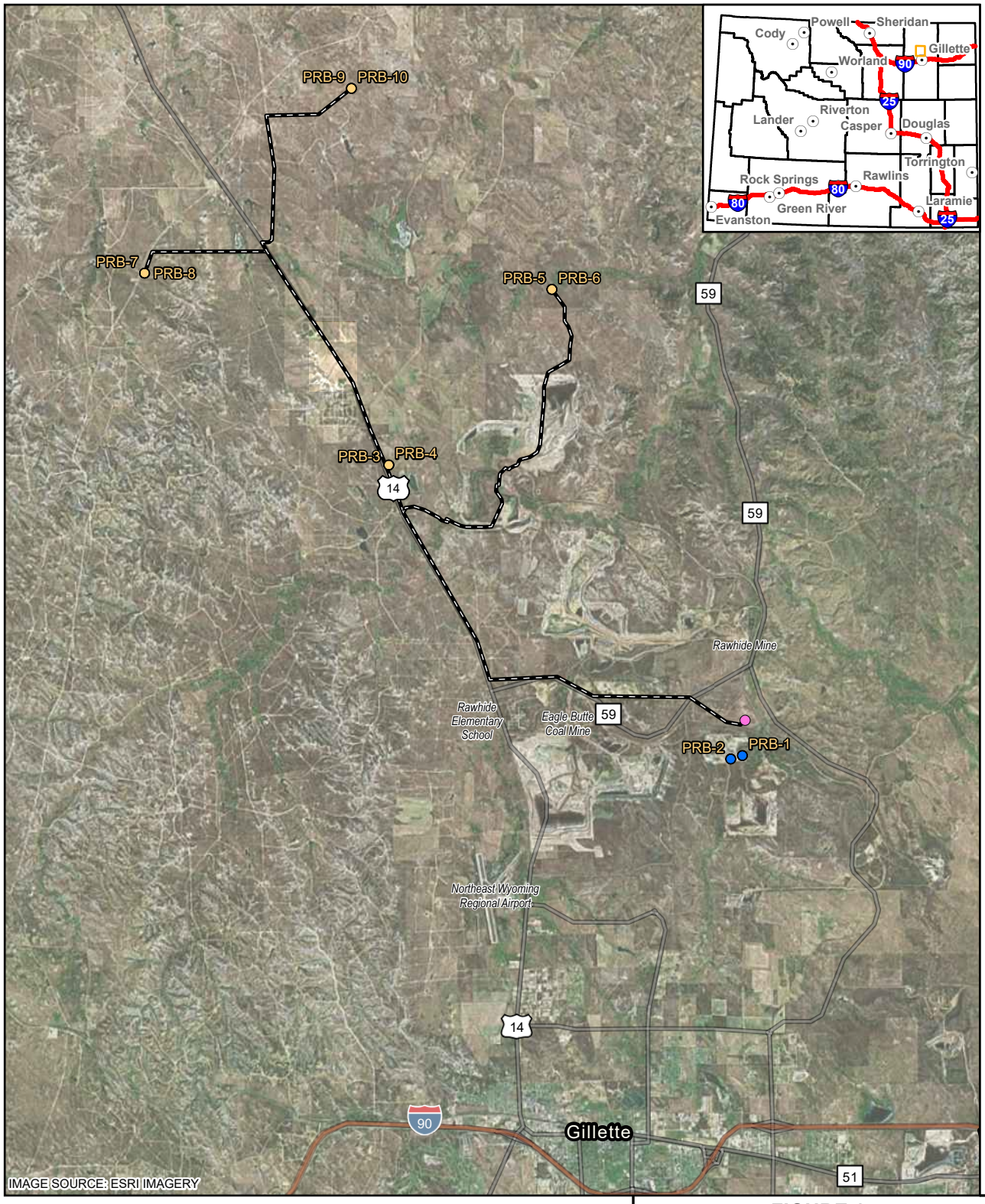
Pierina Fayish
National Energy Technology Laboratory
626 Cochran Mill Rd
Pittsburgh PA 15236
Pierina.Fayish@netl.doe.gov
(412) 386-5428

Thank you for your assistance.

Sincerely,



Pierina N. Fayish



EXPLANATION

- INJECTION POINT
- PRE-EXISTING INJECTION POINT
- DRY FORK STATION AND CCS SITE
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- PROJECT LOCATION

N

0 12,500'

FIGURE 1

VICINITY MAP

ENVIRONMENTAL ASSESSMENT
WYOMING CARBONSAFE
GILLETTE, WY

...\UW - DOCUMENTS\CARBONSAFE_EA\GIS\MAPPING\UW_CARBONSAFE_EA\UW_CARBONSAFE_EA_062723.APRX

Department of Environmental Quality

To protect, conserve and enhance the quality of Wyoming's environment for the benefit of current and future generations.

Mark Gordon, Governor

Todd Parfitt, Director

November 7, 2023

National Energy Technology Laboratory
Attn: Pierina Fayish
626 Conchran Mill Rd
Pittsburg, PA 15236

Via: Pierina.Fayish@netl.doe.gov

Re: Proposed CarbonSAFE Project in Gillette, Wyoming

Dear Ms. Pierina Fayish,

The Wyoming Department of Environmental Quality Water Quality Division (WDEQ/WQD) appreciates the Department of Energy's (DOE) and the University of Wyoming's ongoing efforts to coordinate with WDEQ/WQD on the CarbonSAFE Project near Gillette, Wyoming. WDEQ/WQD has reviewed the DOE's October 11, 2023 letter regarding its intent to develop an Environmental Assessment (EA) for the Wyoming CarbonSAFE Phase IV Project. The DOE's proposed action is to provide cost-shared financial assistance to the University of Wyoming for a carbon capture and sequestration project. The project proposes to capture and compress carbon dioxide (CO_2) from the Dry Fork Station, construct approximately 27 linear miles of 10-inch subsurface pipeline from the Dry Fork Station to five well pads and inject, via ten wells, approximately 57.5 million metric tons of CO_2 into subsurface pore space of the targeted geologic formations over a 30-year period. The scoping letter acknowledges that the injection of CO_2 is subject to permit requirements by the WDEQ/WQD's Underground Injection Control (UIC) Program Class VI Program as outlined in Wyoming Water Quality Rules, Chapter 24 and indicates that, if selected for funding, the University of Wyoming, School of Energy Resources would pursue UIC Class VI permits separate from the NEPA process. Other WDEQ/WQD Division permits may be required for this project as well.

