

Environmental Assessment for the Grieve Unit CO₂ Enhanced Recovery Project Natrona County, Wyoming

WY-050-EA11-108



**Prepared for the Bureau of Land Management,
Lander Field Office**

July 2012



Grieve Unit CO₂ Enhanced Recovery Project Environmental Assessment

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CHAPTER 1: PURPOSE AND NEED

1.1 Introduction

This Environmental Assessment (EA) has been prepared to disclose and analyze the environmental consequences of the Grieve Unit CO₂ (GUCO₂) Enhanced Oil Recovery (EOR) project (Project) as proposed by Elk Petroleum Incorporated (Elk). The EA is a site specific analysis of potential impacts that could result with the implementation of a proposed action or alternatives to the proposed action. The EA assists the BLM in project planning and ensuring compliance with the National Environmental Policy Act (NEPA), and in making a determination as to whether any “significant” impacts could result from the analyzed actions. “Significance” is defined by NEPA and is found in regulation 40 CFR 1508.27. An EA provides evidence for determining whether to prepare an Environmental Impact Statement (EIS) or a statement of “Finding of No Significant impacts” (FONSI). If the decision maker determines that this project has “significant” impacts following the analysis in the EA, then an EIS would be prepared for the project. If not, a Decision Record (DR) may be signed for the EA approving the selected alternative, whether the proposed action or another alternative. A DR, including a FONSI statement, documents the reasons why implementation of the selected alternative would not result in “significant” environmental impacts.

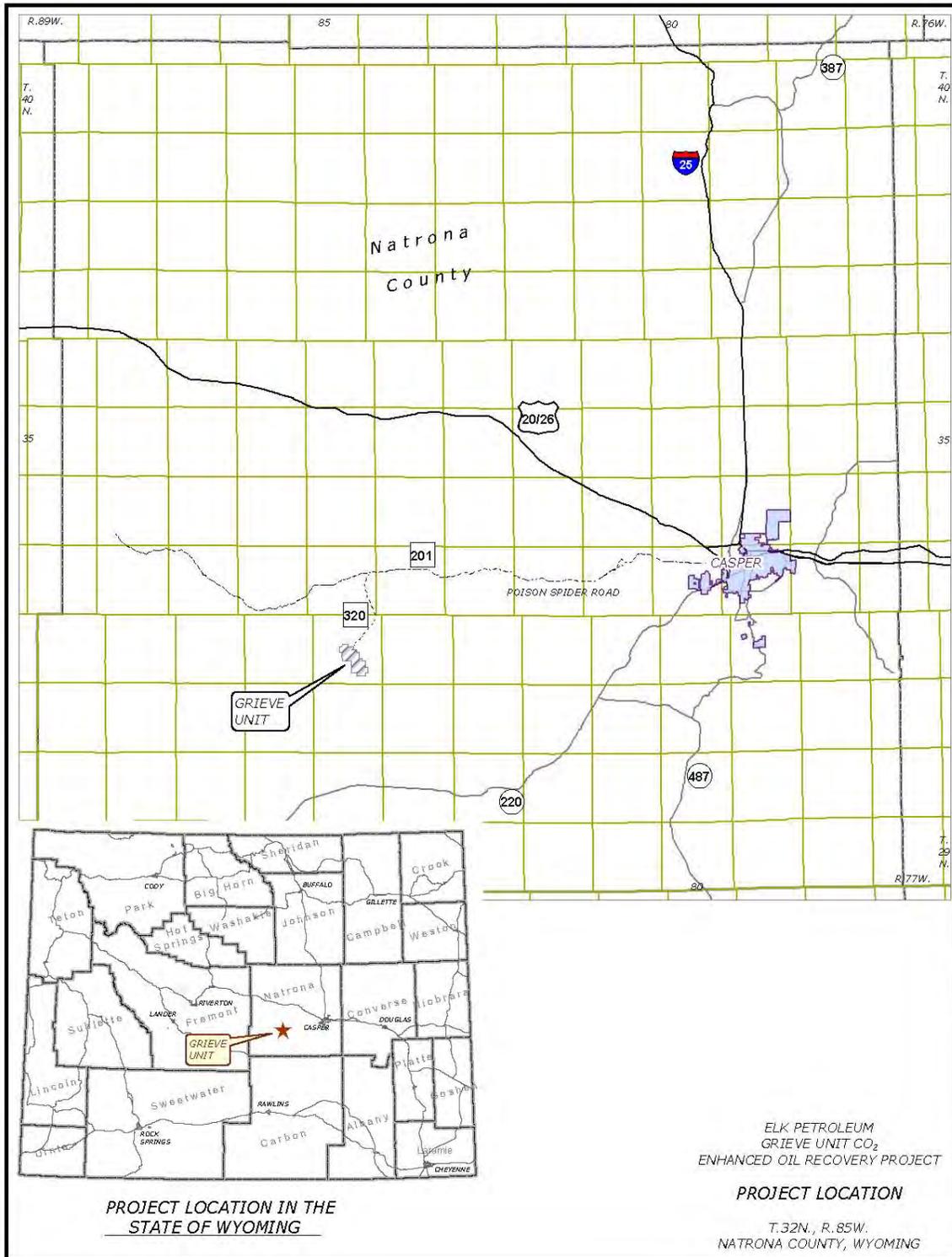
1.2 Background

The Grieve Unit lies within the Gas Hills Management Unit of the Lander Field Office of the Bureau of Land Management. Figure 1.2.1 provides a general location map showing the Grieve Unit CO₂ Enhanced Oil Recovery project and its location in central Wyoming.

Elk, the operator of the Grieve Unit, proposes to implement enhanced recovery from the Cretaceous Muddy “Grieve Sand” in the Grieve Unit using a miscible CO₂ flood with water injection to assist with reservoir re-pressurization. The Grieve Unit is an excellent CO₂ candidate as the field has not undergone secondary water-flood production.

Crude oil has been produced from the Cretaceous Muddy “Grieve Sand” in the Grieve Field since 1954; the area was later unitized. The Grieve Unit is made up of Federal, State and Fee minerals, which are held by the Grieve Unit designation. The field was initially developed and produced conventionally; in 1960 production rates were enhanced through gas injection, in 1977 the reservoir was “blown down” as the natural gas and oil were depleted. Production continues at low rates, currently, two wells are in operation, one well is producing crude oil and the other is a produced water injection well. In 2009, one well was drilled and shut-in. A map of the existing Grieve Unit is identified as Figure 1.2.2.

Figure 1.2.1: Location map of the Grieve Unit CO₂ enhanced oil recovery project area



Elk proposes to drill a total of 10 new crude oil and injection wells, on 6 new well pads, in the existing Grieve Unit in western Natrona County, Wyoming. Eight of these proposed wells are located on BLM managed surface or will access the federal mineral estate. Other project components include: a 3.62 mile CO₂ pipeline, a 3.75 mile 230 kV power line and substation, a new 2.62 mile underground 25 kV power distribution line and substation, replace and expand the existing infield gathering/injection system flow lines and a new CO₂ recycling and production facility. A project description for the project was received by the Lander Field Office (LFO) in March 10, 2011.

1.3 Need for the Proposed Action

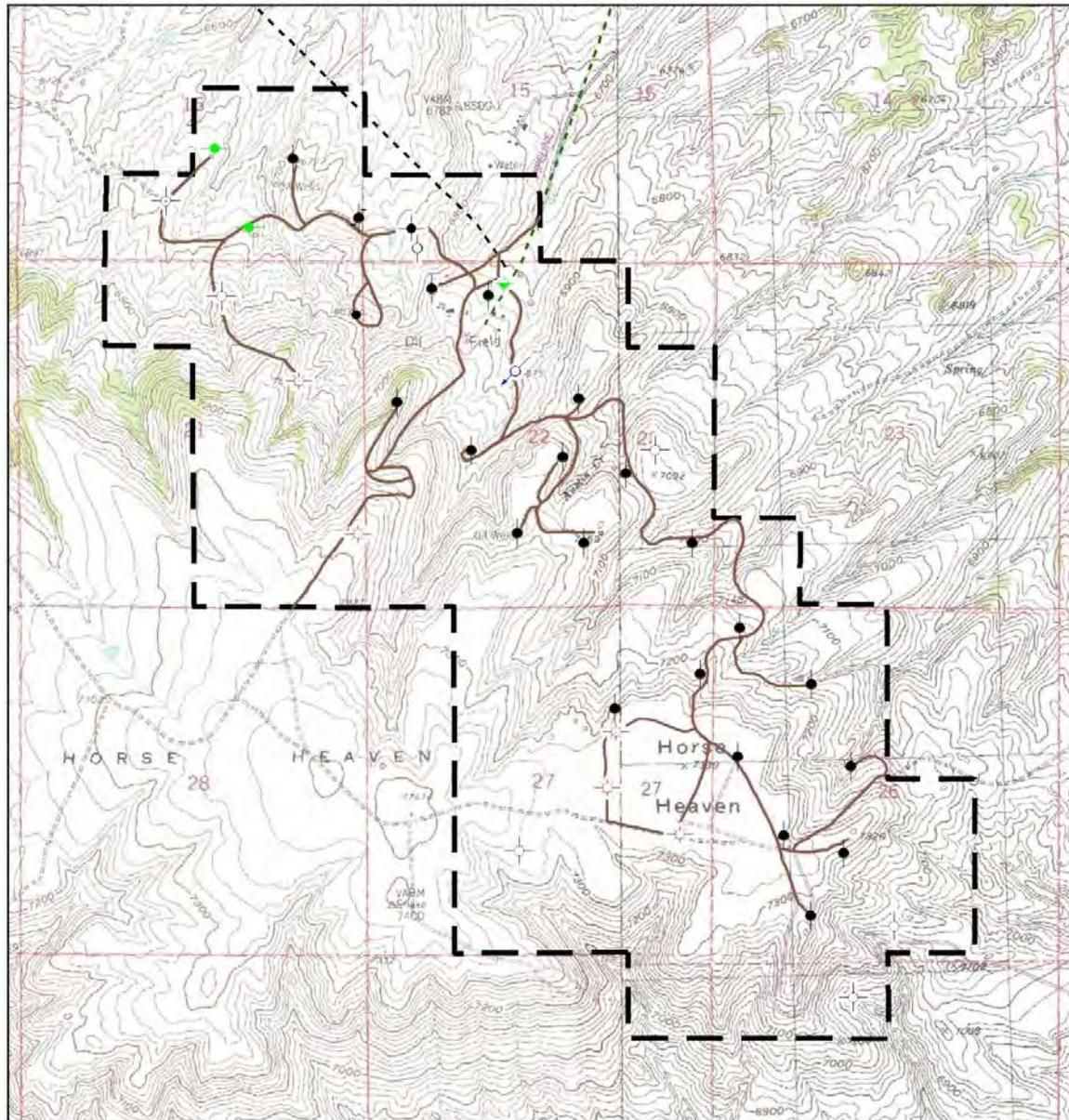
Elk, along with Tri-State Generation and Transmission (Tri-State), a utility power supplier, have filed, or will be filing, eight Applications for Permit to Drill, numerous Sundry Notices to re-work existing wells, and three rights-of way applications. The need is for BLM to respond to the applicants proposals to exercise valid existing rights by developing minerals within the Federal Grieve Unit WYW-109538X and corresponding Federal Leases. Consistent with the lease terms and conditions the operator shall explore and develop the federal minerals and, if successful, to produce the oil in commercial quantities.

Concurrent with BLM's requirements is the need for Western Area Power Administration (Western), a federal agency under Department of Energy, to respond to a new network load point of delivery along its existing Badwater to Spence 230-kV transmission line. Western must consider interconnection requests to its transmission system in accordance with its Open Access Transmission Tariff (Tariff) and the Federal Power Act (FPA), as amended. Western satisfies FPA requirements to provide transmission service on a non-discriminatory basis through compliance with its Tariff. Under the Tariff, Western offers capacity on its transmission system to deliver electricity when capacity is available. In reviewing interconnection requests, Western must ensure that existing reliability and service is not degraded. If BLM approves the Grieve Unit EOR project, Western would construct, operate, and maintain a switchyard at the requested point of delivery.

1.4 Purpose of the Proposed Action

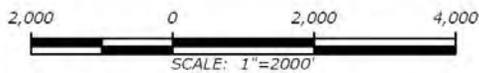
BLM is considering approval of a submitted proposal by the operator of the Federal Grieve Unit and utility supplier to develop new and enhance existing facilities for exploration and production of hydrocarbon resources under the authority of the Mineral Leasing Act of 1920 (the MLA), as amended, the Mining and Minerals Policy Act of 1970, the Federal Land Policy and Management Act of 1976 (FLPMA), the National Materials and Minerals Policy, Research, and Development Act of 1980, and the Federal Onshore Oil and Gas Leasing Reform Act of 1987. The intent of the MLA and its implementing regulations is to allow lessees to explore for and develop oil and gas or other mineral reserves on federally administered lands, including enhancing the production from depleted leases already under conventional production. FLPMA mandates that BLM manage public lands on the basis of multiple use [43 U.S.C. § 1701(a) (7)]. Minerals are identified as one of the principal uses of public lands in Section 103 of FLPMA and

Figure 1.2.2 - The existing Grieve Unit



LEGEND

- | | | |
|-----------------------------|-------------------------|---------------------------------|
| ● OIL WELL | ○ TEMPORARILY ABANDONED | --- 8' CRUDE OIL ROW |
| ● SHUT IN OIL WELL | ○ INJECTION WELL | --- NORTH GRIEVE CRUDE OIL LINE |
| ● ABANDONED OIL WELL | ○ SHUT IN GAS WELL | --- EXISTING ACCESS ROADS |
| ● DRY HOLE, SHOW OF OIL | ○ JUNKED | --- GRIEVE UNIT OUTLINE |
| ● TEMPORARILY ABANDONED OIL | ○ DRY HOLE | |



ELK PETROLEUM
GRIEVE UNIT CO.
ENHANCED OIL RECOVERY PROJECT
EXISTING CONDITIONS
T32N., R. 85W.
NATRONA COUNTY, WYOMING

are recognized as an appropriate use of federal lands and minerals in the Lander Resource Management Plan, signed June 9, 1987.

Consistent with these rights and authorities, the Operator of the leases have filed eight Applications to Permit to Drill, numerous Sundry Notices to conduct oil and gas operations as well as a right-of-way application for the proposed CO₂ pipeline, meter station and access road. The Operator will also be filing right-of-way applications for the proposed underground 25 kV power distribution line and the 230 kV power transmission line. BLM will consider approval of the proposed drilling and subsequent operations in a manner that avoids or reduces impacts on approximately 171 acres of BLM surface and/or mineral estate.

Western proposes to consider the request under its Tariff provisions and will identify and construct any system modifications necessary to accommodate the proposed point of delivery. Western's Federal action of approving the interconnection and any system modifications would be implemented through the construction of a sectionalizing switchyard and associated infrastructure for the interconnection to the Badwater to Spence 230 kV transmission line.

1.5 Conformance with BLM Land Use Plan

BLM management decisions for lands within the GUCO₂ Project Area are contained in the Final Resource Management Plan/Environmental Impact Statement for the Lander Resource Area, Lander, Wyoming (BLM 1986). Additional guiding documents include: Grazing Supplement to the Final Resource Management Plan/Environmental Impact Statement for the Lander Resource Area, Lander, Wyoming (BLM 1986) (BLM 1987); and Record of Decision for the Lander Resource Management Plan, signed June 9, 1987. The Lander Resource Management Plan (LRMP) is currently undergoing revision.

The environmental analysis that supports the decisions made in the LRMP is documented in LRMP EIS (1986). Resource and management values described in the LRMP that are applicable to the Proposed Action are described in Chapter 3, Affected Environment. The Lander Field Office "Summary of the Analysis of the Management Situation for the Lander Resource Management Plan Revision," dated June 30, 2009, was also considered in the development of Chapter 3 of the EA.

The Lander Resource Management Plan states that "public lands will be made available for oil and gas leasing and development to the maximum extent possible, while giving due consideration to the protection of other significant resource values." The proposed project area is located in the Gas Hills Management Unit (GHMU) and is open for oil and gas leasing/development activities in conformance with the RMP. All the lands in the GUCO₂PA have been leased. Surface disturbing activities, including mineral exploration and development, are permitted in the GHMU, subject to the guidelines and constraints found in the LRMP. Generally, many of those are expressed as stipulations attached to the oil and gas leases.

The Grieve Unit CO₂ Enhanced Oil Recovery Project EA will incorporate the appropriate decisions, terms, and conditions of use described in the RMP. Site specific use authorizations [i.e., ROWs, permits] for well pads, roads, pipelines, and associated facilities will be processed

through the BLM Application for Permit to Drill (APD) and Sundry Notice process. In accordance with 43 CFR 1610.5-3, the Proposed Action has been reviewed and has been found to be in conformance with the LRMP.

1.6 Relationship to Statutes, Regulations, or other Plans

Drilling of federal minerals is subject to the BLM's Onshore Oil and Gas Orders (43 CFR Subpart 3164 – Special Provisions). BLM Onshore Order Nos. 1 and 2 require an applicant to comply with the following conditions:

- Operations must result in the diligent development and efficient recovery of resources;
- All activities must comply with applicable federal, state, and local laws and regulations applicable to federal leases;
- All activities must include adequate safeguards to protect the environment;
- Disturbed lands must be properly reclaimed; and
- All activities must protect public health and safety.

Onshore Order No. 1 specifically states that lessees and Operators should be held fully accountable for their contractors' compliance with the requirements of the approved permit and/or plan (43 CFR Part 3160; March 7, 2007).

Pipeline and road rights-of-way on federal lands would be issued under the authority of the MLA of 1920, as amended, or the FLPMA. Right-of-way grants authorizing construction of ancillary facilities, access roads, and pipelines would provide Operators certain rights subject to the terms and conditions incorporated into the grant by the BLM.

The development of this project would not affect the achievement of the Wyoming Standards for Healthy Rangelands (August 1997).

The proposed Project would comply with all applicable federal, state, and local agency laws, plans, and permits required for this activity, including, but not limited to, those issued by the US Environmental Protection Agency (EPA), US Office of Pipeline Safety (OPS), US Fish and Wildlife Service (FWS), Wyoming Oil and Gas Conservation Commission (WOGCC) that has regulations and standards affecting well spacing, permits, and safety, Wyoming Department of Environmental Quality (WDEQ) which has jurisdiction over air and water quality, Wyoming State Historic Preservation Office (SHPO), and the Wyoming State Engineers Office (WSEO). The following list (Table 1.6.1) includes the other authorities that may apply to BLM actions.

The area was assessed as per the Wyoming Instruction Memorandum (IM) WY-IM-2012-019 (Greater Sage-grouse Habitat Management Policy on Wyoming Bureau of Land Management (BLM) Administered Lands including the Federal Mineral Estate), the Governor's Greater Sage-Grouse Core Area Protection Strategy, executive Order 2011-5 (2011), the State Land and Investments Board Greater Sage-grouse Core Area Guidelines (2009, to be revised). The IM directs the BLM to analyze Greater Sage-grouse habitat out to a minimum of four miles from the project location. This analysis is to occur both within and outside of the Greater Sage-grouse core areas (core areas as designated by the Wyoming Governor's Executive Order EO 2011-5).

The Proposed Action is in conformance with the *State of Wyoming Land Use Plan* (Wyoming State Land Use Commission 1979), and the Natrona County Development Plan (1998) and complies with all other relevant federal, state, and local laws. Table 1.1 provides an overview of major laws applicable to oil and gas development and an overview of the key regulatory requirements that would govern oil and gas project implementation. Additional approvals, permits, and authorizing actions may be necessary.

Table 1.6.1: Major Federal, State, and Local Permits, Approvals, and Authorizing Actions Applicable to Oil and Gas Development in Natrona County, Wyoming

Agency	Permit, Approval, or Action	Authority
United States		
Bureau of Land Management (BLM)	Rights-of-way (ROW) grants and temporary use permits for power lines, pipelines, off lease access roads and central tank batteries on BLM-managed land	Mineral Leasing Act of 1920, as amended (30 U.S.C. 185); Onshore Oil and Gas Unit Agreements: Unproven Areas, as amended (43 C.F.R. 3180); FLPMA of 1976 (43U.S.C. 1701)
	Authorization for flaring and venting of natural gas on BLM-managed land	Mineral Leasing Act of 1920, as amended (30 U.S.C. 181 et seq.); Requirements for Operating Rights Owners and Operators, as amended (43 C.F.R. 3162)
	Plugging and abandonment of a well on BLM-managed land	Mineral Leasing Act of 1920, as amended (30 U.S.C. 181 et seq.); Requirements for Operating Rights Owners and Operators, as amended (43 C.F.R. 3162)
	Antiquities and cultural resource permits on BLM-managed land	Antiquities Act of 1906, as amended (16 U.S.C. 431-433); Archaeological Resources Protection Act of 1979, as amended (16 U.S.C. 470aa-47011); Preservation of American Antiquities, as amended (43 C.F.R. 3)
	Approval to dispose of produced water on BLM-managed land	Mineral Leasing Act of 1920, as amended (30 U.S.C. 181 et seq.); Special Provisions, as amended (43 C.F.R. 3164); Onshore Oil and Gas Order No. 7 as amended (58 Federal Register 47,354)
Fish and Wildlife Service (USFWS)	Coordination, consultation and impact review of federally listed threatened and endangered (T&E) species	Fish and Wildlife Coordination Act (16 U.S.C. 661-666c); Section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C.

		1536); Bald Eagle Protection Act (16 U.S.C. 668-668dd)
	Migratory bird impact coordination	Migratory Bird Treaty Act (16 U.S.C. 704)
Environmental Protection Agency (EPA)	Spill Prevention Control and Countermeasures (SPCC) Plans	Oil Pollution Prevention, as amended (40 C.F.R. 112)
State of Wyoming		
Department of Environmental Quality, Water Quality Division (WDEQ/WQD)	WYPDES permits for discharging waste water and storm water runoff	WDEQ-WQD Rules and Regulations, Chapter 18; Wyoming Environmental Quality Act, Article 3, Water Quality, as amended (W.S. 35-11-301 through 35-11-311); Section 405 of the Federal Water Pollution Control Act (Clean Water Act) (codified at 33 U.S.C. 1345); EPA administered (40 C.F.R. 122); State Program Requirements (40 C.F.R. 123); EPA Water Program Procedures for Decision-making, as amended (40 C.F.R. 124)
	Administrative approval for discharge of hydrostatic test water	Wyoming Environmental Quality Act, Article 3, Water Quality, as amended (W.S. 35-11-301 through 35-11-311)
Department of Environmental Quality, Air Quality Division (WDEQ/ADQ)	Permits to construct and permits to operate	Clean Air Act, as amended (42 U.S.C. 7401 et seq.); Wyoming Environmental Quality Act, Article 2, Air Quality, as amended (W.S. 35-11-201 through 35-11-212)
Wyoming Board of Land Commissioners/Land and Farm Loan Office	Approval of oil and gas leases, ROWs for long-term or permanent off-lease/off-unit roads and pipelines, temporary use permits, and development on state lands	Public Utilities, W.S. 37-1-101 et seq.
Wyoming Oil and Gas Conservation Commission (WOGCC)	Permit to drill, deepen or plug back (APD process)	WOGCC Regulation, Chapter 3, Operational and Drilling Rules, Section 2 Location of Wells
	Permit to use earthen pit (reserve pit)	WOGCC Regulations, Chapter 4, Environmental Rules, Including Underground Injection Control Program Rules for Enhanced Recovery and Disposal Projects, Section 1, Pollution and Surface

		Damage (Forms 14A and 14B)
	Authorization for flaring or venting of gas	WOGCC Regulations, Chapter 3, Operational and Drilling Rules, Section 45 Authorization for Flaring or Venting of Gas
	Permit for Class II underground injection wells	Underground Injection Control Program: Criteria and Standards, as amended (40 C.F.R. 146); State Underground Injection Control Programs, State-administered program- Class II Wells, as amended (40 C.F.R. 147,2551)
	Well plugging and abandonment	WOGCC Regulations, Chapter 3, Section 14, Reporting (Form 4) Section 15, Plugging of Wells, Stratigraphic Toxic, Core, or Other Exploratory Holes (Form 4)
State Engineer's Office (WSEO)	Permits to appropriate ground water (use, storage, wells, dewatering)	W.S. 41-3-938, as amended (Form U.W. 5)
Wyoming Preservation Office (SHPO)	Cultural resource protection, programmatic agreements, consultation	Section 106 of National Historic Preservation Act of 1966, as amended (16 U.S.C. 470 et req.) and advisory Council Regulations on Protection of Historic and Cultural Properties, as amended (36 C.F.R. 800)
County		
Natrona County	Strive for consistency with the 1998 Natrona County Development Plan; Area H Rattlesnake Hills.	

1.7 IDENTIFIED ISSUES AND RESOURCES

BLM is directed by guidance, statute, or regulation to describe the environment of area(s) to be affected or created by alternatives under consideration. CEQ regulations direct BLM to concentrate effort on attention on important issues, especially the presence or absence of the potentially significant resources presented in Table 1.7.1. All areas presented in Table 1.7.1 were considered but many were not considered pertinent to the proposed action or affected to a degree of any importance and therefore were not carried forward for further analysis. If particular resources are not affected beyond minimal amount, or if the resource is not present, there will be no further discussion of the resources in the Affected Environment (Chapter 3), or in any of the subsequent impact analysis. The discussion of these environmental impacts is therefore restricted to topics related to resources which are affected and carried forward for analysis.

Table 1.7.1 – Potentially Significant Resources

Resource	Guidance or authority	Present in Project Area
Floodplains	EO 11998; 10 CFR 1022	Not present
Wetlands	EO 11990; 10 CFR 1022, CEQ 1508.27(b)(3)	Present
Threatened, endangered, or candidate species and/or their critical habitat , and other special status (e. g., state-listed) species	CEQ 1508.27(b)(9)	Present - greater sage-grouse, Ferruginous hawk and white-tailed prairie dog
Prime or unique farmland	7 USC 4201; CEQ 1508.27(b)(3)	Not present
State or national parks, forests, conservation areas, or other areas of recreational, ecological, scenic, or aesthetic importance	CEQ 1508.27(b)(3)	Not present
Wild and Scenic Rivers	16 USC 1271; CEQ 1508.27(b)(3)	Not present
Natural resources (e.g., vegetation, rangeland, soils, minerals, fish, wildlife, water bodies)	CEQ 1508.8	Present – vegetation, rangelands, soils, minerals, and wildlife. No fisheries present.
Coastal Zone areas	16 USC 1451 et seq.	Not present
Property of historic, archeological, or architectural significance (including sites on or eligible for the National Register of Historic Places and the National Registry of Natural Landmarks	EO 11593; CEQ 1508.27(b)(3)(8)	Not present
Native American Concerns	EO 13007	Present
Minority and low-income populations (including a description of their use and consumption of environmental resources)	EO 12898	Not present
Migratory Birds	EO 13186	Present

1.7.1 Relevant Issues and Resources

The BLM internal and public scoping processes led to the identification of the following land and resource management issues and concerns potentially associated with the Proposed Action, relevant issues carried forward in this analysis include the following:

1.7.1.1 Climate, Climate Change, & Air Quality

- Potential effects to air quality due to increased traffic, emissions, production activities and associated effects on existing county, state, and BLM roads.

- Impacts to climate change and the State of Wyoming commitment to CO₂ (Green House Gas) sequestration and enhanced recovery of oil from existing fields.

1.7.1.2 Cultural

- Provide protection of cultural and Native American resources, including protection of sites within the project area.

1.7.1.3 Wildlife including T&E, Special Status Species

- Ensuring protection of the BLM designated Special Status Species ferruginous hawks and other raptors during nesting season, sagebrush obligate song birds and white-tailed prairie dog.
- Protection of the BLM designated Special Status Species greater sage-grouse potentially affected by the project including all seasonal habitats with specific emphasis on protection of designated Core Population Areas.
- Effect of project related noise on greater sage-grouse.
- Indirect, connected, related, long-term and cumulative impacts of the project on wildlife habitats and diversity.
- Cumulative effects of the proposed project when combined with ongoing crude oil and natural gas drilling and development.

1.7.1.4 Soils

- Soil productivity and erodibility are potentially affected by project construction activities.

1.7.1.5 Vegetation including Invasive Non-Native Species, Threatened and Endangered and Special Status Species

- Ensuring protection of the BLM designated Special Status Species and their habitats.
- Project related impacts to rangeland condition and plant community diversity.
- Control of invasive, non-native species (weeds).
- Project disturbance reclamation.

1.7.1.6 Water Quality (Groundwater & Surface Water)

- Impacts on wetlands and riparian areas.
- Impact to ephemeral and intermittent drainages from erosion from disturbed sites.
- Possible effects to surface and groundwater resources from well drilling and completion, construction and operations activities.
- Exotic organisms such as Aquatic Invasive Species (AIS) will be controlled as required by the Wyoming Game and Fish Department (WGFD).

1.7.1.7 Socioeconomics

- Impacts of the project to the Federal, State, local economies.
- Providing opportunity for alternative energy sources including wind projects.

1.7.2 Resources Considered but Eliminated from Further Analysis

Using the same evaluation process discussed in Section 1.7.1, above, the following land and resource management issues and concerns were determined not to be relevant to this project and were eliminated from Further Analysis.

1.7.2.1 Floodplains - none are present

1.7.2.2 Prime or Unique Farmlands Soils - none are present

1.7.2.3 Wild and Scenic Rivers - none are present

1.7.2.4 Coastal Zone Areas - none are present

1.7.2.5 Minority and low-income Populations

1.7.2.6 State, or Natural Parks, Forests, Conservation Areas, or other Areas of Recreational, Ecological, Scenic, or Aesthetic Importance

- The proposed project is in an area designated as VRM Class IV, which is highly tolerant of manmade/industrial features.
- None of the other listed resources are present in the area.

1.7.2.7 Historical and Paleontological

- There are no known historical or architectural resources in the project area.
- There are no known paleontological resources in the project area.

1.7.2.8 Social

- Environmental justice and impacts to minority communities will not occur as a result of the project. While the Eastern Shoshone and Northern Arapaho tribes are residents of Fremont County and were consulted relative to Native American cultural resources the reservation is located over one hundred twenty miles to the west of the project area. The cities of Riverton and Casper, and their associated minority communities are over 120 and 50 miles away, respectively, and will not be directly affected by the project.

1.7.2.9 Geologic/physiologic

- No geologic hazards are known to occur in the project area.
- Locatable and leaseable minerals would not be affected by the project as BLM LFO knows of no deposits or other proposals for development of these resources. Leaseable minerals in the project area are held by Elk.

1.7.2.10 Wild Horses

- There are no BLM designated wild horse herd management areas (HMAs) in the project area.

1.7.2.11 Rangeland and Other Land Uses

- No direct impacts to grazing/livestock management infrastructure due to project related construction as design features will be implemented to eliminate any impacts.
- No impacts on grazing lessees and private land owners.
- The ability to graze livestock in the project area will not be affected by the project; the number of animals permitted as animal unit months or AUMs will not be changed as a result of the project.

1.7.2.12 Recreation

- No impacts to recreation and leisure activities resulting from the project, including no loss of accessibility of the area to hunters.
- Hunting opportunities will not change as wildlife in the area has, over the last 50 years, either habituated to the well field activities or has moved to other areas.
- There are no BLM authorized commercial outfitters in the project area.

1.7.2.13 Wildlife including Threatened and Endangered and BLM Special Status Species related issues determined not to be relevant and will not be discussed further in this EA:

- WGFD has determined that big game critical winter ranges will not be impacted by the project.
- The Wyoming State Engineers Office (2012) has determined that the North Platte River Species, as defined in the Endangered Species Act (ESA), would not be affected by the project as the area is not hydrologically connected to the North Platte River.
- There are no fisheries were identified in the project area.
- The 2005 Statewide Programmatic Biological Assessment (BA) for Black-footed Ferrets (BLM 2005) indicates three historic ferret observations are known from the Lander Field Office (FO), all from Fremont County. Only one significant prairie dog complex has been identified in the FO (BLM 2005); all other areas in Lander field office, including the Grieve Unit project area, were deemed “block cleared” (BLM 2005, WGFD 2004). Therefore, the project area is not likely to provide habitat for black-footed ferrets. In addition, the BA (BLM 2005) determined that oil and gas projects in the block cleared areas were “Not likely to adversely affect” meaning that all effects to the species and its critical habitat are beneficial, insignificant, or discountable (BLM 2005). A concurrence letter from the USFWS was received by BLM, with the direction that when an activity occurs within a FO that *could* impact black-footed ferrets, then specific additional consultation must take place (BLM 2005). The project area is not likely to adversely affect black-footed ferrets.

1.7.2.14 Vegetation including Invasive Non-Native Species, Threatened and Endangered and Special Status Species related issues determined not to be relevant and will not be discussed further in this EA:

- No Threatened or Endangered plant species or their habitats were identified as being potentially impacted by in the project actions.
 - No individuals or populations of blowout penstemon were found during field surveys, and based on the lack of suitable habitat characteristics; local habitat was

confirmed unsuitable for blowout penstemon. A data request from the Wyoming Natural Diversity Database (WYNND) indicates there have been no known occurrences of blowout penstemon within or near the proposed project area (WYNDD 2011).

- No individuals or populations of Ute ladies'-tresses were found during field surveys, and based on the lack of suitable habitat characteristics, local habitat was confirmed unsuitable for Ute ladies'-tresses. A data request from the WYNND indicates there have been no known occurrences of Ute ladies'-tresses within or near the proposed project area (WYNDD 2011).

1.8 Summary

The proposed project is consistent with all applicable Federal, State and local laws and regulations and is in conformance with applicable land Use Plans and leases. The Operator holds active Federal, State and Fee oil and gas leases in the established Grieve Unit. The Operator is responsible for the application and acquisition of appropriate permits. In addition, Elk has entered into contracts for the shipping and delivery of CO₂ from ExxonMobil and Anadarko and the delivery of power from the Western Area Power Authority (Western). This EA evaluates the effect of the proposed action on natural resources and the environment given the successful implementation of the design features discussed in Chapter 2.

CHAPTER 2 - PROPOSED ACTION AND ALTERNATIVES

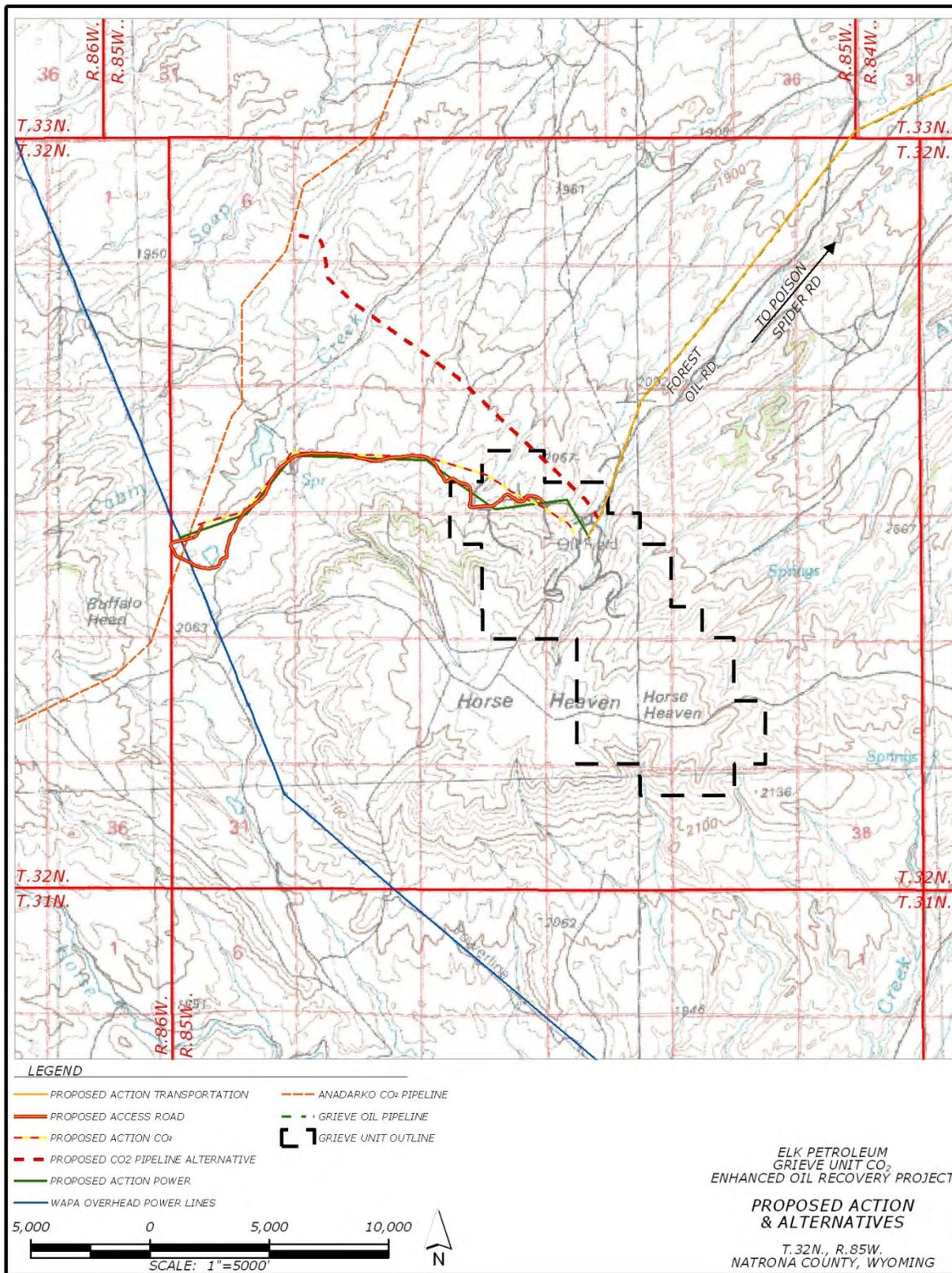
2.1 INTRODUCTION

Elk met with the Lander BLM staff in March 2011 to discuss their proposal for enhanced oil recovery at the existing Grieve Unit using CO₂ re-pressurization. Following this initial meeting and subsequent field visits, BLM LFO requested Elk evaluate various alternatives to some of the components of their proposal. Changes were made to the Elk proposal as a result of these analyses, including re-routing the CO₂ pipeline, relocation or changes to some well sites and the underground installation of the 25 kV power distribution line. As a result of these deliberations, the No Action and the Proposed Action alternatives are evaluated in detail in this EA (Figure 2.1.1).

- Section 2.2 provides the No Action Alternative, which would result in a continuation of the current production of one well in the field. In the event that the Operator submitted applications for additional work in the Unit, the BLM would evaluate each under a separate NEPA process.
- The Proposed Action is discussed in Section 2.3 and includes the drilling of ten new wells, the installation of a CO₂ pipeline, an aboveground 230 kV transmission line, an underground 25 kV power distribution line, two electrical substations, replacement and enlargement of the existing infield fluids gathering and distribution system, and the replacement of the existing central production facility. Existing wells will be reworked and/or plugged under Sundry Notice approvals. Crude oil production in response to reservoir re-pressurization with CO₂ and produced water is expected to be significant.
- Section 2.4 provides an overview of Alternatives Considered but Eliminated from Further Analysis and includes a CO₂ pipeline co-located in the existing Grieve to North Grieve crude oil pipeline right-of-way, above ground installation of the 25 kV power line, and a variety of additional considerations.

Potential impacts to sage-grouse, cultural sites and wetlands were identified relative to the Grieve/North Grieve crude oil right-of-way alternative, while disruptions in sage-grouse habitat conservation were identified as issues for the installation of the aboveground 25 kV distribution line. The Proposed Action, through the application of BLM required COAs and Stipulations and Design Features, avoids or minimizes impacts to wetlands, cultural sites, BLM Special Status Species, including sage-grouse, and maximizes the re-use and co-location of infrastructure.

Figure 2.1.1 – Grieve Unit CO₂ project proposed action and alternatives considered



2.2 ALTERNATIVE A – NO ACTION

CEQ regulations at 40 CFR 1502.14(d) require that an environmental analysis include the alternative of No Action. Under the No Action alternative, the Proposed Action will not take place. Inclusion of the No Action alternative allows the comparison of the environmental effects of taking no action with those of permitting the proposed activity or an alternative activity to go forward.

Consideration of the No Action alternative is required even if the federal agency is under legislative command to act. In the case of the Grieve Unit CO₂ EOR project, the operator possesses oil and gas leases that grant the "right and privilege to drill for, mine, extract, remove and dispose of all oil and gas deposits" in the leased lands, subject to the terms and conditions incorporated in the lease (Form 3110-2). BLM can constrain further development of the leases and the Unit according to lease stipulations and can condition proposed development activities so they are pursued in ways that avoid, minimize or mitigate environmental impacts. The principal purpose of the No Action alternative is to provide a benchmark, enabling the public and the decision maker to compare the relative magnitude of the environmental effects of the action alternatives.

For analytical purposes, the Grieve Unit CO₂ EOR No Action Alternative means that the CO₂ project components of the Proposed Action will not be approved on federal surface or mineral estate; the associated well pads, roads and pipelines will not be constructed, production facilities as proposed will not be installed, and the associated production and CO₂ injection activity will not take place. Elk could continue producing the Unit in its current form; it is comprised of 24 existing inactive wells, 2 active wells and a simple tank battery; a No Action Alternative decision would forgo the opportunity to recover an additional 12 million barrels BBL of crude oil from the field. Elk could apply for permits through the BLM Sundry Notice process for updates to existing wells and infrastructure. Crude oil is currently being transported via Poison Spider Road to Casper via haul truck. The Grieve Unit is currently marginally productive due to a loss of reservoir energy. BLM could request Elk to plug uneconomic wells.

A finding of No Action does not preclude development of the federal mineral estate in the future. BLM will evaluate any future proposal on its own merits. Proposals for exploration or development, including rights-of-way for access across federal lands, will be subject to site-specific analysis prior to approval or authorization. Future proposals to develop the hydrocarbon resource and exercise existing lease rights on Federal mineral estate will be received and processed by the BLM on a case-by-case basis.

2.3 ALTERNATIVE B – PROPOSED ACTION

Overview and Summary

The Environmental Assessment for the project considers all modifications, surface disturbances, and disruptions, within and outside the Unit, associated with the Proposed Action. Upgrades to operating facilities within the Grieve Unit will be permitted through the BLM Sundry Notice approval process. The Cumulative Effects Analysis (Chapter 4.2) will include not only the Proposed Action and all modifications, surface disturbances, and disruptions associated with the Proposed Action but also the existing facilities and anticipated operation of the CO₂ project.

In order to implement the proposed Grieve Unit CO₂ (GUCO₂) enhanced oil recovery (EOR) project Elk will make the following modifications to the existing Grieve Unit infrastructure including new electrical service and a CO₂ pipeline into the field from the west.

- a) **CO₂ pipeline and delivery point:** Elk has entered into a CO₂ purchase agreement with ExxonMobil, and a tie-in agreement with Anadarko, for delivery of CO₂ to the field. The Anadarko CO₂ line is located approximately 3.62 miles to the west of the Grieve Unit. Elk will build a new eight inch CO₂ pipeline connecting the Anadarko line to the Grieve Unit. A 1 acre CO₂ meter station will be installed on a 5 acres site at the connection point of the Grieve and Anadarko CO₂ lines.
- b) **New and existing wells** will be drilled, recompleted or plugged and abandoned to achieve the most efficient reservoir re-pressurization and production pattern.
- c) **Existing access roads, well sites, gathering lines and electricity** will be used to the maximum extent possible.
- d) **In-field liquids gathering and distribution systems** will consist of three sets of flow lines in a corridor branching off to the respective wells. These trunk lines will roughly follow the route of the existing natural gas/crude oil gathering pipeline system and branch off to the individual wells via the most direct cross country route or parallel to the well site access roads, depending on topography and the location of existing flow lines in the Unit.
- e) **One centralized production, separation and CO₂ re-pressurization facility** is anticipated. This will be constructed at the site of the existing Grieve Unit central facility in an effort to minimize surface disturbance.
- f) **Electricity:** It is estimated at 15,000 to 20,000 horse power will be needed for the proposed CO₂ project, to accomplish this:
 1. Tri-State will construct a new 3.75 mile overhead 230 kV power line from the existing Western system to the Grieve Unit central facility.
 2. Two electrical sub-stations/switchyards will be necessary for the proposed overhead power line; a switchyard will be located at the interconnect point with the Western system and a substation in the Grieve Unit.
 3. Electrical service will be needed at the CO₂ pipeline tie-in point meter station; this will be drawn from the in-field power infrastructure and installed underground, generally following the CO₂ pipeline access ROW, from the existing Grieve #17 well back to the meter station, approximately 2.6 miles of line.
 4. The well-field infrastructure will continue to be electrified using the existing power service; any new in-field power will be installed underground, to the extent feasible. The nature of those upgrades is unknown and will be analyzed if and when the need arises.

- g) **Crude oil will be transported to market** via the existing 8 inch crude oil line from the Grieve Unit to a pipeline terminal located in Mountain View/Casper.
- h) **Reclamation of disturbed areas** will be expedited, following the site specific reclamation plan developed for the project (Appendix B).

2.3.1 Construction

Following is a general discussion of proposed construction techniques to be used by Elk during project implementation. These construction techniques will be generally applicable to all drill sites, pipelines, and access roads within the project area, but may vary in detail between the individual well sites. Estimates of anticipated surface disturbance were generated from the development that has occurred in the Grieve Unit to date and design specification for the various infrastructure components. The disturbance anticipated from the development of the proposed project is shown in Table 2.3.1. Total short-term project disturbance is estimated at 171.0 acres. After successful interim reclamation, long-term disturbance is estimated at 35 acres.

Table 2.3.1 - Anticipated surface disturbance from Grieve Unit CO₂ EOR proposed action

Category	Proposed Action Components	Proposed Action Disturbance Assumptions	New Short Term (ST) (acres)	New Life of Project (LOP) (acres)
Multi-well pads	4	New wells average initial disturbance average 3.3 acres; reduced to 1.5 acres *	13.2	6.0
Single well pads	2	New wells initial disturbance average 3.0 acres; reduced to 1.04 acres **	6.0	2.08
Monitoring well	-0-	Re-enter existing well	-0-	-0-
Well site access roads	0.5 mi	Initial construction 24 ft wide Reduced to 16 ft driving surface	1.45	0.96
Centralized facility and Horse Heaven Substation	-0-	Remove unnecessary and antiquated equipment; replace with new and reclaim unused areas.	-0-	-0-
Un-used wells	-0-	Plug and abandon; reclaim sites; assume 1.04 acres each	2.08	-0-
In-field gathering/injection pipelines (single lines)	3.7 mi	Follow the alignment of the existing infield gathering lines and access roads to the extent possible; construction ROW 40 ft wide	18.08	-0-
In-field gathering/distribution pipelines (multiple lines)	4.5 mi	Follow the alignment of the existing infield gas line and access roads to the extent possible; construction ROW 100 ft wide	54.75	-0-
Western Buffalo Head substation	10.0 acres	Locate Western breakers and step-down sub-station	10.0	10.0
Western existing 230 kV transmission line ROW fiber optics	11.2 mi.	String overhead along existing 230kV line, replacing existing ground wire; existing Western ROW	-0-	-0-

Table 2.3.1 - Anticipated surface disturbance from Grieve Unit CO₂ EOR proposed action

Category	Proposed Action Components	Proposed Action Disturbance Assumptions	New Short Term (ST) (acres)	New Life of Project (LOP) (acres)
Tri-State 230 kV transmission line ROW***	3.75 mi	3.75 mi; 21 to 24 H-brace pole and 6 to 8 three pole structures (average disturbance 0.15 acre per structure)	3.6	0.02
Tri-State 230 kV transmission line ROW, structure access roads	0.33 mi	16 ft wide unimproved 2-track structure access roads	0.63	0.63
25 kV underground distribution line	2.6 mi.	2.6 miles; located on the south edge of the CO ₂ pipeline construction ROW disturbance. Trenching of 355 ft. of wetlands (10 ft blade width)	0.05	-0-
CO ₂ tie-in meter station	5.0 acres	Fenced yard with building containing metering equipment and outside pipeline connections	5.0	2.5
CO ₂ connector line ROW	3.62 mi.	75 ft initial construction disturbance width	32.90	-0-
Power line / CO ₂ line access road	3.5 mi.	24 ft wide construction, 16 ft. LOP	10.11	6.75
Total acres of new disturbance			171.05 ST	34.94 LOP

assume no new disturbance on existing well sites

* Initial new well disturbance average 3.3 acres reduced to 1.5 acres for operations

** Initial new well disturbance average 3.0 acres reduced to 1.04 acres for operations

*** Will use in-filed common staging area during construction

a) Well Pad Construction

Multi-well pads will be prepared by clearing an area approximately 325 feet by 200 feet; an average pad disturbance is estimated at 3.3 acres, including cut-and-fill, per pad. Single well pads will measure 325 X 175 feet, resulting in approximately 3.0 acres per site. Well locations will be cleared of vegetation and topsoil as appropriate and determined in the Reclamation Plan (Appendix C). Recovered topsoil will be stockpiled for future use in reclamation. The well locations will be leveled using standard cut-and-fill construction techniques as provided in the BLM “Gold Book” (DOI/USDA 2006). Once drilling operations have been completed and production ensues, well pads will be partially reclaimed, resulting in life-of-project disturbance of 1.5 acres per multi-well pad and 1.04 acres for single well pads. See Appendix D (APD with Master Surface Use Plan of Operations) for a typical multi-well site layout. In the unlikely event that a newly drilled well is not productive the entire site will be reclaimed as directed in the Reclamation Plan (Appendix B). New well pad locations are indicated on Figure 2.3.1.

Components of the well pad include a lined, earthen reserve pit with a liner having a permeability less than 10⁻⁷ cm/sec., generally described as 12-mil reinforced poly, to contain drilling fluids, cuttings, and water produced during drilling and completion operations. Venting of any gas produced will be over an unlined emergency pit. These emergency pits are unlined as they serve as backdrop to any flaring necessary for safety during the operations. Gas venting is

not anticipated. All pits will be constructed in accordance with BLM IM-2012-007 (BLM 2011a; Appendix D) requirements. The reserve pits on the multi-well pads will measure approximately 120 feet long by 80 feet wide and 12 feet deep while the single well pad reserve pits will be approximately 75 X 50 feet. One side of the pits will be ramped with a 2:1 slope. The reserve pit will be fenced on three non-working sides during drilling; the fourth side will be fenced at the time the rig is removed (Appendix C).

b) Road Construction

Elk proposes to use existing crowned and ditched roads to and within the project area to the extent possible; new roads will be constructed only as needed. Construction of new well access roads in the GUCO₂PA is estimated to be less than 0.5 miles and 3.5 miles of improved access road to the CO₂ pipeline tie-in point/power line substation.

The proposed project map (Figure 2.3.1) indicates existing and proposed road locations. Due to the size and weight of vehicles expected to regularly travel roads in the project area, all roads will be crowned and ditched, with a 14 to 16 foot driving surface, turn-outs and a 24-foot initial disturbance width. Culverts, low water crossings, and cattle guards will be installed where necessary and approved in well specific APDs and ROWs; gravel surfacing will be installed where needed. All disturbances related to access roads will be reseeded with the exception of the driving surface. Details of the proposed road construction can be found in Appendix C.

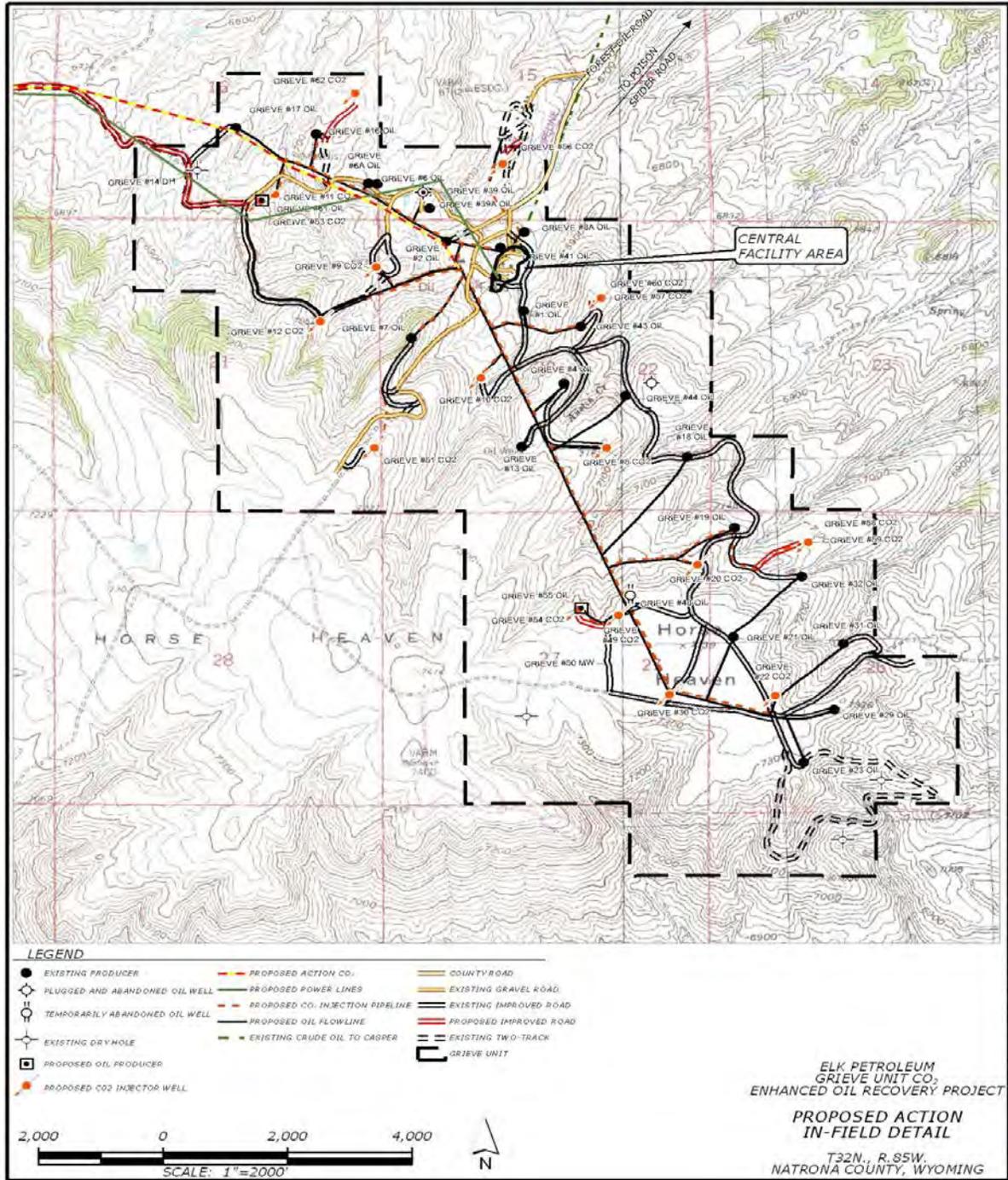
Proposed roads will be established as follows:

- Use of existing Collector Roads (multi-purpose, upgraded roads),
- Use of existing Resource Roads to access well roads,
- Development of new Well Roads,
- Development of Special Purpose Roads to access the CO₂ pipeline meter station, power structures and substation.

An estimate of workforce and traffic for the Proposed Action is found in Table 2.3.3. Vehicle traffic required for the implementation/construction of the Proposed Action will include:

- Equipment needed for road and well site construction activities,
- Drilling rigs, work-over rigs and associated equipment,
- Water trucks for drilling, and various construction activities,
- Well completion service company activity,
- Pipeline and in-field gathering and injection system construction,
- 230 kV overhead power line and sub-stations equipment delivery and installation,
- 25 kV underground power line installation,
- Central facility equipment delivery and construction,
- Well site, road and pipeline reclamation operations, and
- Light truck traffic associated with daily field operations and maintenance.

Figure 2.3.1 – In-field development detail of the proposed Grieve Unit CO₂ project



The locations of the proposed roads have been placed to maximize transportation efficiency and reduce redundancy. Roads will be closed and reclaimed by the Operator when they are no longer required for operations, unless otherwise directed by the BLM or the private landowners.

Project related roads will be maintained by the operator. The Operator and Natrona County will work cooperatively to maintain the county roads.

Roads and pipelines on BLM-administered public lands constructed in association with the Proposed Action will require BLM right-of-way authorizations and/or Sundry Notices, which could include additional mitigation to further minimize environmental impacts.

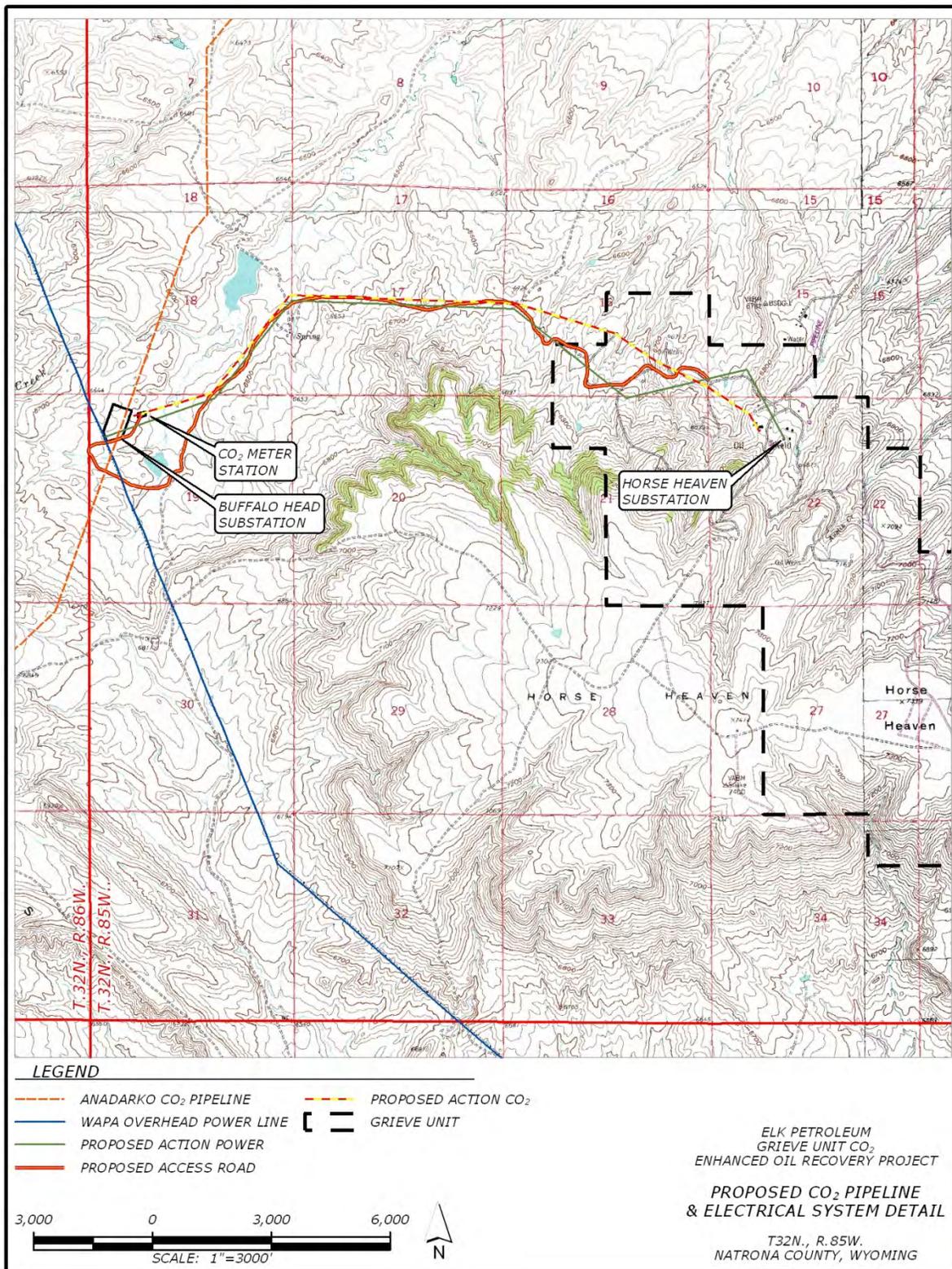
c) Pipeline Construction

The in-field pipeline system will be installed to all existing and proposed production and injection wells. The main trunk lines will be constructed within a 100-foot-wide construction corridor, generally following the existing disturbance corridor for the out-of-service natural gas/gathering system; each well will be connected using the corridor previously used, cross country or parallel to the well site access road, whichever is most direct.

CO₂ pipeline construction will follow the appropriate Department of Transportation/Office of Pipeline Safety (DOT/OPS) construction standards as detailed in the CO₂ Pipeline ROW SF-299 application (Figure 2.3.2). Pipeline construction will involve a standard sequence of operations: pipe stringing, trench excavation, pipe bedding, pipe lowering, pipe padding, and trench backfilling. All materials, equipment, and techniques, including quality assurance/control checks, will be to industry standard and DOT/OPS regulations. The construction disturbance width, including topsoil stripping, will be 100 feet with the exception of wetland areas where underground boring installation will be used and on areas of steep topography that require wider side slope lay-backs. The pipeline trench will be excavated mechanically with a track excavator to a depth that allows at least 3.5 feet of material to be placed on top of the pipeline. Trench width will be approximately 36 inches. Soil will be backfilled promptly into the trench following installation. Site re-grading will occur where necessary. Reclamation of the pipeline construction right-of-way will be initiated per BLM requirements; storm water/erosion control mitigations will be applied and maintained until the pipeline vegetation is re-established. The commitment to bore under designated wetlands precludes the need for US Army Corps of Engineers (USACE) wetland permits.

Approximately 1,575 BBL of water will be needed for pipeline integrity/hydro testing purposes. The source of this water will be Muddy produced water which will be recycled back into the produced water system and reused for reservoir re-pressurization.

Figure 2.3.2 – Proposed CO₂ pipeline and electrical system alignment



A CO₂ meter station will be needed at the tie-in of the Grieve CO₂ line to the existing Anadarko line. This station will be a 5 acre tract at the west end of the Grieve CO₂ line (Figure 2.3.2). The 1 acre fenced meter station comprises a steel building to house electronic metering

equipment, lighting, heaters, remote monitoring devices and piping manifolds. Additional above ground piping will be inside the fenced area. Redundant energy sources will be available at the meter station in the event of an electrical power failure. The exact configuration of this redundant power source is not currently known, but will likely be a combination of solar and propane generated electricity and heat.

d) Power Line Construction

It is estimated at 15,000 to 20,000 horse power will be needed for the proposed CO₂ project. Elk and the area power suppliers (High Plains Power and Tri-State) asked Western to conduct a feasibility study for obtaining power, from the existing Western transmission lines, for the Grieve Unit. Western has determined that power is available in their system for the Grieve CO₂ project. The existing Western 230 kV power line is located approximately 3.75 miles to the west of the Unit (Figure 2.3.2).

Tri-State will construct a new 3.75 mile overhead 230 kV power distribution line from the Western system to the Grieve Unit central facility. Elk will ask BLM to approve a SF-299 application and POD for construction of this new line. Power line construction along a new ROW will require an approved BLM SF-299 ROW application and POD; the detail on the construction of the distribution line can be found in the permit application and SF-299 (Figure 2.3.2).

Two electrical sub-stations/switchyards will be necessary for the proposed overhead power line; one will be located at the interconnect point with the Western system and another in the Unit (Figure 2.3.2).

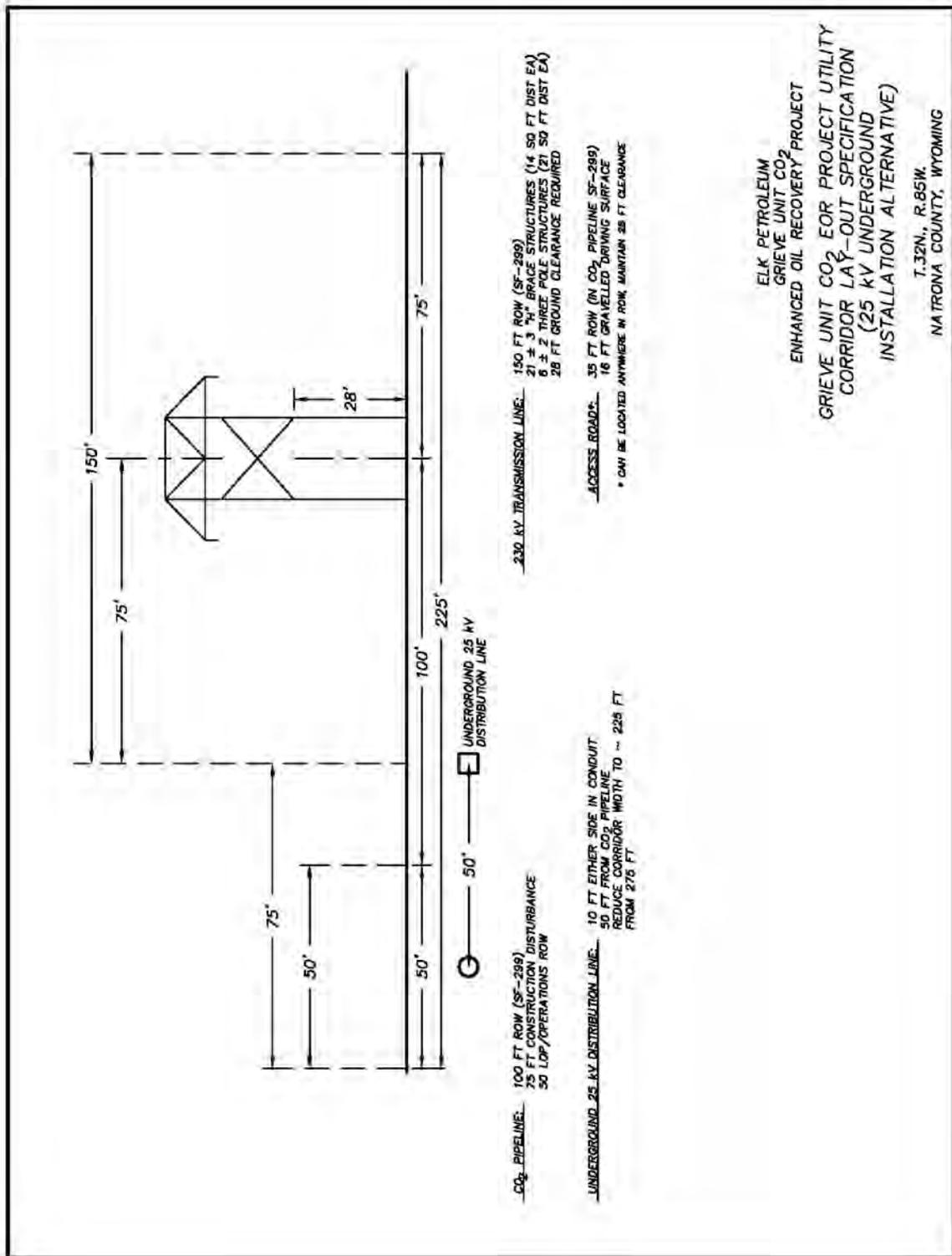
- 1) **Western will provide a right-of-way application to the BLM for approval of their new Buffalo Head switchyard**, this facility will be located on a 10 acre tract at the west end of the Tri-State 230-kV power line (NW Section 19) and to the east of the existing Western lines. This secure and fenced yard will house three-ring 230-kV 1200 Amp power circuit breakers and associated breaker pads, bus pole supports, and modular control building. For communications, Western will install approximately 11.2 miles of new overhead fiber optic ground wire from its Spence Substation to the proposed Buffalo Head Switchyard by replacing the existing over-head ground wire on the line. Splice boxes or "pulling sites" would be located at the substations. Additional "pulling sites" may be required depending on the cable reel or spool length and "pulling sites" would be located within the existing ROW easement for the Badwater to Spence transmission line.
- 2) **The Horse Heaven sub-station** will be located on private land at the existing Grieve Unit central facility (center N ½ Section 22) and house the necessary transformer equipment for the in-field service.

Electricity for the CO₂ pipeline tie-in point meter station will be drawn from the in-field power infrastructure and installed underground, along the south side of the CO₂ pipeline construction ROW, from the Grieve #17 well site back to the meter station. The SF-299 ROW application and POD for this power line will be provided by Elk to BLM for approval prior to construction. The underground line will be installed along the southern edge of the CO₂ pipeline ROW construction disturbance, resulting in no additional removal of vegetation or soils except for five wetland crossing areas.

The in-field production equipment will continue to be electrified using the existing power service. Existing pole structures will be used to the extent possible, new in-field power will be installed underground, to the extent feasible. Upgrades to the existing in-field electrical distribution system may be necessary as production increases. The nature of those upgrades is unknown and will be analyzed if, and when, the need arises.

It is anticipated that the co-located utility corridor configuration will be as depicted in Figure 2.3.3.

Figure 2.3.3 – Co-located utility corridor schematic



2.3.2 New and Existing Wells (Drilling, Work Over and Completion)

Three types of wells are needed for implementation of the Grieve Unit miscible CO₂ flood (with water injection to assist with reservoir re-pressurization), including water supply wells, CO₂/water injectors and oil producers. Existing wells will be worked over or recompleted under the Sundry Notice process while new wells will require approved Applications for Permit to Drill (APD). Sundries and APDs on federal surface or mineral estate must be approved by both the BLM and the Wyoming Oil and Gas Conservation Commission (WOGCC), all other wells must be approved only by the WOGCC. It is anticipated that eighteen (18) CO₂/water injection wells will be needed for efficient implementation of CO₂ EOR.

a) Drilling

Elk proposes ten new wells (Table 2.3.2) on six pads to augment the existing wells; eight of these wells, located on four pads, will require approved BLM and WOGCC APDs. The other two wells are located on State and fee lands and minerals requiring only WOGCC approval. An example BLM APD and MSUPO is provided as Appendix C. Eight of these will be new wells will be completed as injection wells into the Muddy formation and could serve several functions, including:

- 1) Water injection to assist with reservoir re-pressurization for oil recovery,
- 2) CO₂ injection to assist with reservoir re-pressurization,
- 3) Produced water management, and
- 4) Pressure maintenance of the crude oil reservoir.

Two of the anticipated injection wells may be used as water supply wells during the re-pressurization phase of the project and recompleted as Muddy injection wells following reservoir “fill-up.” Two new crude oil wells will be used for production of the field. Some of the anticipated producing wells may be utilized as water injectors for reservoir re-pressurization for a period of time. These wells have been or will be approved through the State of Wyoming/USEPA UIC program, as necessary.

Table 2.3.2 – Grieve Unit proposed well locations (all are located in T32N-R85W, Natrona County)

Well Name	Surface Location	Bottom Location	Hole	Well Type
Grieve Unit #53*	SWSE Sec. 16	NWNE Sec. 21		CO ₂ /H ₂ O Injection
Grieve Unit #54*	SWNE Sec. 27	NENW Sec. 27		CO ₂ /H ₂ O Injection
Grieve Unit #55*	SWNE Sec. 27	NENE Sec. 27		Oil Production
Grieve Unit #56	SESW Sec. 15	Fee surface and minerals		CO ₂ /H ₂ O Injection
Grieve Unit #57*	SWNE Sec. 22	SENE Sec. 22		CO ₂ /H ₂ O Injection
Grieve Unit #58*	NENW Sec. 26	SWSW Sec. 23		CO ₂ /H ₂ O Injection
Grieve Unit #59 *	NENW Sec. 26	SENE Sec. 26		CO ₂ /H ₂ O Injection
Grieve Unit #60*	NWNE Sec. 22	NWNE Sec. 22		CO ₂ /H ₂ O Injection
Grieve Unit #61*	SWSE Sec. 16	NWNE Sec. 21		Oil Production
Grieve Unit #62	NESE Sec. 16	State surface and		CO ₂ /H ₂ O Injection

Table 2.3.2 – Grieve Unit proposed well locations (all are located in T32N-R85W, Natrona County)

Well Name	Surface Location	Bottom Location	Hole	Well Type
		minerals		

* shared surface locations

Four two-well pads will measure roughly 325 X 200 ft., and two single well pads will be roughly 325 X 175 feet.

Drilling commences following construction of the access road and well pad when a drilling rig is transported to the well site and erected on the prepared well pad, refer to Section 2.3.1(a). Additional equipment and materials needed for drilling operations will also be trucked to the well site.

Drilling will begin by digging a rectangular pit, called a cellar, where the hole will be drilled. The cellar provides space for the casing head spools and blowout preventers that will be installed under the rig. The rat- and mouse- holes are also drilled under the rig. Drilling operations normally include (1) keeping a sharp bit on the bottom of the drill pipe in order to drill as efficiently as possible, (2) adding a new joint of pipe as the hole deepens, (3) tripping the drill string out of the hole to put on a new bit and running it back to the bottom as needed to achieve the desired depth, and (4) casing installation and cementing in the hole.

The wells are expected to be approximately 6,500 feet in depth. The average time from spud to completion is approximately 30 days, with drilling occurring for 15 to 20 of those days. The time required for completion activities depends on testing, geology, availability of equipment and the economics of the well in question. Individual well site drilling and completion operations could be delayed due to BLM site specific timing stipulation compliance. Well control systems will be designed to meet the conditions likely to be encountered in the boreholes and will be in conformance with BLM and State of Wyoming requirements. Drilling and completion operations will be permitted through the State of Wyoming Department of Environmental Quality (DEQ), Air Quality Division (AQD). No abnormal temperatures or pressures are anticipated. No hydrogen sulfide gas (H₂S) has been encountered in or known to exist from previous wells drilled to similar depths in the general project area. Appendix C contains greater detail on anticipated drilling procedures.

Water needed for drilling operations will be produced water from the Muddy formation. Water for cementing purposes will either be hauled from fresh water sources in Casper or taken from the existing water well and reservoir owned and operated by Elk and located within the Grieve Unit. The existing water well is the Grieve Unit #6 located in the NE Section 15-T32N-R85W, State of Wyoming Permit Number PI3567P. Elk has no plans to drill additional water wells for the proposed Grieve CO₂ EOR project.

Water will be hauled via tank truck over existing roads from the point of diversion to the proposed drilling locations. No additional construction will be required on/along the proposed

water haul routes and no off-lease federal lands will be crossed on/along the proposed water haul routes.

Approximately 7,500 barrels (Bbl) of water will be needed for drilling each well with another 5,000 Bbl needed, for construction, dust control and completion, over the life of the well. The actual water volume used in drilling operations will be dependent upon the depth of the well and any losses that might occur during drilling.

Drilling mud will consist of fresh water, native clays, and bentonite gel. During drilling and completion operations, certain wastewaters will be generated, including mud return fluids, in addition to any produced formation water. Following completion of the well, all drilling and formation fluids will be circulated back to the reserve pit.

During drilling operations a reserve pit is fenced on three sides; once the rig is moved off location the pit is fenced on all four sides to prohibit wildlife or livestock from entering the pit. If feasible, reserve pit fluids may be recycled to other drilling locations to reduce the volumes of water needed. After the reserve pit is completely dry, the pit is backfilled or, as an alternative, pit contents could be hauled to DEQ approved disposal facilities. The operator will comply with BLM IM No. WY-2012-007, Management of Oil and Gas Exploration and Production Pits (BLM 2011a).

Well sites will be reclaimed and pits closed as required by Operating Order Number 1 (BLM 2007) and IM No. WY-2012-007 (BLM 2011a), "Earthwork for interim and final reclamation must be completed within 6 months of well completion or well plugging (weather permitting). All pads, pits, and roads must be reclaimed to a satisfactorily revegetated, safe, and stable condition, unless an agreement is made with the landowner or Surface Managing Agency to keep the road or pad in place. Pits containing fluid must not be breached (cut) and pit fluids must be removed or solidified before backfilling. Pits may be allowed to air dry subject to BLM or FS approval, but the use of chemicals to aid in fluid evaporation, stabilization, or solidification must have prior BLM or FS approval. Seeding or other activities to reestablish vegetation must be completed within the time period approved by the BLM or the FS (BLM 2007)."

Hazardous materials, as defined by Occupational Health and Safety Act (OSHA), may be used in the drilling and completion of the Grieve Unit CO₂ Project. Routine drilling, completion and production operation wastes are exempt from the hazardous waste regulations found in Resource Conservation and Recovery Act (RCRA) (40 CFR 261.4). It is not anticipated that materials or chemicals considered hazardous under Superfund Amendment and Reauthorization Act of 1986 (or CERCLA) as amended, the RCRA or extremely hazardous wastes as defined in 40 C.F.R. 355 will be used in the Proposed Action. If a hazardous waste were to be generated as the result of an unusual operation it will be segregated for appropriate disposal. A complete accounting of all hazardous materials that may be utilized during project development and production operations are identified in the Operators OSHA required Worker-Right-to-Know or Hazard Communication Plan.

b) Existing Well Workovers

Existing wells will be worked over or recompleted following approval under the BLM and WOGCC Sundry Notice processes.

It is anticipated that eighteen (18) CO₂/water injection wells are needed for efficient implementation of CO₂ EOR project; ten of these will be existing Grieve Unit wells. These wells will be re-completed to serve specific functions, including:

- 1) Water injection to assist with reservoir re-pressurization,
- 2) CO₂ injection for oil recovery,
- 3) Produced water management, and
- 4) Pressure maintenance of the crude oil reservoir.

Eight (8) existing wells will continue to be used for production of the field. An additional eleven (11) existing wells may be utilized as needed, likely as crude oil producers, based on reservoir analysis and optimization. Some of the producing wells may be utilized as water injectors for re-pressurization for a period of time. These wells will be approved through the State of Wyoming/EPA UIC program as necessary.

As mentioned in Section 2.3.2 a), it is anticipated that two or more new or existing wells would be completed or re-completed into the Cloverly, Tensleep or Madison to provide the volumes of water needed for initial reservoir re-pressurization. Once reservoir “fill-up” had occurred these wells would be re-completed into the Muddy for use as either injection or production wells.

c) Well Completion

Well completion operations isolate aquifers and hydrocarbon-containing formations with surface and production casing and cement to prevent CO₂, oil and/or water movement from formation to formation and isolate the production zones. Completion operations also stimulate well bores through fracturing, perforating, acidizing or other activities appropriate to the reservoir characteristics. All well casing and cementing operations on these wells will be conducted in compliance with applicable rules and guidance and with BLM Operating Order No. 2 (BLM 1988) and the WOGCC rules. The intended purpose of the well (i.e. CO₂ injector, water injector, crude oil producer) will dictate the downhole completion process conducted. As the field progresses through time, and as dictated by reservoir response to re-pressurization, wells may be re-completed to accommodate a change in use, these operations will be permitted through the BLM and/or WOGCC Sundry Notice process, as appropriate. Individual well site completion operations could be delayed due to BLM site specific timing stipulation compliance.

In past Grieve Unit operations, hydraulic fracturing or “fracking” has not been used due to the high quality of the reservoir rock. It is not anticipated that hydraulic fracturing of the reservoir rock will be used in future operations of the Grieve CO₂ project. In the event that fracturing is necessary the operator will comply with BLM and WOGCC hydraulic fracturing rules.

During completion and testing, any gas flow will be vented or flared over the un-lined emergency pit. Venting or flaring at oil and gas facilities is regulated by three agencies, the WDEQ/AQD, the WOGCC and the BLM. Each agency regulates these activities with a slightly different objective. The WDEQ is concerned about the emission of regulated pollutants while the WOGCC and BLM are concerned about the loss or waste of the natural gas resource and the

loss of royalty income. All three agencies are concerned about safety of the public with regard to the venting of H₂S gas. No H₂S has been encountered in the Grieve Unit CO₂ project area; in addition, large volumes of natural gas are not expected.

2.3.3 CO₂ and Water Injection/Re-Pressurization

Elk requested, through the WOGCC, an aquifer exemption for the Cretaceous Muddy “Grieve Sand” throughout the Grieve Unit (GGA 2011). WOGCC and the EPA have approved (WOGCC 2012) this request. As provided in Section 2.3.2, Elk will inject into 10 existing wells and eight new wells, at various locations in the field, into the Muddy as part of the miscible CO₂ flood with water injection to assist with reservoir re-pressurization.

It is assumed that CO₂ and water injection will occur over an 18 to 24 month period prior to reservoir pressure being adequate to produce crude oil. While CO₂ injection will not require additional compression and will be accomplished using pipeline delivery pressure, some additional horsepower (500 to 1000 hp) will be required for water injection. At this time, it is anticipated that adequate electrical power is available in the field for this operation, if this power is not available temporary electrical generators may be used and located at the central facility, if these are needed they will be permitted through the WDEQ/AQD.

It is estimated that 860 BCF (billion cubic feet) of CO₂ will be injected over the 25 year life of the project; of this 220 BCF would be purchased, the remaining 640 BCF would be recycled CO₂.

Water for reservoir re-pressurization will be obtained from new or existing wells in the field which will be completed or re-completed in one of the water bearing formations, the Cloverly, Tensleep or the Madison. Approximately fifty-two million barrels of water will be needed over the 25 year life of the project; of this, approximately 22 million Bbl would be taken from the water supply wells, mentioned above, for initial re-pressurization. The remaining 30 million BBL would be seventy-five percent recycled Muddy produced water with 25 percent make-up water from one of the water supply wells in the field. All water supply wells will be permitted and approved through the WOGCC, BLM and WSEO, as appropriate.

The intended purpose of a well (i.e. CO₂ injector, water injector, crude oil producer) may change as the field re-pressurization and oil recovery progresses through time. Changes in well use will be dictated by reservoir response to re-pressurization; wells may be re-completed to accommodate a change in use, these operations will be permitted through the BLM and/or WOGCC Sundry Notice process, as appropriate. Injection wells will be approved through the State of Wyoming UIC program, as necessary.

2.3.4 Production

Artificial lift systems (ALS), including beam pumping units, have been used at production wells in the Grieve Unit in the past, to facilitate removal of formation water and crude oil. It is anticipated that under CO₂ EOR conditions these wells will flow naturally; in the alternative, ALS will be installed, and removed, as needed, to facilitate production in the field.

Installed well site production facilities will include, as applicable and appropriate, the wellhead and ALS, or injection manifold and a free-standing solar or electricity powered computerized monitoring, control, and telemetry panel. Together these units will occupy less than 1 acre at each well head.

The produced fluids stream will be transported to the central facility via the in-field distribution/gathering system. This production stream will require separation of oil, water and CO₂ in a three-phase separator at the central facility. Following separation, CO₂ is recycled and pressurized for re-injection into the reservoir via the in-field distribution system; crude oil is stored in on-site tankage until sufficient volumes have been collected for shipping down the sales pipeline; produced water is also held in tankage until re-injected into the reservoir for pressure maintenance or disposal. Separation equipment and tankage will be situated at the central facility within containment dikes and in compliance with an EPA required Spill Protection Countermeasure and Control (SPCC) Plan.

Disposal of produced water, if not injected for reservoir pressure maintenance, will be in accordance with a plan approved by the BLM as provided for in Operating Order No. 7, Disposal of Ground Water (BLM 1993). Produced water disposal operations are also regulated by WDEQ and/or the WOGCC, as appropriate. All injection wells will be permitted through the WOGCC and BLM approval processes and through the State of Wyoming UIC program, as necessary.

2.3.5 Operations and Maintenance

After CO₂/water injection has been initiated, routine field operations will occur on a year-round basis, weather and site conditions permitting. Maintenance of the various mechanical components of CO₂ EOR project will occur at intervals recommended by manufacturers, or as needed, based on telemetry and on-site visits. The CO₂ pipeline meter station will be monitored remotely from the central facility and visited on a regular basis as will the Western Buffalo Head substation.

A well-facility operator will visit each well pad daily to ensure that equipment is functioning properly. All operations will be conducted in accordance with industry standards for safe and efficient operation. All project roads and wells will be inspected periodically by the Operator, the BLM and WOGCC. The Operator will be responsible for maintaining access roads to minimize any resource damage or loss and ensure safe operating conditions. Field road maintenance operations typically include blading and/or gravel additions. Winter maintenance includes blading to remove snow from the access roads and the well pads. Field office and equipment yards are proposed at the central facility.

2.3.6 Workforce and Traffic

The expected traffic levels associated with the Proposed Action are addressed in Table 2.3.3, which provides a conceptual representation of types and maximum frequencies of typical traffic that could be expected during the various construction, drilling and production phases. The 'Trip Type' column lists the various service and supply vehicles associated with this type of activity and tends to demonstrate a maximum activity level. The 'Round-Trip Frequency' column includes the number of trips, both external (i.e., to/from each project area) and internal (within each project area).

Table 2.3.3 – Grieve Unit CO₂ EOR project traffic and workforce estimates.

Trip Type	Round-Trip Frequency	Manpower
<i>Construction (roads and well sites)(estimate 4 days per well site)</i>		
Two ton truck	2/day	
Pick-up trucks	3/day	
Seed Driller and tractor	1/day	
Rubber tired backhoe	1/day	
Track hoe	1/day	
Dozer	2/day	
Road grader	2/day	
Water wagon/water truck	2/day	
Scraper	2/day	
Belly dump tractor and trailer	3/day	
<i>Drilling (15-20 days per well; 1 well at a time)</i>		
Rig move	10 trucks/well	
Rig supervisor	1/day	
Rig crews	2 vehicles/day	
Engineers	2/week	
Mechanics	1/week	
Supply delivery	2/week	
Water truck	1/week	
Mud trucks	1/week	
Drill bit/tool delivery	2/week	
Pipe/tubulars	1/wk	
Fuel	1/wk	
<i>Completion (10 days per well completion)</i>		
Small truck mounted rig/crew	1/day	
Cement crew	3 trucks/2 trips	
Consultant	1/day	
Well loggers/Perforators	1 trip/well	
Fracing/stimulation equipment	1 /day	
Fracing/stimulation crews	1 /day	
Power systems placement	2/day	
Other field development	3/day	
Testing and operations	2/day	
Fuel	1/wk	
<i>Workovers (15-20 days per well; 1 well at a time)</i>		
WO Rig move	2 trucks/well	
WO Rig supervisor	1/day	
WO Rig crews	2 vehicles/day	
Engineers	2/week	
Mechanics	1/week	
Supply delivery	2/week	
Water truck	1/week	
Mud trucks	1/week	
Drill bit/tool delivery	2/week	
Pipe/tubulars	1/wk	
Fuel	1/wk	
<i>CO₂ Pipeline Construction</i>		
Bulldozers	5 for 10 days	5 for 10 days
Track Backhoes	4 for 10 days	4 for 10 days

Table 2.3.3 – Grieve Unit CO₂ EOR project traffic and workforce estimates.