Over the past three years, the University of Wyoming, School of Energy Resources (SER) has been collaborating with WDEQ/WQD on the CarbonSAFE Project. SER has previously obtained two Class I Well permits from the UIC Program for testing purposes, and these wells would not be used to inject CO_2 until the Class VI conversion process is completed. The Class I well permits currently held by SER are PRB #1 (UIC Permit 2021-215) and PRB #2 (UIC Permit 2021-216), which WDEQ/WQD issued on November 5, 2021. The following Class VI well requirements must be met prior to CO_2 injection: (1) applying to WDEQ/WQD to convert the two existing Class I wells and permits to Class VI wells and permits; (2) applying for a Class VI permit for each of the eight proposed wells to construct and test the wells; (3) if unitization is required, obtaining a Unitization Order from the Wyoming Oil and Gas Conservation Commission (WYOGCC); and (4) obtaining authorization to inject from the WDEQ. Class VI applications must include a

detailed site characterization analysis and the results of numerical modeling of the entire Area of Review (AoR), which includes the CO_2 plume, associated pressure front, and displaced fluids. Permitted Class VI wells are required to inject below the lowest Underground Source of Drinking Water or aquifer, unless a depth waiver is granted. Following the proposed 30 years of injection, SER would need to continue monitoring the storage site until the WDEQ/WQD approves site closure. Closure occurs after demonstration that the CO_2 plume has stabilized. An operator may apply for transfer of liability no sooner than 20 years following injection activities, but the operator would not receive a certificate of project completion until the site receives approval for closure, the permit is terminated, and financial assurance is returned. Additional information is available from the UIC Program at https://deq.wyoming.gov/water-quality/groundwater/uic/class-vi/. DOE should contact WDEQ/WQD's UIC Program should additional information regarding the Class VI permitting process be necessary to develop the EA.

In accordance with Title 35, Chapter 11 of the Wyoming Statutes and Wyoming's Water Quality Rules, WDEQ/WQD is responsible for the protection and restoration of the quality of waters of the state. The WDEQ/WQD also implements some sections of the Clean Water Act in Wyoming. As such, WDEQ/WQD has included recommendations to help the EA identify potential surface and ground waters in proximity to the project area as well as information that can be used to evaluate potential impacts to the quality of those waters and identify steps to minimize potential impacts. The EA should specifically explain how groundwater and surface waters will be protected from the impacts of construction activities and release of chemicals, petroleum products, produced water, and any hazardous substances, should any of these be associated with the project.

Surface Waters. WDEQ/WQD identified the following Class 3B waters in proximity to the proposed pipeline construction area that should be identified and evaluated as part of the EA: Dry Creek, Rawhide Creek, Little Rawhide Creek, Jamison Prong, Wildcat Creek, and North Wildcat Creek. As outlined in Wyoming Water Quality Rules, Chapter 1, Wyoming Surface Water Quality Standards, Class 3 waters are designated for aquatic life other than fish, recreation, agriculture, industry, wildlife, and scenic value uses. Wyoming Surface Water Quality Standards also describe the numeric and narrative water quality criteria applicable to these designated uses, along with the applicable antidegradation provisions.

WYPDES Outfalls. WDEQ/WQD has identified multiple Wyoming Pollutant Discharge Elimination System (WYPDES) permitted outfalls near Rawhide Creek, Little Rawhide Creek, and Dry Creek within proximity to the proposed construction area. This information could be used when discussing water resources and existing land uses within the EA. The WDEQ/WQD can provide information on WYPDES outfalls if requested by the DOE.

Public Water Supplies and Source Water Protection Area. WDEQ/WQD's evaluation indicates that the project is in proximity to public water supply (PWS) wells and the associated source water protection area. WDEQ/WQD recommends the project sponsor coordinate directly with the PWS regarding potential impacts. WDEQ/WQD also recommends the EA identify the PWS and source water protection area, evaluate potential impacts to the PWS and source water protection area, and identify specific actions that will be implemented as needed to protect the PWS and the source water protection area.

Sensitive Aquifer. WDEQ/WQD's evaluation indicates that a sensitive aquifer is within the proposed project area located at a depth of approximately 300 ft or more. As such, WDEQ/WQD recommends that

the EA identify sensitive aquifers and all actions that will be implemented, as needed, to minimize potential impacts to groundwater such as best management practices (BMPs) to prevent spills during construction activities. Additional information is available at http://deq.wyoming.gov/waterquality/groundwater.

Nonpoint Source Pollution. WDEQ/WQD encourages projects to minimize potential impacts to surface and ground water quality by implementing BMPs for activities that do not require WDEQ-issued permits. These include, but are not limited to, practices associated with stream and lakeshore restoration; road construction and maintenance; rangeland management; wildland fire; silviculture; recreation management; and vegetation and mineral management. The EA can identify the BMPs that will be used during construction and maintenance of the project to minimize nonpoint sources of pollution. Additional information on nonpoint source pollution and recommended BMPs are available at http://deq.wyoming.gov/wqd/non-point-source/.

In addition to the above recommendations, WDEQ/WQD would like to highlight the following permits and requirements that may apply to the project, depending on the eventual scope of the project. The permits identified below are not intended to be a comprehensive list. Additional research will be necessary to ensure that all applicable local, state, and federal permits are included in the EA.

Spill Reporting. Wyoming Water Quality Rules, Chapter 4, requires that the WQD be notified of any oil or hazardous substances that have been released and that enter, or threaten to enter, waters of the state. Spills can be reported to WDEQ via phone at 307-777-7501 or online at http://wyospills.org/.

Construction Stormwater Permits. If construction activities, including those related to access roads, borrow and stockpile areas, and equipment staging and maintenance areas, associated with the project will cumulatively disturb one or more acres, a WYPDES storm water discharge permit is required. Coverage under the Large Construction General Permit is required for construction activities that cumulatively disturb five or more acres, and coverage under the Small Construction General Permit is required for construction activities that cumulatively disturb between one and five acres. In addition, if any part of a construction project falls within a Greater Sage-Grouse Core Area (SGCA), the owner or operator must coordinate with Wyoming Game and Fish to ensure that the project is consistent with the Governor's Executive Order 2019-3, Greater Sage-Grouse Core Area Protection. A map of sage-grouse core areas in Wyoming can be found at https://wgfd.wyo.gov/Habitat/Sage-Grouse-Management/Sage-Grouse-Data. Additional information is available at https://deq.wyoming.gov/water-quality/wypdes/discharge-monitoring-reports/storm-water-permitting/.

Temporary Discharges Involving Construction Activities General Permits. If the project involves the temporary discharge of water associated with construction dewatering, disinfection of potable water lines, and/or hydrostatic testing of pipes, tanks, or other similar vessels, coverage under a WYPDES General Permit is required. Additional information is available at https://deq.wyoming.gov/water-quality/wypdes/discharge-permitting/.

Clean Water Act 401 Certifications. If the project will result in the discharge of dredge or fill into Waters of the United States that requires a Clean Water Act Section 404 Dredge and Fill permit issued by the United States Army Corps of Engineers, the project will also require a Clean Water Act Section 401 Water Quality Certification from WDEQ/WQD. The 401 Certification ensures that the federal permit will comply

with Wyoming's Water Quality Rules, Chapter 1, Wyoming Surface Water Quality Standards, with stipulations associated with the 401 Certification included as conditions in the federal permit. Additional information is available at https://deq.wyoming.gov/water-quality/watershed-protection-2/cwa-section-401-turbidity-wetland/401-water-quality-certification/.

Temporary Turbidity Waiver. If the project involves any activity that will result in an increase in turbidity for waters designated as drinking water supplies and/or fisheries, a temporary turbidity waiver is recommended. In accordance with Chapter 1, Section 23(c)(ii), the Water Quality Division Administrator may authorize temporary increases in turbidity above the numeric criteria and may impose whatever controls, monitoring, and best management practices are necessary to maintain and protect all water uses. Applications must be submitted and waivers approved by the WDEQ/WQD Administrator before work begins. Additional information is available at https://deq.wyoming.gov/water-quality/watershed-protection-2/cwa-section-401-turbidity-wetland/http://deq.wyoming.gov/wqd/cwa-section-401-turbidity-wetland/resources/turbidity/.

Again, WDEQ/WQD appreciates the opportunity to coordinate with DOE and UW on the CarbonSAFE Project and looks forward to future collaboration on this and other carbon capture and sequestration projects. Should you have any questions regarding our comments or need additional information to support development of the EA, please contact Tori Nye at tori.nye@wyo.gov or 307-777-7050.

Sincerely,

Jennifer Zygmunt
Water Quality Division Administrator

cc: Keith Guille, WDEQ Outreach Manager
Lily Barkau, WDEQ/WQD, Groundwater Section Manager
Tyler Harris, WDEQ/WQD, Underground Injection Control Program

APPENDIX F

Social Cost of Carbon Calculations

Phase 1 Well and Pipeline Construction Emissions
Carbon Safe, Dry Fork Station 405 MW Facility, Campbell County, Wyoming

Phase 1: Well and Pipeline Construction

This phase will last a total of 75 days beginning with first day of well and pipeline construction and concluding when the well and pipeline have been completed

Description	Model	Power Output		Engine Tier	Hours per day	Quantity	Total Days	Total Operational Hours	Emission factors (g/hp-hr)			Source	Emission Rate (tpy)			Emission Rate (lbs/day)		
									CO_2	CH_4	N_2O		CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
CAT D6N Dozer	CAT D6N	166	HP	4f	8	1	20	160	623.8	1.1E-02	5.1E-03	[1] EPA NONROADS 2008a. SCC:2270010010, industrial equipment, oil field equipment	18.3	3.3E-04	1.5E-04	1826.3	3.3E-02	1.5E-02
Backhoe	Case 580N	55	HP	4f	8	1	50	400	692.3	1.1E-02	5.1E-03	[1] EPA NONROADS 2008a. SCC:2270010010, industrial equipment, oil field equipment	16.8	2.7E-04	1.2E-04	671.6	1.1E-02	4.9E-03
CAT Skip Loader	CAT 415F2	68	HP	4F	8	1	20	160	692.2	1.1E-02	5.1E-03	[1] EPA NONROADS 2008a. SCC:2270010010, industrial equipment, oil field equipment	8.3	1.4E-04	6.1E-05	830.1	1.4E-02	6.1E-03
Drilling Rig	Drill Max DM450	350	HP	4f	8	1	25	200	530.4	1.1E-02	5.1E-03	[1] EPA NONROADS 2008a. SCC:2270010010, industrial equipment, oil field equipment	40.9	8.7E-04	3.9E-04	3274.0	7.0E-02	3.1E-02
Grader	Cat C4.4	128	HP	4f	8	1	50	400	623.8	1.1E-02	5.1E-03	[1] EPA NONROADS 2008a. SCC:2270010010, industrial equipment, oil field equipment	35.2	6.4E-04	2.9E-04	1408.2	2.6E-02	1.1E-02
Pipe Layer	Cat C15	319	HP		8	2	50	800	530.4	1.1E-02	5.1E-03	[1] EPA NONROADS 2008a. SCC:2270010010, industrial equipment, oil field equipment	149.2	3.2E-03	1.4E-03	5968.0	1.3E-01	5.7E-02
Pickup Truck	F-150	400	HP		4	10	75	3000	7	0	0	[2] fueleconomy.gov	70	0	0	1866.7	0.0E+00	0.0E+00
Total													**338.7**	**5.4E-03**	**2.4E-03**	**15844.9**	**2.8E-01**	**1.3E-01**

Notes:

[1] CH4 and N2O factor source: 2009 API O&G GHG Methodologies Compendium, Table 4-17 (Diesel Construction). Uses relationships 130,500 Btu/gallon, 2545 Btu/hp-hr.

[2] Emission factor for pickup truck CO_2 is 7 tpy/vehicle taken from fueleconomy.gov for a 2019 Ford F150 Pickup 4WD

Assumes 45% highway and 55% city driving based on a total of 15,000 miles/yr

Assume a 400 HP, gasoline engine F-150

Phase 2 Capture Plant Construction Emissions
Carbon Safe, Dry Fork Station 405 MW Facility, Campbell County, Wyoming

Phase 2: Capture Plant Construction
This phase will last a total of 250 days beginning with first day of plant construction and concluding when the plant has been completed