Trip Type	Round-Trip Frequency	Manpower
Tired Backhoes	2 for 8 days	2 for 8 days
Brushhogs	2 for 4 days	2 for 4 days
Side booms	4 for 10 days	4 for 10 days
Tractors/drills	4 for 5 days	4for 5 days
Welding Trucks	10 for 12 days	20for 12 days
½ ton Pick-ups	8 for 25 days	8 for 25 days
¾ ton Pick-ups	5 for 25 days	5 for 25 days
1 ton truck	3 for 29 days	3 for 29 days
5 ton truck	2 for 15 days	2 for 15 days
Semi-dump trucks	2 for 4 days	2 for 4 days
Stringing trucks	5 for 15 days	5 for 15 days
NDT trucks	2 for 15 days	4 for 15 days
CP trucks	2 for 12 days	4 for 12 days
Day Labors		8 for 25 days
<i>In-Field Flowline Systems Construction</i>		
Bulldozers	5 for 20 days	5 for 20 days
Track Backhoes	5 for 20 days	5 for 20 days
Tired Backhoes	2 for 10 days	2 for 10 days
Bushhogs	2 for 8 days	2 for 8 days
Side booms	5 for 10 days	5 for 10 days
Tractors/drills	3 for 8 days	5 for 8 days
Welding trucks	4 for 25 days	8 for 25 days
½ ton Pickups	3 for 35 days	3 for 35 days
¾ ton Pickups	6 for 35 days	6 for 35 days
1 ton Trucks	4 for 35 days	4 for 35 days
5 ton Truck	2 for 20 days	2 for 20 days
Semi-dump trucks	2 for 20 days	2 for 20 days
Stringing trucks	2 for 15 days	2 for 15 days
NDT trucks	2 for 10 days	2 for 10 days
CP trucks	2 for 2 to 10 days	4 for 2 to 10 days
Day labors		25 for 30 days
<i>Central Facility Construction (approximately 8 months to complete)</i>		
Bulldozers	2 for 30 days	2 for 30days
Track Backhoes	1 for 25 days	1 for 25 days
Tired Backhoes	2 for 45 days	2 for 45 days
Bushhogs	1 for 2 days	2 for 2 days
Manlifts	4 for 65 days	4 for 65 days
Large Crane Truck	1 for 20 days	1 for 20 days
Small Crane Truck	4 for 60 days	4 for 60 days
Welding trucks/ 8	8 for 120 days	16 for 120days
½ ton Pickups/ 8	8 for 240 days	8 for 240days
¾ ton Pickups/ 5	5 for 240 days	5 for 240 days
1 ton Trucks/ 5	5 for 180 days	5 for 180 days
5 ton Truck/ 1	1 for 70 days	1 for 70 days
Semi-dump trucks/ 2	2 for 40 days	2 for 40 days
Off Road Fork Lift/ 5	5 for 160 days	5 for 160 days
NDT trucks/ 2	2 for 45 days	2 for 45 days
Semi-Trucks/ 2	2 for 50 days	2 for 50 days
Day labors		25 for 210 days
<i>25 and 230 kV Line Power Construction (approximately 6 months to complete)</i>		

Table 2.3.3 – Grieve Unit CO₂ EOR project traffic and workforce estimates.

Trip Type	Round-Trip Frequency	Manpower
Bulldozers	1 for 10 days	1 for 10 days
Track Backhoes	1 for 20 days	1 for 20 days
Tired Backhoes	1 for 20 days	1 for 20 days
Bushhogs	2 for 6 days	2 for 6 days
Manlifts	4 for 40 days	4 for 40 days
Large Crane Truck	1 for 10 days	1 for 10 days
Small Crane Truck	2 for 15 days	2 for 15 days
½ ton Pickups	4 for 180 days	4 for 180 days
¾ ton Pickups	4 for 120 days	4 for 120 days
1 ton Trucks	3 for 40 days	3 for 40 days
5 ton Truck	1 for 15 days	1 for 15 days
Semi-dump trucks	1 for 5 days	1 for 5 days
Off Road Fork Lift	2 for 45 days	2 for 45 days
Semi-Trucks	1 for 30 days	1 for 30 days
Day labors		15 for 195 days
<i>Substation Construction (approximately one year to compete both)</i>		
Bulldozers	2 for 12 weeks	
Excavator	2 for 12 weeks	
Grader	2 for 12 weeks	
Water truck*	1 for 12 weeks	
Tractor trailers	6 to 8 for 45 weeks	
Pressure digger	1 for 12weeks	
Concrete trucks	16 for 12 weeks	
Materials trucks	6 for 12 weeks	
Backhoe	1 for 12 weeks	
Bucket trucks	2 for 18 weeks	
Boom trucks	2 for 18 weeks	
Man-lifts	2 for 18 weeks	
Cranes	2 for 18 weeks 2 for 4 weeks	
1 ten wheeled trucks	1 for 4 weeks	
Pickups	4 to 15 for 52 weeks	
Bobcats	3 for 3 weeks	
<i>Production/Long-term Workforce</i>		
Production foreman	1/5days/wk	
Field operators	10/day	
I&E techs	2/day	
Well field maintenance and pumpers trucks	2/day	

* Water trucks may be necessary during all phases of construction to minimize fugitive dust and for fire suppression.

The flow of activity in the development of the Grieve Unit CO₂ EOR project will, generally, be as follows:

- 1) Continue existing well workovers and re-entries,
- 2) Construct the CO₂ pipeline and meter station, reconstruct access road
- 3) Install 25 kV underground power to meter station,
- 4) Install in-field distribution and gathering pipeline systems,
- 5) Construct new well locations and access roads,
- 6) Drill and complete new wells, connect to distribution and gathering systems,
- 7) Remove unneeded existing equipment at the central facility site,

- 8) Construct the new central facility,
- 9) Construct overhead power line from Buffalo Head to central facility,
- 10) Construct electrical substations, and
- 11) Continue reclamation activities.

Some of these activities will occur simultaneously, completion of all new project components should be complete in three or four work seasons, should the project be approved. The field work season in the Grieve Unit is typically April to November, and dependent on weather and BLM site specific stipulations for resource protection. All work will be followed by reclamation activities.

2.3.7 Reclamation and Abandonment

Another major component of the Grieve Unit CO₂ proposal is the reclamation of unneeded areas existing disturbance in the field. Fifty-six years of equipment and production modifications have occurred in the Grieve Unit, resulting in a considerable quantity of out-of-service equipment, necessitating a significant housekeeping effort. This effort will occur primarily of private lands associated with the central facility. Work on the federal mineral estate or BLM managed lands will be approved through the Sundry Notice process. This work will be completed over an extended period of time and could include the following:

- 1) Plug and abandon unneeded wells,
- 2) Remove unnecessary existing production equipment and infrastructure including tanks, treaters, separators, power lines and poles, concrete bases, etc.,
- 3) Close and backfill any existing production pits,
- 4) Remove existing houses and backfill the cellars. These are located on private land and off the unit but are related to previous Grieve Unit operations, and
- 5) Reclaim disturbed areas associated with above activities.

In addition to reclaiming unneeded areas of the existing Grieve Unit, new project components will be reclaimed through re-seeding and stabilization. All surface disturbing activity will be covered by a Storm Water Pollution Protection Plan (SWPPP) as required by the WDEQ/Water Quality Division. The WDEQ/WQD will not release the SWPPP until “uniform perennial vegetative cover with a density of 70% of the typical or native background vegetative cover for the area has been established on all disturbed unpaved areas and areas not covered by permanent structures” (WDEQ/WQD May 2011).

The seed mixes for reclamation will be recommended or approved by the LFO based on the information found in the GUCO₂PA Reclamation Plan (Appendix B). The seed mixes are based on both the pre-existing vegetative community and the soil types found in specific sites within the project area. Seeding rates are assumed for drill seeding. Seeding rates will be doubled if seed were broadcast. Reclamation success criteria will be determined based on the BLM standards for final and interim reclamation. The identified seed mixes could be modified or added to by the BLM, as needed or required to meet the LFO objectives for reclamation; the LFO uses the Wyoming Reclamation Plan as a guide in developing acceptable project level reclamation plans.

Weed control is integral to the success of project reclamation; the GUCO₂PA Weed Management Plan, found in Appendix E, will be followed. Forbs and shrubs may be seeded after grasses have become established and weedy species are under control. A variety of forb and shrub species and their seeding rates can be found in the Reclamation Plan (Appendix B).

Following construction, all areas not occupied by Proposed Action features, or needed for field operations, will be reclaimed in the next growing season, or as directed by the authorizing agency. All disturbed areas, not needed for operation, will be reclaimed to the approximate landform existing prior to construction. Remaining disturbed areas will be reclaimed following abandonment of project components. Stockpiled topsoil will be used as part of the seedbed preparation. Reclamation and site stabilization techniques will be applied as specified in the Reclamation Plan. Unnecessary or redundant road segments may be cooperatively reclaimed by the Operator with concurrence from BLM and local landowners/allotment lessees.

Any mulch applied to areas with high soil erosion potential, or where use is otherwise indicated, will be free from mold and noxious weed seeds. Site preparation may include ripping or chiseling to break up compacted soils, increase water penetration, promote root growth, and control erosion. Soil amendments may be recommended depending on soil type and reclamation potential.

Implementation of the Proposed Action will result in surface disturbance. Estimates of that disturbance are found in Table 2.3.1. Interim reclamation of individual well sites will result in LOP disturbance of 1.5 acres for two well pads and 1.04 acres for single well pads. During the project development phase the access road driving surface, turn-outs, drainage structures and installation of storm water best management practices (as found in the SWPPP) could result in full use of the 24-foot right-of-way. The in-field gathering and distribution system 100-foot construction ROW will be disturbed as will the 225-foot wide corridor used for the CO₂ pipeline, power line and access road corridor. However, all these areas, with the exception of the 16-foot driving surface of the access road, will be reclaimed in their entirety.

2.3.8 Design Features of the Proposed Project

Design Features include all applicable agency rules and regulations, Standard Operating Procedures, Stipulations (including Conditions of Approval) and best management practices that have become commitments and are enforceable under this EA. These Design Features are included as part of the proposed project as Conditions of Approval in an effort to prevent or reduce environmental effects from occurring during project implementation and to minimize the type and magnitude of effects to resources in the project area. Many Design Features are cross-cutting and will benefit numerous resources for example; those features listed for protection of Water Resources are protective of Soils, Vegetation and Wetlands.

The Design Features to which Elk has committed in agency submittals, agreed upon based on the on-site inspections with BLM, or as regulated and required by BLM and other applicable agencies are compiled below.

Design features are different from Mitigation Measures, as used in this EA. Mitigation measures are practices that were not incorporated into the Proposed Action or Alternatives but that

analysis determined would work to further reduce impacts to specific resources, these are identified as applicable and appropriate in Chapter 4.

2.3.8.1 Climate, Climate Change, & Air Quality

- The Operator will contact the Wyoming Department of Environmental Quality (WDEQ), Air Quality Division to determine the permit requirements, prior to the installation of any oil and gas well production equipment. The Air Quality Division will provide the owner/operator with forms and guidelines for permitting and controlling air contaminant emissions from this equipment. The operator will adhere to all applicable local, state, and federal air quality regulations and standards. The operator will adhere to all applicable ambient air quality standards, permit requirements (including preconstruction, testing, and operating permits), motorized equipment and other regulations, as required by the State of Wyoming, Department of Environmental Quality, Air Quality Division (WDEQ-AQD).
- The production of dust will be significantly reduced through accepted dust abatement techniques. Techniques include, but are not limited to, the seeding of all disturbed areas that are not utilized during the well production phase (i.e. borrow ditches and topsoil and spoil piles) and the application of water to roadways during dry periods.
- The operator will not allow burning garbage or refuse at well locations or other facilities. Any flaring will be conducted under the permitting provisions of Chapter 6, Section 2 (Oil and Gas Production Facilities Permitting Guidance) of the Wyoming Air Quality Standards and Regulations and the WOGCC rules.

2.3.8.2 Cultural

A Class III cultural inventory for proposed project has been completed.

- Elk will adhere to the proposed well pad relocation delineated in the field within the following legal locations: *T.32N., R.85W., Sections 22 N¹/₂SW¹/₄NE¹/₄, S¹/₂NW¹/₄NE¹/₄ (Grieve Unit 57/60 well pad)*

Prior to any surface disturbing activities, Elk shall install temporary protective fencing along the north and east edges of the subject well pad. Prior to installation, locations and types of fencing will be determined by the BLM. The fencing will be left in place until all work is completed.

- Elk will provide an archeologist, with a current BLM Cultural Resources Use Permit, to monitor ground clearing operations and inspect the open pipeline trench at the following locations: *T.32N., R.85W., Section 19 All (access roads, power lines, pipeline and Buffalo Head Switchyard)*

Blade Monitoring: The archeologist shall notify the BLM prior to beginning blade monitoring. Construction methods shall be utilized which will allow the identification of cultural resources without endangering the personnel monitoring the construction activities. The archeologist will specify the depths of cuts made by earth moving equipment. Monitoring will continue until work is completed or until strata that could possibly contain cultural resources will no longer be disturbed. If potentially significant cultural resources are identified, and the archeologist determines that further operations will affect the resource, Elk will suspend all activities in the vicinity of such a discovery until notified to proceed by the BLM. BLM will evaluate, or will have evaluated, such discoveries in accordance with the *Monitor Blading and Open Trench Inspection Discovery Plan for the Grieve Unit CO₂ Powerline, Powerline Access Roads, and CO₂ Pipeline Alternate Route 2*. The decision as to

the appropriate measures to mitigate adverse effects to significant cultural resources shall be made by BLM after consulting with Elk.

Open Trench Inspection: Open trench inspection will take place before soil, lines, or other materials are placed in the trench.

The archeologist will notify BLM prior to beginning the open pipeline trench inspection. Soil stratigraphy shall be recorded whether or not cultural resources are discovered. If cultural resources are discovered in the trench, BLM will evaluate, or will have evaluated, such discoveries in accordance with the *Blading Monitor and Open Trench Inspection Discovery Plan for the Grieve Unit CO₂ Powerline, Powerline Access Roads, and CO₂ Pipeline Alternate Route 2*. The decision as to the appropriate measures to mitigate adverse effects to significant cultural resources will be made by BLM after consulting with Elk.

Treatment of cultural resources discovered: Excavations, methods, analysis, results, and report write up will follow guidelines as outlined in the *Blading Monitor and Open Trench Inspection Discovery Plan for the Grieve Unit CO₂ Powerline, Powerline Access Roads, and CO₂ Pipeline Alternate Route 2*.

Within 5 working days, Elk will notify BLM of the date construction is completed. A report of all archeological activities, including descriptions of soil stratigraphy, shall be submitted to BLM within 30 days of completion of the field work. If the report is not completed within 30 days of the end of construction, the archaeologist will notify BLM of the preliminary results in writing or via email, reason for the delay, and estimated report completion date. If the report is authorized as preliminary, a final report shall be submitted to BLM within 6 months of completion of field work.

- Any cultural and/or paleontological resource (historic or prehistoric site or object or fossil) discovered by Elk, or any person working on his behalf, on public or Federal land shall be immediately reported to BLM. Elk will suspend all operations in the immediate area of such discovery until written authorization to proceed is issued by BLM. An evaluation of the discovery will be made by BLM to determine appropriate actions to prevent the loss of significant cultural or scientific values. Elk will be responsible for the cost of evaluation and any decision as to proper mitigation measures shall be made by BLM after consulting with Elk. One National Register Eligible resource was found near the well pad and additional cultural monitoring will be required at this site. The well location is not considered to occur in a high potential for vertebrate fossils and/or scientifically significant nonvertebrate fossils area. If cultural or paleontological resources are discovered at any time during construction, all construction activities will stop and the BLM will be immediately notified. Work will not resume until a Notice to Proceed is issued by the BLM.

2.3.8.3 Wildlife including Threatened and Endangered and BLM Special Status Species

- All pits and open cellars will be fenced to limit access by wildlife and livestock. Fencing will meet BLM specifications found in the Gold Book (DOI/USDA 2006).
- Netting will be placed over all production pits to minimize access by migratory birds and wildlife. Netting will also be required over reserve pits that have been identified to contain oil, as defined in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), section 101 (14), as determined by visual evaluation.
- Offsite activities in the project area by operational personnel that are unrelated to the proposed project will be prohibited. All project employees will be notified of all applicable wildlife laws and penalties associated with unlawful take and harassment.

- Anti-perching devices will be required on all above ground power structures, including the 230 kV power line, associated with the proposed action. Any new power line facilities shall be constructed in accordance with the standards outlined in *Suggested Practices for Raptor Protection of Power Lines* (Raptor Research Foundation, Inc, 1996, as updated). The BLM reserves the right to require modifications or additions to all power line structures placed in the project right-of-way, should they be necessary to ensure the safety of large perching birds. Such modifications and/or additions shall be made by the holder of the ROW permit without liability or expense to the United States government.
- Raptor nesting timing restrictions – Surface disturbing and/or disruptive activities will be prohibited within ¾ mile of active raptor nests from February 1 to July 31. Actual distances and dates may vary based on topography, species, season of use, and other pertinent factors.
- Minimize disturbance to BLM designated Special Status Species habitats.
- Greater sage-grouse (*Within Core Areas*):
 - Surface occupancy and/or disruptive activities are prohibited on or within a six tenths (0.6) mile radius of the perimeter of occupied sage-grouse leks.
 - Surface disturbing and/or disruptive activities are prohibited from March 15 to June 30 in all nesting and early brood-rearing habitats inside core regardless of distance from the lek.
 - Disruptive activity is restricted on or within six tenths (0.6) mile radius of the perimeter of occupied sage-grouse leks from 6 pm to 8 am from March 1 to May 15.
 - New noise level, at the perimeter of a lek, should not exceed 10dBA above ambient levels from 6pm to 8am during the initiation of breeding (March 1 to May 15).
 - Surface disturbing and/or disruptive activities are prohibited in winter concentration areas from December 1 to March 14.
- Utilize native plant species for reclamation purposes (preferably local seeds and species that are preferred by sage grouse).
- The 25 kV electric distribution line to the Meter Station, and any enlargement of service in the field, will be installed underground to minimize disruptions to sage-grouse Core habitat areas.
- To minimize the possible impacts of project related noise on wildlife, muffle and maintain all motorized equipment according to manufacturers' specifications.
- Remote monitoring of wells and pipelines to reduce field visits during operations and reduce stress on raptors and other wildlife.

The following wildlife related issues have been determined not to be relevant and will not be discussed further in this EA:

- WGFD has determined that big game critical winter ranges will not be impacted by the project.
- The 2005 Statewide Programmatic Biological Assessment (BA) for Black-footed Ferrets (BLM 2005) indicates three historic ferret observations are known from the Lander Field Office (FO), all from Fremont County. Only one significant prairie dog complex has been identified in the FO (BLM 2005); all other areas in Lander field office, including the Grieve Unit project area, were deemed “block cleared” (BLM 2005). Therefore, the project area is not likely to provide habitat for black-footed ferrets. In addition, the BA (BLM 2005) determined that oil and gas projects in the block cleared areas were “Not likely to adversely affect” meaning that all effects to the species and its critical habitat are beneficial,

insignificant, or discountable (BLM 2005). A concurrence letter from the USFWS was received by BLM, with the direction that when an activity occurs within a FO that *could* impact black-footed ferrets, then specific additional consultation must take place (BLM 2005). The project area is not likely to adversely affect black-footed ferrets.

- The Wyoming State Engineers Office (2012) has determined that the USFWS listed Platte River Species, as defined in the Endangered Species Act (ESA), would not be affected by the project as the area is not hydrologically connected to the North Platte River.
- There are no fisheries were identified in the project area.

2.3.8.4 Soils

- Soil productivity and erodibility are potentially affected by project construction activities.
- Construct all project components in accordance with the soils protection measures provided in the *Gold Book, Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development* (DOI/USDA 2006). Topsoil will be salvaged from all disturbed areas.
- Install runoff and erosion control measures such as water bars, berms, and interceptor ditches as needed and in accordance with the WDEQ/WQD SWPPP.
- Existing roads will be used whenever possible. Standards for road design will be consistent with BLM guidance (DOI/USDA 2006).

2.3.8.5 Vegetation including Invasive Non-Native Species, Threatened and Endangered and Special Status Species

- Minimize disturbance to BLM designated Special Status Species habitats.
- The operator has prepared a Reclamation Plan (Appendix B) for all aspects of the Proposed Action. The plan meets the interim and final reclamation objectives of Chapter 6 of *The Gold Book, Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development* (DOI/USDA 2006).
- Interim well site reclamation consists of minimizing the footprint of disturbance by reclaiming all portions of the well site not needed for production. Interim road reclamation consists of reclaiming portions of the road not needed for vehicle travel.
- Final reclamation occurs when the operator plugs the wells due to a commercially unviable well sites or the end of production. Final road reclamation includes re-contouring the road back to the original contour, seeding, and any other techniques that would be helpful to improving reclamation success (DOI/USDA 2006).
- The operator has prepared a Weed Management Plan (Appendix E). Weeds would be controlled on all disturbed areas during the life of the project. Weed control methods would be in accordance with guidelines established by the EPA, BLM, or appropriate authorities.
- Project roads not required for routine operation and maintenance of producing wells and ancillary facilities will be reclaimed and revegetated, with BLM and landowner/allotment lessee concurrence.

The following vegetation related issues have been determined not to be relevant and will not be discussed further in this EA:

- No Threatened or Endangered plant species or their habitats were identified as being potentially impacted by in the project actions.
 - No individuals or populations of blowout penstemon were found during field surveys, and based on the lack of suitable habitat characteristics; local habitat was confirmed

unsuitable for blowout penstemon. A data request from the Wyoming Natural Diversity Database (WYNND) indicates there have been no known occurrences of blowout penstemon within or near the proposed project area (WYNDD 2011).

- No individuals or populations of Ute ladies'-tresses were found during field surveys, and based on the lack of suitable habitat characteristics, local habitat was confirmed unsuitable for Ute ladies'-tresses. A data request from the WYNND indicates there have been no known occurrences of Ute ladies'-tresses within or near the proposed project area (WYNDD 2011).

2.3.8.6 Water Quality (Groundwater, Surface Water and Wetlands)

- Culverts will be installed on all ephemeral and intermittent drainage road crossings; all designated wetlands will be bored to facilitate pipeline construction.
- The Buffalo Head substation is designed with a storm water retention pond.
- Construction of well sites and other non-linear features within 500 feet of surface water and/or riparian areas or within 100 feet of the inner gorge of ephemeral channels will be prohibited. Possible exceptions to this will be granted by the BLM for linear features based on an environmental analysis and site-specific mitigation plans.
- Equipment servicing, fueling and staging operations will not occur within 500 feet of streams or riparian areas.
- Sanitary sewage facilities (portable chemical toilets) will be provided at designated locations and will not be located within 500 feet of a waterway or wetland.
- All crossing of wetlands will be bored under if feasible or if boring is found to be more destructive than trenching (i.e. likely to perforate a perched water table). Trenching may be allowed if disturbance is minimal (less than 1/10 acre). In the event wetlands are trenched, monitoring will be required following construction, and annually thereafter, until successfully reclaimed.
- Wells will be cased during drilling; case and cement all wells in accordance with BLM Onshore Order No. 2 and WOGCC rules to protect all high quality water aquifers. High quality water aquifers are aquifers with known water quality of 10,000 TDS or less. Wells will adhere to the appropriate BLM and WOGCC cementing policy.
- Construct reserve pits as directed in BLM Operating Order No. 1 and BLM IM No. WY-2012-0007. The reserve pit will be lined with reinforced synthetic liner, minimum 12 mil thickness with permeability less than 10^{-7} cm/sec. and a bursting strength of 175 x 175 pounds per inch (ASTMD 75179) or according to stipulation.
- Maintain two foot of freeboard on all reserve pits to minimize the risk of overflowing. Shut down drilling operations until the problem is corrected if leakage is found outside the pit.
- All tank batteries and facilities designed to contain fluids will be surrounded by an impervious dike designed to contain 110% of the contents of the largest vessel should a leak or spill occur. Spill Prevention Control and Countermeasure Plans (SPCC) will be written and implemented as necessary, in accordance with 40 CFR 112. Spills of oil, gas, or any other potentially hazardous substance will be reported immediately to the BLM and WDEQ/WQD, and will be mitigated immediately, as appropriate, through cleanup or removal to an approved disposal site.
- Protect ground water by adhering to all requirements of the WOGCC/EPA permit for underground injection of CO₂ and produced water (WOGCC 2012).

- In the event that wells require hydraulic fracturing adhere to the provisions of the WOGCC and BLM rules regarding this activity.
- Hydrostatic test water used in conjunction with pipeline testing and all water used during construction activities from sources having sufficient quantities and appropriation permits approved by the State of Wyoming SEO and WDEQ/WQD.
- Hydrostatic test water will be re-used by injection into the Muddy for reservoir re-pressurization.
- Install runoff and erosion control measures such as water bars, berms, and interceptor ditches as needed and in accordance with the WDEQ/WQD SWPPP.

2.3.8.7 Socioeconomics

- Federal, State, local economies all stand to benefit from the successful implementation of the Proposed Action.
- Implementation of the Proposed Action does not interfere with existing opportunities for the development of alternative energy sources, including wind projects, in the area.
- There are no BLM authorized commercial outfitters in the project area.

Overarching Design Features associated with the project implementation include:

Facilities:

- The existing and new access roads will be designed, constructed, and/or maintained as a crowned and ditched road in accordance with the minimum standards of a local or resource road as established in the *BLM Road Standards Manual, Section 9113*, and in *The Gold Book, Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development* (DOI/USDA 2006). No flat blading of access road is permitted.
- Facilities will be standard in size. All permanent OSHA exempt above ground production facilities will be painted the color *Carlsbad Canyon (2.5Y 6/2)* or *Covert Green 18-0617 TPX*.

Transportation:

- Except in emergency situations, access will be limited to dry conditions to prevent severe rutting (creation of ruts in excess of 4" deep) of the road surface. If rutting occurs all processes will cease until the roads are of proper condition. All road damage will be fixed by grading. Culverts will be installed where needed to allow drainage in all draws and natural drainage areas. On-site reviews will be conducted with BLM personnel for approval of proposed access prior to any construction.
- Snow removal equipment will be equipped with shoes to keep the blade six (6) inches above the natural ground surface. Locations of snow stockpiles, if needed, will be designated in advance by the Authorized Officer.

BLM Lease Stipulations:

- A *Lease Notice (LN)* that any surface use or occupancy within the following areas is strictly controlled or, if absolutely necessary, prohibited: 1) slopes in excess of 25 percent; 2) within 500 feet of surface water and/or riparian areas; 3) where material is frozen or during periods when the soil material is saturated or when watershed damage is likely to occur; 4) within 500 feet of Interstate highways and 200 feet of other existing rights-of-way (i.e., U.S. and

State highways, roads, railroads, pipelines, power lines); or 5) within ¼ mile of occupied dwellings. The prohibition could require relocating proposed operations up to 200 meters, but not off the leasehold, and prohibiting surface disturbance activities for up to 60 days.

Health and Safety

- Health and safety issues are regulated by State and Federal occupational safety programs and compliance is the responsibility of the Operator and their contractors.
- The management of solid wastes generated by the project components including produced water, crude oil and reserve pit fluids are regulated by State and Federal environmental programs and compliance is the responsibility of the Operator and their contractors.
- Sanitary wastes are disposed of in portable toilets for long-term construction, drilling and completion operations. These wastes are hauled to municipal sewage treatment plants for final disposal.
- Produced water within the project area is currently managed through the use of permitted injection/disposal wells. These facilities have been permitted by the WOGCC, the WDEQ and the BLM.
- Elk has a responsibility to comply with the State and Federal regulations applicable to their operations. Documents regarding spill response planning, Community Right-to-Know reports, SPCC Plans, etc., are maintained by the company.
- Elk and their contractors will follow common wildfire safety operating procedures including the BLM requirements for minimizing the risk wildfire from project related construction activities; the risk is not unique to this project. Pipeline and site construction fire-prevention measures are in place during the summer construction season. These include using equipment with spark arrestors, welding in cleared areas only and the ready availability of fire extinguishers or water trucks in the event fire occurs. Natrona County, the BLM, and the companies working in the area implement, and require, extra precautions in the event of drought or high fire danger.
- Elk Petroleum provided information to Natrona County Road and Bridge Department regarding the potential for a substantial increase in heavy equipment traffic on Poison Spider Road. In 2011, the County invested substantial funds and manpower to improving the road surface and safety. Poison Spider is also used by seasonal residents of the Rattlesnake Hills, the surrounding rural residents and livestock operators as well as numerous recreationalists and “Sunday-drivers.”
- The United States Department of Transportation (USDOT) regulations also address the safe transportation of hazardous materials (i.e. crude oil, drilling mud chemicals, etc) on the national roads and highways. The USDOT Office of Pipeline Safety (OPS) provides regulatory oversight of pipelines carrying hazardous liquids such as crude oil and CO₂.

2.4 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM FURTHER ANALYSIS

In accordance with 40 CFR 1502.14(a), the BLM is required to explore and evaluate all reasonable alternatives. The following alternatives were considered by the BLM but found to be unreasonable as discussed below. Thus, these alternatives were eliminated from detailed study.

The following alternative utility alignments were evaluated.

Sage-grouse Core Avoidance Alternative

Consideration was given to a route up and over Horse Heaven to the south to connect into the Western power grid and the Anadarko CO₂ pipeline thus greatly reducing but not eliminating potential disturbance and disruption impacts to the sage-grouse core area. This route was determined to be unreasonable due to the need for year-round access for the CO₂ meter station and the power lines; topographically the route would include numerous steep sections and would be longer for all utilities resulting in greater surface disturbance. During the winter the route would be impassable thus requiring an alternative access route to be constructed or improved. The Proposed Action alignment takes advantage of an existing access route and provides for the shortest interconnection distances from the existing power grid and CO₂ pipeline to the existing Grieve central facility and all operations are supported by one access road.

Alternative 230 kV Alignment Routes were evaluated. In the original Elk proposal the 230 kV power line was not co-located with the CO₂ line and access road, and would, therefore, have required a separate year-round access road to be constructed. BLM requested an analysis of alternative routes that would follow, partly or entirely, the originally proposed CO₂ pipeline route (refer to the following discussion of the CO₂ Pipeline Route). All of the routes considered would have significantly added to the overhead disruptions in the sage-grouse Natrona Core Area as well as potentially impacting an active golden eagle nest and sites of Native American cultural importance.

Alternative Western Communications Infrastructure

Western determined they need the ability to communicate with the proposed Buffalo Head substation. They considered the use of microwave transmission of signal using the existing microwave tower on Horse Heaven. It was determined that this structure did not have the height needed to relay communications between the Spence and Buffalo Head substations. Consideration was then given to installing a new microwave tower on Horse Heaven. In order for this to work, given terrain considerations, Western would have to replace the existing 60 foot Horse Heaven tower with a 200 foot tower and install a second 200 foot microwave tower at the Buffalo Head substation. Western determined the replacement of 11.2 miles of existing 230 kV line ground wire with a fiber optics ground wire is a more reasonable alternative.

Well pad locations were moved to address topography and Native American cultural resource issues. One well location was changed due to steep terrain, this change reduced overall surface disturbance from the well pad cuts and fills and access road construction. Two well pads were evaluated by the affected tribes, resulting in one pad being moved slightly and re-designed; the other pad was determined to be acceptable as proposed. The number of proposed new wells was increased by the Operator but the number of well pads stayed the same due to the commitment to use directional drilling to the extent feasible.

CO₂ Pipeline Route

Elk originally proposed to install the CO₂ line and access road parallel to the existing North Grieve Unit crude oil pipeline ROW, and tie into the existing Anadarko CO₂ line at the juncture with the North Grieve Unit crude oil line (Figure 2.1.1). Access for pipeline alignment construction and operations included an additional 1.9 miles of new and long term disturbance. In addition, preliminary resource evaluation disclosed (a) potential impacts to significant Native

American cultural sites, (b) potential disruption to an active golden eagle nest, (c) potential disruption to the Soap Creek sage-grouse lek as well as additional disturbance and disruption in the Natrona Core Area, and (d) numerous wetland crossings. The Proposed Action CO₂ pipeline alignment avoids or significantly reduces these potential resource conflicts in addition to co-locating all utilities and access roads into a single corridor.

Overhead Installation of the 25 kV Power Line

Consideration was also given to installing the 25 kV power line overhead from the Grieve #17 to the CO₂ meter station. This would have added another 75 feet to the width of the utility corridor as well as additional power poles (disruptions in the form of above ground structures and potential raptor perches) sage-grouse Core Area.

CHAPTER 3 - AFFECTED ENVIRONMENT

3.1 INTRODUCTION

This chapter presents the potentially affected existing environment of the impact area as identified by BLM interdisciplinary team (IDT) or public scoping and presented in Chapter 1.

This chapter also provides the baseline for comparison of impacts to those same resources as described in Chapter 4.

See Chapter 2 for details of the proposed project components and the area involved as well as the design features developed for application to the proposed project in an effort prevent or reduce environmental effects from occurring during project implementation and to minimize the type and magnitude of effects to resources in the project area. The various regulatory programs affecting the proposed project, as discussed in Chapter 1, will be addressed as appropriate in the following discussion of the Affected Environment. Figure 2.1.1 shows the area involved in the proposed project and possible project component locations; however, the project area is not necessarily the area to be analyzed for each of the resources discussed below. The size and location of these areas vary depending on the resource and is described in each resource section.

3.2 GENERAL SETTING

The Grieve Unit CO₂ project lies within the Wyoming Basin ecoregion, Rolling Sagebrush Steppe (Chapman et al. 2004). This ecoregion is a broad arid intermontane basin interrupted by hills and low mountains and dominated by grasslands and shrublands. The semiarid Rolling Sagebrush Steppe is a vast region of rolling plains with hills, cuestas, mesas, terraces, and near, ridges, alluvial fans, and outwash fans. Potential natural vegetation is mostly sagebrush steppe the mountains, footslopes, with the eastern edge of the region having more mixed grass prairie (Chapman et al. 2004).

Much of the region is used for livestock grazing. The region contains major natural gas and petroleum producing fields. The Wyoming Basin also has extensive coal deposits along with areas of trona, bentonite, clay, and uranium mining (Chapman et al. 2004).

The project is located within the eastern extents of the Wind River Basin. The Wind River Basin is a topographical depression that is bounded by the Wind River Mountains to the west and southwest, the Sweetwater Arch to the south, the Casper Arch to the east, and the Owl Creek Mountains to the North. The predominate topographic feature within the project area is a relatively flat plateau named Horse Heaven that lies at an elevation of 7,300 feet above mean sea level. This plateau rises 1,000 feet above the surrounding area and has several ephemeral stream drainages that form steep gullies that come off the plateau in a radial geometry. The Horse Heaven Plateau is situated approximately 2.5 miles east of the Rattlesnake Hills which run in a northwest to southeasterly trend.

The drainages from the project area run from the Horse Heaven plateau in a northeasterly direction. Eventually these drainages run into the west-to-east flowing Poison Spider Creek, a tributary to the North Platte River.

Average annual precipitation is 6 to 16 inches and varies with elevation and proximity to mountains. The region has a continental climate with cold winters and mild summers. Precipitation is greatest from spring to summer, tapering off during the fall and winter months. An average of 76.9 inches of snow falls during the year (annual high 137.6 inches in 1982), with the majority of the snow distributed evenly between November and April.

3.3 RESOURCES/ISSUES BROUGHT FORWARD FOR ANALYSIS

Only those environmental elements and resources identified as potentially being affected and discussed in Chapter 1 are discussed below. The description of the affected environment portrays what is, not what would be if the proposal is approved.

3.3.1 Climate, Climate Change, & Air Quality

3.3.1.1 Climate

The GUCO₂ project area is located in a semiarid (dry and cold), mid-continental climate regime. The area is typified by dry, windy conditions with limited rainfall and long, cold winters. The nearest meteorological measurements were collected at the Casper, Wyoming airport(1948-2010), located 53 miles east of the project area at an elevation of 5,340 feet amsl (WRCC 2011).

The annual average total precipitation at Casper, Wyoming is 12.0 inches, with annual totals ranging from 6.6 inches (1988) to 20.5 inches (1982). Precipitation is greatest from spring to summer, tapering off during the fall and winter months. An average of 76.9 inches of snow falls during the year (annual high 137.6 inches in 1982), with the majority of the snow distributed evenly between November and April.

The region has cool temperatures, with average temperature (in degrees Fahrenheit [°F]) ranging between 13.0°F and 33.7°F in January to between 54.1°F and 87.7°F in July. Extreme temperatures have ranged from -41°F (1990) to 104°F (1954). The frost free period generally occurs from May through September.

The closest comprehensive wind measurements are collected at the Casper/Natrona County International Airport meteorological monitoring station located northwest of Casper, Wyoming, 53 miles east of the GUCO₂PA. As is typical for central Wyoming, the prevailing wind is generally from the south and west.

The frequency and strength of winds greatly affect the transport and dispersion of air pollutants. The annual mean wind speed is 12 miles per hour (mph), and that relatively high average wind speed indicates the presence of good dispersion and mixing of any potential pollutant emissions resulting from the GUCO₂ project area.

3.3.1.2 Climate Change and Air Quality

The Wyoming Ambient Air Quality Standards (WAAQS) and National Ambient Air Quality Standards (NAAQS) are health-based standards which define the maximum concentration of air pollutants allowed at all locations to which the public has access. EPA criteria air pollutants for which standards exist are carbon monoxide (CO), nitrogen dioxide (NO₂), ozone (O₃), particulate matter less than 10 microns in effective diameter (PM₁₀), particulate matter less than 2.5 microns in effective diameter (PM_{2.5}), and sulfur dioxide (SO₂).

Air quality monitoring is conducted near the project area for PM₁₀ and PM_{2.5} at the Casper City and County Building at Center and C Streets. The nearest measurements of NO₂, SO₂, and O₃ are monitored by WDEQ-AQD at South Pass in Fremont County, 100 miles west-southwest of the project area. The nearest CO measurements are collected in Uinta County at the Murphy Ridge monitoring site.

The monitored concentrations described above are considered ambient air background concentrations, and are used as an indicator of existing conditions in the region. These concentrations are assumed to include emissions from industrial sources in operation and from mobile, urban, biogenic and other non-industrial emissions sources. They are considered by WDEQ-AQD to be the most representative of background conditions within the project area, and are compared to the WAAQS and NAAQS in Table 3.3.1.1. The project area is designated as attainment for all criteria pollutants.

Federal air quality regulations adopted and enforced by WDEQ-AQD limit incremental emission increases to specific levels defined by the classification of air quality in an area. The Prevention of Significant Deterioration (PSD) Program is designed to limit the incremental increase of specific air pollutant concentrations above a legally defined baseline level. Incremental increases in PSD Class I areas are strictly limited, while increases allowed in Class II areas are less strict. The project area and surrounding areas are classified as PSD Class II. The closest Federal PSD Class I area is the Bridger Wilderness Area, which is approximately 101 miles west of the project area.

Table 3.3.1.1 - Monitored air pollutant background concentrations and Wyoming and National Ambient Air Quality Standards (µg/m³)

Pollutant	Monitoring Site	Averaging Time	Measured Background Concentration	Wyoming and National Ambient Air Quality Standards	Incremental Increase Above Legal Baseline	
					PSD Class I	PSD Class II
Carbon Monoxide (CO)	Murphy Ridge ¹	1-hour	1026	40,000	n/a	n/a
		8-hour	798	10,000	n/a	n/a
Nitrogen Dioxide (NO ₂)	South Pass ²	Annual	0.4	100	2.5	25
		1-hour	10.0	188(NAAQS)	n/a	n/a
Ozone (O ₃)	South Pass ²	8-hour ⁴	141.1	157	n/a	n/a

Table 3.3.1.1 - Monitored air pollutant background concentrations and Wyoming and National Ambient Air Quality Standards ($\mu\text{g}/\text{m}^3$)

Pollutant	Monitoring Site	Averaging Time	Measured Background Concentration	Wyoming and National Ambient Air Quality Standards	Incremental Increase Above Legal Baseline	
					PSD Class I	PSD Class II
Particulate matter (PM_{10})	Casper ³	24-hour	30	150	8	30
		Annual	16	50 (WAAQS)	4	17
Particulate matter ($\text{PM}_{2.5}$)	Casper ³	24-hour ⁵	12.3	35	n/a	n/a
		Annual	4.6	15	n/a	n/a
Sulfur Dioxide (SO_2)	South Pass ²	1-hour	31.4	196(NAAQS)	n/a	n/a
		3-hour	11.4	1,300	25	512
		24-hour	1.9	365(NAAQS) 260(WAAQS)	5	91
		Annual	0.3	80(NAAQS) 60(WAAQS)	2	20

Source: WDEQ-AQD, 2011b.
¹ Background data collected at Murphy Ridge, Wyoming during 2008, WDEQ-AQD.
² Background data collected at South Pass, Wyoming, 2009, (1-hour SO_2 , 2008) WDEQ-AQD.
³ Background data collected in Casper, Wyoming. 2010, WDEQ-AQD.
⁴ From EPA's Air Quality System (AQS) Quick Look Report (AMP450). Ozone values were flagged with an AQS qualifier code "ro", which means WDEQ is investigating the possibility of a stratospheric ozone intrusion exception event.
⁵ 3-year average of the 98th percentile 24-hour concentrations.

The WDEQ-AQD, under its EPA-approved State Implementation Plan, is the primary air quality regulatory agency responsible for determining potential impacts once detailed industrial development plans have been made, and those development plans are subject to applicable air quality laws, regulations, standards, control measures, and management practices. Therefore, the WDEQ-AQD has the ultimate responsibility for reviewing and permitting the project prior to its operation. Unlike the conceptual 'reasonable, but conservative' engineering designs used in NEPA analyses, any WDEQ-AQD air quality preconstruction permitting demonstrations required would be based on very site-specific, detailed engineering values, which would be assessed in the permit application review. Any facility developed under the proposed action which meets the requirements set forth under Wyoming Air Quality Standards and Regulations (WAQSR) Chapter 6 will be subject to the WDEQ-AQD permitting and compliance processes.

All NEPA analysis comparisons to the PSD Class I and II Increments are intended to evaluate a threshold of concern, and do not represent a regulatory PSD increment consumption analysis. The determination of PSD increment consumption is an air-quality regulatory agency responsibility. Such an analysis would be conducted as part of the New Source Review process for a major source, as would an evaluation of potential impacts to Air Quality Related Values (AQRV) such as visibility, aquatic ecosystems, flora, fauna, etc. performed under the direction of the WDEQ-AQD in consultation with federal land managers, or would be conducted to determine minor source increment consumption.

The 1977 Clean Air Act amendments established visibility as an AQRV that Federal land managers must consider. The 1990 Clean Air Act amendments contain a goal of improving visibility within PSD Class I areas. The Regional Haze Rule finalized in 1999 requires the states, in coordination with federal agencies and other interested parties, to develop and implement air quality protection plans to reduce the pollution that causes visibility impairment.

Visibility impairment is measured in terms of change in light extinction or change in deciview (dv). Potential changes to regional haze are calculated in terms of perceptible “just noticeable change in visibility” when compared to background conditions. A dv change of 1.0 or 2.0 (equivalent to a 10 percent and 20 percent change in extinction) represents a small but perceptible change in visibility. The BLM considers a 1.0 dv change to be a significance threshold for visibility impairment, although there are no applicable local, state, tribal, or federal regulatory visibility standards. Other federal agencies use a 0.5 dv change as a screening threshold for significance.