Description	Model	Power Output		Engine Tier	Hours per day	Quantity	Total Days	Total Operational Hours	Emission factors (g/hp-hr)			Source	Emission Rate (tpy)			Emission Rate (lbs/day)		
									CO_2	CH_4	N_2O		CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
CAT D6N Dozer	CAT D6N	166	HP	4f	8	1	75	600	623.8	1.1E-02	5.1E-03	[1] EPA NONROADS 2008a. SCC:2270010010, industrial equipment, oil field equipment	68.5	1.2E-03	5.6E-04	1826.3	3.3E-02	1.5E-02
Backhoe	Case 580N	55	HP	4f	8	2	75	1200	692.3	1.1E-02	5.1E-03	[1] EPA NONROADS 2008a. SCC:2270010010, industrial equipment, oil field equipment	50.4	8.2E-04	3.7E-04	1343.1	2.2E-02	9.8E-03
CAT Skip Loader	CAT 415F2	68	HP	4F	8	2	75	1200	692.2	1.1E-02	5.1E-03	[1] EPA NONROADS 2008a. SCC:2270010010, industrial equipment, oil field equipment	62.3	1.0E-03	4.6E-04	1660.2	2.7E-02	1.2E-02
CAT 336 EL Excavator	CAT336 EL	308	HP	T4I	8	2	100	1600	530.4	1.1E-02	5.1E-03	[1] EPA NONROADS 2008a. SCC:2270010010, industrial equipment, oil field equipment	288.1	6.1E-03	2.8E-03	5762.2	1.2E-01	5.5E-02
CAT 740 Hauler	CAT740	489	HP	4i	8	2	100	1600	530.4	1.1E-02	5.1E-03	[1] EPA NONROADS 2008a. SCC:2270010010, industrial equipment, oil field equipment	457.4	9.8E-03	4.4E-03	9148.4	2.0E-01	8.7E-02
Mobile Crane 90-ton	LTM 115-53	400	kW		8	3	200	4800	530.4	1.1E-02	5.1E-03	[1] EPA NONROADS 2008a. SCC:2270010010, industrial equipment, oil field equipment	1505.3	3.2E-02	1.4E-02	15052.8	3.2E-01	1.4E-01
Crawler crane 330-to	Liebherr LR 1300	270	HP		8	1	200	1600	624.1	1.1E-02	5.1E-03	[1] EPA NONROADS 2008a. SCC:2270010010, industrial equipment, oil field equipment	297.2	5.4E-03	2.4E-03	2971.9	5.4E-02	2.4E-02
Grader	Cat C4.4	128	HP	4f	8	1	75	600	623.8	1.1E-02	5.1E-03	[1] EPA NONROADS 2008a. SCC:2270010010, industrial equipment, oil field equipment	52.8	9.6E-04	4.3E-04	1408.2	2.6E-02	1.1E-02
Vibratory Compactor	CAT CP56	157	HP	4f	8	1	75	600	623.8	1.1E-02	5.1E-03	[1] EPA NONROADS 2008a. SCC:2270010010, industrial equipment, oil field equipment	64.8	1.2E-03	5.3E-04	1727.3	3.1E-02	1.4E-02
4k Water Truck	Freightliner M2	350	HP	3	8	2	100	1600	530.4	1.1E-02	5.1E-03	[1] EPA NONROADS 2008a. SCC:2270010010, industrial equipment, oil field equipment	327.4	7.0E-03	3.1E-03	6548.0	1.4E-01	6.3E-02
Fork lift	F50c	75	HP	tier 4	8	2	200	3200	692.3	1.1E-02	5.1E-03	[1] EPA NONROADS 2008a. SCC:2270010010, industrial equipment, oil field equipment	183.2	3.0E-03	1.3E-03	1831.5	3.0E-02	1.3E-02
Pickup Truck	F-150	400	HP		4	10	75	3000	7	0	0	[2] fueleconomy.gov	70	0	0	1866.7	0.0E+00	0.0E+00
Total													3427.3	6.9E-02	3.1E-02	51146.8	1.0E+00	4.5E-01

Notes:
[1] CH4 and N2O factor source: 2009 API O&G GHG Methodologies Compendium, Table 4-17 (Diesel Construction). Uses relationships 130,500 Btu/gallon, 2545 Btu/hp-hr.
[2] Emission factor for pickup truck CO_2 is 7 tpy/vehicle taken from fueleconomy.gov for a 2019 Ford F150 Pickup 4WD
Assumes 45% highway and 55% city driving based on a total of 15,000 miles/yr
Assume a 400 HP, gasoline engine F-150

Phase 3 Capture Plant Operation Emissions
Carbon Safe, Dry Fork Station 405 MW Facility, Campbell County, Wyoming

Phase 3: Plant Operation

This phase will last a total of 30 years as CO_2 is sequestered.

Description	Model	Power output		Engine Tier	Hours per day	Quantity	Total Days	Total Operational Hours	Emission factors (g/hp-hr)			Source	Emission Rate (tpy)			Emission Rate (lbs/day)		
									CO_2	CH_4	N_2O		CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
Emergency Engine		2011	HP					500	188.3	0.007638	0.001528	[1] EPA Emission Factors for Greenhouse Gas Inventories	2.09E+02	8.5E-03	1.7E-03	1143.6	4.6E-02	9.3E-03
Pickup Truck	F-250	430	HP		4	4	365	5840	7	0	0	[2] fueleconomy.gov	1.94E+01	0.0E+00	0.0E+00	106.2	0.0E+00	0.0E+00
Thumper truck	XF16-180TP	500	HP		8	1	365	400	530.4	1.1E-02	5.1E-03	[3] EPA NONROADS 2008a. SCC:2270010010, industrial equipment, oil field equipment	1.17E+02	2.5E-03	1.1E-03	640.7	1.4E-02	6.1E-03
Total													3.45E+02	1.1E-02	2.8E-03	1.89E+03	6.0E-02	1.5E-02

Notes

Boilers, heat exchangers, compressors, and air coolers are electrically driven and not included in the emissions estimate.

[1] EPA Emission Factors for Greenhouse Gas Inventories

[2] Emission factor for pickup truck CO_2 is 7 tpy/vehicle taken from fueleconomy.gov for a 2019 Ford F150 Pickup 4WD (no F-250 information was available)

Assumes 45% highway and 55% city driving based on a total of 15,000 miles/yr

Assume a 430 HP, gasoline engine F-250

[3] CH4 and N2O factor source: 2009 API O&G GHG Methodologies Compendium, Table 4-17 (Diesel Construction). Uses relationships 130,500 Btu/gallon, 2545 Btu/hp-hr.

Facility Wide Summary

Carbon Safe, Dry Fork Station 405 MW Facility, Campbell County, Wyoming

Summary:

Dry Fork Station plans to construct a CO2 sequestration plant in Gillette, WY. The project will be in construction approximately 325 days and then begin operation for 30 years. The emission summary is shown below.

Description	Duration	Emission Rate CO_2		Emission Rate CH_4		Emission Rate N_2O		Emission Rate CO_2e	
		tpy	lbs/day	tpy	lbs/day	tpy	lbs/day	tpy	lbs/day
Phase 1 - Well and Pipeline Construction	75 days	338.68	15,844.87	0.01	0.28	0.00	0.13	339.55	15,889.32
Phase 2 - Capture Plant Construction	250 days	3,427.26	51,146.77	0.07	1.00	0.03	0.45	3,438.13	51,305.59
Phase 3 - Plant Operation	30 years	345.01	1,890.45	0.01	0.06	0.00	0.02	346.12	1,896.54
Total		4,110.95	68,882.09	0.08	1.34	0.04	0.59	4,123.80	69,091.45

Short Ton (tpy) to Metric Tons (MT) coversion:

Description	Duration	CO_2		CH_4		N_2O		CO_2e	
		MT	lbs/day	MT	lbs/day	MT	lbs/day	MT	lbs/day
Phase 1 - Well and Pipeline Construction	75 days	307.34	15,844.87	0.0049	0.28	0.0022	0.13	308.12	15,889.32
Phase 2 - Capture Plant Construction	250 days	3,110.03	51,146.77	0.0622	1.00	0.0279	0.45	3,119.90	51,305.59
Phase 3 - Plant Operation	30 years	313.07	1,890.45	0.0099	0.06	0.0026	0.02	314.08	1,896.54
Total		3,730.44	68,882.09	0.0771	1.34	0.0327	0.59	3,742.10	69,091.45

GHGs Sequestered (Phase 3)

Description	Duration	Sequestration CO_2		Sequestration CH_4		Sequestration N_2O		Sequestration CO_2e	
		MT	lbs/day	MT	lbs/day	MT	lbs/day	MT	lbs/day
Phase 3 - Plant Operation (emissions)	30 years	313.07	1,890.45	0.01	0.06	0.00	0.02	314.08	1,896.54
Phase 3 - Plant Operation (sequestration)	30 years	-1,923,368.00	-5,269.50	-217.93	-0.60	-34.75	-0.10	-1,939,173.30	-5,312.80
Total		-1,923,054.93	-3,379.05	-217.92	-0.54	-34.75	-0.08	-1,938,859.22	-3,416.26

Dry Fork Station 405 MW facility emissions history (Source: EPA)

Year	CO2 mt CO2e	CH4 mt CO2e	N2O mt CO2e
2012	3,225,722	7,510	13,021
2013	3,255,149	8,904	15,438
2014	3,298,143	860	16,392
2015	3,098,741	8,956	15,528
2016	2,808,698	8,108	14,058
2017	3,282,713	9,482	16,441
2018	3,043,862	8,791	15,243
2019	2,705,153	7,815	13,550
2020	3,279,994	9,477	16,433
2021	2,902,530	8,383	14,536
2022	2,592,811	7,485	12,980
Average	2,892,633	7,433	14,131
AR4 GWP	1	25	298
Average (tpy)	3,188,582	328	52
Average (MT)	2,892,633	297	47
CCS Capture (MT)	1,923,368	218	35

SOCIAL COST OF CARBON DIOXIDE (CO_2) ESTIMATING TOOL

Base Year: 2025 (Enter the base year on the instructions tab, step 2.)

	Enter CO_2 emissions (metric tons) (Use negative numbers for emission reductions)			Phase 1 Present Value (in Base Year) of Estimated SC-CO_2 by emissions year (2020$)[1]				Phase 2 Present Value (in Base Year) of Estimated SC-CO_2 by emissions year (2020$)[1]				Phase 3 Present Value (in Base Year) of Estimated SC-CO_2 by emissions year (2020$)[1]				Per ton SC-CO_2 Value (2020$/metric ton CO_2)[2,3]			
Year of Emissions	Phase 1	Phase 2	Phase 3	5% Average	3% Average	2.5% Average	3% 95th Percentile	5% Average	3% Average	2.5% Average	3% 95th Percentile	5% Average	3% Average	2.5% Average	3% 95th Percentile	5% Average	3% Average	2.5% Average	3% 95th Percentile
2020				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	14	51	76	152
2021				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	15	52	78	155
2022				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	15	53	79	159
2023				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	16	54	80	162
2024				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	16	55	82	166
2025	307			$5,200	$17,341	$25,494	$51,990	$0	$0	$0	$0	$0	$0	$0	$0	17	56	83	169
2026		3,110		$0	$0	$0	$0	$51,561	$173,591	$255,651	$521,368	$0	$0	$0	$0	17	57	84	173
2027			-1,923,055	$0	$0	$0	$0	$0	$0	$0	$0	-$31,217,156	-$106,149,587	-$156,613,777	-$319,356,905	18	59	86	176
2028			-1,923,055	$0	$0	$0	$0	$0	$0	$0	$0	-$30,542,955	-$104,937,390	-$155,126,115	-$316,232,383	18	60	87	180
2029			-1,923,055	$0	$0	$0	$0	$0	$0	$0	$0	-$29,860,594	-$103,705,756	-$153,617,855	-$313,018,950	19	61	88	183
2030			-1,923,055	$0	$0	$0	$0	$0	$0	$0	$0	-$29,175,469	-$102,456,845	-$152,090,887	-$309,726,095	19	62	89	187
2031			-1,923,055	$0	$0	$0	$0	$0	$0	$0	$0	-$28,624,208	-$101,315,110	-$150,641,540	-$306,861,996	20	63	91	191
2032			-1,923,055	$0	$0	$0	$0	$0	$0	$0	$0	-$28,057,925	-$100,152,965	-$149,172,416	-$303,903,549	21	64	92	194
2033			-1,923,055	$0	$0	$0	$0	$0	$0	$0	$0	-$27,481,967	-$98,972,569	-$147,685,343	-$300,857,117	21	65	94	198
2034			-1,923,055	$0	$0	$0	$0	$0	$0	$0	$0	-$26,895,999	-$97,775,970	-$146,183,610	-$297,728,861	22	66	95	202
2035			-1,923,055	$0	$0	$0	$0	$0	$0	$0	$0	-$26,304,701	-$96,565,114	-$144,665,773	-$294,529,036	22	67	96	206
2036			-1,923,055	$0	$0	$0	$0	$0	$0	$0	$0	-$25,707,605	-$95,341,847	-$143,135,016	-$291,263,035	23	69	98	210
2037			-1,923,055	$0	$0	$0	$0	$0	$0	$0	$0	-$25,108,797	-$94,107,918	-$141,592,870	-$287,936,078	23	70	99	213
2038			-1,923,055	$0	$0	$0	$0	$0	$0	$0	$0	-$24,507,705	-$92,864,986	-$140,042,197	-$284,557,144	24	71	100	217
2039			-1,923,055	$0	$0	$0	$0	$0	$0	$0	$0	-$23,907,895	-$91,614,624	-$138,481,574	-$281,129,503	25	72	102	221
2040			-1,923,055	$0	$0	$0	$0	$0	$0	$0	$0	-$23,309,637	-$90,358,317	-$136,913,771	-$277,661,366	25	73	103	225
2041			-1,923,055	$0	$0	$0	$0	$0	$0	$0	$0	-$22,768,763	-$89,099,869	-$135,305,089	-$273,768,486	26	74	104	228
2042			-1,923,055	$0	$0	$0	$0	$0	$0	$0	$0	-$22,226,545	-$87,838,075	-$133,693,431	-$269,865,663	26	75	106	232
2043			-1,923,055	$0	$0	$0	$0	$0	$0	$0	$0	-$21,684,337	-$86,574,197	-$132,078,667	-$265,959,070	27	77	107	235
2044			-1,923,055	$0	$0	$0	$0	$0	$0	$0	$0	-$21,143,367	-$85,309,427	-$130,464,343	-$262,051,109	28	78	108	239
2045			-1,923,055	$0	$0	$0	$0	$0	$0	$0	$0	-$20,604,747	-$84,043,824	-$128,850,194	-$258,145,174	28	79	110	242
2046			-1,923,055	$0	$0	$0	$0	$0	$0	$0	$0	-$20,070,171	-$82,780,608	-$127,237,174	-$254,243,427	29	80	111	246
2047			-1,923,055	$0	$0	$0	$0	$0	$0	$0	$0	-$19,539,126	-$81,519,680	-$125,626,187	-$250,350,977	30	81	112	249
2048			-1,923,055	$0	$0	$0	$0	$0	$0	$0	$0	-$19,013,147	-$80,261,978	-$124,017,003	-$246,469,587	30	82	114	253
2049			-1,923,055	$0	$0	$0	$0	$0	$0	$0	$0	-$18,492,954	-$79,007,439	-$122,412,646	-$242,600,970	31	84	115	256
2050			-1,923,055	$0	$0	$0	$0	$0	$0	$0	$0	-$17,979,190	-$77,758,808	-$120,812,775	-$238,749,538	32	85	116	260
2051			-1,923,055	$0	$0	$0	$0	$0	$0	$0	$0	-$17,306,924	-$75,795,387	-$119,413,436	-$231,844,712	32	85	118	260
2052			-1,923,055	$0	$0	$0	$0	$0	$0	$0	$0	-$16,997,872	-$74,453,492	-$117,488,210	-$225,957,692	33	86	119	261
2053			-1,923,055	$0	$0	$0	$0	$0	$0	$0	$0	-$16,679,009	-$73,125,467	-$115,585,859	-$220,216,923	34	87	120	262
2054			-1,923,055	$0	$0	$0	$0	$0	$0	$0	$0	-$15,884,770	-$71,811,640	-$113,706,414	-$214,618,879	34	88	121	263
2055			-1,923,055	$0	$0	$0	$0	$0	$0	$0	$0	-$15,573,304	-$70,512,312	-$111,849,889	-$209,952,390	35	89	122	265
2056				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	35	90	123	267
2057				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	36	91	124	269
2058				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	37	92	125	271
2059				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	37	92	127	273
2060				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	38	93	128	275
2061				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	39	95	129	280
2062				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	40	96	131	285
2063				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	41	98	132	290
2064				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	42	99	134	295
2065				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	44	100	135	300
2066				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	45	102	137	305
2067				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	46	103	138	311
2068				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	47	105	140	316
2069				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	48	106	141	321
2070				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	49	108	143	326
TOTALS:	307	3,110	-55,768,593	$5,200	$17,341	$25,494	$51,990	$51,561	$173,591	$255,651	$521,368	-$666,666,839	-$2,576,211,203	-$3,914,504,058	-$7,849,556,617				