Visibility conditions can be measured as standard visual range (SVR). SVR is the farthest distance at which an observer can just see a black object viewed against the horizon sky; the larger the SVR, the cleaner the air. Visibility within the Project Area and the surrounding region of central Wyoming is considered to be very good. Continuous visibility-related optical background data have been collected in the PSD Class I Bridger Wilderness, as part of the Interagency Monitoring of Protected Visual Environments (IMPROVE) program. The average SVR at the Bridger Wilderness is over 200 kilometers (Visibility Information Exchange Web System – VIEWS, 2011).

Atmospheric deposition refers to the processes by which air pollutants are removed from the atmosphere and deposited on terrestrial and aquatic ecosystems, and it is reported as the mass of material deposited on an area per year (kg/ha-yr). Air pollutants are deposited by wet deposition (precipitation) and dry deposition (gravitational settling of pollutants). The chemical components of wet deposition include sulfate (SO₄), nitrate (NO₃), and ammonium (NH₄); the chemical components of dry deposition include SO₄, SO₂, NO₃, NH₄, and nitric acid (HNO₃).

The National Acid Deposition Program (NADP) and the National Trends Network (NTN) station monitors wet atmospheric deposition and the Clean Air Status and Trends Network (CASTNET) station monitors dry atmospheric deposition at a site near Centennial/Brooklyn Lake, which is approximately 101 miles south-southeast of the project area. The total annual background deposition (wet and dry) reported as total nitrogen (N) and total sulfur (S) deposition for year 2009 at the Centennial site is 3.13 kg/ha-year and 1.68 kg/ha-year, respectively (EPA, 2011).

Total deposition levels of concern (LOC) for atmospheric deposition have been established for sensitive areas in the GUCO₂ project area region. The “red line” LOC represents an estimate of the total pollutant loadings that each sensitive area can tolerate. If an analysis done under Federal Land Managers’ Air Quality Related Values Work Group (FLAG) Report (FLAG 2010) guidelines indicates loading above these values, it may be suggested that the land manager recommend a reduction of emissions from new sources unless data are available to indicate that no AQRVs in the PSD Class I area are likely to be adversely affected. The “green line” LOC

represents the total pollution loadings (current plus proposed new source contribution) below which a land manager can recommend a permit be issued for a new source, unless data are available that indicate otherwise. Cumulative impacts plus background are compared to these LOCs. The sulfur deposition “red line” LOC for Class I areas surrounding the GUCO₂ project area is 20 kg/ha-yr and sulfur deposition “green line” is 5 kg/ha-yr. The nitrogen deposition “red line” LOC for Class I areas surrounding the GUCO₂ project area is 10 kg/ha-yr and nitrogen deposition “green line” is 3-5 kg/ha-yr (Fox et al., 1989). It is understood that the Forest Service no longer considers these levels of concern to be protective; however, in the absence of alternative Federal Land Managers’ approved values, comparisons with these values is made. The BLM uses these values as NEPA analysis thresholds since they are considered the levels below which significant impacts are not likely to occur.

The FLAG provides Deposition Analysis Thresholds (DATs), which are 0.005 kg/ha/yr for both N and S in the western U.S., as significance thresholds for N and S deposition when analyzing direct impacts from a proposed facility subject to New Source Review. However, 0.005 kg/ha/yr represents an assumed natural background level and is considered ultra-conservative for NEPA analyses.

The total GHG emissions from all sources in the State of Wyoming were approximately 56 million metric tons of CO₂e (Center of Climate Strategies [CCS] 2007) in 2005.

3.3.2 CULTURAL RESOURCES

Western Archaeological Services (WAS) conducted a Class III survey of the entire project area in 2011 and 2012. The objectives of a Class III cultural resource inventory are to provide a complete record of the cultural properties, identifiable from surface and natural exposures (profiles), occurring within the study area, and to determine the relationship of the cultural resources to proposed disturbance areas. Federal involvement in the undertaking includes the review of all permits and administrative responsibility for all affected cultural resources.

Modern disturbances have impacted the project area, including uranium prospecting pits, buried pipelines, well locations and their associated access roads and pipelines, reclaimed well locations, two-track trails, upgraded roads, fences, other oil field facilities, overhead power lines, stock dams and ponds, livestock and wildlife grazing, erosion, deflation, and various activities associated with ranching and energy development. Factors affecting preservation of cultural resources in the general project area include overgrazing, bioturbation, cryoturbation and wind deflation.

File searches from the State Historic Preservation Office (SHPO) and records at WAS were consulted as baseline data for this project. General Land Office Maps (GLO) on the SHPO web site were also consulted to determine if any previously documented historic resources were present in the vicinity of the project area.

Standard survey methodology was used to conduct the inventory. Standard 30 meter wide transects were employed for coverage of the block surveys and linear rights-of-way. Where present, subsurface deposition exposed in stream cut banks, road cuts, pipeline disturbances,

animal burrows, or animal trails were examined. Ant hills were examined for the presence of micro-artifacts including pressure flakes or small beads. Bedrock exposures were also closely examined. Due to the prevalence of prehistoric stone circle and cairn sites in the project area, any area outside of but within close proximity to the project area considered to have high potential for containing these sites was examined. Such areas would include wind-sheltered benches and/or ridge crest margins with an open visual aspect.

A total of 70 block acres and 347.96 linear acres were inventoried during the current project. Of this, 10 block acres and 63.62 linear acres lie on State of Wyoming Land, 60 block acres and 171.51 linear acres lie on public land and 123.35 linear acres lie on private land.

Six isolated resources, five newly recorded sites, and two previously recorded sites were identified. Three sites are historic in age including the Alcova to Copper Mountain transmission line, historic cabins, and a historic telephone line. Four sites are prehistoric and consist of campsites, stone circles, and cairns. All but two prehistoric sites are considered not eligible for the National Register of Historic Places (NRHP).

Tribal consultation was conducted in October and November of 2011; as a result, two of the newly recorded prehistoric sites were determined eligible for the NRHP.

Project area soils consist of mixed residual/colluvial sandy clay/sandy clay loam with gravel, lag cobble, and small boulder content on ridge crests, and mixed residual/alluvial sand/sandy clay in the drainage bottoms in Sections 15, 16, 17, 21, and 22, T32N, R85W. Topography flattens in Sections 18 and 19, T32N, R85W, as the land approaches a broad, marshy area at the confluence of multiple ephemeral drainages from which Cabin Creek continues to the northeast. Soils within this area consist of mixed residual/alluvial silty sandy clay in the drainage bottom, and residual and alluvial silty sandy clay on the raised benches and margins of the drainage. Some small, sparse areas of eolian sheet sands and low dunes of undetermined depth have formed in this area, particularly along the western margin of Cabin Creek in the NW¹/₄ SW¹/₄ of Section 19, T32N, R85W. The mixed residual/colluvial sandy clay/sandy clay loam, mixed residual/alluvial sand/sandy clay has a low to no potential for containing intact, buried cultural deposits, while the mixed residual/alluvial silty sandy clay has a low potential and the eolian sheet sands have a limited potential. The eolian sands represent the only areas of perceived depositional potential in the entire project area.

3.3.3 WILDLIFE INCLUDING THREATENED AND ENDANGERED AND BLM SPECIAL STATUS SPECIES

Wildlife habitats that could be affected by the project include areas which would be physically disturbed by well, road, pipeline, power line and production facility construction. Zones of influence are those areas surrounding a given human activity which could also affect wildlife use. These disturbance areas vary with wildlife species and kind of human activity.

Many species of birds, mammals, amphibians, and reptiles may be found within the Wyoming Basin. The most common large game animals found in the project area are pronghorn antelope, mule deer, and elk. Other mammals include coyote, fox, skunk, badger, white-tailed prairie dog,

whitetail jackrabbit, and a variety of small rodents. The area also contains greater sage-grouse. Raptors found in the area include ferruginous hawk, golden eagle, prairie falcon, and burrowing owl.

Reptiles found in the study area include northern sagebrush lizard, short-horned lizard, intermountain wandering garter snake and the prairie rattlesnake (Cerovski et al. 2004). Amphibians are uncommon in the area but the tiger salamander and the northern leopard frog may be found in the project area. The proposed development is not expected to impact the common species found in the project area; therefore, they are not considered in this analysis. Those species considered in this document include species considered by the USFWS as threatened, endangered, candidate or proposed for listing status, as well as big game species, raptors, and BLM sensitive species.

Information regarding the occurrence of species included in this analysis was obtained from several sources. Greater sage-grouse lek locations, seasonal big game range designations, raptor nest locations, and locations for threatened and endangered species were obtained from the Wyoming Game and Fish Department's (WGFD) Wildlife Observation System, the BLM GIS database, the Wyoming Natural Diversity Database (WYNDD) and field surveys. Management of wildlife in Wyoming is split between the WGFD, which is responsible for species management, and the land manager, who has responsibility for the habitat. In the Grieve Unit project area, which comprises mostly public land, BLM is the primary land manager.

3.3.3.1 General Wildlife Species

Big Game Species

Elk (*Cervus elaphus*), pronghorn antelope (*Antilocapra americana*), and mule deer (*Odocoileus hemionus*) occur on the project area during various times of the year. Big game populations are managed by the WGFD within designated "herd units." The BLM manages habitat on federal lands and split estate lands where the surface remained with the federal government.

Big game seasonal habitats are designated by the WGFD as winter, yearlong, winter/yearlong, crucial winter, crucial winter/yearlong, spring/summer/fall and out (non-use areas). Winter ranges are used by a substantial number of animals from mid-November through April. Winter/yearlong ranges are occupied throughout the year but, during winter, additional animals from other areas migrate there. Yearlong ranges are occupied throughout the year and usually do not increase in population through the winter season. Crucial winter and crucial winter/yearlong describes a seasonal range that has been documented as a determining factor in a population's ability to maintain itself at or above population objective over the long term. Overlapping use of winter and winter/yearlong habitats by two or more species is a greater management concern than those areas used by a single species (WGFD 2010b).

Spring/summer/fall ranges are used before and following conditions of freezing temperatures, deep snow and other winter attributes. If an area has little or no recorded use of big game activity it is designated as "out."

Elk The Grieve Unit CO₂ project falls within the Rattlesnake Elk Herd Unit 742, as designated by WGFD. The Rattlesnake elk herd is a relatively small population with potentially significant interchange with adjacent herd units in the Bighorn Mountains, Green Mountain, and Ferris Mountains. Elk frequently cross the southern herd unit boundary (the Dry Creek Road) (WGFD 2010a). While elk are frequently seen in the existing oil field and surrounding area, WGFD has not identified any specific seasonal habitat, or range, in the Grieve Unit area.

Pronghorn The project area is within the southern portion of Rattlesnake Pronghorn Herd Unit 745 and the northern edge of Beaver Rim Herd Unit 632. These very large herd areas have a combined population objective of greater than 37,000 animals (WGFD 2010a). There is a large amount of interchange between these two herd areas. The pronghorn population is generally believed to be stable although WGFD biologists have expressed concern regarding the over objective populations and the poor sagebrush leader growth. For the purpose of this analysis, the portion of the herd unit analyzed is limited to the Grieve Unit CO₂ project area.

The majority of the proposed action falls within the Rattlesnake Herd Unit in winter/yearlong habitat. The remainder of the pronghorn habitat in the project area is classified as spring/summer/fall. Pronghorn are commonly seen in this habitat from early March through mid-November. Preferred pronghorn habitat may be characterized by a sagebrush/rabbit-brush plant community with an open view. The WGFD has not designated any crucial winter range for pronghorn in the project area or vicinity.

Mule Deer The project area is within the Rattlesnake Mule Deer Herd Unit 758. The population objective for the herd unit is 5,500 while the model estimate for the 2010 population was 4,533 or 17.6% below objective (WGFD 2010a). The population has been below objective since 2006, primarily due to poor fawn productivity and survival (WGFD 2010a).

Approximately two-thirds of the GUCO₂ project falls within WGFD designated winter/yearlong mule deer habitat; no crucial winter range for this species are found in or around the Grieve Unit project.

Other Mammals

The Grieve Unit area is home to many species of non-listed, non-sensitive wildlife, including coyote (*Canis latrans*), white-tailed jackrabbit (*Lepus townsendi*), desert cottontail (*Sylvilagus audubonii*), red fox (*Vulpes vulpes*), striped skunk (*Mephitis mephitis*), various species of rodents, and bats. There are no anticipated effects to other mammals from the proposed action and these species will not be discussed further. Species that are Threatened, Endangered, Proposed and Candidate under the Endangered Species Act (ESA) are discussed in Section 3.3.3.2; BLM Special Status Species are discussed in Section 3.3.3.3.

The cottontail rabbit is the only species of “small game” occurring within the project area. The species, which is found in the project area, is the desert cottontail (*Sylvilagus audubonii*) (Cerovski et al. 2004). Usually seen during early morning and late afternoon, they are generally inactive during mid-day. As with most cottontails, they occupy tall vegetation, rock outcrops and where escape cover may be found.

Upland Game Birds

Greater sage-grouse (*Centrocercus urophasianus*) and mourning dove (*Zenaida macroura*) are the only upland birds which occur within the project area. Greater sage-grouse is discussed in Section 3.3.3.2.

Mourning Dove are relatively common in the area from mid-April through early September. The habitats used include open ponderosa pine forest, juniper woodland, deciduous riparian corridors, sagebrush steppe and grasslands with shrubs (Faulkner 2010). Nesting is most common along deciduous riparian corridors, although nests can be found a few feet off the ground in sagebrush, greasewood and other indigenous shrubs. Doves may nest more than once each season depending on arrival date, weather, nesting success and other factors.

Raptors

A variety of raptor species are known to occur in and around the project area during various seasons of the year. Raptor surveys of the Grieve project area were conducted in the spring of 2011. Nesting habitat was identified for golden eagle (*Aquila crysaetos*), ferruginous hawk (*Buteo regalis*), red-tailed hawk (*Buteo jamaicensis*), American kestrel (*Falco sparverius*), great-horned owl (*Bubo virginianus*) and burrowing owl (*Athene cunicularia*). Two active golden eagle, two ferruginous hawk and three red-tailed hawk nests were located during the 2011 surveys (Table 3.3.3.1 and Figure 3.3.3.1). Four other active nests were also located; these were determined to be non-raptor nests, likely black-billed magpie. Twelve inactive nests were also identified in the survey area. No occupied nests were found during spring 2012 surveys of previously identified and newly located nests within 1 mile of any proposed project component.

It is possible that some of the older documented raptor nests may have deteriorated beyond being suitable for raptor nesting and the nest sites are no longer available or used by breeding raptors. Nevertheless, nest sites with nests in suitable condition have the potential to be active in any given year. Moreover, each year new nests are built. All raptors and their nests are protected from take or disturbance under the Migratory Bird Treaty Act (16 USC, §703 *et seq.*) and Wyoming [Revised] Statute (WRS 23-1-101 and 23-3-108). Golden and bald eagles also are afforded additional protection under the Bald and Golden Eagle Protection Act, amended in 1973 (16 USC, §669 *et seq.*).

The Grieve Unit project area provides significant cliff or stick-nest habitat to support the species discussed above. Ferruginous hawks have the advantage of nesting on the elevated rock features, plateaus and poorer substrates that occur in the area. The scattered white-tailed prairie dog colonies and badger burrows found in the project provide ample nesting habitat for burrowing owls. Great-horned owl pellets are found in the area, therefore, it is presumed they may nest somewhere in the area.

Raptors of casual occurrence include prairie falcon (*Falco mexicanus*), northern harrier (*Circus cyaneus*), and rough-legged hawk (*Buteo lagopus*). Other raptor species such as the sharp-shinned hawk (*Accipiter striatus*, a forest species) and short-eared owl (*Asio flammeus*, a wetland/forest species) may be seen here during spring and/or fall migration. Bald eagle habitat

does not exist within the project area. The Lander and Casper BLM Field Office databases identified ten known and historic raptor nests in the project area. A number of the project area federal oil and gas leases contain raptor stipulations.

Neotropical Songbirds

Many species of neotropical songbirds utilize the project area for breeding, feeding, migration, and as year-round habitats. All habitats throughout the project area are used to some degree by these species, but especially sagebrush-grassland, mountain shrub, and riparian vegetation communities. The Migratory Bird Treaty Act (16 USC, §703 *et seq.*) protects 836 migratory bird species (to date) and their eggs, feathers, and nests from disturbances. Several migratory raptors and songbird species are also listed as BLM Sensitive Species (Section 3.3.3.3).

Table 3.3.3.1 - Grieve Unit project area raptor surveys – May and June 2011

Nest ID # on map	WP #/ Photo No. (GUXXX)	Easting*	Northing*	QQ S-T-R	Substrate (if known)	Status **	Species, condition and data source
HISTORIC BLM RECORD LOCATIONS							
001	BLM 1	330596	4734338	NWSW 18-32-85	No nest located	N	Historic FH; BLM 1 record location
002	BLM 2	330404	4735943	NWSW 7-32-85	No nest located	N	Historic FH; BLM 2 record location
003	BLM 3	333774	4735718	NWSE 9-32-85	No nest located	N	Historic FH; BLM 3 record location
004	BLM 4 /GU007	332411	4734785	SESW 17-32-85	Stick pile on rock outcrop	IA	Inactive FH; Disheveled; white wash
		332326	4734967	NENW 17-32-85			BLM 4 record location
005a	GU008/BLM 5	331846	4734534	SESW 18-32-85	cottonwood	NR	Near dam on Cabin Ck. Reservoir; lg. nest; inactive; Historic FH; two nests; magpie?
005b	GU009/ BLM 5	331847	4734526	SESW 18-32-85	cottonwood	NR	Near dam on Cabin Ck. Reservoir; med. nest; inactive; Historic FH; two nests; magpie?
		331645	4374664	SWNE 18-32-85			BLM 5 record location
006	GU015 /BLM 9	334065	4736895	SESW 4-32-85	Stick pile on ridge	IA	Historic FH; old nest; inactive
		334078	4736870	SESW 4-32-85			<i>BLM 9 record location</i>
007	GU016/ BLM 10	334166	4736987	SESW 4-32-85	Stick pile on ridge	IA	Historic FH; old nest; inactive

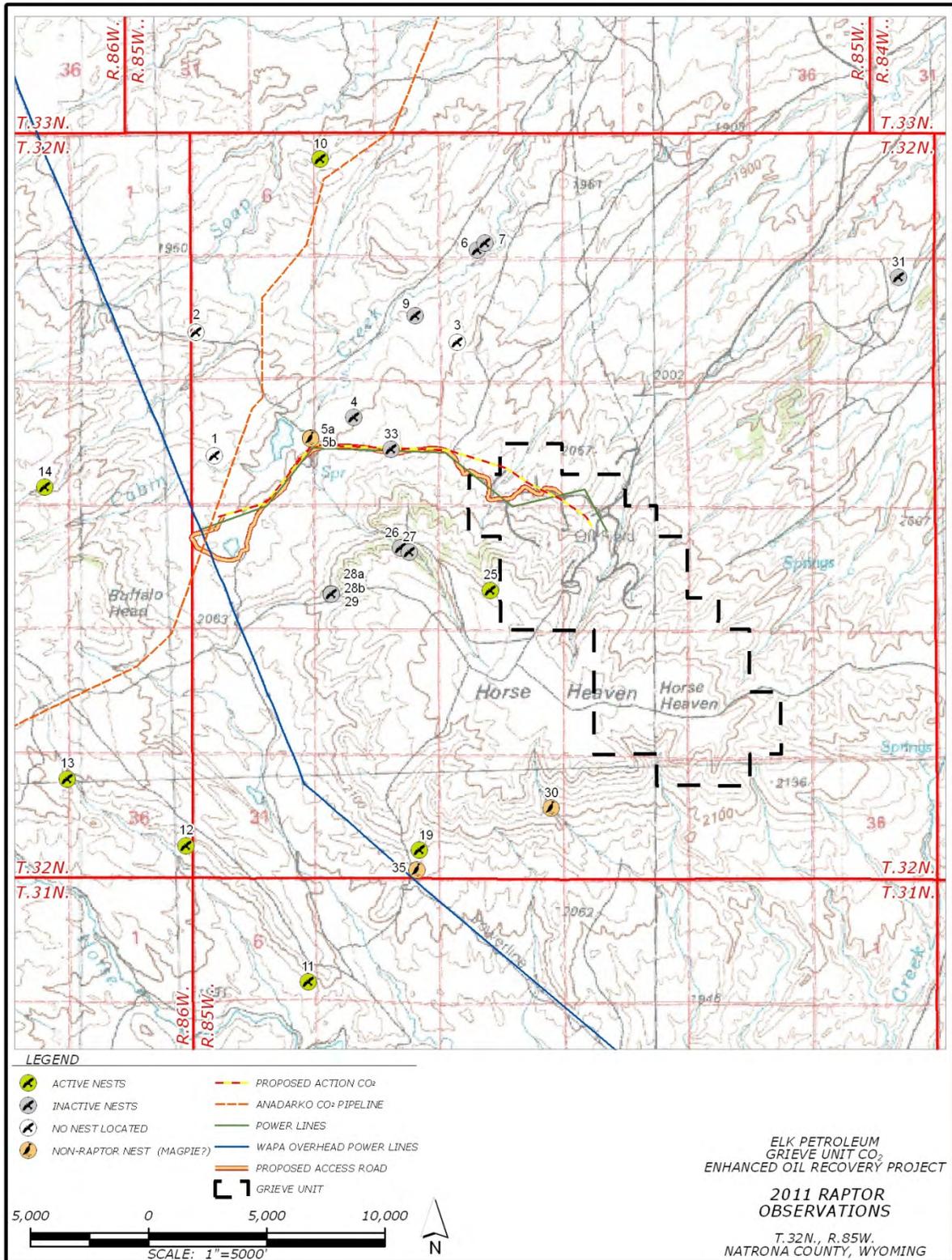
Table 3.3.3.1 - Grieve Unit project area raptor surveys – May and June 2011

Nest ID # on map	WP #/ Photo No. (GUXXX)	Easting*	Northing*	QQ S-T-R	Substrate (if known)	Status **	Species, condition and data source
		334186	4736981	SESW 4-32-85			<i>BLM 10 record location</i>
009	GU019/ BLM 11	333241	4736076	SENE 8-32-85	Stick pile	IA	Historic FH; inactive (photo hard copy only)
		333363	473181	SENE 8-32-85			<i>BLM 11 record location</i>
010	GU022/BLM 12	332067	4738128	NWNW 5-32-85	Rock outcrop	A	Golden eagle; active nest; two downy white young observed
		331914	4738188	NENE 6-32-85			<i>BLM 12 record location</i>
NEW OBSERVATIONS							
011	GU010	331622	4727524	SESE 6-31-85	Rock outcrop	A	Two adult FH flying near nest; active; feathers and white wash observed
012	GU011	330092	4729325	NESE 36-32-86	Rock outcrop	A	Nest in good condition; evidence of usage inc white wash; adult FH spotted in nest during May 13 aerial survey; movement in nest?
013	013	328590	4730228	NENE 35-32-86	Cottonwood	A	RTH; active nest observed from air; two adults in area; <i>no photos</i>
014	GU004/014	328398	4733996	SESE 14-32-86	Cottonwood tree	A	RT; active nest; two adults in area; 350 yds. from PD town; no sign of BO or MP
019	GU014	333103	4729181	SESE 32-32-85	Cottonwood	A	RT seen leaving nest; active
025	GU042/GU043	334107	4732507	NESW 21-32-85	Aspen	A	Stick nest; GE (?) feather below aspen (GU 042)
026	GU044	332963	4733084	SWNE 20-32-	Pine tree	IA	Unknown (RT?); inactive

Table 3.3.3.1 - Grieve Unit project area raptor surveys – May and June 2011

Nest ID # on map	WP #/ Photo No. (GUXXX)	Easting*	Northing*	QQ S-T-R	Substrate (if known)	Status **	Species, condition and data source
				85			
027	GU045/GU046	333079	4733028	SENE 20-32-85	Aspen	IA	Large stick nest; inactive
028a	GU047	332060	4732517	NWSW 20-32-85	Pine tree	IA	Stick nest #1 (larger); inactive
028b	GU048	332060	4732517	NWSW 20-32-85	Pine tree	IA	Two nests in same tree; both inactive (GU047/048/049)
029	GU049	332057	4732517	NWSW 20-32-85	Pine tree	IA	Stick nest #2 (smaller); inactive
030	GU050	334819	4729679	SENE 33-32-85	Shrub (willow?)	NR	Small stick nest; magpie
031	GU051	339483	4736398	NWNE 12-32-85	Stick pile on ridge	IA	Remnants of old stick pile
033	GU057	332883	4734359	NWSE 17-32-85	Pine tree	IA	Two small stick nests; one in poor condition; both inactive
035	GU013	333068	4728926	SESE 32-32-85	Cottonwood	NR	Two nests; no evidence of activity; magpie?
<p>* NAD 83, UTM Zone 13 ** N = no nest located A = active raptor nest IA = inactive raptor nest NR = non-raptor nest (magpie?)</p>							

Figure 3.3.3.1 - Raptor nests in the Grieve Unit project area



3.3.3.2 Threatened and Endangered Wildlife Species

The U.S. Fish and Wildlife Service suggests that this analysis examine the habitat for the federally designated threatened, endangered, proposed or candidate wildlife species which may occur in the project area (Table 3.3.3.2). The statuses of these potentially affected federally designated species are summarized below.

Table 3.3.3.2 - Threatened and endangered wildlife species possible in project area

Species	Status *	Habitat	Status in Project Area / Comments
Black-footed ferret	E	Prairie dog colonies	Eight polygons identified outside the project. Under 200 acres in complex. Not likely to adversely affect determination; falls with block cleared area (Cerovski 2004).
Platte River Species	E	Perennial tributaries	WSEO (2012) has determined no ground water depletion associated with project; No effect determination.
Greater Sage-grouse	Warranted but Precluded	Sagebrush steppe	One known active lek within 4 miles of GUCO ₂ PA; available associated seasonal habitat; State designated “Core Area.”

* **T** - threatened, **E** - endangered, **P** – proposed for listing

Greater Sage-grouse is a sagebrush obligate found entirely in the western United States and Canada, primarily in the intermountain west. Wyoming contains more sage-grouse than all other states combined. The species remains common in Wyoming because its habitat is relatively intact compared to other states. In western Natrona County, as in most of Wyoming, the harsh climate has limited habitat loss and conversion to settlements and agriculture. Historically, disturbance to greater sage-grouse habitat in the area resulted from livestock grazing and oil field development. The greater sage-grouse is considered a sagebrush ecosystem umbrella species, which assumes that conserving its habitats will benefit other species of conservation concern who share the same habitats (i.e., pygmy rabbit, sage thrasher, and sage sparrow; Rowland *et al.* 2006).

Sage-grouse depend on extensive areas of sagebrush for food and cover throughout the year. This dependency includes using sagebrush for forage, nesting habitat, brood-rearing habitat, and winter thermal cover. In addition, sage-grouse require a variety of sagebrush habitat types to meet life-history requirements. Typically, strutting grounds or leks are located in open patches within sagebrush habitat and the surrounding area is considered potential nesting habitat. Nesting habitat tends to have higher sagebrush density, taller live and residual grasses, more live and residual grass cover, and little bare ground (Connelly *et al.* 2004). Mesic habitats also are important for brood-rearing during the summer and fall months. The proximity of nesting habitat to brood-rearing habitat increases its value for broods, but may increase risk for nests (Dzialak *et al.* 2011).

Sage-grouse exhibit fidelity to leks, winter and summer areas, and nesting areas (Schroeder *et al.* 1999). They may be affected by sagebrush community disturbance and removal. Sage-grouse tend to avoid areas that may provide perching or roosting opportunities for raptors (i.e., fence posts, power lines, and structures). Human activity during the breeding season may disrupt lek attendance and affect local breeding success. Populations across the west have declined from historic levels due to a wide range of factors including drought, habitat loss, and habitat degradation (Connelly and Braun 1997, Braun 1998, Connelly *et al.* 2000 and 2004).

As stated in the draft Lander RMP (BLM 2011b), “greater sage-grouse populations have been declining across the western United States, prompting several petitions to list them as threatened under the ESA. In March 2010, the USFWS announced its 12-month finding that listing of the greater sage-grouse is “warranted but precluded.” Thus, the species is designated as a candidate for listing with the USFWS and will be reviewed annually to determine if the listing status should be changed. As identified in the USFWS 2010 finding, the greater sage-grouse population in the planning area is part of Management Zone II, one of seven Management Zones for greater sage-grouse delineated by the Western Association of Fish and Wildlife Agencies based upon ecological and biological attributes, which includes sage-grouse populations throughout the Wyoming Basin (USFWS 2010). Threats to greater sage-grouse in Management Zone II are discussed at length in the USFWS finding and would apply to the planning area.”

Greater sage-grouse population levels throughout the (Lander) planning area plummeted during the 1990s and then experienced a resurgence in the 2000s. This resurgence is thought to be related to precipitation events that promoted grass growth, thus aiding survival of young (BLM 2011b). Threats to greater sage-grouse include degradation, loss, and fragmentation of habitat, predation, West Nile virus, and human disturbance during sensitive periods (BLM 2011b).

Research is beginning to demonstrate that sage-grouse are sensitive to noise, most notably when it affects habitats used during breeding and nesting seasons (Blickley *et al.* 2012). Noise related to ongoing workover activities may exceed 55 dBA within close proximity to the equipment or operation in question. No site specific noise data are available for the project area; but it is assumed that ambient noise levels within the area to be 30 to 40 dBA. The project area is subject to frequent strong winds which may add 5 to 10 dBA to normal ambient levels. Locally higher noise levels may be experienced proximal to operating workover and completion operations.

Certain conservation measures and stipulations are enforced by the BLM in accordance with the BLM sensitive species management guidance (BLM 2010a) and by state agencies under the Governor’s Executive Order 2011-5 (WGFD 2011a). This Executive Order (EO) is implemented in sage-grouse habitat on public as well as on private lands, where the activities on private and state land are subject to review or approval by state or federal agencies.

It is the policy of WY BLM (IM No. WY-2012-019, BLM 2012) to manage sage-grouse seasonal habitats and maintain habitat connectivity to support population objectives set by the Wyoming Game and Fish Department. This guidance is consistent with guidelines provided in the Wyoming Governor’s Sage-Grouse Implementation Team’s Core Area Protection strategy and the Governor’s Executive Order (Order 2011-5) and provides restrictions on surface

disturbance and disruptive activities during certain times of the year. As described in IM No. WY-2012-019, the LFO will consider and evaluate the following sage-grouse habitat conservation measures related to timing, distance, and density for all proposed projects.

Greater sage-grouse populations are hunted in some areas of Wyoming, including the project area (WGFD 2011a). Since 1995, sage-grouse harvest numbers have been reduced by earlier opening dates, shorter hunting season length, and lower bag limits.

WGFD sage-grouse database identified no leks within two miles of the project area (Figure 3.3.3.2) while 15 leks area known within 11 miles of the project. Of these, only three leks have been consistently unoccupied since the early 1980's. Scattered data exists for approximately 50 percent of these leks until the year 2000 when survey effort in the area increased significantly (WGFD 2011b). Although inconsistency in the number of leks surveyed each year is evident in the data, the surveyed leks are generally occupied. Since 2006, there has been a general decline in the number of birds attending leks in the area and this trend is consistent with that seen for the Natrona and Greater South Pass Core Areas as well as the Statewide trend (Figure 3.3.3.3) (Taylor et al. 2011 using WGFD 2011b data).

Greater sage-grouse aerial surveys were conducted over the project area in April and May 2011 in an effort to determine use of the area by the species. Much of the project falls within the State designated Natrona Core Population Area (Figure 3.3.3.2). The survey area was defined by buffering the Grieve Unit and associated pipeline and power line routes by four miles. The area was surveyed using small aircraft, following the Wyoming Game and Fish Department survey protocol, on April 15, April 28 and May 6, 2011. No new leks were observed during the aerial flights although grouse were observed throughout the survey period on the Austin Creek and Burnt Wagon leks, located 7 and 5 miles to the northeast of the survey area, respectively (Figure 3.3.3.2). Opportunistic records of grouse were made when in the field conducting other surveys (Figure 3.3.3.4); these include six grouse on April 15, a concentrated area of scat piles and a few late summer chicks. Ground surveys are coordinated annually by the WGFD, the 2011 peak male lek attendance data for the leks within the vicinity of the project indicated Austin Creek was attended by 41 males, Burnt Wagon by 8 males and Soap Creek by 12 males. One lek (Soap Creek) is located just shy of 4 miles northwest of the project boundary and was attended by 12 males in 2011 (WGFD 2011b).

Figure 3.3.3.2 – Greater sage-grouse leks in the vicinity of the Grieve Unit

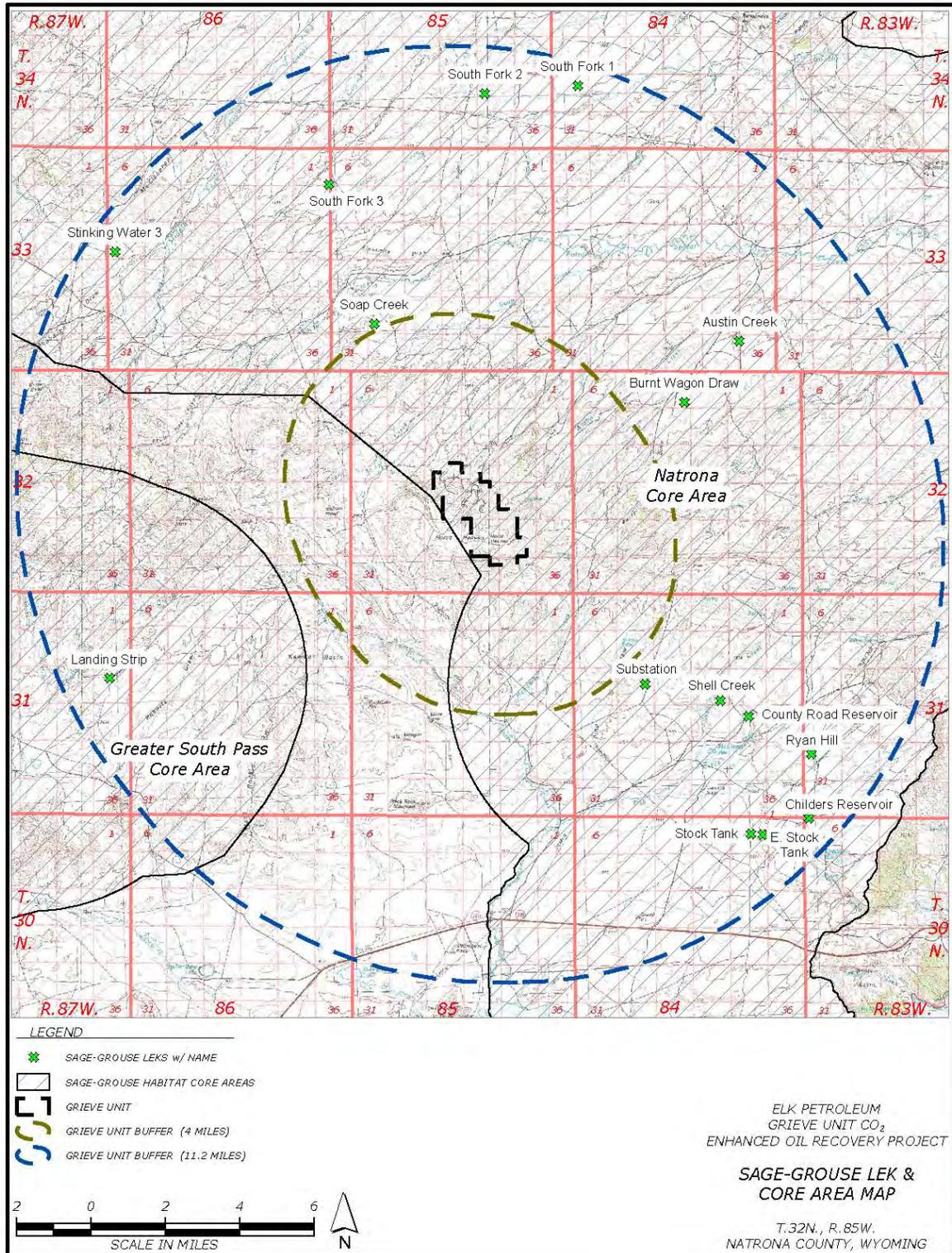


Figure 3.3.3.3 - Grieve Area average peak male lek attendance comparisons

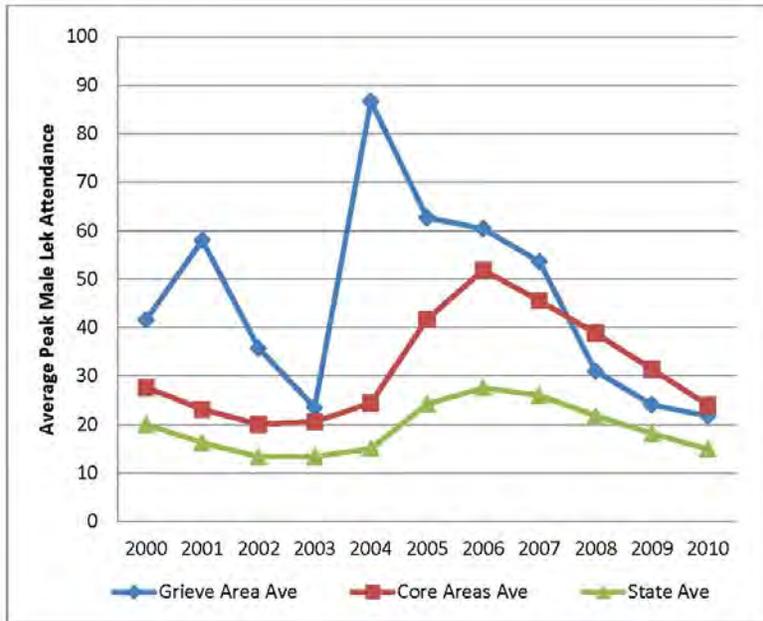
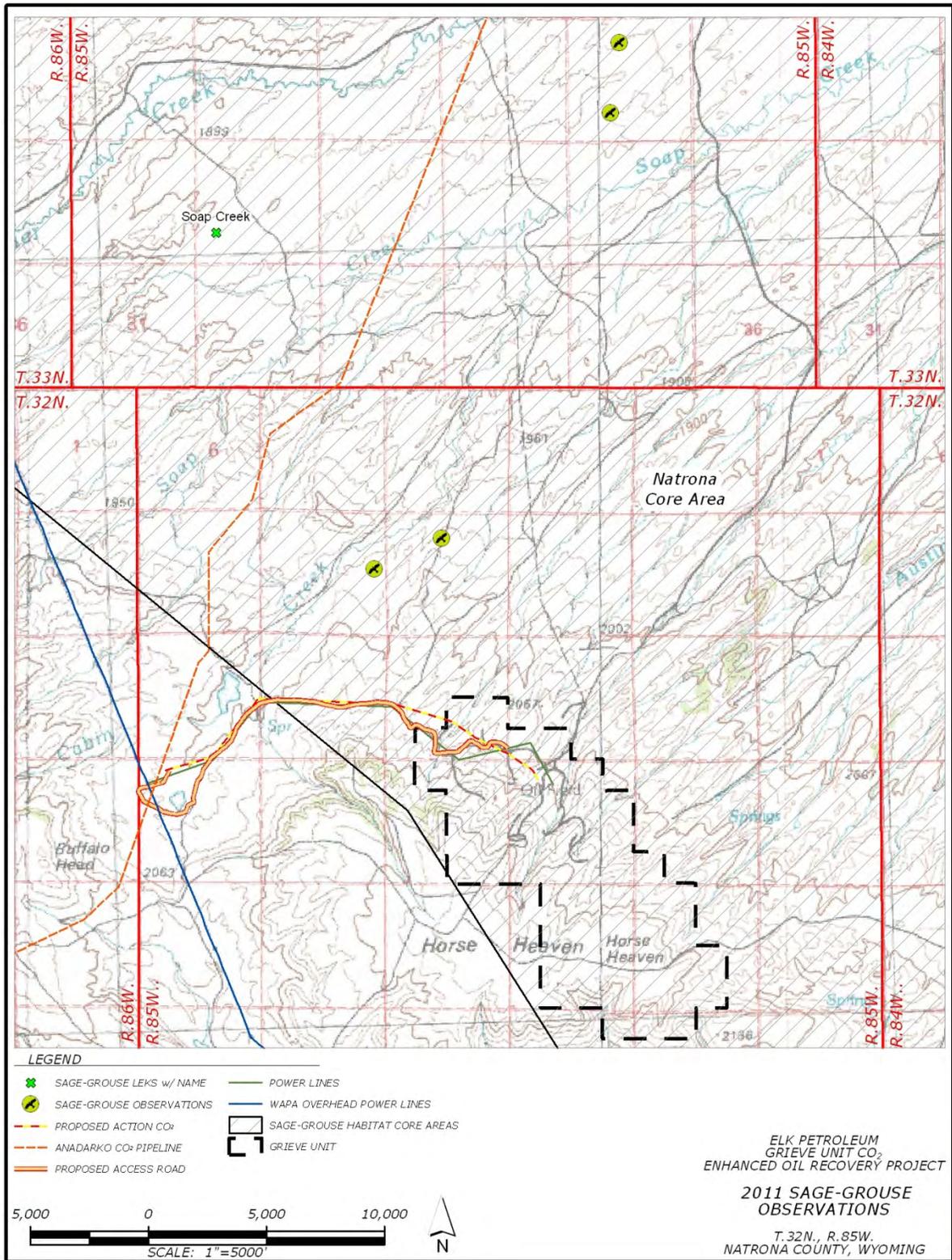


Figure 3.3.3.4 - Greater sage-grouse observations in the Grieve Unit project area



3.3.3.3 BLM LFO Sensitive Wildlife Species List

The assessment area for sensitive wildlife species is the GUCO₂PA boundary. The Wyoming BLM sensitive species and management policy (BLM 2010a) emphasizes planning, management, and monitoring of sensitive species and directs management of these species to avoid or minimize adverse impacts. It is not the intent of the policy to create severe restrictions on activities such that other multiple use activities cannot occur. The policy goals of this policy are to:

- Maintain vulnerable species and habitat components in functional BLM ecosystems,
- Ensure sensitive species are considered in land management decisions,
- Prevent the need for species listing under the Endangered Species Act 1973, and
- Prioritize needed conservation work with an emphasis on habitat.

Fourteen terrestrial wildlife species designated by the BLM as sensitive are present, potentially present, or historically documented within the project area, or potentially could be affected by the Proposed Action (Table 3.3.3.3). The following species descriptions, and associated literature citations, were taken from the BLM Wyoming Sensitive Species Policy and List (BLM 2010a).