Present Value (in Base Year) of Estimated SC-CO_2 for all CO_2 emissions (2020$)

	5% Average	3% Average	2.5% Average	3% 95th Percentile
Phase 1	$5,200	$17,341	$25,494	$51,990
Phase 2	$51,561	$173,591	$255,651	$521,368
Phase 3	-$666,666,839	-$2,576,211,203	-$3,914,504,058	-$7,849,556,617
Total	-$666,610,078	-$2,576,020,271	-$3,914,222,913	-$7,848,983,259

[1] The social cost estimates from the IWG represent the present value of damages from that year's emissions discounted back to the year of emissions. These columns discount that value to the base year in order to calculate the total net present value.

[2] Values from 2020–2050 are from *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide, Interim Estimates under E.O. 13990.* Interagency Working Group on Social Cost of Carbon, United States Government. February 2021.

[3] Values from 2051–2070 are from *Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Consumer Furnaces,* Appendix 14A. U.S. Department of Energy. June 2022.

SOCIAL COST OF METHANE (CH_4) ESTIMATING TOOL

Base Year: 2025 (Enter the base year on the instructions tab, step 2.)

	Enter CH_4 emissions (metric tons) (Use negative numbers for emission reductions)			Phase 1 Present Value (in Base Year) of Estimated SC-CH_4 by emissions year (2020$)[1]				Phase 2 Present Value (in Base Year) of Estimated SC-CH_4 by emissions year (2020$)[1]				Phase 3 Present Value (in Base Year) of Estimated SC-CH_4 by emissions year (2020$)[1]				Per ton SC-CH_4 Value (2020$/metric ton CH_4)[2,3]			
Year of Emissions	Phase 1	Phase 2	Phase 3	5% Average	3% Average	2.5% Average	3% 95th Percentile	5% Average	3% Average	2.5% Average	3% 95th Percentile	5% Average	3% Average	2.5% Average	3% 95th Percentile	5% Average	3% Average	2.5% Average	3% 95th Percentile
2020				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	666	1,485	1,953	3,906
2021				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	693	1,532	2,009	4,035
2022				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	720	1,579	2,064	4,163
2023				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	747	1,626	2,120	4,292
2024				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	775	1,673	2,175	4,420
2025	0			$4	$8	$11	$22	$0	$0	$0	$0	$0	$0	$0	$0	802	1,720	2,230	4,548
2026		0		$0	$0	$0	$0	$49	$107	$139	$282	$0	$0	$0	$0	829	1,767	2,286	4,677
2027			-218	$0	$0	$0	$0	$0	$0	$0	$0	-$169,255	-$372,540	-$485,629	-$987,044	856	1,814	2,341	4,805
2028			-218	$0	$0	$0	$0	$0	$0	$0	$0	-$166,321	-$371,050	-$485,003	-$983,903	884	1,861	2,397	4,934
2029			-218	$0	$0	$0	$0	$0	$0	$0	$0	-$163,282	-$369,331	-$484,119	-$980,108	911	1,908	2,452	5,062
2030			-218	$0	$0	$0	$0	$0	$0	$0	$0	-$160,156	-$367,397	-$482,990	-$975,699	938	1,954	2,508	5,190
2031			-218	$0	$0	$0	$0	$0	$0	$0	$0	-$158,120	-$366,802	-$483,216	-$975,345	972	2,010	2,572	5,344
2032			-218	$0	$0	$0	$0	$0	$0	$0	$0	-$155,914	-$365,930	-$483,145	-$974,185	1,007	2,065	2,635	5,498
2033			-218	$0	$0	$0	$0	$0	$0	$0	$0	-$153,560	-$364,798	-$482,789	-$972,264	1,041	2,121	2,699	5,652
2034			-218	$0	$0	$0	$0	$0	$0	$0	$0	-$151,077	-$363,421	-$482,163	-$969,629	1,075	2,176	2,763	5,806
2035			-218	$0	$0	$0	$0	$0	$0	$0	$0	-$148,481	-$361,815	-$481,280	-$966,322	1,110	2,231	2,827	5,959
2036			-218	$0	$0	$0	$0	$0	$0	$0	$0	-$145,791	-$359,994	-$480,154	-$962,386	1,144	2,287	2,891	6,113
2037			-218	$0	$0	$0	$0	$0	$0	$0	$0	-$143,020	-$357,973	-$478,796	-$957,859	1,179	2,342	2,955	6,267
2038			-218	$0	$0	$0	$0	$0	$0	$0	$0	-$140,182	-$355,763	-$477,219	-$952,779	1,213	2,397	3,019	6,421
2039			-218	$0	$0	$0	$0	$0	$0	$0	$0	-$137,290	-$353,379	-$475,434	-$947,183	1,247	2,453	3,083	6,574
2040			-218	$0	$0	$0	$0	$0	$0	$0	$0	-$134,356	-$350,832	-$473,452	-$941,105	1,282	2,508	3,147	6,728
2041			-218	$0	$0	$0	$0	$0	$0	$0	$0	-$131,702	-$348,206	-$471,151	-$933,345	1,319	2,564	3,210	6,873