Table 3.3.3.3 - BLM LFO Sensitive Wildlife Species List within or near the Grieve Unit project area occurrence potential and habitat associations

Common Name	Scientific Name	Occurrence Potential ¹	Habitat Association ²
Mammals			
Long-eared myotis	<i>Myotis evotis</i>	pp	Caves, forest, shrublands
Swift fox	<i>Vulpes velox</i>	pp	Grasslands
Townsend's big-eared bat	<i>Corynorhinus townsendii</i>	pp	Caves, forest, shrublands
White-tailed prairie dog	<i>Cynomys leucurus</i>	P	Sagebrush-grasslands
Birds			
Brewer's Sparrow	<i>Spizella breweri</i>	pp	Sagebrush
Burrowing owl	<i>Athene cunicularia</i>	pp	Grasslands
Ferruginous hawk	<i>Buteo regalis</i>	P	Sagebrush-grasslands
Loggerhead shrike	<i>Lanius ludovicianus</i>	P	Shrublands
Long-billed curlew	<i>Numenius americanus</i>	pp	Grasslands
Mountain plover	<i>Charadrius montanus</i>	pp	Grasslands
Sage sparrow	<i>Amphispiza belli</i>	P	Sagebrush
Sage thrasher	<i>Oreoscoptes montanus</i>	P	Sagebrush
Amphibians			
Great Basin spadefoot	<i>Spea intermontana</i>	pp	Spring seeps, sagebrush
Northern leopard frog	<i>Rana pipiens</i>	pp	Plains and foothills ponds

¹ Occurrence potential includes: present (P), potentially present (pp);(Cerovski 2004; BLM 2010a, TEC unpublished data).

² Cerovski 2004.

Mammals

Townsend's Big-eared Bat is distributed throughout most of Wyoming but is concentrated in the southeastern and north-central portions of the state (Hester and Grenier 2005). Townsend's big eared bat requires undisturbed roosting structures such as caves or abandoned mines during all seasons and stages of its life cycle. Also, *C. townsendii* has high degree of site fidelity. The major threats on BLM-administered lands are: the disturbance or loss of roost sites in caves and abandoned mines due to recreation in caves, mine reclamation, and renewed mining; loss, degradation, and disturbance of foraging habitat; pesticides and other contaminants (Gruver and Keinath 2003; Gruver and Keinath 2006). Habitat for this species is not known to occur in the project area; this species will not be discussed further in this document.

Long-eared Myotis occurs throughout most of Wyoming at elevations between 5000 and 9800 ft. This species inhabits primarily coniferous forest and woodland (Hester and Grenier 2005). Long-eared Myotis uses a wide variety of roosts, including buildings, rock crevices, and hollow trees. Roosts are more likely to be found in close proximity of foraging sites and water sources. The major threats on BLM-administered lands are: disturbance or modification of the roost environment caused by human activities; alteration of foraging areas such as wetlands and riparian systems; wind energy development; chemicals used in forest management practices and toxins associated with mining operations (Buseck and Keinath 2004). While the species has not been documented in the project area, suitable habitat for the species is present.

Swift Fox occurs in the northeastern, east-central, southeastern, and south-central portions of the state (WGFD 2006). This species is generally uncommon (Dark-Smiley and Keinath 2003), and its population trend within Wyoming is currently unknown (Stephens and Andersons 2005). Swift foxes require large open areas of prairie and grassland habitats (Dark-Smiley and Keinath 2003). The major threats on BLM-administered lands are: collisions with automobiles; destruction and fragmentation of suitable habitat due to energy development; predation and interspecific competition (with coyote and red fox); decline of colonial rodent populations (Stephens and Andersons 2005). While the species has not been documented in the project area, suitable habitat is present.

White-tailed Prairie Dog is distributed in the western and the central parts of Wyoming, mostly dominated by sagebrush (WGFD 2005). In June 2010 the FWS announced a determination that the white-tailed prairie dog did not warrant protection under the Endangered Species Act, noting, "We know that white-tailed prairie dog colonies exist in areas with long-term oil and gas development. Some of the largest and most robust colonies are located near areas of intense oil and gas development" (FWS 2010d). White-tailed prairie dog abundance continues to fluctuate dramatically at the local scale. Population status and trends are unknown but are suspected to be stable (WGFD 2006). Sylvatic plague, poisoning, recreational shooting, and habitat loss and fragmentation due to energy development, livestock grazing, and road development are considered the major threats (Keinath 2004). The species has recently undergone a downward trend and it is thereby designated as Sensitive in Wyoming. The white-tailed prairie dog is present throughout the project area

Birds

Numerous sagebrush obligate species of passerine birds migrate through, nest and raise their young within the project area. Among the several hundred species of birds known to occur in the western Natrona County some are species of high federal concern. Greater sage-grouse, sage thrasher, Brewer's sparrow, sage sparrow, mountain plover and loggerhead shrike are seen here during the spring. Other common birds include western bluebird, vesper sparrow, white-crowned sparrow and horned larks.

Sage Sparrow occurs in the summer throughout most of the state where sagebrush is present (WGFD 2005). Sage Sparrows prefer large and undisturbed tracts of tall and dense sagebrush. The main threat is habitat loss, degradation and fragmentation due to invasion of cheatgrass, wildfires and prescribed burns, off-road motorized use, grazing and increasing road and energy development (Holmes and Johnson 2005). Suitable sagebrush habitat is widespread and abundant within the project area and the sage sparrow is expected to breed, and has been observed, within the project area.

Burrowing Owl reaches its highest concentration (in Wyoming) in the south and east, although Borrowing Owls occur and breed throughout most of the state (WGFD 2006). This species requires short-grass habitats and prefers open areas within grasslands, deserts and shrub-steppes (McDonald et al. 2004). The major threats are: habitat loss and fragmentation due to invasion of cheatgrass, energy and road network development (Lantz et al. 2004); declining of colonial burrowing mammals, especially prairie dogs; human disturbance; the use of insecticides and rodenticides; loss to predation (McDonald et al. 2004). Potential burrowing owl habitat (prairie dog and badger burrows) exists in the project area, but the species was not observed during the 2011 project level field surveys.

Ferruginous Hawk breeds across a large portion of Wyoming, and some individuals are found during winter in the southern part of the state. This species occupies arid and open grassland, and shrubsteppe (Travsky and Beauvais 2005). Ferruginous hawks rely on large areas of native grass and shrubs with abundant prairie dogs, other ground squirrels, and jackrabbits (Travsky and Beauvais 2005). Also, this species is sensitive to human activities and disturbances during the breeding season and appears to have high site fidelity (Travsky and Beauvais 2005; Gillihan et al. 2004). The major threats on BLM-administered lands are: habitat loss and fragmentation due to energy development, increasing road density and cheatgrass invasion; declining prairie dogs and ground squirrel activities; human disturbance during the reproductive period; overgrazing; recreational activities, especially motorized vehicle trails; wind energy development (Travsky and Beauvais 2005; Collins and Reynold 2005). Field surveys, in 2011, documented two active and six inactive ferruginous hawk nests (Table 3.3.3.1 and Figure 3.3.3.3) in the Grieve project survey area.

Mountain Plover is found throughout Wyoming in suitable habitat (WGFD 2006). Mountain Plover nests in grasslands, mixed grassland areas, short-grass prairie, shrub steppe, cultivated lands, and prairie dog towns. This species has a narrow range of habitat requirements and appears to have a high degree of site fidelity (Smith and Keinath 2004; Dismore 2003). The major threats are: loss, degradation, and fragmentation of nesting habitat; disturbance by human activities; eradication of prairie dog colonies (68 FR 53083). In May 2011, the FWS determined that the Mountain Plover does not warrant protection under the Endangered Species Act. Suitable habitat for this bird is generally considered flat grasslands with sparse, low growing vegetation and bare ground. Habitats where prairie dogs are found offer much of the needed requirements. Preferentially,

plover nests are found on slopes seldom exceeding 5% during nesting, but during fledging, the clutch and adult may be found utilizing denser vegetation and steeper terrain. Although habitat is present, no mountain plover were observed in the 2011 field surveys conducted for the Grieve project.

Loggerhead Shrike, like all shrikes in Wyoming, are migratory and occur throughout the state. According to Dorn and Dorn (1999) the Loggerhead Shrike is a “common summer resident” in Wyoming from roughly March through September. Important habitat characteristics are the presence of dense shrubs or trees for nesting with nearby open herbaceous areas for foraging (grasslands or pastures) and a high perch density (Keinath and Schneider 2005). The major threats are loss and degradation of breeding and wintering habitats, cattle grazing, collisions with vehicles, and drought (Keinath and Schneider 2005; Wiggins 2005). The preferred habitats of the loggerhead shrike are present in the project area.

Long-billed Curlew can be found throughout most of Wyoming in suitable habitat. Long-billed Curlew occurs in a variety of grasslands communities, from short grass prairies to cultivated hay fields to sagebrush-grasslands (Dark-Smiley and Keinath 2004). The greatest threat to this species on BLM-administered lands in Wyoming is habitat loss, degradation, and fragmentation due to urban and oil/gas development, climate change, and some invasive species infestations. Other threats are: disturbance during breeding season by excessive vehicle traffic, recreation, grazing and nest destruction caused by the agricultural practice called “dragging” (Dark-Smiley and Keinath 2004; Sedgwick 2006). The species was not observed during the 2011 field surveys, suitable breeding habitat for the curlew is present in the project area.

Sage Thrasher is considered a common summer resident and occurs throughout most of Wyoming where sagebrush is present (WGFD 2005). Sage thrashers are sagebrush obligates and seem to be quite selective in sites used for nesting and breeding habitat (Buseck et al. 2004). The greatest threat to Sage Thrasher is habitat loss, modification, and fragmentation due to invasion of nonnative plant species (cheatgrass), agricultural practices, fire, urban and natural resource development, and increased recreational activity (Buseck et al. 2004). Suitable sagebrush habitat is widespread and abundant within the Grieve project area. The sage thrasher is expected to breed within the project area.

Brewer’s Sparrow is considered a common summer resident in Wyoming and occurs throughout most of the state (WGFD 2005). The Brewer’s Sparrow is a sagebrush obligate. The major threats on BLM-administered lands are habitat loss, degradation and fragmentation due to road and oil/gas development, invasion of cheatgrass, livestock grazing, wildfires and prescribed burns (Holmes and Johnson 2005). Brewer’s sparrow is expected to breed within the project area.

Amphibians

Northern Leopard Frog The Fish and Wildlife Service recently determined the Northern Leopard Frog does not warrant protection under the Endangered Species Act (USFWS October 2011). It is found in most of Wyoming, around beaver ponds (WGFD 2005). Northern leopard frogs require small fishless ponds for reproduction and upland habitats for summertime foraging (Smith and Keinath 2004; 2007). The major threats include: loss and degradation of habitat due to livestock grazing, urban development, oil and gas development, poor forestry practices, groundwater pumping,

mining, invasive plant species, and non-native predators; diseases; road impacts, water pollution, air pollution, and effects due to climate change (74 FR 31389). Suitable habitat for the species does occur in the project area.

Great Basin Spadefoot occurs mostly west of the Continental Divide in the Wyoming Basin and the Green River Valley, but is also found east of the divide in Fremont and Natrona counties (WGFD 2005). The Great Basin Spadefoot relies on both aquatic and terrestrial environments. They also require safe passages between these areas and loose soil to burrow (Buseck et al. 2005; WGFD 2005). The major threats include: habitat alteration and fragmentation due to road and oil/gas development, water manipulation, and environmental contamination; invasive plant species, such as cheat grass, and non-native predators (Buseck et al. 2005). Habitat for this species occurs in the project area.

3.3.4 SOILS

3.3.4.1 General Description of Major Soil Types

The Natural Resource Conservation Service (NRCS) completed an order 3 soil survey in 1985 of Natrona County which includes the Proposed GUCO₂ project area (NRCS 1997). All soils information found within this document is derived from the NRCS Natrona County Soil Survey. A total of 17 soil series and 12 soil map units occur within the project area (Table 3.3.4.1 and Figure 3.3.4.1).

Table 3.3.4.1 - NRCS map unit symbols and map unit descriptions found within the proposed Grieve Unit CO₂ EOR project area according to the NRCS Soil Survey of Natrona County, Wyoming.

Map Unit Symbol	Map Unit Description
104	Alcova - Stunner, 3-15% slopes
110	Aquic Ustifluvents, saline, 0-3% slopes
129	Boettcher - Pinelli - Worfman loams, 3-15% slopes
137	Brownsto - Lupinto complex loams, 6-40% slopes
162	Cragosen gravelly loam, 6-30% slopes
163	Cragosen - Chalkcreek Association, 3-45% slopes
183	Forelle loam, 2-9 % slopes
184	Forelle - Diamondville complex, 3-15 % slopes
217	Lupinto - Alcova complex, 3-30% slopes
227	Orella - Cadoma - Petrie clay loams, 3-30% slope
256	Rock Outcrop - Ustic Torriorthents, shallow - Rubble land complex, 30-100% slopes
285	Tisworth sandy loam, 0-5% slopes

The majority of soil series are very deep and have a predominant loam soil surface texture. Other surface textures found include gravelly loam, cobbly loam, clay loam, sandy loam and fine

sandy loam. Soils are generally well drained. Most soils have formed in alluvium and siltloam alluvium derived from various sources.

3.3.4.2 Erosion Potential

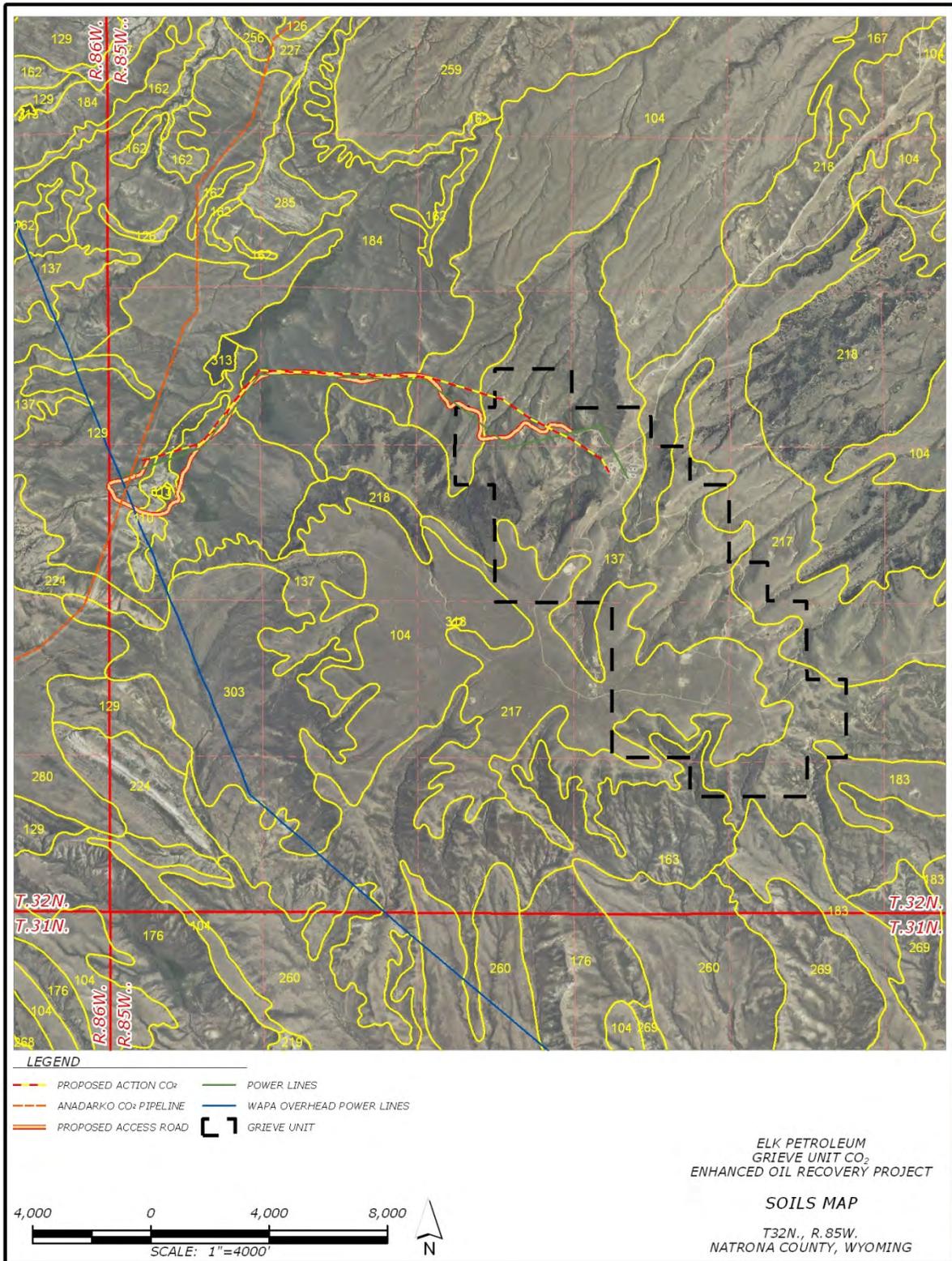
Most of the soils found within the project area are susceptible to wind and water erosion. The soils generally have a severe water erosion hazard with rapid surface runoff and a moderate wind erosion hazard.

3.3.4.3 Soil Ratings and Limitations

Within the project area, suitability of soil as a source of topsoil is rated generally as poor and is limited by small stones, slope, high clay content, depth to rock, excess salt, excess sodium and reclamation difficulty. The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth (NRCS 1997).

The NRCS rating for the construction of roads is considered mostly as severe which means that soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possible increased maintenance are required (NRCS 1997). Soils are generally limited for road construction by slope, flooding, frost action, shrink-swell, low strength, depth to rock, and large stones.

Figure 3.3.4.1 - Soils in project area and vicinity



Limited Reclamation Potential Soils

Limited Reclamation Potential (LRP) areas are defined by the Lander Field Office. The following site and soil characteristics were used to identify LRP areas:

1. Soil textures with poor water holding capacity;
2. Soil textures prone to excessive amounts of erosion by wind or water;
3. Soils with high levels of salts that interfere with plant growth;
4. Soils on slopes in excess of 25%;
5. Soil profiles that limit water holding capacity and/or create rooting-zone limitations; and
6. Coarse fragments that limit common reclamation practices.

LRP determinations identified NRCS map units that met the proper criteria. The LRP map units located within the project area included Map Unit 110 – Aquic Ustifluvents, saline, 0-3% slopes and Map Unit 137 -Brownsto - Lupinto complex loams, 6-40% slopes. NRCS map Unit 110 affects the NW ¼ of section 19, T33N R85W and the SE ¼ of section 18, T33N R85W. NRCS map unit 137 affects the majority of soil located within the project boundary. See Figure 3.3.4.1 for LRP designated areas.

Soils with Excess Salts

Reclamation processes could be hindered by excess salts in the soil which limit the ability of plants to take up water or high sodium concentrations which cause the dispersion of clay particles resulting in a massive structure (soil sealing), which impedes water movement. According to the NRCS the Orella and Tisworth soil series have excess salts or high sodium concentrations.

Soil Compaction

Soil compaction negatively affects plant growth, nutrient cycling, and water infiltration, percolation, and storage, due to decreased pore space and increased density. Increased runoff and erosion may result from the compaction. Soils are more resistant to compaction when they are dry, have well-developed structure or high aggregate stability, vegetative cover, and high organic matter (NRCS 2001). Sandy loam, loam, and sandy clay loam soils compact more easily than other soils (NRCS 2001). Based on surface horizon texture, the majority of soil series are susceptible to compaction.

3.3.4.4 Hydric Soils and Hydrologic Soil Groups

Hydric soils are defined by the National Committee for Hydric Soils as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (Federal Register 1994). No soils series found within the project area are considered as hydric by the Natrona County NRCS; however, hydric soils were identified during wetland delineation field work and were located mainly in drainage bottoms and flood plains. NRCS Map unit 185-Tisworth sandy loam, 0-5% slopes is found within the project area and may contain the minor inclusion of the hydric Typic Fluvaquents series on floodplains. The Typic Fluvaquent series is hydric criteria code 4 which means that the soil is frequently flooded for long durations or very long durations during the growing season. It meets hydric flooding criteria but does not meet saturation or ponding criteria.

Hydrologic soil groups refer to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil that is bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff (NRCS 1997). Soils are assigned to four groups. The majority of soil series found within the project area are in group D, these soils have a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material (NRCS 1997). Several soil series are also found in hydrologic group B; soils in this group have moderately low runoff potential when thoroughly wet and water transmission through the soil is unimpeded (NRCS 1997).

3.3.4.5 Biological Soil Crusts

The following discussion of biological soil crusts is taken from the United States Geological Survey (USGS 2006).

“Biological soil crusts are formed by living organisms and their by-products, creating a crust of soil particles bound together by organic materials. Chemical and physical crusts are inorganic features such as a salt crust or platy surface crust, often formed by trampling.”

“The general appearance of the crusts in terms of color, surface topography, and surficial coverage varies. This color is due in part to the density of the organisms and to the often dark color of the cyanobacteria, lichens, and mosses. Crusts generally cover all soil spaces not occupied by vascular plants, and may be 70% or more of the living cover.”

“Crusts play an important role in the environment. Because they are concentrated in the top 1 to 4 mm of soil, they primarily affect processes that occur at the land surface or soil-air interface. These include soil stability and erosion, atmospheric nitrogen-fixation, nutrient contributions to plants, soil-plant-water relations, infiltration, seedling germination, and plant growth.”

“Crusts are well adapted to severe growing conditions, but poorly adapted to compressional disturbances. Domestic livestock grazing, and more recently, recreational activities (hiking, biking, and off-road driving) and military activities place a heavy toll on the integrity of the crusts. Disruption of the crusts brings decreased organism diversity, soil nutrients, stability, and organic matter. Full recovery of crust from disturbance is a slow process, particularly for mosses and lichens.”

Biological soil crusts likely are found throughout the project area, no specific surveys were conducted.

3.3.4.6 Existing Soil Disturbances

Soil disturbance exists within the project area, fifty-six years of oil production has resulted in equipment and production facilities scattered throughout the Grieve Unit. According to BLM-LFO disturbance data, existing soil disturbances occur on approximately 230 acres and includes pipelines, utility lines, roads, facilities, well pads, production pits, and production equipment and infrastructure. In addition, circa 1960, four housing units and a school were built immediately to the south of the Unit boundary. The area was homesteaded in the late 1800's by the Grieve

family, and livestock grazing operations have occurred in the area since then. As a result of that activity there are man-made stock water ponds, fences, old structures and ranch roads.

3.3.5 VEGETATION INCLUDING INVASIVE NON-NATIVE SPECIES, THREATENED AND ENDANGERED AND SPECIAL STATUS SPECIES

3.3.5.1 Plant Communities in the Grieve Unit Project Area

The proposed GUCO₂ project area is located in the Western Range and Irrigated Land Resource Region within the Central Desertic Basins and Plateaus Major Land Resource Area (MLRA 34A) (NRCS 2006). MLRA 34A is primarily located in the Wyoming Basin Province of the Rocky Mountain System. The majority of MLRA 34A is characterized by a semi-desert grass-shrub zone. Average annual precipitation within this zone is 8 to 16 inches (NRCS 2006). Elevation within the proposed project area generally ranges from approximately 6,210 to 7,370 feet above sea level.

Based on plant community descriptions for the 10-14" Precipitation Zone High Plains Southeast Ecological Site Descriptions (ESD) (Braze 2008 a-g) and field observations, uplands within the proposed disturbance area of the GUCO₂ project area are dominated by sagebrush shrublands primarily composed of Big Sagebrush/Mid-Grass plant community and sagebrush grasslands composed of Bluebunch Wheatgrass/Rhizomatous Wheatgrass plant community. Grasslands composed of a Rhizomatous Wheatgrass/Needle-and-thread plant community are less common and interspersed throughout the sagebrush shrublands and grasslands. Saline lowlands are comprised of Alkali Sacaton/Basin Wildrye plant communities. Non-saline drainages and lowlands are dominated by Western Wheatgrass/Kentucky Bluegrass, Nebraska Sedge/Bunchgrass, and Baltic Rush/Annual Forb plant communities. Limber Pine is common on the southern hills of the GUCO₂ project area, but occurrence is limited within the proposed disturbance area.

Big Sagebrush/Mid-Grass Plant Community

The Big Sagebrush/Mid-Grass plant community is found on Loamy ecological sites primarily on level plains, slopes, and along drainage edges with shallow to moderately deep soils in the western portion of the proposed disturbance area. Big sagebrush (*Artemisia tridentata*) dominates the site. The understory is composed primarily of western wheatgrass (*Elymus smithii*), needle-and-thread (*Hesperostipa comata*), green needlegrass (*Nassella viridula*), blue grama (*Bouteloua gracilis*) prairie junegrass (*Koeleria macrantha*), Sandberg bluegrass (*Poa secunda*), and threadleaf sedge (*Carex filifolia*). Other shrub species include birdfoot sagebrush (*Artemisia pedatifida*), green rabbitbrush (*Chrysothamnus viscidiflorus*), and rubber rabbitbrush (*Ericameria nauseosa*). Total ground cover for this plant community is typically 80-90% (Braze 2008a).

Bluebunch Wheatgrass/Rhizomatous Wheatgrass Plant Community

The Bluebunch Wheatgrass/Rhizomatous Wheatgrass plant community is found on Shallow Loamy ecological sites on rolling slopes or rough, broken topography with shallow soils primarily in the eastern portion of the proposed disturbance area. Dominant grasses within this community include bluebunch wheatgrass (*Elymus spicatus*), western wheatgrass, blue grama,

threadleaf sedge, and Sandberg bluegrass. Big sagebrush, birdfoot sagebrush, and green rabbitbrush are common. Total ground cover for this plant community is typically 40-60% (Braze 2008b).

Rhizomatous Wheatgrass/Needle-and-thread Plant Community

The Rhizomatous Wheatgrass/Needle-and-thread plant community is found on Loamy ecological sites on nearly level to gentle slopes with moderately deep soils in isolated locations in the western portion of the disturbance area. This site is dominated by western wheatgrass, needle-and-thread, bluebunch wheatgrass, green needlegrass, prairie junegrass, blue grama, and Sandberg bluegrass. Shrub cover within this community is less than 25% and composed primarily of big sagebrush and rubber rabbitbrush. Total ground cover for this plant community is typically 80-90% (Braze 2008a).

Alkali Sacaton/Basin Wildrye Plant Community

The Alkali Sacaton/Basin Wildrye plant community is found on Saline Subirrigated ecological sites located primarily in the southwestern portion of the proposed utility corridor. Common plant species within the community include alkali sacaton (*Sporobolus airoides*), Sandberg bluegrass, Nuttall's alkaligrass (*Puccinellia nuttalliana*), western wheatgrass, tufted hairgrass (*Deschampsia caespitosa*), bluejoint reedgrass (*Calamagrostis canadensis*), and Baltic rush (*Juncus balticus*). Basin wildrye (*Elymus cinereus*) was absent in this community within the proposed disturbance area. Shrubs are a minor component of this plant community and consist of big sagebrush and rubber rabbitbrush. Total ground cover for this plant community is typically 80-90% (Braze 2008c).

Western Wheatgrass/Kentucky Bluegrass Plant Community

The Western Wheatgrass/Kentucky Bluegrass plant community is found on Subirrigated ecological sites within ephemeral drainages with moderately deep to deep soils throughout the proposed disturbance area. Western wheatgrass, Kentucky bluegrass (*Poa pratensis*), and green needlegrass dominate. Low growing sedges and forbs are common. Silver sagebrush (*Artemisia cana*), big sagebrush, and rubber rabbit brush are present. Total ground cover for this plant community is typically greater than 95% (Braze 2008d).

Nebraska Sedge/Bunchgrass Plant Community

The Nebraska Sedge/Bunchgrass plant community is found within drainages with seasonal to permanent water regimes. All occurrence of this community are within drainages classified as wetlands, based on field surveys, and are found in isolated locations throughout the proposed disturbance area. Dominant species include Nebraska sedge (*Carex nebraskensis*), Prairie cordgrass (*Spartina pectinata*), and alkali sacaton, tufted hairgrass, and bluejoint reedgrass. Total ground cover for this plant community is typically greater than 95% (Braze 2008g).

Baltic Rush/Annual Forbs Plant Community

The Baltic Rush/Annual Forbs plant community is found in similar topographic positions as the Nebraska Sedge/Bunchgrass plant community. All occurrence of this community are within drainages classified as wetlands, based on field surveys, and are found in isolated locations throughout the proposed disturbance area. Baltic rush (*Juncus balticus*) is the dominant species. Other common species include Kentucky bluegrass, Timothy (*Phleum pratense*) and carpet

bentgrass (*Agrostis stolonifera*). Annual forbs are not as prevalent within the disturbance area as described in the ESD. Total ground cover for this plant community is typically greater than 95% (Braze 2008g).

Limber Pine Plant Community

The Limber Pine plant community is isolated primarily to the steeper slopes located in the southern portion of the project area; however, isolated stands are located throughout the project area and within the proposed disturbance area on Very Shallow and Shallow Loamy ecological sites. The canopy of this community is dominated by limber pine (*Pinus flexilis*). The understory is dominated by low growing shrubs and grasses. Shrub species include birdfoot sagebrush, common snowberry (*Symphoricarpos albus*), and big sagebrush. Western wheatgrass is the dominant grass species. Total ground cover for this plant community is typically 60-80%.

3.3.5.2 Invasive Non-Native Species

Non-native species invasion and establishment has become an increasingly important result of previous and current disturbance in Wyoming. These species often out-compete desirable plant species and reduce the overall production of desired grasses, forbs, and shrubs, which serve as forage sources for livestock and wildlife. Additionally, sites dominated by invasive, non-native species often have a different visual character that may negatively contrast with surrounding undisturbed vegetation. The proposed Grieve Unit CO₂ EOR Project Area is subject to noxious weed infestation, especially on new disturbances.

Surveys for Wyoming State Listed Noxious Weeds, Wyoming Weeds of Concern, and Natrona and Fremont County Declared Weeds were conducted within the proposed Grieve Unit CO₂ EOR Project Area (Wyoming Weed and Pest Council 2010a, 2010b, and Fremont County Weed and Pest 2011). Survey areas included current and proposed disturbance areas. Surveyed weed species observed during the weed inventory were GPS located or marked on aerial imagery maps.

Three Wyoming State Listed Noxious Weeds were observed: diffuse knapweed (*Centaurea diffusa*), spotted knapweed (*Centaurea maculosa*), and Canada thistle (*Cirsium arvense*). Six Natrona County Declared Weeds were observed: showy milkweed (*Asclepias speciosa*), cheatgrass (*Bromus tectorum*), wild licorice (*Glycyrrhiza lepidota*) (also listed as Wyoming Weed of Concern), curlycup gumweed (*Grindelia squarrosa*), halogeton (*Halogeton glomeratus*), and foxtail barley (*Hordeum jubatum*). Occurrences, of these species, were typically within and along existing disturbances; however, observations also occurred within native areas proposed for disturbance. Observed species were typically found as isolated individuals or small populations. Refer to the Weed Management Plan (Appendix E) for locations of weed species observed within the proposed project area.

3.3.5.3 BLM LFO Sensitive Plant Species List

Special status species are: (1) Threatened, Endangered, and Candidate species and (2) BLM Sensitive Plant Species. A Special Status Species report for the Grieve CO₂ project area is on file at the BLM LFO.

The BLM has developed a list of sensitive plant species for public lands in Wyoming to help focus management efforts toward maintaining habitats under a multiple use mandate and to prevent the future listing of threatened and endangered species under the ESA. This list is reviewed annually to determine additions and deletions based on recommendations from BLM and non-BLM authorities (BLM 2010a). Those sensitive species identified on the BLM LFO sensitive species list are found on Table 3.3.5.2.

Of the eleven BLM LFO sensitive species, two sensitive plant species were determined to have potential habitat or were present within the proposed project area: Rocky Mountain twinpod (*Physaria saximontana* var. *saximontana*) and limber pine (*Pinus flexilis*).

Rocky mountain twinpod is found on sparsely vegetated rocky slopes of limestone, sandstone or clay (BLM 2010a). This habitat was very limited within the proposed project area (0.6 acres); only occurring at one location between the proposed CO₂ pipeline corridor and access road in NW ¼ SW ¼ of Sec. 17, T32N R85W. A *Physaria spp.* was found at this location; however, due to the timing of the survey (after the flowering period), the plant was not identified beyond genus. This species has not been previously documented within or near the proposed project area (WYNDD 2010).

Limber pine occurs at timberline and lower elevations with sagebrush, usually on western slopes and isolated on eastern slopes of the Rocky Mountains (BLM 2010a). Populations of this species were present within the proposed disturbance and project areas, covering approximately 90.9 acres of the project area. Of these 90.9 acres, approximately 86.7 acres occur outside of the proposed disturbance area. Isolated stands within the proposed disturbance area occur in the SE ¼ SW ¼ Sec. 15, T32N R85W; SE ¼ NE ¼ of Sec. 21, T32N R85W; and SW ¼ NE ¼, NW ¼ NW ¼, and SW ¼ NW ¼ of Sec. 22, T32N R85W encompassing approximately 4.16 acres (based on buffered disturbance boundaries). A small isolated stand of five mid-sized trees and approximately five saplings is also present between the proposed CO₂ pipeline corridor and access road in NW ¼ SW ¼ of Sec. 17, T32N R85W near the proposed 230kV distribution line. Results of the WYNDD data request did not include information for limber pine occurrences within the proposed project area (WYNDD 2011).

Table 3.3.5.1 - BLM Sensitive Plant Species List for the Lander Field Office

Common Name	Scientific Name	Preferred Habitat	Potential Habitat Present within Proposed Project Area	Likely to Occur
Meadow pussytoes	<i>Antennaria arcuta</i>	Moist, hummocky meadows, seeps or springs surrounded by sage/grasslands	No	No
Porter's sagebrush	<i>Artemisia porteri</i>	Sparsely vegetated badlands of ashy or tuffaceous mudstone and clay slopes	No	No
Dubois milkvetch	<i>Astragalus gilviflorus</i> var.	Barren shale, badlands, limestone, and redbed slopes	No	No

Table 3.3.5.1 - BLM Sensitive Plant Species List for the Lander Field Office

Common Name	Scientific Name	Preferred Habitat	Potential Habitat Present within Proposed Project Area	Likely to Occur
	<i>purpureus</i>	and ridges		
Cedar rim thistle	<i>Cirsium aridum</i>	Barren, chalky hills, gravelly slopes, and fine textured, sandy-shaley draws	No	No
Owl Creek miner's candle	<i>Cryptantha subcapitata</i>	Sandy-gravelly slopes and desert ridges on sandstones of the Wind River Formation	No	No
Fremont bladderpod	<i>Lesquerella fremontii</i>	Rocky limestone slopes and ridges	No	No
Beaver rim phlox	<i>Phlox pungens</i>	Sparsely vegetated slopes on sandstone, siltstone, or limestone substances	No	No
Rocky Mountain twinpod	<i>Physaria saximontana</i> var. <i>saximontana</i>	Sparsely vegetated rocky slopes of limestone, sandstone, or clay	Yes	Unknown
Limber pine	<i>Pinus flexilis</i>	Timberline and at lower elevation with sagebrush	Yes	Yes
Persistent sepal yellowcress	<i>Rorippa calycina</i>	Riverbanks and shorelines, usually on sandy soils near high-water line	No	No
Barneby's clover	<i>Trifolium barnebyi</i>	Ledges, crevices, and seams on reddish-cream Nugget Sandstone outcrops	No	No

3.3.6 WATER RESOURCES

3.3.6.1 Surface Water

Stream Classification and Water Use

The Wyoming Department of Environmental Quality, Water Quality Division (WDEQ/WQD 2001) classifies Wyoming surface water resources according to quality and degree of protection. The Wyoming Game and Fish Department also categorizes surface waters as to their ability to support fisheries and other aquatic life.

Surface waters in the project area are within the Poison Spider hydrologic unit (HUC 101800-070403); Poison Spider is a sub-drainage within the North Platte River HUC, discussed above. All the surface waters in the project area and vicinity are considered to be Class 3B surface waters (WDEQ 2001). Specifically, Cabin Creek Reservoir and Cabin Creek, a tributary to Soap Creek and an un-named tributary to Poison Spider Creek, both of which are tributaries to the unimpaired, Class 3B portion of Poison Spider Creek (WDEQ 2010), would be potentially

affected by the proposed project. Poison Spider Creek is located more than ten stream miles northeast of the Grieve Unit. Drainage systems to the south of Horse Heaven are dry and unclassified (WDEQ 2001).

WDEQ/WQD defines *Class 3B waters* (WDEQ/WQD 2000) as: tributary waters including adjacent wetlands that are not known to support fish populations or drinking water supplies and where those uses are not attainable. Class 3B waters are intermittent and ephemeral streams with sufficient hydrology to normally support and sustain communities of aquatic life including invertebrates, amphibians, or other flora and fauna which inhabit waters of the state at some stage of their life cycles. In general, 3B waters are characterized by frequent linear wetland occurrences or impoundments within or adjacent to the stream channel over its entire length. Such characteristics will be a primary indicator used in identifying Class 3B waters.

Surface Water Quality

The water quality characteristics of surface waters generally reflect the chemical nature of precipitation in the region and the geologic strata over which the water flows. Water sampling results are often compared to a numerical standard defined for protection of drinking water, aquatic organisms, and other beneficial water uses. While water quality data exists for lower Poison Spider Creek (WDEQ 2010) there are no surface water quality data available for the surface waters in the vicinity of the Grieve Unit.

Surface Water Rights

Surface water rights in the project area date from 1900, the majority were obtained in the name of James Grieve or Lulu Grieve (WSEO 2011). These irrigation appropriations are generally from Canyon Creek. In the 1940's the Dumbell Ranch obtained surface water rights from Poison Spider Creek and Cabin Creek, including the Cabin Creek Reservoir (WSEO 2011). The proposed project will not affect these water rights or their associated conveyance and storage structures.

3.3.6.2 Groundwater

The Grieve Unit (T32N, R85W) is located in the southeast portion of the Wind River Basin. The Wind River Basin is located in almost the exact center of Wyoming and, in general, is an asymmetrical syncline with its axis nearest and parallel to its north and east edges (WSGS website, 2012). The basin's northern side is bounded by the Bridger-Owl Creek-Washakie mountain ranges, while the south side is bounded by the Granite Mountains. The west side of the basin is bounded by the east-dipping flanks of the Wind River Range. The east side is bounded by topographically low Casper Arch, which is a broad upfold of sedimentary rocks which separates the Wind River Basin and the Powder River Basin. The bounding mountain ranges and the Casper Arch do not allow groundwater to leave the Wind River Basin.

Paleozoic and Mesozoic sediments within the basin are highly deformed and are exposed along the basin bounding uplifts. Recharge occurs through precipitation and runoff on the exposed strata and the resulting groundwater migrates down-dip towards the center of the basin. Tertiary

sediments were deposited after deformation of the Paleozoic and Mesozoic sediments and are relatively flat-lying. Groundwater flow to the Tertiary sediments occurs through precipitation, runoff and movement of water from underlying aquifers upwards along faults and fractures (Hinckley and Heasler, 1987). Only Mesozoic aquifers are exposed in the Grieve Unit area. All are Cretaceous in age, are northwest trending and dip into the basin. They are the Cloverly (Kj), Frontier (Kf), Mesaverde (Kmv) and the Lance (Klm) formations. The Phayles Sandstone is the basal member of the Mesaverde Fm. Tertiary aquifers in the Grieve Unit area are the Paleocene Fort Union Fm (Tfu), the Eocene Wind River Fm (Twdr), the Oligocene White River Fm (Twr) and undifferentiated Miocene rocks to the south.

Groundwater Rights

Existing groundwater rights within one mile of the project area consist of 2 wells permitted for miscellaneous use, refer to the discussion below.

Springs

Numerous springs occur in the general vicinity of the Grieve project; many of these have been developed, to some extent, to enhance the water available for agricultural activities in the area.

Shallow groundwater

There are no domestic use water wells listed in the WSEO database within one mile of the Grieve Unit, and there is only one well listed for stock use, the well depth is 300 feet. This well is located in Section 15-T32N-R85W, in the general vicinity of the abandoned Grieve Unit field housing area (WSEO 2011). The only other well in the search area is the Grieve Unit #6. This well has a depth of 917 feet and is listed for miscellaneous use; historically the Grieve #6 provided water for the employee housing area and school house as well as stock water and some industrial use (Forest Oil 1992). The well will flow to surface in the spring, suggesting a shallow completion and surface recharge; it has been used to fill a nearby pond for the surface owner; the TDS is low (Table 3.3.6.1). The Grieve #6 production interval is unknown; though it has an open hole interval from 748 to 917’ and a casing part at 667’, the artesian flow in the spring and low TDS suggest a shallower source (GGA 2011).

Analysis of logs from the Grieve 31-21 suggests that the Phayles Sand, at a depth of approximately 700 feet, is the lowermost USDW (underground source of drinking water) with TDS (Total Dissolved Solids) in the range of 2,000 to 2,500 mg/l (GGA 2011).

Based on the available information, the depth to shallow, fresh groundwater sources for domestic or stock use that may be impacted by the proposed injection operation is approximately 300 feet (GGA 2011).

Table 3.3.6.1 - Shallow groundwater quality analyses in the Grieve Unit #6

Parameters	Standards		Summary Statistics
	General Water Quality Indicators		
	Drinking Water ¹	Livestock ¹	Grieve Unit #6

Table 3.3.6.1 - Shallow groundwater quality analyses in the Grieve Unit #6

Parameters	Standards		Summary Statistics
General Water Quality Indicators			
Specific Conductance (umho/cm)			718
pH (standard units)	6.5-8.5	6.5-8.5	8.9
Total Hardness (mg/L)			<5
Total Dissolved Solids (mg/L)	500.0	5,000.0	461
Ionic Constituents			
Calcium (mg/L)			1
Magnesium (mg/L)			0.02
Sodium(mg/L)			106
Potassium(mg/L)			3
Chloride (mg/L)	250.0	2000.0	6
Bicarbonate (mg/L)			378
Nitrate + Nitrite (mg/L)	--	100.0	NT ²

1 WDEQ/LQD Quality Standards for Wyoming Groundwaters (WDEQ/WQD 2008b)

2 NT - Not tested

Deep groundwater

In association with historical Grieve Unit operations, the WOGCC had granted aquifer exemptions in portions of the Unit. The exemptions were for produced water disposal by injection into either the Cloverly (6,800 ft. bgs) or the Muddy Sand (6,600 ft. bgs). The permitted injection wells included the Grieve Unit #1 and the Grieve Unit #49, both of which are currently plugged and abandoned or shut-in, respectively.

In addition, Elk has been granted an aquifer exemption for the Muddy Sand covering the entire Grieve Unit for purposes of CO₂ and water injection to re-pressurize the reservoir and enhance oil production (GGA 2011, WOGCC 2012). The basis for the aquifer exemption is three fold: 1) the Grieve Unit has produced significant hydrocarbons, 2) the Muddy Sand is located at approximately 6600 feet - a depth that is not likely to be developed for water supply, and 3) the Muddy Sand exhibits TDS over 7000 mg/l (Table 3.3.6.2) (GGA 2011, WOGCC 2012).

Approval of the Aquifer Exemption was contingent upon many factors demonstrating the integrity of the injection well and isolation of the injection zone (GGA 2011). One of the factors considered by the WOGCC and EPA was, "Injection wells shall be cased and the casing cemented in such a manner that damage will not be caused to fresh water sources."

Table 3.3.6.2 - Groundwater quality analysis for the Muddy formation in the Grieve Unit

Parameters	Standards		Summary Statistics
General Water Quality Indicators			
	Drinking Water¹	Livestock¹	Grieve Unit #9

Specific Conductance (umho/cm)			13000
pH (standard units)	6.5-8.5	6.5-8.5	7.44
Total Hardness (mg/L)			106
Total Dissolved Solids (mg/L)	500.0	5,000.0	7780
Ionic Constituents			
Calcium (mg/L)			25
Magnesium (mg/L)			11
Sodium(mg/L)			2934
Potassium(mg/L)			21
Chloride (mg/L)	250.0	2000.0	2765
Bicarbonate (mg/L)			3945
Nitrate + Nitrite (mg/L)	--	100.0	NT ²

1 WDEQ/LQD Quality Standards for Wyoming Groundwaters (WDEQ/WQD 2008b)

2 NT - Not tested

3.3.6.3 Wetlands and Riparian Areas

Waters of the United States

Waters of the U.S. is a collective term for all areas subject to regulation by the U.S. Army Corps of Engineers (ACOE) under Section 404 of the Clean Water Act (CWA). Waters of the U.S. include the territorial seas, interstate waters, navigable waterways (such as lakes, rivers, and streams), special aquatic sites, and wetlands that are, have been, or could be used for travel, commerce, or industrial purposes; tributaries; and impoundments of such waters. All channels that carry surface flows and that show signs of active water movement are Waters of the U.S. Similarly, all open bodies of water (except ponds and lakes created on upland sites and used exclusively for agricultural and industrial activities or aesthetic amenities) are Waters of the U.S. (EPA 33 CFR § 328.3(a)). Such areas are regulated by the ACOE and EPA. Any activity that involves discharge of dredge or fill material into or excavation of such areas is subject to regulation by the ACOE pursuant to Section 404 of the CWA. Some of the drainages within the project area (as identified from field surveys) exhibit wetland characteristics but may be considered non-jurisdictional wetlands or non-jurisdictional waters of the United States by the ACOE.

Wetlands are aquatic features characterized by three specific components: hydric soils, a dominance of hydrophytic plants, and wetland hydrology. These areas are often inundated or saturated by surface or groundwater at a frequency and duration sufficient to support a vegetation community typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. These sites are typically highly productive and diverse, and provide habitat for many wildlife species. Wetlands play an important role in controlling floodwaters, recharging groundwater, and filtering pollutants (Niering 1985). The National Wetlands Inventory map (EPA 2011) indicates limited wetlands habitat within the

Grieve Unit CO₂ EOR project area, including a few scattered areas of “freshwater emergent vegetation” along the proposed utility corridor.

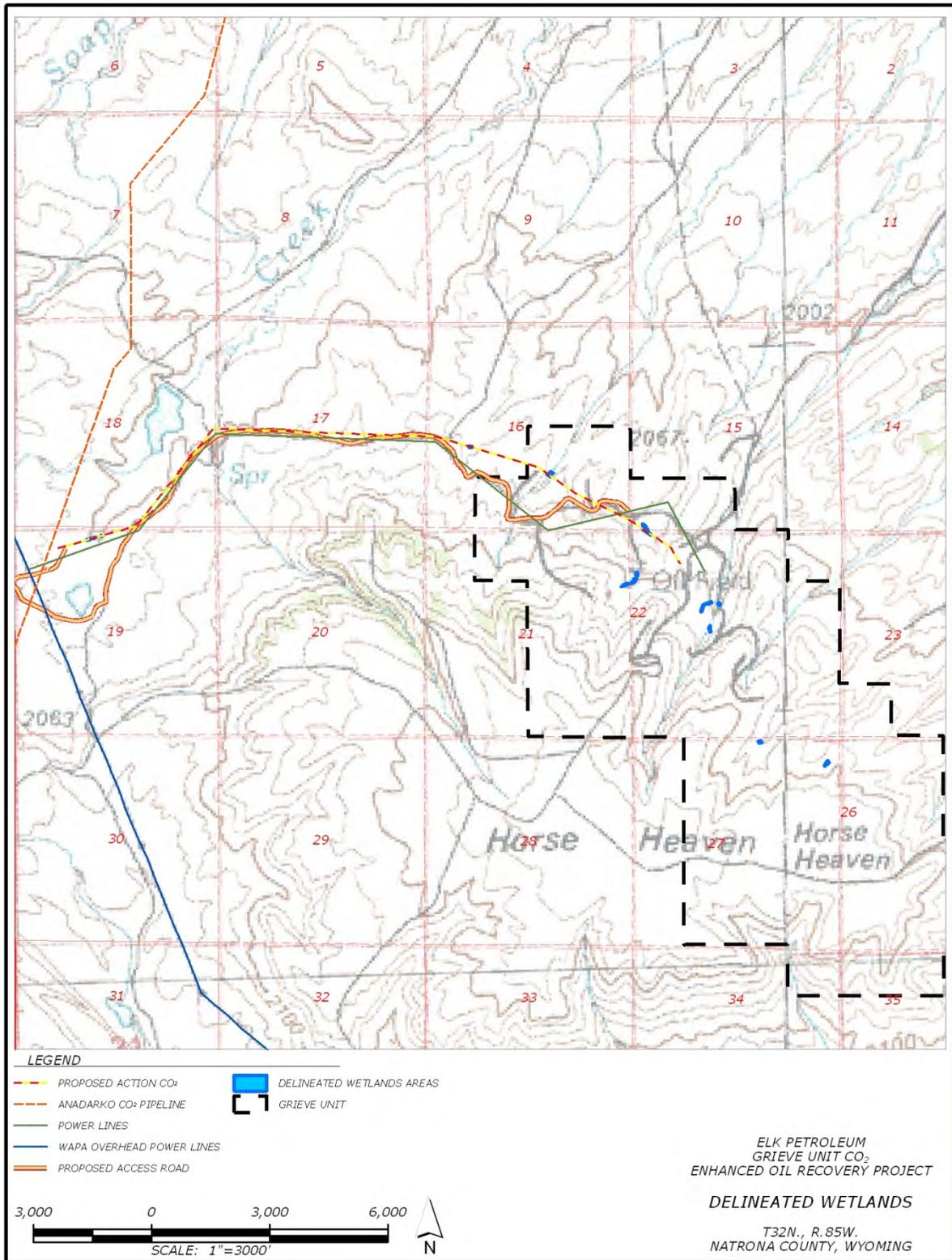
Field observations conducted in August 2011 indicated the presence of wetland hydrology, a dominance of hydrophytic vegetation, and the presence of hydric soils within the proposed action area for the GUCO₂ pipeline, as well as, the overhead and underground power lines (Figure 3.3.6.1). Dominant vegetation species include; Nebraska sedge (*Carex nebrascensis*), Baltic rush (*Juncus balticus*), Common threesquare (*Schoenoplectus pungens*), and Common spikerush (*Eleocharis palustris*). The total acreage of wetlands affected by the proposed project disturbance is approximately 1.53 acres.

These wetlands are classified as Palustrine Emergent, seasonally flooded (PEMC) wetlands, diked/impoundment (PEMCh) wetlands, or Palustrine Aquatic Bed, semipermanently flooded, diked/impoundment (PABFh) wetlands (Cowardin 1978). These wetlands are located within perennial, intermittent, and ephemeral drainages, and open water (either natural or manmade). Hydrology for most wetlands within the project area are dependent upon spring runoff and precipitation. However, the hydrology of a few wetlands located within the Grieve Unit CO₂ project area is potentially maintained by seeps. Field observations indicated that wetlands are not present at the proposed well pad locations as these areas were dominated by upland vegetation and hydric soils were not present. Approximately 0.6 acres of wetlands are located along the proposed alignment of the CO₂ pipeline and underground 25 kV underground power distribution line (Figure 3.3.6.1).

Historic NWI mapping of the project area included classifications of Palustrine Aquatic Bed, semipermanently flooded, diked/impounded (PABFh) and Palustrine Unconsolidated Bottom, semipermanently flooded, excavated (PUBFx). These wetland classifications are either not affected by the purposed disturbances or were not field verified.

The project area is approximately 20 miles from the closest traditional navigable water (TNW), the North Platte River. The U.S Army Corps of Engineers Jurisdictional Determination Form Instructional Guidebook dated June 1, 2007 prevents making a positive determination of a significant nexus if the tributary is “so remote to make the effect of the TNW speculative or unsubstantial.” However, for purposes of this report, all identified wetlands are considered jurisdictional due to their connection to Poison Spider Creek, which is connected to the North Platte River. Final determination of jurisdictional decision lies within the USACE.

Figure 3.3.6.1 - Grieve project area delineated wetlands



3.3.7 SOCIOECONOMICS

The Grieve Unit project lies wholly within Natrona County. The geographic area of analysis for socioeconomic effects includes western Natrona County, focusing on the project area and the greater Casper metropolitan area of central Wyoming.

Population and Employment Demographics

Like Wyoming in general, Natrona County is once again in a period of economic growth in response to an overall up-turn in oil and gas, uranium and alternative energy development. This follows closely on the heels of an energy “crash” that lasted from the third quarter of 2008 to mid-2009. Casper continues to be the most diverse energy sector support center of the state, as it has been since the early days of the oil industry in the late 1800’s. Casper is home to a number of regional offices for oil and gas operations companies, field service providers, and industry trade associations as well as consulting engineering support firms. The oil and gas industry drives the economy of Natrona County, or as stated by the Wyoming Department of Workforce Services (WDWS) (2011) regarding the economic upturn realized in 2011, “job growth showed up in Natrona County where many drilling companies and oil & gas field service firms are located (WDWS 2011).”

As the major energy industry support center of the State, the number of wells spudded throughout the state has a direct correlation to the employment rate in Natrona County. Natrona County, and the region, is experiencing an increase in other forms of energy production, including resurgence in uranium and a growing wind energy sector.

According to the WDWS, the August 2011 unemployment rate in Natrona County was 5.7 percent, slightly higher than the statewide average of 5.5 percent and significantly lower than the nationwide average of 9.1 percent (WDWS 2011). At that time Natrona County reported a workforce of 41,270, almost 39,000 of which were employed. This represents an improvement from the 7.0 percent unemployment rate seen in August 2010 (WDWS 2011). The total income improvements seen in Natrona County were driven by a 30% increase in total mining sector payroll, which includes the oil and gas industry. The next largest growth was seen in the manufacturing sector with an 18.3 percent increase in total payroll over the same period (WDWS 2011). As stated in the 2010 Wyoming Consensus Revenue Estimating Group, or CREG, report, “minerals related employment is one of the key predictors of sales and use tax income” in Wyoming.

The U.S. Census Bureau estimates that Natrona County population grew from 66,533 in 2000 to 75,450 in 2010, a 14.2 percent increase over the ten year period. The majority of the residents live in Casper, with an estimated 2010 population of 55,316.

The population growth in Natrona County over the last decade absorbed most of the existing multi-family affordable single family housing and rental units. With the 2009 economic downturn and the cooling of the oil and gas industry the housing picture changed resulting in few housing starts in central Wyoming. Foreclosures were up. Currently, there are ample housing units for sale, empty rental units and vacancies in many hotels (G. Taylor, pers. com. 2011). In

addition, an estimated 294 new privately-owned residential building permits were issued in 2010 comprising an additional 807 living units (USBC 2010).

Public Services

The nearest law enforcement and emergency response services to the Grieve Unit CO₂ project area is Casper, approximately 53 miles to the east. Wyoming Medical Center, located in Casper, is an accredited Regional Trauma Center with helicopter transport capability.

Economic Diversity

Natrona County is heavily reliant on the minerals industries for its tax base. In addition to minerals, other economic activities that occur within and near the Grieve Unit are livestock grazing and outdoor recreation, principally hunting and wildlife watching. Uranium and wind energy project planning and development are increasing in central Wyoming.

Although there is widespread support for oil and gas development in communities near the study area, the health of public lands and the protection of wildlife and wildlife habitat are also very important to many residents (Blevins et. al.2004, BLM 2003 and 2006).

CHAPTER 4 - ENVIRONMENTAL EFFECTS (IMPACTS) AND CUMULATIVE IMPACTS

4.1 INTRODUCTION

This chapter provides an analysis of the potential environmental consequences that could result from implementation of either the No Action or the Proposed Action, the development of the Grieve Unit CO₂ (GUCO₂) project.

This chapter analyzes impacts to the following relevant issues, as identified in Chapter 1, and is organized by resource in the same order as found in Chapters 2 and 3:

Climate, Climate Change, & Air Quality

- Potential effects to air quality due to increased traffic, emissions, production activities and associated effects on existing county, state, and BLM roads.
- Impacts to climate change and the State of Wyoming commitment to CO₂ (Green House Gas) sequestration and enhanced recovery of oil from existing fields.

Cultural

- Provide protection of cultural and Native American resources, including protection of sites within the project area.

Wildlife including Threatened and Endangered and Special Status Species

- Ensuring protection of the BLM designated Special Status Species ferruginous hawks and other raptors during nesting season, sagebrush obligate song birds and white-tailed prairie dog.
- Protection of the BLM designated Special Status Species greater sage-grouse potentially affected by the project including all seasonal habitats with specific emphasis on protection of designated Core Population Areas.
- Effect of project related noise on greater sage-grouse.
- Indirect, connected, related, long-term and cumulative impacts of the project on wildlife habitats and diversity.
- Cumulative effects of the proposed project when combined with ongoing crude oil and natural gas drilling and development.

Soils

- Soil productivity and erodibility are potentially affected by project construction activities.

Vegetation including Invasive Non-Native Species and Special Status Species

- Protection of the BLM designated Special Status Species and their habitats.
- Project related impacts to rangeland condition and plant community diversity.
- Control of invasive, non-native species (weeds).
- Project disturbance reclamation.

Water Quality (Groundwater & Surface Water)

- Impacts on wetlands and riparian areas.

- Impact to ephemeral and intermittent drainages from erosion from disturbed sites.
- Possible effects to surface and groundwater resources from well drilling and completion, construction and operations activities.

Socioeconomics

- Impacts of the project to the Federal, State, local economies.
- Providing opportunity for alternative energy sources including wind projects.

Design features which are measures, proposed by the applicant and/or required by the BLM, that would avoid or reduce impacts have been identified in Chapter 2, Section 2.3.8. The following impact assessment takes these design features into consideration. If, after successful implementation of design features, impacts remain these impacts are either unavoidable or can be eliminated or reduced through the implementation of mitigation measures. Any additional opportunities to mitigate impacts are presented in this chapter under the mitigation summary for each resource. Such measures are designed to further reduce or avoid unnecessary or undue impacts. BLM will conduct Inspection and Enforcement (I&E) throughout the life of the field.

Chapter 4 provides the scientific and analytical basis for comparisons of the alternatives, and provides a disclosure of the probable consequences (impacts, effects) of each alternative. Residual effects are those impacts, if any, that remain after the application of the design features and any identified additional mitigation measures.

4.2 GENERAL ANALYSIS ASSUMPTIONS

Impacts have been categorized according to the phase of development and duration of activities on the resources. Temporary impacts would be defined in this section as impacts that occur during of construction and drilling operations and any additional activities that are limited in duration of not more than 30-45 days. Short-term impacts would be defined as impacts to the resources that persist after drilling operations have been completed and remains until interim reclamation has been successfully completed. Short-term impacts could last up to 5 years or until interim reclamation standards are achieved. Long-term impacts would be defined as the life of the producing well, which typically is more than 20 years or until the well has been abandoned and final reclamation standards have been achieved.

Impacts are also categorized by direct or indirect, and beneficial or adverse. The analysis identifies these types of impacts and compares the alternative accordingly.

Direct impacts are those effects that are caused by the action and occur at the same time and place. Indirect impacts are those effects that are caused by the action and are later in time or farther removed in distance but are still reasonably foreseeable. Sometimes it is difficult to separate these to impacts and so the effects maybe describe together.

4.3 RELEVANT ISSUES AND RESOURCES - IMPACT ANALYSIS

4.3.1 CLIMATE, CLIMATE CHANGE, & AIR QUALITY

- Potential effects to air quality due to increased traffic, emissions, production activities and associated effects on existing county, state, and BLM roads.

- Impacts to climate change and the State of Wyoming commitment to CO₂ (Green House Gas) sequestration and enhanced recovery of oil from existing fields.

Air pollutant emissions would occur temporarily during infrastructure and field development and over the Life of the Project (LOP) during oil production. These emissions would impact air quality in the project area. Pollutants emitted would include particulate matter less than 10 microns in diameter (PM₁₀), particulate matter less than 2.5 microns in diameter (PM_{2.5}), nitrogen oxides (NO_x), carbon monoxide (CO), volatile organic compounds (VOC), and sulfur dioxide (SO₂).

The emission of these pollutants and their air quality impacts are limited by regulations, standards, and implementation plans established under Wyoming Air Quality Standards and Regulations (WAQSR). Under FLPMA and the Clean Air Act, the BLM cannot conduct or authorize any activity that does not conform to all applicable local, state, tribal, or federal air quality laws, statutes, regulations, standards, or implementation plans. As such, significant impacts to air quality from project-related activities would result if it is demonstrated that:

- National Ambient Air Quality Standards (NAAQS) or Wyoming Ambient Air Quality Standards (WAAQS) would be exceeded; or
- Class I or Class II PSD Increments would be exceeded; or
- Air Quality Related Values (AQRVs) would be impacted beyond acceptable levels.

All NEPA analysis comparisons to PSD Class I or Class II increments are intended to evaluate a threshold of concern, and do not represent a regulatory PSD increment consumption analysis. The determination of PSD increment consumption is an air quality regulatory agency responsibility. Such an analysis would be conducted to determine minor source increment consumption or, for major sources, as part of the New Source Review process. The New Source Review process would include an evaluation best available control technologies (BACT) and evaluate potential impacts to AQRV such as visibility, aquatic ecosystems, flora, fauna, etc., performed under the direction of federal land managers.

4.3.1.1 Impacts of Alternative A: No Action

4.3.1.1.1 Direct and Indirect Impacts

Under the No Action Alternative the proposed action and all its associated components would not be constructed, and no additional drilling would occur on federally managed lands and leases. As a result, no additional air emissions would be generated and no additional impacts to air quality would occur from the development of the federal mineral estate. The area would be in compliance with all ambient air quality standards and PSD increments. There would not be any impacts to AQRVs, including regional haze and atmospheric deposition at the distant PSD Class I Bridger Wilderness Area. In addition there would not be any impact to climate change.

4.3.1.1.2 Cumulative Impacts

Under the No Action Alternative, the well sites and access roads would not be constructed and no drilling would occur. As a result, no air emissions would be generated and no impacts to

cumulative air quality or to AQRV's would occur from this development. In addition there would not be any impact to climate change.

4.3.1.1.3 Mitigation Measures - not applicable

4.3.1.1.4 Residual Impacts - not applicable

4.3.1.1.5 Monitoring and/or Compliance - not applicable

4.3.1.2 Impacts of Alternative B: Proposed Action

4.3.1.2.1 Direct and Indirect Impacts

Emission sources would occur as part of field development (construction) and oil production. Construction emission sources include vehicle traffic, well pad and road construction, pipeline construction, construction of field support facilities including centralized production and power lines and substations, and well drilling and completion activities. These activities would temporarily elevate pollutant levels, but impacts would be localized and would occur only for the short-term duration of the activities.

Fugitive dust emissions (PM₁₀ and PM_{2.5}) would result from work crews commuting to and from the work site and from the transportation and operation of equipment during construction. Wind-blown fugitive dust emissions would also occur from open and disturbed land during construction. Gas venting is not anticipated; however, any gas releases during the development of 10 proposed new wells would be regulated by WDEQ-AQD. Sulfur is not present in the oil found in the Grieve Unit CO₂ Project Area; therefore, no hydrogen sulfide (H₂S) emissions would occur during well development or during production.

Emissions from construction were quantified using accepted methodologies, including manufacturer's emission factors, EPA emission factors, and engineering estimates. Total criteria pollutant emissions from construction of both a single well and field-wide are shown in Table 4.3.1.

Table 4.3.1 – Estimated Grieve Unit CO₂ project construction emissions

Activity	Tons					
	PM ₁₀	PM _{2.5}	NO _x	CO	SO ₂	VOC
Single Well:						
Well Pad Construction	0.066	0.006	--	--	--	--
Well Pad and Road Construction Traffic	0.76	0.08	--	--	--	--
Well Pad and Road Construction Heavy Equipment	0.006	0.006	0.17	0.096	0.005	0.015
Drill Rig Engines	0.083	0.083	2.48	1.43	0.09	0.17
Drilling Traffic	0.34	0.034	--	--	--	--
Completion Engines	0.041	0.041	1.24	0.72	0.046	0.083
Completion Traffic	0.55	0.05	--	--	--	--
Total Single-Well Construction Emissions (tons/well)	1.9	0.30	3.9	2.2	0.1	0.3

Table 4.3.1 – Estimated Grieve Unit CO₂ project construction emissions

Activity	Tons					
	PM ₁₀	PM _{2.5}	NO _x	CO	SO ₂	VOC
Field-Wide:						
Well Pad Construction	0.38	0.04	--	--	--	--
Well Pad and Road Construction Traffic	0.76	0.08	--	--	--	--
Well Pad and Road Construction Heavy Equipment	0.03	0.03	1.00	0.58	0.03	0.09
Support Facilities Construction	11.49	1.09	--	--	--	--
Support Facilities Construction Traffic	1.82	0.18	--	--	--	--
Support Facilities Construction Heavy Equipment	0.14	0.14	4.29	2.48	0.12	0.38
Substation Construction	10.30	0.98				
Substation Construction Heavy Equipment	0.26	0.26	7.74	4.47	0.22	0.69
Pipeline Construction	35.56	3.37	--	--	--	--
Pipeline Construction Traffic	0.98	0.10	--	--	--	--
Pipeline Construction Heavy Equipment	0.05	0.05	1.40	0.81	0.04	0.12
Drill Rig Engines	0.83	0.83	24.76	14.31	0.91	1.65
Drilling Traffic	3.38	0.34	--	--	--	--
Completion Engines	0.41	0.41	12.38	7.15	0.46	0.83
Completion Traffic	5.49	0.55	--	--	--	--
Total Annual Field-Wide Construction Emissions (tons/year)	79.4	9.2	51.6	29.8	1.8	3.8

During production in the field, vehicle traffic traveling on unpaved roads during routine field operations and maintenance activities would result in emissions of fugitive dust. Well sites would be powered by electricity; therefore, no diesel combustion equipment would be required at well sites during production. The product would be piped to the centralized production facility, where CO₂ and water are separated from the oil. CO₂ is pressurized for reinjection, oil is stored for shipment, and produced water is piped to the injection wells for reinjection. The separation process is a closed system and compression at the centralized facility is powered by electricity; therefore air pollutant emissions from the central production facility would be expected to be negligible. Pollutant emissions from wells during production would be limited to any pressure release required during the estimated 10 well workovers per year in the field.

Production equipment is subject to current and future WDEQ-AQD O&G production facility BACT guidance. Annual emissions calculated for production activities are summarized in Table 4.3.1.2.

Table 4.3.1.2 – Estimated Grieve Unit CO₂ project annual production

emissions

Activity	Tons/Year					
	PM ₁₀	PM _{2.5}	NO _x	CO	SO ₂	VOC
Workover Rig Engines	0.14	0.14	4.29	2.48	0.16	0.29
Production Traffic	4.67	0.46	--	--	--	--
Emergency Generator	0.005	0.005	0.21	1.68	0.01	0.05
Total Annual Production Emissions	4.8	0.6	4.5	4.2	0.2	0.3

As shown in Table 4.3.1.1, construction, drilling, and completion of a single well site would emit less than 4 tons of NO_x and less than 2 tons of PM₁₀. This well development phase would be temporary and would occur in isolation, with no other sites in the field under concurrent development, and the emission rates quantified would be spread over the construction period of 34 days (estimated: 4 days pad and road construction, 20 days drilling, 10 days completion).

Air pollutant concentration impacts from well production in the field would be expected to be negligible given that quantified emission rates of any one pollutant are less than 5 tons per year field-wide, as shown in Table 4.3.1.2, a result of a relatively small number of wells in the field, the use of electric line power, and no proposed stationary fuel combustion sources.

Given the quantity of emissions associated with construction and operation activities of the proposed action, project source emissions would not cause or substantially contribute to a violation of any applicable ambient air quality standard, and the proposed action would comply with all applicable PSD increments. The contribution from project source emissions to ambient pollutant concentrations and AQRV's, including regional haze and atmospheric deposition at the distant PSD Class I Bridger Wilderness Area would be negligible.

Climate change analyses are comprised of many factors, including GHGs, land use management practices, the albedo effect, etc. The tools necessary to quantify climatic impacts from this small-scale Project are presently unavailable. Therefore, climate change analysis for the purpose of this document is limited to accounting and disclosing factors that contribute to climate change.

Direct GHG emissions were estimated for the Proposed Action. Annual GHG emissions calculated for the Proposed Action are listed in Table 4.3.1.3.

Table 4.3.1.3 – Estimated Grieve Unit CO₂ project annual GHG emissions

Activity	CO ₂ e Emissions (metric tons/year)
Construction:	
Well Pad and Road Construction Heavy Equipment	17.4
Support Facilities Construction Heavy Equipment	52.1
Substation Construction Heavy Equipment	188.1
Pipeline Construction Heavy Equipment	34.0
Drill Rig Engines	2593.2
Completion Engines	1296.6

Total Construction Emissions:	4181.3
Production:	
Workover Rig Engines	448.8
Emergency Generator	14.8
Total Production Emissions:	463.6

Indirect emissions of GHG from electricity consumption also are associated with the oil and gas industry. The estimated 15,000 to 20,000 horsepower requirement for this project can be met with existing regional power availability and would require no additional generating capacity.

The total direct emissions of GHG from the Proposed Action over the 30-year LOP are approximately 18,098 metric tons, or 0.03 percent of the Wyoming budget. Impact assessment of specific Project-related activities cannot be determined.

GHG emissions from the Proposed Action are offset through the reduction in atmospheric CO₂ venting at the ExxonMobil Shute Creek Gas Plant, which will provide CO₂ to the Grieve Unit. In an order under Wyoming Oil and Gas Conservation Commission Docket 434-2010 (WOGCC 2010) and in preceding orders, ExxonMobil is required to “diligently pursue and develop a market for CO₂” to reduce the atmospheric release of marketable CO₂. The Shute Creek Gas Plant underwent a compressor expansion completed in November 2010 to increase CO₂ production from 230 Mmcf/day to 340 Mmcf/day to meet market demand. Total CO₂e emitted over the LOP from construction and production activities (18,089 metric tons, equivalent to approximately 348 Mmcf) is 0.16 percent of the 220 Bcf of CO₂ to be purchased from the Shute Creek Gas Plant for sequestration within the Grieve Unit, a volume that would otherwise be vented to the atmosphere in the absence of the sequestration market.

4.3.1.2.2 Cumulative Impacts

Cumulative impacts to air quality would include impacts from the proposed Project emissions in combination with impacts from regional background emission sources. Calculated field-wide annual emissions of criteria pollutants during production are small, as shown in Table 4.2. The cumulative impact of this small amount of air pollutant emissions on regional air quality would be anticipated to be negligible, and the Proposed Actions would be expected to have negligible impact on regional ambient air quality standards or AQRVs at the Bridger Wilderness Area.

The tools necessary to quantify climatic impacts from this small-scale project are presently unavailable. Therefore, climate change analysis for the purpose of this document is limited to accounting and disclosing factors that contribute to climate change. Both direct and indirect emissions of GHGs were estimated for the Proposed Action above, and the total of these emissions from the Proposed Action represent a small contribution, 0.03 percent, to the Wyoming GHG budget (CCS 2007).

A cumulative reduction in GHGs could occur in the region through the reduction in atmospheric CO₂ release at the ExxonMobil Shute Creek Gas Plant, which will provide CO₂ to the Grieve

Unit. Total CO₂e emitted over the LOP from construction and production activities (18,089 metric tons, equivalent to approximately 348 Mmcf) is 0.16 percent of the 220 Bcf of CO₂ to be purchased from the Shute Creek Gas Plant for sequestration within the Grieve Unit. The purchased volume would otherwise be vented to the atmosphere in the absence of the sequestration market, and facilitates a region-wide reduction in CO₂ emissions.

4.3.1.2.3 Mitigation Measures

Implementation of the design features found in Chapter 2 should avoid or reduce impacts to air quality.

The WDEQ-AQD requested the addition of the mitigation found below to assure appropriate state permits are acquired for any temporary or permanent equipment used in association with this project. With application of this measure, state requirements for permitting for emissions would be met.

- The proponent would seek appropriate permits and follow state protocol for approval of all on-site temporary or permanent equipment used in association with this project from the Wyoming Department of Environmental Quality, Air Quality Division.

4.3.1.2.4 Residual Effects

Residual effects to air quality are considered relatively transient in nature, the effect not continuing beyond final reclamation of the emitting source. The concept of “global climate change” is premised on the concept that carbon based air emissions are residual in the environment and the effects realized for decades, if not longer. The injection of CO₂ into the subsurface (sequestration) is consistent with the State of Wyoming desire to reduce overall CO₂ emissions into the environment and the statutory mission of the Enhanced Oil Recovery Commission and the Enhanced Oil Recovery Institute at the University of Wyoming (State Statute 30-8-101).

4.3.1.2.5 Monitoring and/or Compliance

Compliance with the Wyoming Department of Environmental Quality, Air Quality Division rules and regulations as outlined in the Chapter 2 Design Features, and described in detail in Chapter 3, will provide protection to the resource.

4.3.2 CULTURAL RESOURCES

4.3.2.1 Impacts of Alternative A: No Action

4.3.2.1.1 Direct and Indirect Impacts

Under the No Action Alternative, the development of the federal mineral resource associated with the Proposed Action would not occur. State and fee mineral leases could undergo further development in the Grieve Unit and the existing production operations would continue. Selection of the No Action alternative does not preclude BLM from considering new proposals on a case by case basis, if brought forward.

4.3.2.1.2 Cumulative Impacts

As demonstrated above, there would be no cumulative impacts realized from the selection of the No Action alternative.

4.3.2.1.3 Mitigation Measures - not applicable

4.3.2.1.4 Residual Impacts - not applicable

4.3.2.1.5 Monitoring and/or Compliance - not applicable

4.3.2.2 Impacts of Alternative B: Proposed Action

4.3.2.2.1 Proposed Action Direct and Indirect Effects

Analysis of potential impacts to cultural resources considers both direct and indirect impacts. Direct impacts may occur by:

- Physically altering, damaging, or destroying all or part of a resource.
- Altering characteristics of the surrounding environment that contribute to the resource's significance.
- Introducing visual or audible elements that are out of character with the property or alter its setting.
- Neglecting the resource to the extent that it deteriorates or is destroyed.

Direct impacts can be assessed by identifying the types and locations of proposed activities and determining the exact location of cultural resources that could be affected. Indirect impacts could result from the effects of project-induced changes to land use patterns. For example, the creation of new roads increases public access to the area which could result in possible illegal collection of cultural resources.

Adverse effects to historic properties would be mitigated first by avoidance, then by other measures determined in consultation with the Wyoming State Historic Preservation Office and affected Tribes as appropriate. In some instances, monitoring by a professional archaeologist of surface disturbing activity is useful to reduce the potential damage to cultural resources. Direct impacts would primarily result from construction related activities. Activities considered to have the greatest potential effect on cultural resources include blading of well pads and associated facilities and the construction of roads and pipelines. Sites located outside the project area would not be directly affected by the construction activities.

Based on the cultural resource surveys conducted in the summer of 2011 and the spring of 2012 (Section 3.3.2), cultural resource clearance is recommended for the Elk Petroleum, Grieve Unit CO₂ power line, individual power line structure access roads, utility corridor access road and CO₂ pipeline route. Six newly recorded isolates, three newly recorded sites, and two previously recorded sites were identified during the current project. The isolates are not considered to be significant cultural resources. Adjustments made in the alignment of the existing two track road that provides access for utility corridor resulted in the avoidance of one site while scattered areas of lithic scatter, recommended as not eligible, will be impacted by road re-construction activities. The eolian sands along the proposed access road re-construction represent the only areas of

perceived depositional potential in the entire project area. Due to the potential of the eolian sands in NW¼ of Section 19, T32N, R85W, a blading monitor is recommended in that area for construction of the access roads, power line, pipeline, and Buffalo Head Switchyard.

In addition, cultural resource clearance is recommended for the well locations, access roads, and in-field pipelines. Two newly recorded sites were identified during the current project. One cairn site was recommended as unevaluated pending Native American consultation. The site would not be physically impacted by construction. The viewshed of the cairn is severely impacted by an overhead power line and multiple well locations, access roads, and pipelines. The other site is a prehistoric cairn site that was recommended as unevaluated pending Native American consultation. The site could be physically impacted by construction. Tribal consultation was conducted on both sites in October and November 2011 with the Eastern Shoshone and Northern Arapaho tribal elders, observers and Tribal Historic Preservation Officer (THPO). Alternative well site locations and mitigation were provided for one site and approval granted for the other.

4.3.2.2.2 Cumulative Impacts

Disturbance and/or loss of unidentified sites or artifacts may add to the cumulative loss of information about our heritage in the project area and throughout the region, if these resources are not identified, inventoried, and/or appropriately protected or mitigated. However, such losses are not expected as the design features found in Chapter 2 would be implemented. Any potential future development projects with federal involvement would require the same level of analysis and protection. In the absence of cultural resource clearances and/or other federally mandated cultural resource protection measures on private lands, increased impacts to cultural resources may occur.

Cumulative impacts to cultural resources would be minimized by the avoidance of cultural resource sites with surface expression, and the identification and recovery of information from subsurface finds representing buried resources or sites during open trench monitoring.

4.3.2.2.3 Mitigation Measures

None recommended, application of the design features identified in Chapter 2 would minimize potential impacts to cultural resources.

4.3.2.2.4 Residual Effects

Residual effects to the cultural resources could occur even if mitigation measures are applied and unidentified resources were impacted. These effects would not rise to the level of significance.

4.3.2.1.5 Monitoring and/or Compliance

Application of the design features in Chapter 2, which provide specific monitoring requirements are adequate to protect cultural resources.

4.3.3 WILDLIFE INCLUDING THREATENED AND ENDANGERED AND BLM SPECIAL STATUS SPECIES

Standards for healthy public rangelands require that such lands are capable of sustaining viable populations and a diversity of native animal species appropriate to that habitat. Those habitats that support threatened, endangered species, species of special concern, or sensitive species will be maintained.

With increasing surface disturbance, the potential for direct and indirect impacts to wildlife increases however the use of existing transmission line corridors, utility corridors and the activity within the existing federal oil and gas unit habitat fragmentation and associated disturbance is reduced. Indirect effects would include impacts from additional noise, dust, and human presence. Some of these species may alter their behavior and home range use within the proximity of project infrastructure and adjacent areas.

4.3.3.1 General Wildlife Species

4.3.3.1.1 Impacts of Alternative A: No Action

4.3.3.1.1.1 Direct and Indirect Effects

Under the No Action Alternative, the development of the federal mineral resource associated with the Proposed Action would not occur. State and fee mineral leases could undergo further development in the Grieve Unit and the existing production operations would continue. Selection of the No Action alternative does not preclude BLM from considering new proposals on a case by case basis, if brought forward.

4.3.3.1.1.2 Cumulative Impacts

As demonstrated above, there would be no cumulative impacts realized from the selection of the No Action alternative as conditions would not change.

4.3.3.1.1.3 Mitigation Measures - not applicable

4.3.3.1.1.4 Residual Impacts - not applicable

4.3.3.1.1.5 Monitoring and/or Compliance - not applicable

4.3.3.1.2 Impacts of Alternative B: Proposed Action

4.3.3.1.2.1 Direct and Indirect Effects

The effects on wildlife resulting from the proposed project would include displacement of wildlife, loss or temporary disturbance of wildlife habitats, an increase in the potential for collisions between wildlife and motor vehicles, and an increase in the potential for illegal kill, harassment and disturbance of wildlife due to increased human presence and improved vehicle access. The magnitude of impacts to wildlife resources would depend on a number of factors including the type and duration of disturbance, the species of wildlife present, time of year, and successful implementation of avoidance and mitigation practices.

The direct disturbance of wildlife habitat in the project area likely would reduce habitat availability and effectiveness for a variety of big game and small mammals, birds, reptiles, amphibians, and their predators. An increase in mortality from increased vehicle use of roads in the project area would also be expected. An estimated 171 acres of short-term, or temporary, disturbance would be affected by new surface-disturbing project activities under the Proposed Action which would potentially affect wildlife. Interim reclamation would be implemented following each stage of project activities and is expected to return most habitats to pre-disturbance conditions in the long term. Interim reclamation is expected to reduce the number of acres lost to approximately 35 acres of direct habitat loss. Re-establishment of “pre-disturbance” conditions in the high elevation sagebrush steppe environment of the north side of the Grieve project area is likely to take more than 20 years. Re-establishment of the grass dominated habitats of Horse Heaven (the southern portion of the area) will occur over the short term.

The extent of wildlife displacement is impossible to predict for most species since the response to disturbance varies from species to species and can even vary between different individuals of the same species. After initial avoidance, some species may acclimate to the activity and begin to reoccupy areas previously avoided (Kuck *et al.* 1985). During construction, it is expected that some resident species will avoid active project areas. Disturbances from human activity and traffic would reduce wildlife use of habitats immediately adjacent to these areas by species sensitive to indirect human disturbance (noise and visual disturbance). Wildlife use of these areas would be lowest during the construction phase when human activities are more extensive and localized. Disturbance would decline during the production phase of operations and some animals may become habituated to equipment, facilities, and infrequent human presence, and may reoccupy habitats near disturbed areas.

The reaction of individual animals to noise and human presence varies depending on the intensity of the noise source and whether it is continuous or intermittent. Transient loud noises would provoke alarm responses; however, many animals habituate to more constant, lower-level noise sources that are not associated with negative visual stimuli or experiences such as being chased or hunted (reviewed in Busnel and Fletcher 1978; Weisenberger *et al.* 1996). This acclimation and reoccupation may occur following construction and drilling operations when the project moves into the production phases where less noise and human activities would take place. As a result, species might acclimate to the well-pad production facilities and use habitats adjacent to such sites, particularly at night when facilities-maintenance activities do not occur (Thompson and Henderson *et al.* 1998, Dzialak *et al.* 2011a; 2011b, Webb *et al.* 2011).

Increased traffic levels on new and existing roads could increase the potential for wildlife/vehicle collisions for the life of the project.

Due to the relatively high reproduction potential of some species and the relatively small amount of habitat disturbed, small mammal and songbird populations should quickly rebound to pre-disturbance levels following reclamation of utility corridors, unused portions of roads, well pads, and wells that prove to be unproductive. If displacement occurs re-colonization is expected once project related disturbance is reduced. No long-term effects on populations of common small mammals and songbirds are expected. Any potential impacts to amphibians are expected to be minimal due to project avoidance of riparian/wetland areas and the design features applied to wetland area pipeline crossings (see Section 4.3.6.3, Wetlands). Species that are Threatened,

Endangers, Proposed and Candidate under the Endangered Species Act (ESA) are discussed in Section 4.3.3.3; BLM Special Status Species are discussed in Section 4.3.3.4.

Big Game

Human-caused surface disturbances such as well pads, pipelines and roads can reduce use of surrounding habitat by wildlife. There is generally a zone of decreased use surrounding these sites due to the increased human activity. On average this zone extends to approximately 0.7 miles from development for big game species (Hebblewhite 2008). The area of aversion generally is the least for pronghorn and increases for elk and mule deer (Powell 2003, Berger 2006, Sawyer *et al.* 2006a). Consequently, project development impacts to big game can extend beyond the physically disturbed area.

Effects on big game species would include direct loss of habitat and forage, and increased disturbance from activities associated with the project. Disturbance of big game species during the parturition period and on winter range can increase stress and may influence species distribution and productivity (Hayden-Wing 1979, Morgantini and Hudson 1980) as well as individual survival. No crucial big game winter range has been identified for pronghorn, mule deer or elk in the project area. No crucial big game parturition areas are found in the project area. No big game migration corridors were identified in the literature (Feeney *et al.* 2004).

Big game will be affected, however the level of effect is expected to be within the acceptable range, as the project area represents less than one percent of pronghorn, mule deer, or elk winter or year-long range within the respective herd units. Individuals could be impacted by the project activities due to avoidance of human activities. Snow removal could impede big game movement if berms were too high or if there were no breaks in the berms. Design features, as found in Chapter 2 will be implemented to minimize impacts to big game species. Available habitat in the project area will be reduced until pre-disturbance reclamation conditions are achieved; big game species are expected to return to the area as they have with the existing production operations.

There is potential for an increase in poaching and harassment of big game, particularly during winter. Big game would be expected to demonstrate some avoidance of the area for the life of the project due to an increase in human presence, although some individuals may habituate to the human activity.

Upland Game Birds

No effect on migrating Mourning Dove is anticipated from implementation of the proposed action. Greater sage-grouse is discussed in Section 4.3.3.3.

Raptors

Raptor nesting and foraging habitat is found throughout much of the Grieve CO₂ project area. All raptor species and active nests are protected under the Migratory Bird Treaty Act (MBTA), golden eagles are further protected under the Bald and Golden Eagle Protection Act (BGEPA). In general, birds are more sensitive to indirect impacts, such as unexpected noises, than mammals. Literature suggests that noise levels greater than 49 dBA within breeding habitat from April 1 through June 30 are a negative impact to game and non-game birds, especially at night (WGFD 2010b). The Proposed Action could have some potential for noise impacts above

49 dBA within raptor breeding habitat during the construction phase. Development too close to nests of some species of raptors has been identified to result in the nest abandonment or failure.

There are seven active, four unknown and twelve inactive raptor nests known in and near the Grieve CO₂ project area (refer to Section 3.3.3). Active raptor nests will have a nesting season timing stipulation buffer of three-quarters of a mile from February 1 to July 31. Actual distances and dates may vary based on species, topography, season of use and other pertinent factors (BLM 2011b). These stipulations are intended to prevent nest abandonment. There is one active raptor nest within $\frac{3}{4}$ mile of or within the Grieve project area; this nest was not observed as occupied during spring 2012 surveys.

There is a reasonable potential that burrowing owls may inhabit suitable prairie dog, ground squirrel or badger burrows within the project area, although no burrowing owls were identified during the 2011 surveys. Some potential habitat loss will occur from project construction activities as white-tailed prairie dogs are seen along the access roads and on the existing well sites in the field. The project components, as proposed, do not impact the most densely populated prairie dog colonies in the project area, further reducing the possibility of impacting nesting burrowing owls. Active burrowing owl nests would be protected by a nesting season timing stipulation buffer from April 1 to September 10 within $\frac{1}{2}$ mile of an identified nest.

These surface disturbance and seasonal timing stipulations apply to all surface disturbing activities as well as drilling, and completion activities within the designated species specific protective buffer. Exceptions to these stipulations may be granted by the BLM AO if the nest is not active or fledglings are no longer using the nest.

4.3.3.1.2.2 Cumulative Impacts

The cumulative effects analysis area for wildlife varies depending on the habitat needs of the species. Figure 4.3.3.1 illustrates the general area of analysis, the Grieve CO₂ project buffered by ten miles. Within the ten mile buffer there are six delineated oil fields and numerous outside oil wells for a total 96 active and 194 inactive wells, crude oil and CO₂ pipelines, county roads, ranching operations, power transmission and distribution lines and one power substation.

Impacts to big game species would be as described for the Proposed Action and increased to include other on-going, permitted and reasonably foreseeable activities within the respective WGFD designated herd units.