2042			-218	$0	$0	$0	$0	$0	$0	$0	$0	-$128,996	-$345,436	-$468,680	-$925,239	1,357	2,620	3,273	7,018
2043			-218	$0	$0	$0	$0	$0	$0	$0	$0	-$126,249	-$342,532	-$466,050	-$916,813	1,394	2,676	3,336	7,162
2044			-218	$0	$0	$0	$0	$0	$0	$0	$0	-$123,471	-$339,504	-$463,269	-$908,093	1,432	2,732	3,399	7,307
2045			-218	$0	$0	$0	$0	$0	$0	$0	$0	-$120,672	-$336,362	-$460,346	-$899,103	1,469	2,788	3,462	7,452
2046			-218	$0	$0	$0	$0	$0	$0	$0	$0	-$117,859	-$333,115	-$457,290	-$889,867	1,507	2,844	3,524	7,596
2047			-218	$0	$0	$0	$0	$0	$0	$0	$0	-$115,040	-$329,771	-$454,110	-$880,406	1,544	2,900	3,587	7,741
2048			-218	$0	$0	$0	$0	$0	$0	$0	$0	-$112,223	-$326,340	-$450,812	-$870,741	1,582	2,955	3,650	7,886
2049			-218	$0	$0	$0	$0	$0	$0	$0	$0	-$109,413	-$322,829	-$447,406	-$860,892	1,619	3,011	3,713	8,031
2050			-218	$0	$0	$0	$0	$0	$0	$0	$0	-$106,616	-$319,245	-$443,897	-$850,879	1,657	3,067	3,776	8,175
2051			-218	$0	$0	$0	$0	$0	$0	$0	$0	-$102,964	-$312,846	-$436,576	-$827,889	1,680	3,096	3,807	8,193
2052			-218	$0	$0	$0	$0	$0	$0	$0	$0	-$99,403	-$306,873	-$429,731	-$807,210	1,703	3,128	3,841	8,228
2053			-218	$0	$0	$0	$0	$0	$0	$0	$0	-$95,948	-$300,888	-$422,852	-$787,032	1,726	3,159	3,874	8,263
2054			-218	$0	$0	$0	$0	$0	$0	$0	$0	-$92,597	-$294,991	-$416,159	-$767,253	1,749	3,190	3,908	8,297
2055			-218	$0	$0	$0	$0	$0	$0	$0	$0	-$89,347	-$289,182	-$409,541	-$748,048	1,772	3,221	3,942	8,332
2056			-218	$0	$0	$0	$0	$0	$0	$0	$0	-$86,293	-$283,810	-$403,303	-$729,834	1,797	3,256	3,979	8,373
2057				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	1,823	3,291	4,017	8,415
2058				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	1,848	3,326	4,055	8,456
2059				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	1,873	3,360	4,092	8,497
2060				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	1,899	3,395	4,130	8,539
2061				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	2,021	3,548	4,296	9,067
2062				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	2,143	3,702	4,462	9,594
2063				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	2,264	3,856	4,628	10,122
2064				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	2,386	4,009	4,794	10,650
2065				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	2,508	4,163	4,960	11,177
2066				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	2,632	4,325	5,141	11,758
2067				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	2,757	4,488	5,323	12,338
2068				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	2,881	4,651	5,504	12,919
2069				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	3,006	4,814	5,686	13,499
2070				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	3,130	4,976	5,867	14,079
TOTALS:	0	0	-6,538	$4	$8	$11	$22	$49	$107	$139	$282	-$3,885,599	-$10,212,956	-$13,836,564	-$27,148,456				

Present Value (in Base Year) of Estimated SC-CH_4 for all CH_4 emissions (2020$)

	5% Average	3% Average	2.5% Average	3% 95th Percentile
Phase 1	$4	$8	$11	$22
Phase 2	$49	$107	$139	$282
Phase 3	-$3,885,599	-$10,212,956	-$13,836,564	-$27,148,456
Total	-$3,885,546	-$10,212,840	-$13,836,414	-$27,148,152

[1] The social cost estimates from the IWG represent the present value of damages from that year's emissions discounted back to the year of emissions. These columns discount that value to the base year in order to calculate the total net present value.

[2] Values from 2020–2050 are from *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide, Interim Estimates under E.O. 13990.* Interagency Working Group on Social Cost of Carbon, United States Government. February 2021.

[3] Values from 2051–2070 are from *Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Consumer Furnaces,* Appendix 14A. U.S. Department of Energy. June 2022.

SOCIAL COST OF NITROUS OXIDE (N_2O) ESTIMATING TOOL

Base Year: 2025 (Enter the base year on the instructions tab, step 2.)