The pronghorn herd units affected by Grieve project are very large and include in addition to the on-going activities listed above, to the north there is expanding natural gas development, to the west of the Rattlesnake Hills is the proposed Cameco in-situ uranium project as well as the reclaimed Gas Hills mining district, and to the south there have been discussions of wind energy and transmission lines but no projects formally proposed. No crucial winter range for the species is impacted by the Grieve Unit so cumulative impacts to crucial habitat will not occur. The hunt areas affected by the Grieve project are geographically the same as the herd units described below for mule deer and elk.

The on-going, permitted and reasonably foreseeable activities within the affected mule deer and elk herd units can be described similar to those affecting pronghorn with the exception of the

Cameco project and the Gas Hills mining district. Again, no crucial winter range for either species is impacted by the Grieve Unit so cumulative impacts to crucial habitat will not occur.

Known raptor nests are identified on Figure 4.3.3.1. The cumulative impacts analysis area for raptors is the Grieve project buffered by one mile. Other on-going, permitted and reasonably foreseeable activities within this area include the existing Anadarko CO₂ pipeline and the Western Power Administration transmission lines.

4.3.3.1.2.3 Mitigation Measures

- Snow removal would be done in a manner that would not preclude movement by big game (i.e., no tall berms or regularly spaced breaks in the berms).
- All field employees and contractors will undergo training regarding wildlife sensitivity and regulations similar to the Pinedale Working with Wildlife program.

4.3.3.1.2.4 Residual Impacts

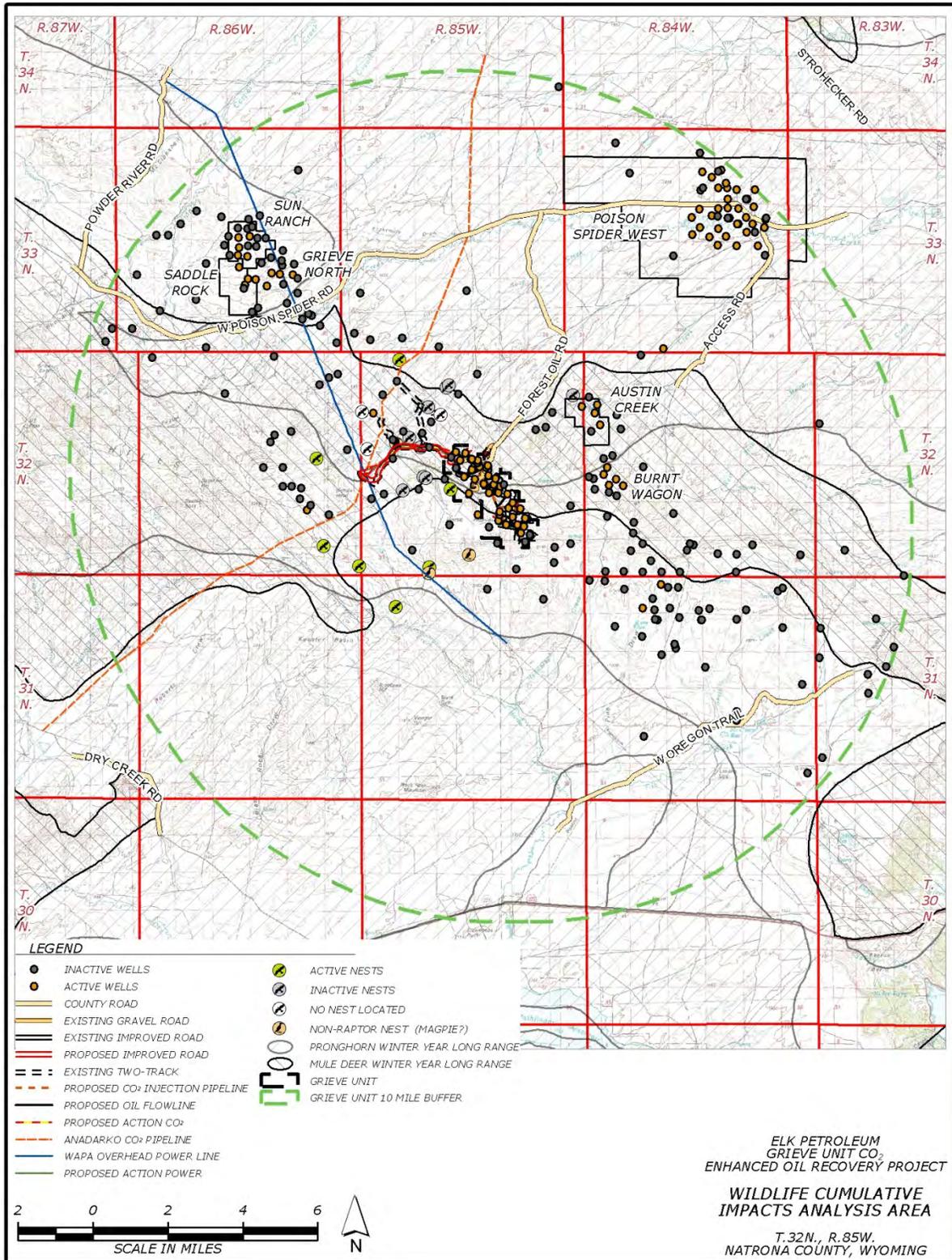
Big Game Residual Impacts - Residual effects, while not reaching the level of significance, would occur even if mitigation measures were implemented as displacement is expected and accidental mortalities may occur.

Raptor Residual Impacts - Residual effects to raptor species, while not reaching the level of significance, would occur even if mitigation measures were implemented as displacement is expected and accidental mortalities may occur. If displacement occurs re-colonization is expected once project related disturbance is reduced.

4.3.3.1.2.5 Monitoring and/or Compliance

Application of the design features in Chapter 2, which provide specific compliance requirements, are adequate to protect wildlife resources.

Figure 4.3.3.1 – Wildlife cumulative impacts analysis area



4.3.3.2 Threatened and Endangered Wildlife Species

4.3.3.2.1 Impacts of Alternative A: No Action

4.3.3.2.1.1 Direct and Indirect Effects

Under the No Action Alternative, the development of the federal mineral resource associated with the Proposed Action would not occur. State and fee mineral leases could undergo further development in the Grieve Unit and the existing production operations would continue. Selection of the No Action alternative does not preclude BLM from considering new proposals on a case by case basis, if brought forward.

4.3.3.2.1.2 Cumulative Impacts

As demonstrated above, there would be no cumulative impacts realized from the selection of the No Action alternative.

4.3.3.2.1.3 Mitigation Measures - not applicable

4.3.3.2.1.4 Residual Impacts - not applicable

4.3.3.2.1.5 Monitoring and/or Compliance - not applicable

4.3.3.2.2 Impacts of Alternative B: Proposed Action

4.3.3.2.2.1 Direct and Indirect Effects

Greater Sage-grouse

Effects to greater sage-grouse could include direct loss of habitat and forage, and increased disturbance from project related activities. Disturbance of sage-grouse during the nesting and brood rearing period and on winter concentration areas can increase stress and may influence species distribution. There may also be a potential for increased poaching and harassment or increased predation from raptors using facilities for perching. Greater sage-grouse would be expected to demonstrate avoidance of the area for the life of the project depending upon the level of human activity and where it occurs in relation to suitable habitat. Noise and human disturbance in proximity to a lek may lead to lek abandonment, reduced nesting and nest failure.

Sage-grouse can be impacted by other activities associated with project development, including increased human activity, increased traffic, noise associated with project construction, drilling and completion activities, as well as traffic and operations.

The eastern two-thirds of the Grieve CO₂ project area is within the Natrona Core Area, as defined by the Sage-Grouse Core Breeding Areas Version 3 Map (WGFD 2011a). Areas of suitable sage-grouse nesting, brood rearing and late brood rearing habitat, as well as potential winter habitat, occur within the project area disturbance area. The western portion of the utility corridor falls outside the designated core area and is dominated by grasslands. There is one lek known within four miles of the Grieve CO₂ project components (Figure 3.3.3.2); brood rearing habitats will be impacted by development in the project. This lek was occupied in 2011,

according to the WGFD 2011 database. No winter concentration areas have been identified in the project area.

The Wyoming Sage-grouse Core Area concept (WGFD 2011a) and the Wyoming BLM Instructional Memorandum for Greater Sage-grouse Habitat Management Policy (WY-2012-019) provides habitat protection to leks within the identified Core Areas and increased mitigation flexibility relative to non-Core Area leks and associated seasonal habitats. This BLM IM generally mirrors, and expands on, the protections provided by the Wyoming Core Area concept.

The Lander Field Office GIS staff ran the required project specific Density Disturbance Calculation Tool (DDCT, WGFD 2012) exercise and determined that there are approximately 568 acres of existing disturbance within the DDCT analysis area with proposed 171 acres of new disturbance. The number of disruptions on the landscape falls below 1 disruption per 640 acres and the number of acres of disturbance is less than 5% (1.07 percent) per 640 acres within the DDCT analysis area (Figure 4.3.3.2). Given the co-location of project infrastructure in previously disturbed corridors, the existing (pre-2008) federal oil and gas unit and the level of commitment to sage-grouse specific design features the WGFD and the BLM have determined that the project will not cause declines in Greater Sage-Grouse populations.

4.3.3.2.2.2 Cumulative Impacts

As discussed above, the DDCT analysis demonstrates that the existing density of oil and gas wells and the disturbance of habitat from the existing and proposed projects are within the limits provided in the DDCT and BLM IM WY-2102-019 and will not cause declines in Greater Sage-Grouse populations. The cumulative impacts analysis area is the Grieve Unit buffered by 11.2 miles (Figure 4.3.3.3). With the exception of a few scattered well proposals in existing fields, there are no known proposed or reasonably foreseeable projects located within the cumulative impacts analysis area.

4.3.3.2.2.3 Mitigation Measures

In addition to the design features listed in Chapter 2,

- Coordinate with the WGFD to determine lek monitoring needs and what data should be reported.
- Be willing to use adaptive management if declines on affected leks are observed and are attributed to the proposed project.

4.3.3.2.2.4 Residual Impacts

Residual effects, while not reaching the level of significance, would occur even if design features are implemented as habitat will be disturbed, displacement is expected and accidental mortalities may occur. If sage-grouse are displaced from suitable habitat, re-colonization is expected once project related disturbance is reduced (Harju et al. 2010).

4.3.3.2.2.5 Monitoring and/or Compliance

Application of the design features in Chapter 2 and the mitigation listed above are adequate to protect greater sage-grouse.

Figure 4.3.3.2 - Greater sage-grouse DDCT analysis area

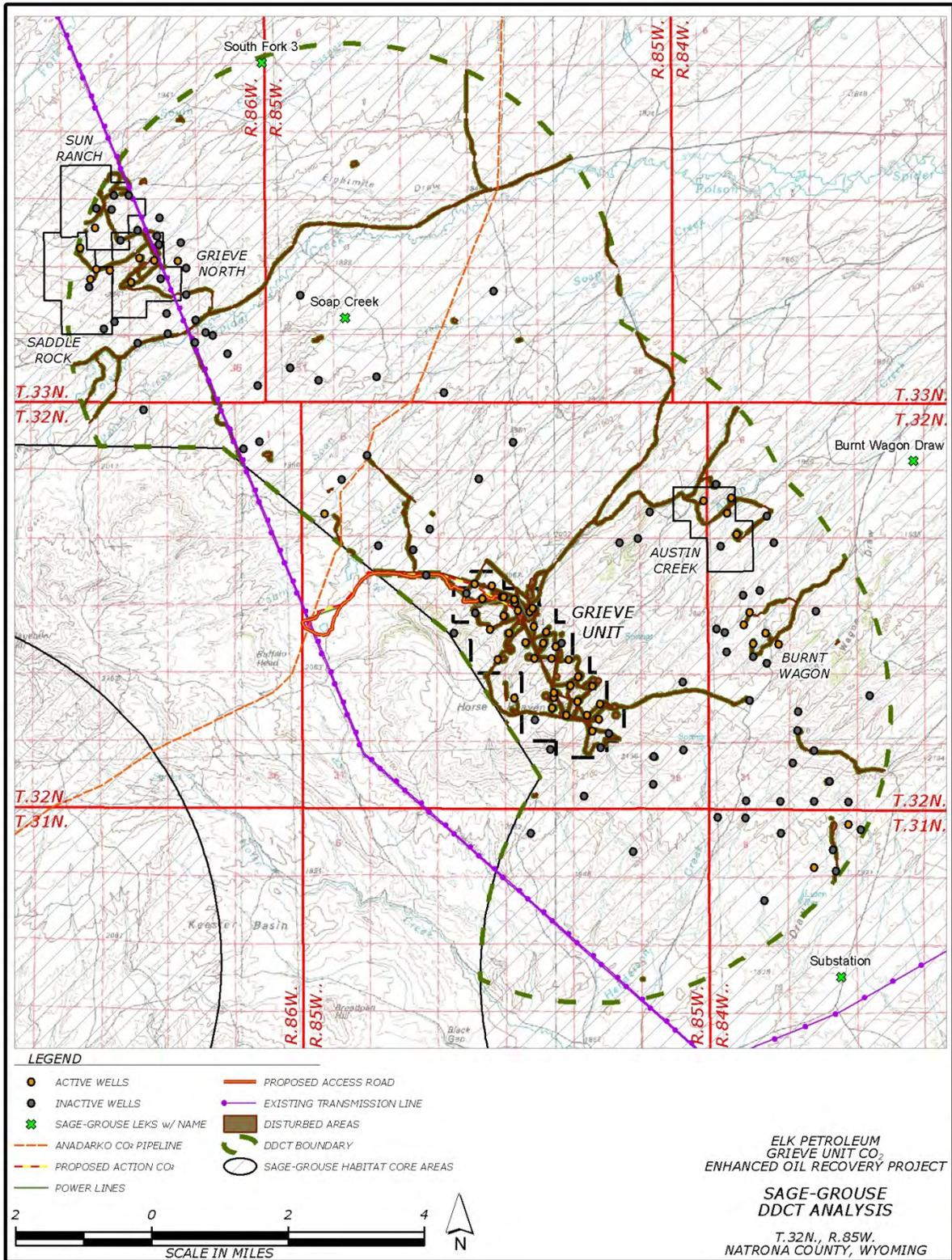
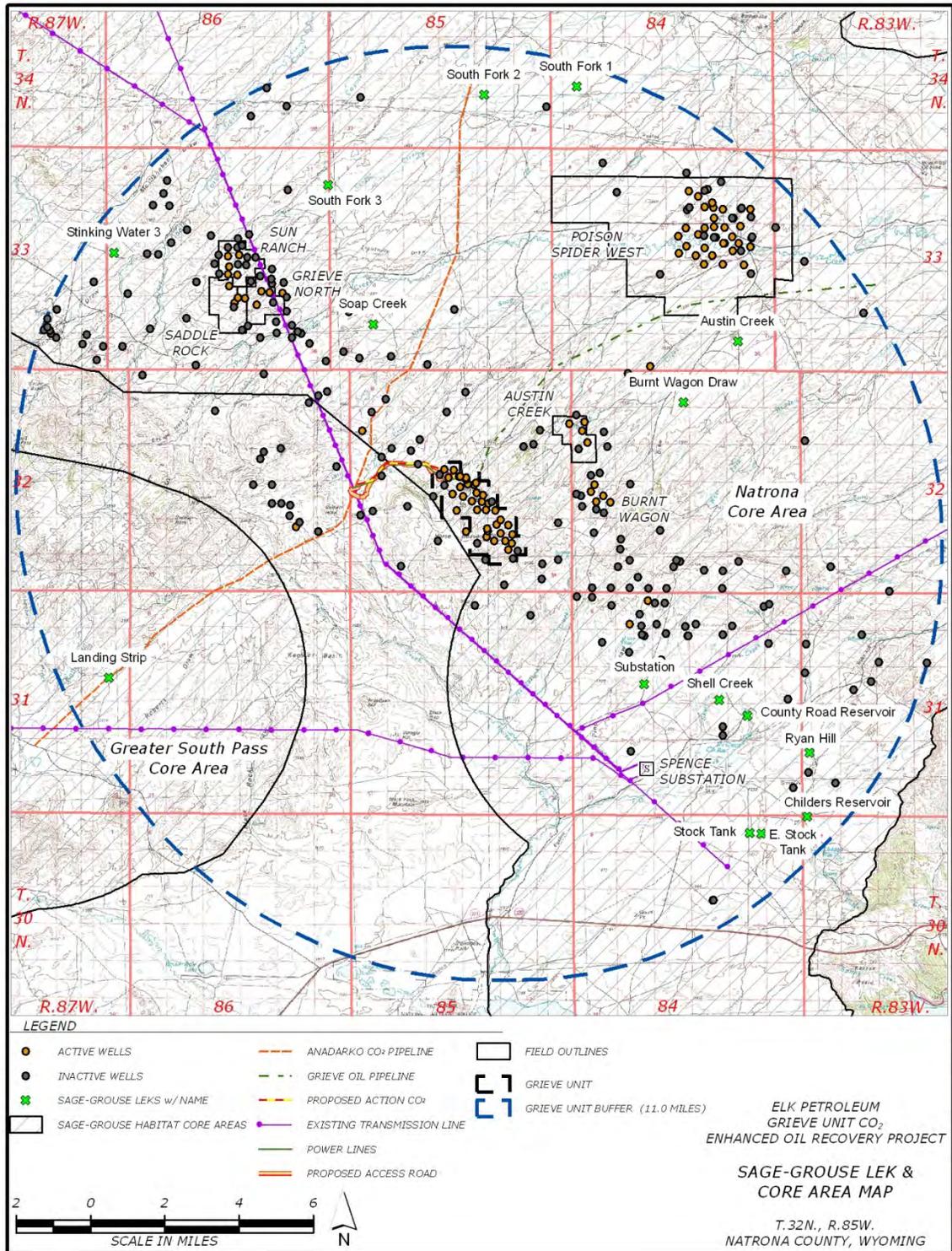


Figure 4.3.3.3 - Greater sage-grouse cumulative impacts analysis area



4.3.3.3 BLM Special Status Wildlife Species

4.3.3.3.1 Impacts of Alternative A: No Action

4.3.3.3.1.1 Direct and Indirect Effects

Under the No Action Alternative, the development of the federal mineral resource associated with the Proposed Action would not occur. State and fee mineral leases could undergo further development in the Grieve Unit and the existing production operations would continue. Selection of the No Action alternative does not preclude BLM from considering new proposals on a case by case basis, if brought forward.

4.3.3.3.1.2 Cumulative Impacts

As demonstrated above, there would be no cumulative impacts realized from the selection of the No Action alternative as conditions would not change.

4.3.3.3.1.3 Mitigation Measures - not applicable

4.3.3.3.1.4 Residual Impacts - not applicable

4.3.3.3.1.5 Monitoring and/or Compliance - not applicable

4.3.3.3.2 Impacts of Alternative B: Proposed Action

4.3.3.3.2.1 Direct and Indirect Effects

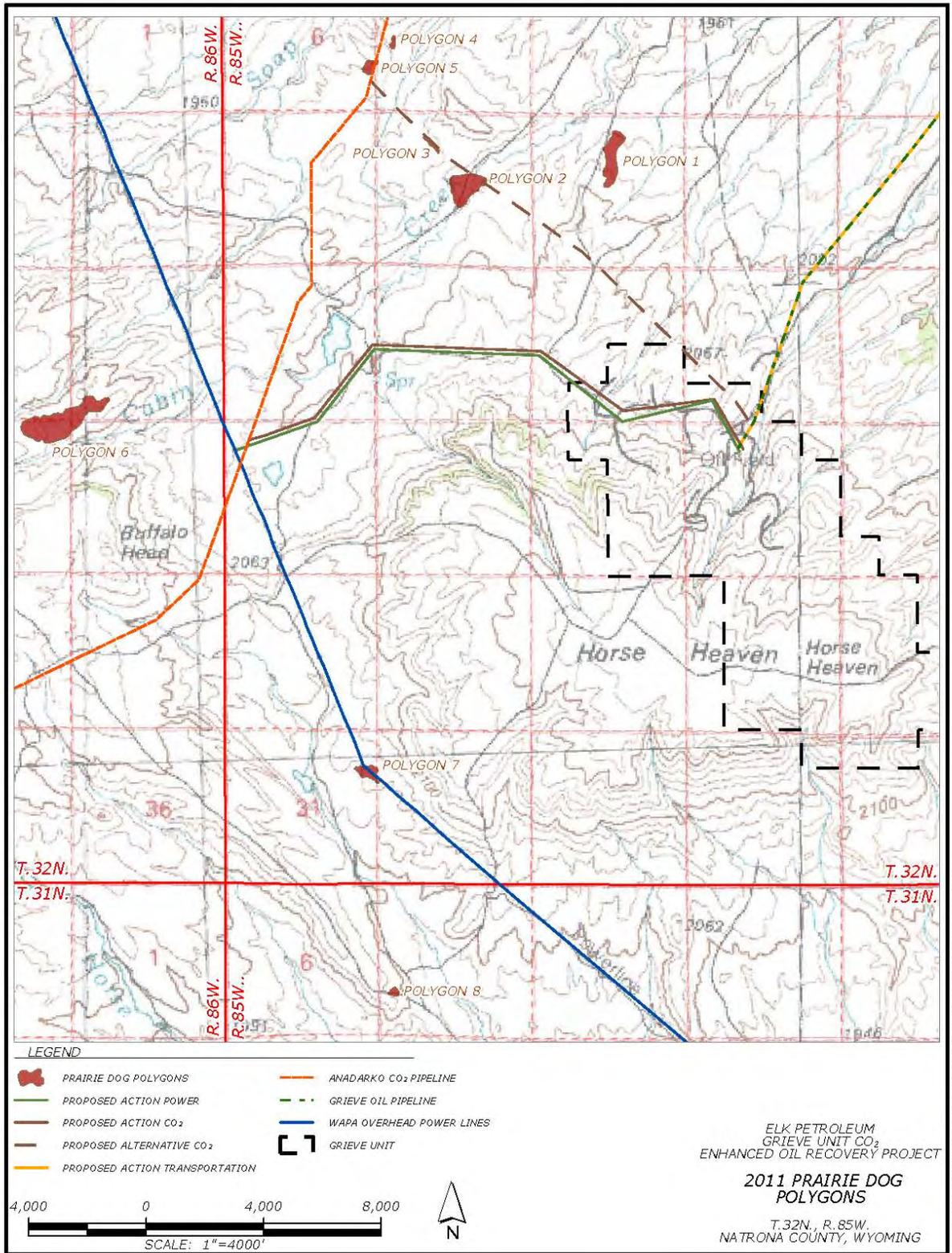
Special Status Mammal Species

Long-eared myotis has the potential to occur in the project area as their preferred roosting and hibernation habitats are found in the project area. BLM has identified equipment stacks as a potential risk to roosting bats; stack caps have been added as a mitigation measure for these species in an effort to preclude incidental roosting. No other adverse effects are foreseen.

Swift foxes have not been documented within the project area which is on the far western edge of the known range of the species in Wyoming (Cеровski 2004). The development associated with implementation of the Proposed Action would result in the temporary loss of suitable foraging habitat; but these negative impacts will be minimized and are not expected to require federal listing of this species.

White-tailed prairie dog burrows are scattered throughout the project area and the larger colonies mapped during the summer of 2011. White-tailed prairie dogs are found throughout the currently developed well field area. The major project components, as proposed, will not impact these mapped colonies (Figure 4.3.3.4). Implementation of the Proposed Action would likely result in direct disturbance of some individual prairie dog burrows and the temporary loss of foraging habitat. Pipelines are thought to contribute to the expansion of prairie dog colonies.

Figure 4.3.3.4 – White-tailed prairie dog colonies



Special Status Bird Species

Brewer's sparrow, loggerhead shrike, sage sparrow, and sage thrasher are the predominant shrub-dependent songbirds that occur within the project area (WGFD 2006, WYNDD 2007). Recent research (Gilbert and Chalfoun 2011) found that when natural gas well density reached more than 8 wells per square kilometer (> 20 wells per square mile) the observed numbers of Brewer's sparrow, sage sparrow and vespers sparrow declined. In the same study, horned lark numbers increased while sage thrashers showed no effect as a result of high density well development (Gilbert and Chalfoun 2011). There are no plans to develop the Grieve Unit to a well density that exceeds 20 wells per section. Activities under the Proposed Action may result in the removal of limited amount of shrub habitat and displace birds from the disturbance area until shrubs are re-established. Design features specific to the greater sage-grouse will also provide habitat protection for these sagebrush obligate species, in addition avoidance of sagebrush habitat to the extent feasible has been added as a mitigation measure.

Burrowing owls may be found in the project area (WGFD 2006, WYNDD 2007) but were not observed during summer 2011 field surveys or during field visits in July 2012. Suitable habitat for the species, white-tailed prairie dog colonies, will not be impacted the major project components (Figure 4.3.3.4), as proposed. Given the lack of suitable habitat, the Proposed Action is not expected to result in the federal listing of this species.

Ferruginous hawks are known to nest within the project area and were observed during the 2011 surveys (Figure 3.3.1). The primary potential impact to ferruginous hawks from project activities is disturbance during nesting, which could result in reproductive failure. Application of the design features described in Section 4.3.3.1, and listed in Chapter 2, for protection of other raptor species will be applied. Given these precautionary measures, the Proposed Action is not expected to result in the federal listing of this species.

Long-billed curlew is an uncommon summer resident, but may be locally common in suitable habitat (WGFD 2004a). The long-billed curlew has not been recorded within the project area but suitable habitat exists within the project area. This species nests on the ground near water, sometimes in a moist hollow and feeds on insects, and aquatic invertebrates (WGFD 2004a). Suitable habitat will be avoided by project construction operations and through the implementation of wetlands avoidance design features thereby reducing the potential for direct impacts to the species.

Mountain plover. The presence of prairie dog colonies (Figure 4.3.3.4) and other suitable habitats indicate that plovers may use some portions of the project area during the year although no high density white-tailed prairie dog colonies were identified in the area. The WYNDD Mountain Plover Species Assessment (WYNDD 2004) indicates that the species has been observed in the general area of the project as does the Wyoming Wildlife Atlas (Cerovski et al. 2004). Mountain plover were not observed during the 2011 wildlife surveys of the project area.

The impacts with the potential for negative effects to mountain plover populations include: loss of nesting habitat, displacement or additional stress due to increased human activities, and increased potential for vehicular collisions due to higher traffic levels on existing and new roads. Due to the general lack of bare ground in the project area, with the exception of new construction

areas, it is not anticipated the mountain plover populations will be impacted by the Proposed Action.

Special Status Amphibian Species

Northern leopard frog sightings have been documented in all counties of Wyoming although this species has not been documented in the project area. Provided that measures are taken to avoid disturbance and contamination of perennial water sources, impacts from the Proposed Action are not expected to affect the species as design features would be applied to minimize wetland disturbance.

Great Basin Spadefoot, as with the Northern Leopard Frog, this species could be present in the project area. Provided that measures are taken to avoid disturbance and contamination of perennial water sources, implementation of the Proposed Action is not expected to affect the species as design features would be applied to minimize wetland disturbance. In addition, the avoidance of sagebrush habitats, to the extent feasible, has been added as a mitigation measure to further avoid potential impacts to this species.

4.3.3.3.2.2 Cumulative Impacts

The cumulative impacts analysis area for the **swift fox, long eared myotis, white-tailed prairie dog, mountain plover and burrowing owl** is the Grieve project buffered by one mile. Other on-going, permitted and reasonably foreseeable activities within this area include the existing Anadarko CO₂ pipeline and the Western Power Administration transmission lines. White-tailed prairie dog colony polygons were mapped immediately adjacent to the Anadarko CO₂ pipeline (Figure 4.3.3.2). Given the application of the design features found in Chapter 2, no cumulative impacts to these species are anticipated.

Cumulative impacts to **sagebrush obligate bird species** were evaluated in the same manner as greater sage-grouse. On-going and permitted activities amount to less than 5 percent surface disturbance and fewer than 1 disruption per 640 acres in suitable habitat in the analysis area. There are no known proposed or reasonably foreseeable actions in the analysis area. Given the application of the design features found in Chapter 2, no cumulative impacts to these species are anticipated.

The cumulative impacts analysis area for **ferruginous hawk** is also the Grieve project buffered by 1 mile and includes the same on-going, permitted and reasonably foreseeable activities as listed relative to the white-tailed prairie dog. A similar analysis area was used for wetland dependent species (i.e. **special status amphibians and long-billed curlew**). Given the application of the design features found in Chapter 2, no cumulative impacts to these species are anticipated.

4.3.3.3.2.3 Mitigation Measures

- Flue stack caps will be placed on all fired equipment such as heater treaters and oil water separators to preclude roosting by bats or small birds.
- Avoidance of sagebrush habitat, to the extent feasible, to minimize disturbance to sagebrush obligate species including the Great Basin Spadefoot.

4.3.3.3.2.4 Residual Impacts

Residual effects to BLM special status species will be minimized through the implementation of appropriate timing limitation stipulations and other design features. If displacement occurs re-colonization is expected once project related disturbance is reduced and habitat is restored.

4.3.3.3.2.5 Monitoring and/or Compliance

Application of the design features found in Chapter 2 and the mitigation measures provided above are adequate to protect wildlife resources.

4.3.4 SOILS

4.3.4.1 Impacts of Alternative A: No Action

4.3.4.1.1 Direct and Indirect Effects

Under the No Action Alternative, the development of the federal mineral resource associated with the Proposed Action would not occur. State and fee mineral leases could undergo further development in the Grieve Unit and the existing production operations would continue. Selection of the No Action alternative does not preclude BLM from considering new proposals on a case by case basis, if brought forward.

4.3.4.1.2 Cumulative Impacts

As demonstrated above, there would be no cumulative impacts realized from the selection of the No Action alternative. Effects to soil resources would remain at current levels within the proposed project area and surrounding cumulative effects analysis area. Livestock grazing comprises the only other existing soil disturbances within the project area. Typically, soil disturbances caused by grazing are limited to soils located in drainage bottoms with higher clay content. The overall impact of this activity on the soil resource is negligible, considering the low to moderate stocking rate currently implemented.

4.3.4.1.3 Mitigation Measures - not applicable

4.3.4.1.4 Residual Impacts - not applicable

4.3.4.1.5 Monitoring and/or Compliance - not applicable

4.3.4.2 Impacts of Alternative B: Proposed Action

4.3.4.2.1 Direct and Indirect Effects

Implementation of the Proposed Action would result in the short-term loss of approximately 171 acres and LOP loss of approximately 35 acres of soil resources and associated production resulting from well pad, access road, pipeline, and power line construction; drilling activities; and hydrocarbon production. All of the Proposed Action construction activities will impact the soil resources found on the GUCO₂ project area. Chapter 2 provides a detailed discussion of each proposed project component and the resulting temporary/short term and LOP disturbance.

Biological impacts to soil resources would include short-term disturbance from blading and stripping of the vegetative cover and destroying the soil structure during construction of well pads, pipelines, and access roads. Soil chemistry, water holding capacity, and nutrient availability would be affected due to salvaging and stockpiling activities. The end result would be a loss in soil organic matter, microbial populations, and productivity.

A change in bulk density and infiltration due to compaction resulting from construction equipment would occur as well. Compaction would be expected up to six inches below the surface and where heavily used access roads and drilling operations on the well pad occur this could cause compaction up to two feet.

Additional impacts to the soil would result from unstable soils exposed to wind and water erosion processes. Erosion of the exposed soils further removes valuable nutrient and basically contributes to the loss of topsoil volumes. This would occur prior to the implementation of the reclamation practices on exposed soils, constructed slopes, soil and subsoil stockpiles, and other areas of new disturbance.

Once interim reclamation practices (Appendix B) are implemented and with time these sites not needed for operations would again become stable and the functionality of the soil resources would be restored. Final reclamation would occur at final abandonment of the well locations and infrastructure. Final reclamation practices would require the restoration of the soil resource to meet the reclamation standards and eventual result in full ecosystem function.

Another major component of the Grieve Unit CO₂ EOR project proposal is the reclamation of unnecessary existing disturbances from past operations that will now be fully reclaimed. Re-disturbance from reclamation activities will result in an eventual benefit to the environment.

4.3.4.2.2 Cumulative Impacts

Past, present, and future livestock grazing would continue to impact the soil resources within the cumulative effects analysis area at the current levels. Typically, soil disturbances caused by grazing are limited to soils located in drainage bottoms with higher clay content. The overall impact of this activity on the soil resource is negligible, considering the low to moderate stocking rate currently implemented.

Careful salvage of soil will be critical to maintain the quality of seed bank. Due to mixing of the A horizon with material lower in the profile during salvaging, the resulting material will likely contain less organic matter than pre-disturbance soils. Construction of well pads, pipelines, and access roads could cause compaction at the surface and up to six inches below the surface. Heavily used access roads could cause compaction up to two feet. No vehicle travel, construction or routine maintenance activities should be performed during periods when the soil is too wet to adequately support vehicles and/or construction equipment.

Existing disturbances within the GUCO₂ project area include pipelines, utility lines, roads, facilities, well pads, production pits, and production equipment and infrastructure. A number of these existing utilities and infrastructure will be utilized while unnecessary existing disturbances will be reclaimed. The success of historical reclamation demonstrates that natural vegetation production and soil conditions can be returned to acceptable and/or near natural amounts through proper reclamation practices.

4.3.4.2.3 Mitigation Measures

See Chapter 2 for applicable Design Features. The implementation of these measures should avoid or reduce impacts to the soils in the project area and watershed.

4.3.4.2.4 Residual Impacts

Residual effects would occur even if the design features found in Chapter 2 are implemented as soils would be dislodged during construction and operations activities and stabilized overtime with the implementation of aggressive reclamation.

4.3.4.2.5 Monitoring and/or Compliance

Application of the design features in Chapter 2, which provide specific compliance and monitoring requirements for construction and reclamation activities associated with the proposed project, are adequate to stabilize and protect the soils resource.

4.3.5 VEGETATION INCLUDING INVASIVE NON-NATIVE SPECIES AND SPECIAL STATUS SPECIES

4.3.5.1 General Vegetation and Invasive Non-native Species

4.3.5.1.1 Impacts of Alternative A: No Action

4.3.5.1.1.1 Direct and Indirect Impacts

Under the No Action Alternative, no additional disturbance or development associated with the GUCO₂ project would occur on BLM administered surface. However, activities previously authorized by the BLM would continue to occur. Effects to the vegetation resources would remain at current levels within those areas. The selection of the No Action alternative would not preclude BLM LFO from approving future projects through project specific NEPA analysis.

4.3.5.1.1.2 Cumulative Impacts

As demonstrated above, there would be no cumulative impacts realized from the selection of the No Action alternative. Effects to vegetation would remain at current levels within the proposed project area and surrounding cumulative effects analysis area. Livestock and wildlife grazing comprise the only other existing disturbance to vegetation within the project area. Considering the low to moderate stocking rate currently implemented in the area the impact of livestock grazing on the soil resource is negligible, considering the low to moderate stocking rate currently implemented.

4.3.5.1.1.3 Mitigation Measures - not applicable

4.3.5.1.1.4 Residual Impacts - not applicable

4.3.5.1.1.5 Monitoring and/or Compliance - not applicable

4.3.5.1.2 Impacts of Alternative B: Proposed Action

4.3.5.1.2.1 Direct and Indirect Impacts

Implementation of the Proposed Action would result in the short-term loss of 171 acres and life of project loss of 35 acres of vegetation cover and production resulting from well pad, access road, pipeline, and power line construction; drilling activities; and production. Direct effects anticipated from the Proposed Action include short-term reduction of herbaceous vegetation and long-term loss of shrub and tree cover. Potential indirect effects include: increased potential for noxious and/or invasive plant species establishment; changes in plant community composition and diversity; and long-term reduction in vegetation cover and production resulting from soil compaction, mixing of soil horizons, and loss of soil productivity.

Disturbances, loss of vegetation cover, and loss of forage productions would be greatest during the construction and drilling phases. Interim reclamation would be implemented, as soon as possible following construction and drilling operations, in areas not required for production operations, to ensure soil stabilization and increase revegetation success. Long-term, or LOP, loss of herbaceous vegetation cover and production would only occur in areas required for the production phase of the proposed project. Over the long term slow growth species, such as Limber Pine or other trees, removed to accommodate construction activities would be experience a slight reduction in number (NRCS 2011b).

All disturbed areas will be seeded with either the Loamy/Shallow Loamy or Saline Subirrigated certified weed-free, interim reclamation seed mix approved BLM LFO, as found in the Reclamation Plan (Appendix B). Listed seed mixes are composed of adequately diverse mixtures of native grasses, forbs, and shrubs. These seed mixes will ensure soil stability, species diversity, cover, and production are restored during interim reclamation. If necessary, reclaimed areas will be fenced in order to enhance reclamation success. Reclaimed areas will be monitored, as outlined in the Reclamation Plan (Appendix B), to determine interim revegetation success. If interim revegetation success is not progressing at the anticipated rate, reseeded will be conducted, and additional measures could be required to ensure successful revegetation of the disturbed areas. Future climatic patterns, precipitation, land use, implementation of appropriate and effective reclamation practices, and control of noxious and non-native invasive species would be primary factors influencing reclamation success and effectiveness.

Disturbance of the soil during construction, drilling, and production phases; unwashed equipment; uninspected plant materials; and increased traffic create conditions suitable for noxious and invasive non-native species to establish and reproduce. Noxious and invasive non-native species may increase fire frequency and intensity, prevent or reduce the establishment of native species, change plant community composition, and reduce overall health and productivity of the native plant communities. Compliance with the proposed GUCO₂ Weed Management Plan (Appendix E) in conjunction with prompt, successful interim reclamation would reduce the opportunity for invasive and non-native species introduction, spread, and reproduction. The Operator will be responsible for timely and effective control of all noxious and non-native species for the life of the proposed project.

4.3.5.1.2.2 Cumulative Impacts

Vegetation resources within the proposed project area would be affected primarily by earth-work activities associated with the construction phase and increased susceptibility to non-native

species invasions resulting from soil disturbance during construction and production phases of the project. Approximately 171 acres of vegetation cover and production will be lost in the short-term as the result of well pad, road, pipeline, and power line construction; drilling activities; and production. Potential effects on vegetation resources would be minimal in the cumulative effects analysis area due to the limited duration and extent of the disturbance and mitigated through the reclamation measures outlined in the GUCO₂ Reclamation Plan (Appendix B) and Weed Management Plan (Appendix E). Additionally, all areas not required for production would be reclaimed as soon as possible following construction and development; reducing the total life of the project disturbance acreage to approximately 35 acres.

Currently, the Proposed Action is the only proposed or active development within the cumulative effects analysis area. Past, present, and future livestock grazing would continue to seasonally impact the vegetation resources within the cumulative effects analysis area at the current levels. Recreation use of current roads and BLM administered lands within the cumulative effects analysis area would continue at current levels. The potential for invasive non-native species invasion and expansion would continue at rates dependent on the currently approved activities. Therefore, cumulative effects would be minimal and mitigated by current management practices.

4.3.5.1.2.3 Mitigation Measures

The implementation of the applicable design features found in Chapter 2 should avoid or reduce impacts to the vegetation in the project area and watershed.

4.3.5.1.2.4 Residual Effects

Residual effects, while not reaching the level of significance, would occur even if the applicable design features are implemented due to the time needed to fully reclaim disturbed areas. In addition, residual effects would result from the opportunity for the introduction of invasive species in areas where vegetation would be disturbed and the time required to mitigate these impacts.

4.3.5.1.2.5 Monitoring and/or Compliance

Application of the design features in Chapter 2, which provide specific compliance and monitoring requirements for construction, reclamation and weed management activities associated with the proposed project, are adequate to enhance, stabilize and protect the vegetation resource in the project area.

4.3.5.2 BLM Wyoming Special Status Plant Species

The BLM has developed a list of sensitive plant species for public lands in Wyoming to help focus management efforts toward maintaining habitats under a multiple use mandate and to prevent the future listing of threatened and endangered species under the ESA. This list is reviewed annually to determine additions and deletions based on recommendations from BLM and non-BLM authorities (BLM 2010a). Those sensitive species identified on the BLM LFO sensitive species list are found on Table 3.3.5.2.

Of the eleven BLM LFO sensitive species, two sensitive plant species were determined to have potential habitat or were present within the proposed project area: Rocky Mountain twinpod (*Physaria saximontana* var. *saximontana*) and limber pine (*Pinus flexilis*).

4.3.5.2.1 Impacts of Alternative A: No Action

4.3.5.2.1.1 Direct and Indirect Impacts

Under the No Action Alternative, no additional disturbance or development associated with the development of the GUCO₂ project would occur on BLM administered surface. However, activities previously authorized by the BLM would continue to occur. Effects to BLM LFO sensitive plant species would remain at current levels within those areas. The selection of the No Action alternative would not preclude BLM LFO from approving future projects through project specific NEPA analysis.

4.3.5.2.1.2 Cumulative Impacts

Under the No Action Alternative, no additional disturbance or development associated with the development of the GUCO₂ project would occur on BLM administered surface. However, activities previously authorized by the BLM would continue to occur as well as other reasonably foreseeable activities within the cumulative effects analysis area. Effects to BLM-LFO sensitive plant species would remain at current levels within the proposed project area and surrounding cumulative effects analysis area.

4.3.5.2.1.3 Mitigation Measures - not applicable

4.3.5.2.1.4 Residual Impacts - not applicable

4.3.5.2.1.5 Monitoring and/or Compliance - not applicable

4.3.5.2.2 Impacts of Alternative B: Proposed Action

4.3.5.2.2.1 Proposed Action Direct and Indirect Effects

As stated in Section 3.3.5.4, there are eleven plant species on the sensitive plant species list for the BLM LFO management area (Table 3.3.4.2). Local habitat was confirmed unsuitable for nine of the BLM LFO sensitive plant species (BKS unpublished data). Therefore, implementation of the Proposed Action would not affect the nine BLM LFO sensitive plant species for which local habitat was confirmed unsuitable.

Suitable habitat and populations of limber pine are present within the proposed project and disturbance areas (BKS unpublished data). Implementation of the Proposed Action will directly impact a three to four individual limber pine within the proposed disturbance area. The removal of a small number of isolated Limber Pine trees will not result in the loss of the project area Limber Pine stands. This removal of isolated, individual trees is consistent with the IM WY-2011-003, "Whitebark and Limber Pine (Five Needle Pine) Management Guidelines for Wyoming BLM (BLM 2010b).

Suitable habitat and, potentially, individuals of Rocky Mountain twinpod are present within the project area and outside of the proposed disturbance area (BKS unpublished data). Implementation of the proposed project would indirectly affect habitat and/or individuals of Rocky Mountain twinpod.

However, direct and indirect effects to individuals/population and/or habitat, will not likely contribute to a trend toward federal listing or loss of viability to the populations or species. Therefore, a “not likely to adversely affect” determination is appropriate for these species.

4.3.5.2.2.2 Cumulative Impacts

Populations of limber pine and potential individuals and suitable habitat for Rocky Mountain twinpod have been identified within the proposed project area. Activities within the cumulative effects analysis area, such as recreational use of BLM administered lands and roads and grazing are not likely to affect the viability of the BLM LFO sensitive plant species within the proposed project area. Cumulative impacts for the BLM LFO sensitive species identified within the disturbance area would increase due to the removal of a small number of limber pine individuals. However, limber pine populations within the proposed project area outside of the disturbance area will likely not be impacted. Due to the limited suitable habitat present within the proposed project area for Rocky Mountain twinpod and lack of proposed activities with the identified suitable habitat, cumulative impacts to this species are minimal.