Year of Emissions	Enter N_2O emissions (metric tons) (Use negative numbers for emission reductions)			Phase 1 Present Value (in Base Year) of Estimated SC-N_2O by emissions year (2020$)[1]				Phase 2 Present Value (in Base Year) of Estimated SC-N_2O by emissions year (2020$)[1]				Phase 3 Present Value (in Base Year) of Estimated SC-N_2O by emissions year (2020$)[1]				Per ton SC-N_2O Value (2020$/metric ton N_2O)[2]			
	Phase 1	Phase 2	Phase 3	5% Average	3% Average	2.5% Average	3% 95th Percentile	5% Average	3% Average	2.5% Average	3% 95th Percentile	5% Average	3% Average	2.5% Average	3% 95th Percentile	5% Average	3% Average	2.5% Average	3% 95th Percentile
2020				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5,779	18,405	27,131	48,256
2021				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5,981	18,842	27,688	49,464
2022				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6,183	19,279	28,244	50,671
2023				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6,385	19,717	28,801	51,879
2024				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6,587	20,154	29,358	53,087
2025	0			$15	$45	$66	$119	$0	$0	$0	$0	$0	$0	$0	$0	6,789	20,591	29,914	54,295
2026		0		$0	$0	$0	$0	$186	$570	$829	$1,503	$0	$0	$0	$0	6,991	21,028	30,471	55,502
2027			-35	$0	$0	$0	$0	$0	$0	$0	$0	-$226,726	-$703,086	-$1,026,265	-$1,857,548	7,193	21,465	31,028	56,710
2028			-35	$0	$0	$0	$0	$0	$0	$0	$0	-$221,992	-$696,508	-$1,019,199	-$1,841,851	7,395	21,902	31,585	57,918
2029			-35	$0	$0	$0	$0	$0	$0	$0	$0	-$217,195	-$689,716	-$1,011,867	-$1,825,493	7,597	22,339	32,141	59,125
2030			-35	$0	$0	$0	$0	$0	$0	$0	$0	-$212,352	-$682,729	-$1,004,286	-$1,808,526	7,799	22,776	32,698	60,333
2031			-35	$0	$0	$0	$0	$0	$0	$0	$0	-$208,663	-$677,159	-$998,112	-$1,795,404	8,047	23,268	33,309	61,692
2032			-35	$0	$0	$0	$0	$0	$0	$0	$0	-$204,845	-$671,335	-$991,641	-$1,781,512	8,295	23,760	33,921	63,051
2033			-35	$0	$0	$0	$0	$0	$0	$0	$0	-$200,917	-$665,276	-$984,892	-$1,766,907	8,542	24,252	34,532	64,410
2034			-35	$0	$0	$0	$0	$0	$0	$0	$0	-$196,898	-$659,000	-$977,883	-$1,751,641	8,790	24,744	35,144	65,770
2035			-35	$0	$0	$0	$0	$0	$0	$0	$0	-$192,807	-$652,525	-$970,629	-$1,735,765	9,038	25,236	35,755	67,129
2036			-35	$0	$0	$0	$0	$0	$0	$0	$0	-$188,658	-$645,868	-$963,148	-$1,719,328	9,285	25,728	36,366	68,488
2037			-35	$0	$0	$0	$0	$0	$0	$0	$0	-$184,468	-$639,046	-$955,454	-$1,702,376	9,533	26,219	36,978	69,847
2038			-35	$0	$0	$0	$0	$0	$0	$0	$0	-$180,249	-$632,073	-$947,562	-$1,684,954	9,781	26,711	37,589	71,206
2039			-35	$0	$0	$0	$0	$0	$0	$0	$0	-$176,013	-$624,964	-$939,487	-$1,667,101	10,029	27,203	38,201	72,565
2040			-35	$0	$0	$0	$0	$0	$0	$0	$0	-$171,772	-$617,733	-$931,242	-$1,648,860	10,276	27,695	38,812	73,924
2041			-35	$0	$0	$0	$0	$0	$0	$0	$0	-$168,213	-$611,205	-$923,608	-$1,631,676	10,567	28,225	39,456	75,349
2042			-35	$0	$0	$0	$0	$0	$0	$0	$0	-$164,603	-$604,533	-$915,793	-$1,614,094	10,857	28,754	40,100	76,773
2043			-35	$0	$0	$0	$0	$0	$0	$0	$0	-$160,955	-$597,731	-$907,809	-$1,596,152	11,147	29,283	40,745	78,197
2044			-35	$0	$0	$0	$0	$0	$0	$0	$0	-$157,282	-$590,813	-$899,670	-$1,577,887	11,437	29,813	41,389	79,621
2045			-35	$0	$0	$0	$0	$0	$0	$0	$0	-$153,593	-$583,790	-$891,388	-$1,559,331	11,727	30,342	42,033	81,045
2046			-35	$0	$0	$0	$0	$0	$0	$0	$0	-$149,899	-$576,675	-$882,975	-$1,540,517	12,018	30,872	42,677	82,470
2047			-35	$0	$0	$0	$0	$0	$0	$0	$0	-$146,209	-$569,480	-$874,442	-$1,521,477	12,308	31,401	43,321	83,894
2048			-35	$0	$0	$0	$0	$0	$0	$0	$0	-$142,530	-$562,214	-$865,800	-$1,502,239	12,598	31,930	43,965	85,318
2049			-35	$0	$0	$0	$0	$0	$0	$0	$0	-$138,870	-$554,889	-$857,059	-$1,482,831	12,888	32,460	44,610	86,742
2050			-35	$0	$0	$0	$0	$0	$0	$0	$0	-$135,235	-$547,513	-$848,230	-$1,463,278	13,179	32,989	45,254	88,166
2051			-35	$0	$0	$0	$0	$0	$0	$0	$0	-$131,732	-$538,606	-$836,194	-$1,427,743	13,479	33,426	45,727	88,606
2052			-35	$0	$0	$0	$0	$0	$0	$0	$0	-$128,428	-$531,179	-$826,985	-$1,407,716	13,798	33,954	46,354	89,984
2053			-35	$0	$0	$0	$0	$0	$0	$0	$0	-$125,149	-$523,742	-$817,728	-$1,387,644	14,118	34,483	46,981	91,362
2054			-35	$0	$0	$0	$0	$0	$0	$0	$0	-$121,891	-$516,273	-$808,447	-$1,367,533	14,438	35,011	47,609	92,739
2055			-35	$0	$0	$0	$0	$0	$0	$0	$0	-$118,660	-$508,796	-$799,117	-$1,347,430	14,758	35,539	48,236	94,117
2056			-35	$0	$0	$0	$0	$0	$0	$0	$0	-$115,559	-$501,663	-$790,196	-$1,326,893	15,091	36,092	48,890	95,463
2057				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	15,425	36,644	49,544	96,808
2058				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	15,758	37,196	50,199	98,154
2059				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	16,091	37,748	50,853	99,499
2060				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	16,424	38,300	51,507	100,845
2061				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	17,077	39,165	52,485	103,794
2062				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	17,730	40,030	53,463	106,743
2063				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	18,382	40,895	54,441	109,692
2064				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	19,035	41,760	55,419	112,641
2065				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	19,687	42,625	56,397	115,590
2066				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	20,354	43,515	57,403	118,657
2067				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	21,020	44,404	58,409	121,725
2068				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	21,686	45,293	59,416	124,793
2069				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	22,352	46,183	60,422	127,860
2070				$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	23,018	47,072	61,428	130,928
TOTALS:	0	0	-1,043	$15	$45	$66	$119	$186	$570	$829	$1,503	-$5,042,363	-$18,176,121	-$27,467,110	-$48,341,707				

Present Value (in Base Year) of Estimated SC-N_2O for all N_2O emissions (2020$)

	5% Average	3% Average	2.5% Average	3% 95th Percentile
Phase 1	$15	$45	$66	$119
Phase 2	$186	$570	$829	$1,503
Phase 3	-$5,042,363	-$18,176,121	-$27,467,110	-$48,341,707
Total	-$5,042,162	-$18,175,506	-$27,466,215	-$48,340,084

[1] The social cost estimates from the IWG represent the present value of damages from that year's emissions discounted back to the year of emissions. These columns discount that value to the base year in order to calculate the total net present value.

[2] Values from 2020–2050 are from *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide, Interim Estimates under E.O. 13990.* Interagency Working Group on Social Cost of Carbon, United States Government. February 2021.

[3] Values from 2051–2070 are from *Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Consumer Furnaces,* Appendix 14A. U.S. Department of Energy. June 2022.