4.3.5.2.2.3 Mitigation Measures

The implementation of the applicable design features found in Chapter 2 should avoid or reduce impacts to the vegetation in the project area and watershed.

4.3.5.2.2.4 Residual Impacts

Residual effects, while not reaching the level of significance, would occur even if the applicable design features are implemented due to the time needed to fully reclaim disturbed areas. In addition, residual effects would result from the opportunity for the introduction of invasive species in areas where vegetation would be disturbed and the time required to mitigate these impacts.

4.3.5.2.2.5 Monitoring and/or Compliance

Application of the design features in Chapter 2, which provide specific compliance and monitoring requirements for construction, reclamation and weed management activities associated with the proposed project, are adequate to enhance, stabilize and protect the special status species habitat in the project area.

4.3.6 WATER RESOURCES

4.3.6.1 Surface Water

4.3.6.1.1 Impacts of Alternative A: No Action

4.3.6.1.1.1 Direct and Indirect Impacts

Under the No Action Alternative, the development of the proposed project and all its component parts would not occur. Surface water related effects consistent with the Proposed Action would be expected as State and fee mineral leases should they undergo additional developed in the Grieve Unit, the existing production operations would likely continue.

4.3.6.1.1.2 Cumulative Impacts

Under the No Action Alternative, no additional disturbance or development associated with the development of the GUCO₂ project would occur on BLM administered surface. However, activities previously authorized by the BLM would continue to occur as well as other reasonably foreseeable activities within the cumulative effects analysis area. Effects to surface waters in the area would remain at current levels within the proposed project area and surrounding cumulative effects analysis area.

4.3.6.1.1.3 Mitigation Measures - not applicable

4.3.6.1.1.4 Residual Impacts - not applicable

4.3.6.1.1.5 Monitoring and/or Compliance - not applicable

4.3.6.1.2 Impacts of Alternative B: Proposed Action

4.3.6.1.2.1 Direct and Indirect Impacts

Surface water in the GUCO₂ project area is within the North Platte River watershed but is not considered, by the Wyoming State Engineers Office (WSEO) to be hydrologically connected to the North Platte River and is, therefore, not subject to the Consent Decree between the States of Wyoming and Nebraska. There are no irrigated lands within the project area or potentially impacted by the project.

Potential direct impacts to surface water resources from the Proposed Action include effects on water quality (e.g., potential contamination of surface water resources from spills or discharges of drilling fluids, petroleum, or other chemicals used for natural gas drilling and production activities).

Contamination of surface water and groundwater can occur in oil fields. Sources of potential contamination include leaks from wellheads, fluids gathering and injection pipelines, storage tanks, and treatment facilities, as well as leaching of contaminants from impacted soils that may be associated with these facilities. In addition, accidental spills of hydrocarbon products, including fuels and petroleum products, or produced water, would have the potential to contaminate surface waters if the spills were to occur when flow was present in the surface water drainages of the proposed project area. The implementation of an appropriate Spill Prevention Countermeasure and Control (SPCC) Plan would minimize, control, and cleanup the affected area. The measures provided in the SPCC Plan would minimize the opportunity for spilled material to enter a surface water feature and subsequently impacts surface water.

Produced fluids would be separated and stored in steel tanks at the central facility. Produced water would be stored in tankage until re-injected into the Muddy formation for pressure maintenance while crude oil would be stored until shipped, via pipeline, to a Casper area

terminal. No impacts to surface water resources in or near the proposed project area are expected in association with the routine management of produced fluids.

Potential direct impacts to surface water resources from the Proposed Action also include increased sedimentation and turbidity of affected surface water as a result of surface disturbance and increased erosion into surface waters via runoff; and

Class 3B surface waters that could be affected by the Proposed Action include Cabin Creek, a tributary to Soap Creek, and an unnamed tributary to the Poison Spider Creek. Design features relative to wetland areas (see Section 4.3.6.3) would be applied as would construction storm water control practices; these activities, in addition to site specific reclamation (Appendix B), will serve to minimize any negative impact to these surface water resources.

The potential for adverse impacts to surface water resources would be greatest shortly after the start of construction activities and would likely decrease in time due to natural stabilization, reclamation, and revegetation efforts.

During construction, increased erosion and subsequent increased sedimentation to intermittent and ephemeral drainages in and near the project area may occur. Since ground-disturbing activities within close proximity to drainages have the greatest potential for impacting water resources, rapid and successful reclamation/revegetation of temporarily disturbed areas and implementation of management actions to reduce erosion are particularly important in minimizing water quality impacts and to assure maintenance of long-term stream health.

With the application of management actions contained in the various design features for erosion and runoff control, the actual amount of sediment that would be transported to the ephemeral drainages within the proposed project area would be reduced. The erosion and runoff control devices used would be specified in the Storm Water Pollution Prevention Plan (SWPPP) and Application for Permit to Drill (APD, Appendix C) prepared for each proposed well pad, access road, and other project components. With implementation of the erosion control practices and the project specific Reclamation Plan (Appendix B), the amount of increased erosion associated with the Proposed Action could be minimal.

Soils compacted on existing roads, new access roads, well pads, pipeline corridors and the substation pads generate more runoff than undisturbed sites. The increased runoff, resulting from approximately 35 acres of LOP disturbance, could lead to slightly higher peak flows in ephemeral drainages following occasional significant storm events potentially increasing erosion of the channel banks. The increased erosion could also increase turbidity in ponds and wetland areas following storm events until vegetated buffers have been re-established. The magnitude of these impacts cannot be quantified, but is expected to be negligible based on the very small increase in surface water runoff that would be generated and the application of design features.

4.3.6.1.2.2 Cumulative Impacts

The cumulative impacts would include the existing soil disturbances on approximately 230 acres (BLM LFO disturbance data) associated with the Grieve Unit and other existing infrastructure i.e. pipelines, utility lines, roads, facilities, well pads, production pits, and production equipment and infrastructure in addition to the approximately 35 acres of proposed LOP disturbance. There are no other projects proposed within the general area of the Grieve Unit.

4.3.6.1.2.3 Mitigation Measures

- In the event that equipment to be used in the Grieve project has been used in an area known to contain aquatic invasive species (AIS) or suspected to contain AIS, the following mitigation measure will be implemented: Equipment will be inspected by an authorized AIS inspector certified in the state of Wyoming prior to its use in any Wyoming water. If AIS are found, the equipment will be decontaminated.

4.3.6.1.2.4 Residual Impacts

Residual impacts resulting from implementation of the Proposed Action would likely be realized from increased erosion and subsequent sediment yield to adjacent drainages over the life of the project, even with the implementation of reclamation and the SWPPP. Over time, stabilization and reclamation of the disturbed areas of the Project would substantially reduce the potential of offsite transport of sediments.

4.3.6.1.2.5 Monitoring and/or Compliance

Application of the design features in Chapter 2, which provide specific compliance and monitoring requirements for construction, storm water management and reclamation activities associated with the proposed project, are adequate to stabilize soils, contain hazardous materials releases and protect the surface water in the project area.

4.3.6.2 Groundwater

4.3.6.2.1 Impacts of Alternative A: No Action

4.3.6.2.1.1 Direct and Indirect Impacts

Under the No Action Alternative, the additional development of the federal mineral resource and associated infrastructure as found in the Proposed Action would not occur. No additional groundwater related effects are expected from the continuation of the existing operation or enhanced development of State and fee mineral leases, should it occur. Injection into the subsurface will likely continue as long as production operations continue. New proposals for development of the Unit could be permitted by BLM if brought forward.

4.3.6.2.1.2 Cumulative Impacts

Under the No Action Alternative, no additional disturbance or development associated with the development of the GUCO₂ pipeline would occur on BLM administered surface. However, activities previously authorized by the BLM would continue to occur as well as other reasonably foreseeable activities within the cumulative effects analysis area. Effects to ground waters in the area would remain at current levels within the proposed project area and surrounding cumulative effects analysis area.

4.3.6.2.1.3 Mitigation Measures - not applicable

4.3.6.2.1.4 Residual Impacts - not applicable

4.3.6.2.1.5 Monitoring and/or Compliance - not applicable

4.3.6.2.2 Impacts of Alternative B: Proposed Action

4.3.6.2.2.1 Direct and Indirect Impacts

Potential impacts to groundwater resources from the Proposed Action include contamination of groundwater with produced water, drilling mud, or petroleum constituents.

Shallow groundwater, including artesian springs, in the project area would be protected by the application of Wyoming Oil and Gas Conservation Commission (WOGCC) well bore construction standards for use of water based mud for drilling through these zones and settling of appropriate casing and cement to below known sources of drinking water. All unneeded boreholes and wells will be properly cemented and abandoned in accordance with BLM and WOGCC rules.

Produced water and CO₂ injection into the Cretaceous Muddy formation has been approved by the WOGCC and the United States Environmental Protection Agency (EPA) (WOGCC Docket No. 437-2011, dated January 10, 2012). This approval (an Underground Injection, or UIC, Permit) contains injection pressure and volume limitations as well as wellbore mechanical integrity testing requirement. Therefore, injection of CO₂ and produced water into the Muddy is not expected to impact shallow ground water sources or potential underground sources of drinking water (USDW) in the project area.

Spills of fuels or produced fluids have the potential to contaminate groundwater resources, especially the shallow groundwater aquifers and springs. Spills from facilities located adjacent to ephemeral drainages would have the greatest potential to contaminate groundwater. The implementation of an appropriate SPCC Plan would minimize, control, and cleanup the affected area. The measures provided in the SPCC Plan would minimize the opportunity for spilled material to enter a surface water feature and subsequently impacts shallow groundwater.

SPCC Plan related management actions would be employed to control potential released hydrocarbons during drilling operations at each well site location as well as during the construction of the various infrastructure components. Therefore, it would be unlikely for a spill of fuel, other petroleum products or produced fluids to migrate off of a well pad or construction site and contaminate shallow groundwater aquifers. Accordingly, the potential for contamination of shallow groundwater resources by drilling or construction products or produced fluids is considered to be negligible.

No produced water would be discharged into surface water drainages or allowed to flow onto the ground surface. There is a chance that produced water could be released during operations as a result of an injection line leak or a tankage failure. New injection lines and tankage reduce this potential. Produced water storage tanks are included in the project SPCC Plan as are crude oil and fuel tanks.

Deep ground water sources would not be affected by the Proposed Action through formation parting, or “fracking,” as discussed in Section 2.3.2 c.

Water Use

Another potential impact to the deep groundwater resource would be in the form of depletions to the North Platte River System although no impacts are anticipated. The Grieve Unit CO₂ project area is in an area determined by the Wyoming State Engineers Office to be non-hydrologically connected to the North Platte River System (WSEO 2012).

For the proposed drilling operations, approximately 25,000 barrels (3.2 acre-feet) of water would be needed for each well during construction, drilling and completion operations. Therefore, drilling of the 10 proposed wells would require an estimated total water use of about 250 thousand barrels, or 32 acre-feet, over the next one to five years. It is anticipated that water for drilling operations would be either produced water from the Muddy formation or from WSEO permitted water supply wells located on private lands within the Unit. Fresh water for cementing operations (hundreds of barrels) would be sourced from either Casper or shallow WSEO permitted groundwater wells in the Grieve project area. One such well is the Grieve #6 well within the unit which was used by previous operators for domestic use.

Approximately 1,600 Bbl (0.2 acre feet) of water will be needed for integrity (hydro-testing) of the pipeline systems. The fresh water used in the pipeline testing will be sourced from either Casper or from permitted shallow groundwater wells in the area. One such well is the Grieve #6 within the unit which was used by previous operators. This water would be recycled back into the water injection system and used for reservoir pressure maintenance.

Water for reservoir re-pressurization will be obtained from new or existing wells in the field which will be completed or re-completed in one of the water bearing formations, the Cloverly, Tensleep or the Madison. Approximately fifty-two million barrels of water will be needed over the 25 year life of the project; of this, approximately 22 million Bbl would be taken from the water supply wells, mentioned above, for initial re-pressurization. The remaining 30 million Bbl would be seventy-five percent recycled Muddy produced water and 25 percent make-up water from one of the water supply wells in the field. All water supply wells will be permitted and approved through the WOGCC, BLM and WSEO, as appropriate.

4.3.6.2.2.2 Cumulative Impacts

The cumulative impacts area for ground water is the Grieve Unit as the WSEO has determined the area is not hydrologically connected to the North Platte River system. As there are no other ground water uses occurring in the project area there are no cumulative impacts to the groundwater resource.

4.3.6.2.2.3 Mitigation Measures

Application of the design features in Chapter 2 and the monitoring requirements contained therein are adequate to protect the groundwater resource in the project area.

4.3.6.2.2.4 Residual Impacts

Residual effects to the shallow fresh groundwater resource from the use/consumption of approximately 0.25 acre feet are negligible.

Residual impacts of the proposed reservoir re-pressurization project include the removal of 3,808 acre feet of groundwater over the life of the project. Additional 2,880 acre feet of produced water will be recycled over the life of the project. No residual effect of the produced water resource found in the Cretaceous Muddy formation is anticipated due to the proposed re-injection practices. No residual effects to fresh or hydrocarbon formation (Cretaceous Muddy) water quality are anticipated with the application of applicable and appropriate BLM, WOGCC and industry construction and operational standards and BMPs.

4.3.6.2.2.5 Monitoring and/or Compliance

Application of the design features in Chapter 2, which provide specific compliance and monitoring requirements for wellbore construction, as well as injection and production operations are adequate to provide protection of the groundwater resources in the project area.

4.3.6.3 Wetlands and Riparian Areas

4.3.6.3.1 Impacts of Alternative A: No Action

4.3.6.3.1.1 Direct and Indirect Impacts

Under the No Action Alternative, the additional development of the federal mineral resource and associated infrastructure as found in the Proposed Action would not occur. No additional wetland and riparian area related effects are expected from the continuation of the existing operation or enhanced development of State and fee mineral leases, should it occur. New proposals for development of the Unit could be permitted by BLM if brought forward by the Operator.

4.3.6.3.1.2 Cumulative Impacts

Under the No Action Alternative, no additional disturbance or development associated with the development of the GUCO₂ project would occur on BLM administered surface. However, activities previously authorized by the BLM would continue to occur as well as other reasonably foreseeable activities within the cumulative effects analysis area. Effects to wetland and riparian areas would remain at current levels within the proposed project area and surrounding cumulative effects analysis area.

4.3.6.3.1.3 Mitigation Measures - not applicable

4.3.6.3.1.4 Residual Impacts - not applicable

4.3.6.3.1.5 Monitoring and/or Compliance - not applicable

4.3.6.3.2 Impacts of Alternative B: Proposed Action

4.3.6.3.2.1 Direct and Indirect Impacts

National wetlands inventory sites were field verified as described in Section 3.3.6. Field observations verified the presence of wetland hydrology, a dominance of hydrophytic vegetation, and the presence of hydric soils within the proposed GUCO₂ pipeline, overhead and underground power lines, and roads.

In an effort to preclude direct impacts to wetland areas Elk has committed to installing the CO₂ pipeline using boring methods. This 3.6 mile pipeline would cross numerous small wetland segments, approximately 0.6 acres of potential impact. In the event that boring under these wetlands is not feasible or would be more damaging than trenching (i.e. perforating a perched water table) the Operator and its contractors will return the impacted area to its pre-construction contour and completely restore the wetland function. This utility line activity would not require an ACOE Pre-construction notification (PCN). The provisions of ACOE Nationwide Permit No. 12 would be followed. Avoidance of wetland impacts also serves to protect riparian areas. Installation of the underground 25 kV power line will result in the disturbance of less than 0.05 acres of wetlands as a result of the need to blade and trench across the approximately 355 lineal feet of designated wetlands identified along the power line alignment, ACOE Nationwide Permit No. 12 provisions also apply to this activity.

Other potential impacts to wetland and riparian areas include impacts to wetland function and sedimentation, resulting from project related construction activities on non-wetland areas. Culverts will be installed properly as to not inhibit flow downstream and affect wetlands located outside the project area. Wetlands and riparian areas could also have an increased susceptibility to non-native species invasions resulting from disturbance during construction and increased traffic within the project area. Activities having the potential to spread noxious weeds into wetlands, dewater a wetland, increase sediment load into a wetland area, or alter the soil chemistry of a wetland would be mitigated through implementation of numerous design features including the Reclamation Plan (Appendix B), Weed Management Plan (Appendix E), SPCC Plan and SWPPP.

4.3.6.3.2.2 Cumulative Impacts

Historically, the North Grieve crude oil pipeline and existing in field access roads could have directly impacted wetlands and riparian area resources in the Grieve area. These areas have been fully reclaimed and design features, such as culverts, installed; indirect impacts remain associated with existing non-vegetated areas operations areas and road surfaces. The proposed project would add a potential impact to wetlands and riparian areas, the application of design features such as boring wetlands, timely reclamation, the SWPPP and SPCC planning reduce the potential for cumulative impacts.

4.3.6.3.2.3 Mitigation Measures

Application of the design features in Chapter 2 and the monitoring requirements contained therein are adequate to protect the wetland and riparian area resources in the project area.

4.3.6.3.2.4 Residual Impacts

Implementation of the operator design features, in conjunction with implementation of the Reclamation Plan (Appendix B), Weed Management Plan (Appendix E), SWPPP and SPCC plans will minimize the potential for residual impacts to delineated wetland and riparian areas.

4.3.6.3.2.5 Monitoring and/or Compliance

Implementation of numerous design features including the Reclamation Plan (Appendix B), Weed Management Plan (Appendix E), SPCC Plan and SWPPP will provide protection to wetland and riparian areas potentially affected by the proposed project as will application of the suggested mitigation measures.

In the event wetlands are trenched, monitoring will be required following construction, and annually thereafter, until successfully reclaimed.

In the event that equipment (i.e. boring equipment, water trucks, etc.) to be used in the Grieve project has been used in areas known to contain AIS or suspected to contain AIS (i.e. southern Colorado), the equipment will be inspected by an authorized AIS inspector certified in the state of Wyoming prior to its use in any Wyoming water.

4.3.7 SOCIOECONOMICS

4.3.7.1 Impacts of Alternative A: No Action

4.3.7.1.1 Direct and Indirect Impacts

Under the No Action Alternative the Proposed Action would be denied and very limited additional crude oil would be produced from the existing configuration of the Grieve Unit. While no additional project related crude oil development would take place on federal leases and the federal oil and gas lease holders would be denied their rights for drilling and enhanced recovery of the federal mineral estate some limited EOR additional drilling and production could occur on the State and fee mineral leases. If the EOR project were denied a significant economic benefit would be denied to the leaseholders. Additional federal minerals would not be recovered and revenues from these un-recovered minerals would not be realized by the federal and state governments, nor would additional tax revenues be realized by local governments. Limited additional socioeconomic effects would be expected to occur beyond the current situation.

4.3.7.1.2 Cumulative Impacts

Under the No Action Alternative, no additional disturbance or development associated with the proposed GUCO₂ project would occur on BLM administered surface. However, activities previously authorized by the BLM would continue to occur.

4.3.7.1.3 Mitigation Measures - not applicable

4.3.7.1.4 Residual Impacts - not applicable

4.3.7.1.5 Monitoring and/or Compliance - not applicable

4.3.7.2 Impacts of Alternative B: Proposed Action

Population and Employment Demographics

The project will enhance local and regional economic conditions and result in the generation of local, state, and federal government tax and royalty revenues once enhanced production commences. Tax revenues to Natrona County will increase with the construction of the proposed infrastructure and the increase in the local tax base. Benefits will accrue to the state and federal governments from the sale of crude oil.

Each component of the proposed project is relatively small and of short-term duration but taken as a whole a wide variety of local and regional craftsmen and laborers will be employed. The associated workforces would not generate noticeable population effects or demand for temporary housing or local government services. The fifteen person workforce associated with the long-term production activities will likely be hired locally although some CO₂ experienced staff may be transferred into the area.

The proposal to enhance crude oil production through reservoir re-pressurization will involve a substantial capital investment. Development and operation of the project would require goods and services from a variety of local and regional contractors and vendors, from the oil and gas service industry and from other industries. Expenditures by the proponent for these goods and services, coupled with employee and contractor spending, will generate economic benefits for Natrona County, and for Wyoming in the form of taxes collected.

The Proposed Action is consistent with the desires of the State of Wyoming (State Statute 30-8-101) to encourage CO₂ sequestration and the opportunities for crude oil CO₂ EOR operations in traditionally depleted fields.

Engineering analysis indicates that approximately 5,000 barrels of oil per day could be realized from CO₂ EOR operations in the Grieve Unit. This level of production, at the current Wyoming crude oil price of approximately \$60 per barrel, would yield over \$100 million dollars to the United States of America over the life of the project, one-half of which is returned to the State of Wyoming. Wyoming would further benefit through severance and ad valorem taxes. Drilling rigs, rig and roustabout crews, and construction would all provide sales taxes back to the Natrona County economy.

Given the national need for additional domestically produced crude oil and the current fiscal condition of both the United States and the State of Wyoming (due to currently low natural gas and coal prices), it is reasonable to assume that the direct and indirect economic impacts of the project would be positive.

4.3.7.2.2 Cumulative Impacts

The cumulative impacts analysis area for economic could be considered in any numbers of ways, from Natrona County to the United States, taken with other energy and economic development projects the proposed Action will result in a benefit to any area of analysis considered.

4.3.7.2.3 Mitigation Measures – none identified

4.3.7.2.4 Residual Impacts

Residual effects to the economic condition of the area could include added stability to the long-term workforce and local economy. The State of Wyoming and the United States would benefit from the increase in oil royalties and severance taxes.

4.3.7.2.5 Monitoring and/or Compliance – none identified

4.4 UNAVOIDABLE ADVERSE IMPACTS

Unavoidable adverse impacts that would result from the implementation of the proposed project are those that cannot be avoided or reversed through implementation of design features or mitigated through the application of identified mitigation measures.

- **Climate, Climate Change, & Air Quality** – While not reaching the level of significance there will be unavoidable adverse impacts to air quality.
- **Cultural** – No unavoidable adverse impacts to cultural resources are anticipated.
- **Wildlife including Threatened and Endangered, and Special Status Species** - Unavoidable adverse impacts may occur relative to some individuals of some species found in the project area, none of these would reach the level of significance (threatening the survival of the population or the species). Habitats on 171 acres will be unavoidably impacted through the implementation of the project.
- **Soils** - Soils will be disrupted, removed, replaced and re-stabilized over the areas disturbed for the implementation of the Grieve CO₂ project. Some of the soils will be dislodged and not reclaimed or re-stabilized resulting in the loss of approximately 35 acres of soil productivity.
- **Vegetation including Invasive Non-Native Species and Special Status Species** - Unavoidable adverse impacts may occur relative to some individuals of some species found in the project area, none of these would reach the level of significance (threatening the survival of the population or the species). Habitat on 171 acres will be unavoidably impacted through the implementation of the project.
- **Water Quality (Groundwater & Surface Water)** - Unavoidable adverse impacts to surface waters found in the project area may occur but would not reach the level of significance (i.e. impaired function). Unavoidable adverse impacts to ground water in the project area may occur as the result of use but would not reach the level of significance (i.e. impaired function or quality).
- **Socioeconomics** - No unavoidable adverse impacts to socioeconomics are anticipated.

4.5 RELATIONSHIP OF SHORT TERM USES AND LONG TERM PRODUCTIVITY

Short term uses would be defined as impacts to the resources that persist after project infrastructure and drilling have been completed and remain up to 5 years or until interim reclamation has been successfully achieved. Long term productivity could be thought of as losses of productivity over the life of the project, which typically is more than 20 years or until the wells have been abandoned and final reclamation standards have been achieved. In the alternative long-term productivity could be defined as the enhanced yield of a resource.

- **Climate, Climate Change, & Air Quality** – In the short term air quality will be impacted by the implementation of the proposed project. Long term productivity may be enhanced due to the effects of carbon sequestration.
- **Cultural** - No short or long term impacts to the cultural resource are anticipated.
- **Wildlife including Threatened and Endangered, Special Status Species** – In the short term some individuals of some species may be displaced from the project area; losses in long term productivity of some species or their habitats may occur.
- **Soils** - In the short term soil losses will occur on 171 acres; losses of long term productivity of soils over 35 acres are also anticipated.
- **Vegetation including Invasive Non-Native Species and Special Status Species** - In the short term losses of vegetation occur on 171 acres; losses of long term productivity of vegetation over 35 acres are also anticipated.
- **Water Quality (Groundwater & Surface Water)** – Short term uses of surface water is not anticipated, nor are losses in long term productivity. Ground water will be used over the life of the project, long term losses in productivity are not anticipated.
- **Socioeconomics** – Short term and long term benefit to the socioeconomic condition of local communities will be realized through improved employment opportunities and the increased tax and royalty revenues realized to local, state and federal governments.

4.6 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Irreversible and irretrievable commitments of resources are those impacts resulting from the implementation of the proposed project that cannot be reversed except perhaps in the extreme long term. No irreversible and irretrievable commitments of resources have been identified relative to the implementation of the Grieve Unit CO₂ project, with the possible exception of the irreversible and irretrievable commitment of the crude oil resource though enhanced recovery production.

4.7 ANY OTHER DISCLOSURES

All necessary and appropriate disclosures have been made in the impacts analysis of each resource.

CHAPTER 5 - CONSULTATION AND COORDINATION

5.1 INTRODUCTION

The issue identification section of Chapter 1 identifies those issues analyzed in detail in Chapter 4. The ID Team Checklist provides the rationale for issues that were considered but not analyzed further. The issues were identified through the public and agency involvement process described in Sections 5.2 and 5.3 below. Resource clearances evaluated and prepared by the BLM ID Team are provided in Appendix F.

5.2 PERSONS, GROUPS, AND AGENCIES CONSULTED

Table 5.1 - List of all persons, groups, and agencies consulted for the purpose of this environmental assessment

Name	Purpose & Authorities for Consultation or Coordination	Findings & Conclusions
Matthew Hoobler	Wyoming State Engineers Office North Platte River Compact Program Lead	The Grieve project area is not hydrologically connected to the North Platte River; the proposed ground water use and will not result in a depletion and no affect to the North Platte River Species
Mary Flanderka	Wyoming Game and Fish Department Habitat Protection Coordinator	Greater Sage-grouse DDCT consultation; the Grieve project as proposed and with added design features is consistent with the Core Area Concept.

Tribes Consulted

Two newly recorded sites were identified as being of potential Native American concern during project surveys. One cairn site was recommended as unevaluated pending Native American consultation. The other site is a prehistoric cairn site that was also recommended as unevaluated pending Native American consultation. Tribal consultation was conducted on both sites in October and November 2011 with the Eastern Shoshone and Northern Arapaho tribal elders, observers and Tribal Historic Preservation Officer (THPO). Alternative well site locations and mitigation were provided for one site and approval granted for the other.

5.3 PUBLIC PARTICIPATION

A scoping notice was printed in the Casper Star Tribune, posted on the BLM LFO website in December 8, 2011. This notice described the project and requesting that any comments regarding the project be submitted to BLM by January 13, 2012. A copy of the BLM website posting and scoping notice are found as Appendix A.

5.3.1 Comment Analysis

All public comment was reviewed by the IDT, each issue presented was compared against the Proposed Action, operator committed and BLM required design features. If the concern was relevant to the proposal and was not adequately covered by the design features mitigation was applied in the EA.

5.3.2 List of Commenters

Three comment letters were received regarding the proposed Grieve CO₂ project.

- James Steidtmann - former director of the Enhanced Oil Recovery Institute at the University of Wyoming
- Wyoming Game and Fish Department – John Emmerich, Deputy Director
- Wyoming Wildlife Federation - Sarah Pizzo (National Wildlife Federation), Joy Bannon (Wyoming Wildlife Federation)

5.3.3 Response to Public Comment

Mr. Steidtmann encouraged the speedy completion of the environmental analysis due to:

- (1) The suitability of the Grieve Unit for CO₂ re-pressurization,
- (2) The opportunity to implement the CO₂ enhanced oil recovery project,
- (3) The close proximity to the Anadarko CO₂ pipeline, and
- (4) The contracts being in place for the CO₂.

Response: The EA was completed in as timely a manner as possible given the number of infrastructure components and issues relative to the appropriate manner in which to evaluate potential disturbance and disruptions to the greater sage-grouse.

Wyoming Game and Fish Department brought forward the following Terrestrial considerations:

- (1) No designated big game crucial winter range in the project area,
- (2) No sage grouse leks in close proximity to the project, but part of the proposal falls within a core area, a DDCT should be completed and construction should not occur in core between March 15 and June 30.

Response: These issues had already been considered and included in the Design Features as appropriate.

Wyoming Game and Fish Department brought forward the following Aquatic considerations:

- (1) Implement best management practices for the control of sediment and other pollutants; disturbed areas should be promptly re-vegetated,
- (2) Placement of equipment fueling, servicing and staging areas at least 300 feet from streams and riparian areas,
- (3) Prevent the spread of aquatic invasive species by following the WGFD regulations

Response: These issues identified in (1) above had already been considered and included in the Design Features, (2) and (3) were added as specific mitigation measures.

Wyoming Wildlife Federation brought forward the following recommendations:

Wildlife

(1) Conduct a site evaluation that includes local expertise, natural resource databases, literature searches, endangered or threatened species, and critical habitats. Use this site survey to screen sites and determine whether sites are suitable for development.

Response: This was a part of the analysis.

(2) Adopt adaptive management protocols.

Response: This was a part of the analysis.

(3) Implement mitigation efforts and winter stipulations for all big game species.

Response: No big game crucial winter range is designated in the project area.

(4) Implement new technologies as developed to increase mitigation effectiveness.

Response: New technologies that mitigate impacts are a major part of the project design.

(5) Evaluate, mitigate, and develop a plan for invasive plant species. How will the company prevent the spread of invasive plants? What mitigation measures will be implemented to prevent the spread of and introduction of invasive plant species? How will the BLM evaluate the landscape to record changes in vegetation through the project? Invasive plants have a detrimental effect for wildlife, native plants, and recreation.

Response: These issues had already been considered and included in the Design Features as appropriate.

(6) Supply a comprehensive analysis of seasonal timing restrictions and the development plan as applied to all wildlife species.

Response: This was a part of the analysis.

(7) Provide current inventory studies and a full analysis of wildlife habitat, wildlife species, and current riparian and stream habitat conditions.

Response: This was a part of the analysis.

(8) Implement measures to mitigate impacts to the greater sage grouse

Response: This issue has already been considered and included in the Design Features as appropriate.

Recreation

(1) If this proposed project results in loss of access for hunting, that loss should be mitigated by access easements in nearby areas.

Response: The project will not change access for hunting from the current condition.

(2) Establish clearly stated language on public access to all public lands within the area.

Response: This is beyond the scope of this project level EA.

(3) Adopt President Bush's Executive Order 13443 from August, 16, 2007, which focuses on expanding and enhancing hunting opportunities on public lands.

Response: This is beyond the scope of this project level EA.

Water Quality

(1) Conduct a comprehensive analysis on all waterways and drainages in the proposed project area, especially waterways located near or crossing roads and staging areas.

Response: This was a part of the analysis.

(2) Conduct a complete and accurate assessment of the impacts (such as contamination and demands on water, if any), including reasonable foreseeable impacts, and baseline sampling of ground and surface water related to this proposed project.

Response: This was a part of the analysis.

(3) Implement a monitoring system and action plan for detecting spills around the proposed project area.

Response: This issue has already been considered and included in the Design Features as appropriate.

(4) Provide current inventory studies and a full analysis of wildlife habitat, wildlife species, and current riparian and stream habitat conditions.

Response: This was a part of the analysis.

Cumulative Impacts

(1) The National Environmental Protection Act requires that the BLM take into account the cumulative impacts of ongoing and likely future energy development, and any ongoing development activities taking place in the Lander Field Office.

Response: This was a part of the analysis at the appropriate resource specific scale.

(2) Develop a cumulative effects scenario that illustrates what may occur to sensitive, threatened or endangered species that are located in areas that will be impacted by the proposed project area and will see habitat changes.

Response: This was a part of the analysis at the appropriate resource specific scale.

(3) Develop a landscape-scale cumulative impacts analysis that addresses the development within and outside of the proposed project area. Include how the project will impact crucial habitat and crucial ranges (such as winter, summer and transitional) for wildlife species, including ungulate populations, as a whole. This will entail the issue of species being pushed onto less suitable habitat. In creating this analysis, the BLM must use the most up-to-date big game seasonal range designation maps that the Wyoming Game and Fish Department will provide.

Response: No big game crucial winter range is designated in the project area.

(4) Identify the amount of surface disturbance and how vegetation removal will be reclaimed.

Response: This issue has already been considered and included in the Design Features as appropriate.

5.4 LIST OF PREPARERS

Table 5.2 - List of BLM preparers

Name	Title	Responsible for the Following Section(s) of this Document
Chris Krassin	Natural Resource Specialist	BLM Project Lead
Karina Bryan	Cultural Resources and	Cultural

Table 5.2 - List of BLM preparers

Name	Title	Responsible for the Following Section(s) of this Document
	Paleontology	
Stuart Cerovski	Resource Advisor, Fluid Minerals	Minerals
Jon Kaminsky	Assistant Field Manager, Minerals	NEPA Process
Tim Kramer	Natural Resource Specialist, Fire and Fuels	Vegetation and Special Status Species
Jared Oakleaf	Outdoor Recreation Planner	Recreation
Leta Rinker	Realty Specialist	ROW advisor
Tom Sunderland	Geology	Geology
Sydney Thielke	GIS Specialist	Sage Grouse DDCT Analysis
Tim Vosburgh	General and Special Status Species Wildlife	Wildlife and Special Status Species
Kristin Yannone	Environmental Planner and Coordinator	NEPA Process

Table 5.2 - Third Party Interdisciplinary Team

Name of Preparers	Area of Expertise
Renee Taylor – Taylor Environmental Consulting	Project lead, document preparation, general and special status species wildlife, surface and ground water, transportation, socioeconomics, transportation, health and safety, noise, visual resources, and range resources
Susan Connell and Jim Zapert – Carter Lake Consulting	Air quality
Melissa Connelly - Stratigraphic Rex	Paleontology
Brian Black	Geology
Mark Knoll – Gene R. George and Associates	Geology, ground water, cartography, document review

Table 5.2 - Third Party Interdisciplinary Team

Name of Preparers	Area of Expertise
Bonnie Percy - Gene R. George and Associates	Ground water; underground injection
Katie Wilson - BKS Environmental Associates	Wetlands and COE Wetland Report
Jacob Mulinix - BKS Environmental Associates	Soils
Dawn Gardener - BKS Environmental Associates	Vegetation and special status plant species Site Specific Reclamation Plan
Clay Wood – BKS Environmental Associates	Weed Management Plan
Ben Garrison and Stacy Goodrick – Western Archaeological Services	Cultural resources

CHAPTER 6.0 - REFERENCES, GLOSSARY AND ACRONYMS

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6.2 GLOSSARY OF TERMS

Note: The following definitions are taken from the draft Lander Resource Management Plan (BLM 2011b), in some cases the definition was shortened to describe only the environmental classifications found in the project area.

Analysis Area: Any lands, regardless of jurisdiction, for which the BLM synthesizes, analyzes, and interprets data for information that relates to planning for BLM-administered lands.

Authorized Surface-disturbing Activities: Public Land resource uses/activities that disturb the endemic vegetation, surface geologic features, and/or surface/near surface soil resources beyond ambient site conditions that are permitted by previously-approved management actions. Examples of surface-disturbing activities include: construction of well pads and roads, pits and reservoirs, pipelines and powerlines, and most types of vegetation treatments (e.g., prescribed fire, etc.).

Big Game Crucial Winter Range: Winter habitat on which a wildlife species depends for survival. Because of severe weather conditions or other limiting factors, no alternative habitat would be available.

CO₂ or Carbon Dioxide Flood: A carbon dioxide flood is an enhanced oil recovery technique that injects fluid into the reservoir. When carbon dioxide is injected, it mixes with the oil and the two compounds dissolve into one another. The injected carbon dioxide acts as a solvent to

overcome forces that trap oil in tiny rock pores and helps sweep the immobile oil left behind after the effectiveness of water injection decreases, resulting in increased oil production.

Class II Wells:

Injection wells that are:

- (1) Brought to the surface in connection with natural gas storage operations, or conventional oil or natural gas production, and may be commingled with wastewaters from gas plants, which are an integral part of production operations, unless those waters are classified as a hazardous waste at the time of injection.
- (2) For enhanced recovery of oil or natural gas.
- (3) For storage of hydrocarbons that are liquid at standard temperature and pressure.

Weed Management Plan: A plan for controlling invasive plant species that incorporates integrated weed management techniques and accounts for pertinent considerations, such as management actions and allocations affecting weeds.

Controlled Surface Use: Surface occupancy or use will be restricted or prohibited unless the operator and surface managing agency arrive at an acceptable plan for mitigation of anticipated impacts. Identified resource values require special operational constraints that may modify the lease rights. Controlled surface use is used for operating guidance, not as a substitute for the No Surface Occupancy or Timing Limitation Stipulations.

Core Area: Executive Order 2011-5, issued by the Governor of Wyoming, delineated a Core Area to protect populations of greater sage-grouse in the state. The Order also outlines restrictions on the density of future development and other human activities that limit impacts to sage-grouse populations.

Design Features: As used in the Grieve CO₂ project EA, are Standard Operating Procedures, Stipulations (including Conditions of Approval), and Operator committed activities and procedures incorporated in to the Proposed Action, and are intended to:

- (a) Avoid the impact altogether by not taking a certain action or parts of an action.
- (b) Minimize impacts by limiting the degree or magnitude of the action and its implementation.
- (c) Rectify the impact by repairing, rehabilitating, or restoring the affected environment.
- (d) Reduce or eliminate the impact over time by preservation and maintenance operations during the life of the action, or
- (e) Compensate for the impact by replacing or providing substitute resources or environments.

Disruptive Activities: Those public land resource uses/activities that are likely to alter the behavior, displace, or cause excessive stress to existing animal or human populations occurring at a specific location and/or time. In this context, disruptive activity(ies) refers to those actions that alter behavior or cause the displacement of individuals such that reproductive success is adversely affected, or an individual's physical ability to cope with environmental stress is compromised. This term does not apply to the physical disturbance of the land surface, vegetation, or features. Examples of disruptive activities may include noise, human foot or vehicle traffic, domestic livestock roundups, or other human presence regardless of the activity. When administered as a land use restriction (e.g., No Disruptive Activities), this term may

prohibit or limit the physical presence of sound above ambient levels, light beyond background levels, and/or the nearness of people and their activities. The term is commonly used in conjunction with protecting wildlife during crucial life stages (e.g., breeding, nesting, birthing, etc.), although it could apply to any resource value on the public lands. The use of this land use restriction is not intended to prohibit all activity or authorized uses.

Ecological Site: A kind of land with a specific potential natural community and specific physical site characteristics, differing from other kinds of land in that the site has the ability to produce distinctive kinds and amounts of vegetation and to respond to management. Ecological sites are defined and described with information about soil, species composition, and annual production.

Ephemeral Stream: A stream that flows only in direct response to precipitation, and whose channel is at all times above the water table. Confusion over the distinction between intermittent and ephemeral streams may be minimized by applying Meinzer's suggestion that the term "ephemeral" be arbitrarily restricted to streams that do not flow continuously for at least 30 days (Prichard et al. 1998). Ephemeral streams support riparian-wetland areas when streamside vegetation reflects the presence of permanent subsurface water.

Exceedance: An event in which measurements of ambient air quality are above the National Ambient Air Quality standard (NAAQS) or Wyoming Department of Environmental Quality (DEQ) standard set for a particular pollutant. For example, an annual average nitrogen dioxide value of 110 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) is an exceedance of both the NAAQS and Wyoming DEQ annual average standard for nitrogen dioxide of $100 \mu\text{g}/\text{m}^3$.

Exception: A one-time exemption for a particular site within an oil and gas leasehold. Exceptions are determined on a case-by-case basis and the stipulation continues to apply to all other sites within the leasehold.

Important Wildlife Habitat: Big game crucial winter range, big game parturition areas, designated critical migration corridors, sage-grouse breeding and nesting areas, raptor concentration areas, and critical fish spawning areas.

Integrated Weed Management: The use of all appropriate weed control measures, including fire, as well as mechanical, chemical, biological, and cultural techniques, in an organized and coordinated manner on a site-specific basis.

Intermittent Stream: A stream that flows only at certain times of the year when it receives water from springs or from some surface source such as melting snow in mountainous areas. Confusion over the distinction between intermittent and ephemeral streams may be minimized by applying Meinzer's suggestion that the term "intermittent" be arbitrarily restricted to streams that flow continuously for periods of at least 30 days (Prichard et al. 1998).

Mitigation Measure: As used in the Grieve CO₂ project EA, are similar to a Design Feature but are these measures or practices that are not incorporated into the proposed action or alternatives and were identified through scoping or subsequent analysis to further reduce impacts of the proposed action.

No Surface Occupancy: The term “no surface occupancy” is used in two ways. It is used in one way to define a no surface occupancy (NSO) area where no surface-disturbing activities of any nature or for any purpose would be allowed. For example, construction or the permanent or long-term placement of structures or other facilities for any purpose would be prohibited in an NSO area.

Occupied Lek: A lek that has been active during at least one strutting season within the last 10 years.

Prairie Dog “Complex”: Defined as a cluster of two or more prairie dog towns or colonies within 3 kilometers of each other (Clark and Stromberg 1987), and bounded by either natural or artificial barriers (Whicker and Detling 1988), which effectively isolate one cluster of colonies from interacting/interchanging with another. Prairie dogs may commonly move among colonies of a cluster, and thereby foster reproductive/genetic viability, but exhibit little emigration/immigration between clusters. A cluster may include some currently unoccupied, through physically suitable (i.e., vegetation, soils, topography, etc.), land immediately adjacent to occupied colonies that support other prairie dog-associated (ecosystem function), obligate or facultative species (e.g., swift fox, mountain plover, burrowing owl, etc.).

Produced Water: Groundwater removed to facilitate the extraction of minerals, such as coal, oil, or gas.

Proper Functioning Condition: The on-the-ground condition of a riparian-wetland area, referring to how well the physical processes are functioning and the state of resiliency that will allow a riparian-wetland area to hold together during a high-flow event, sustaining that system’s ability to produce values related to both physical and biological attributes.

Rangeland: Land on which the native vegetation is predominantly grasses, grass-like plants, forbs, or shrubs suitable for grazing or browsing. This includes lands revegetated naturally or artificially when routine management of that vegetation is accomplished mainly through manipulation of grazing. Rangelands include natural grasslands, savannas, shrublands, most deserts, tundra, alpine communities, coastal marshes, and wet meadows.

Rangeland Health: The degree to which the integrity of the soil and ecological processes of rangeland ecosystems are sustained.

Raptor: Bird of prey with sharp talons and a strongly curved beak, such as hawks, falcons, owls, vultures, and eagles.

Rights-of-Way: A rights-of-way (ROW) grant is an authorization to use a specific piece of public land for a specific project, such as roads, pipelines, transmission lines, and communication sites. The grant authorizes rights and privileges for a specific use of the land for a specific period of time.

Riparian Areas: Riparian areas are a form of wetland transition between permanently saturated wetlands and upland areas. These areas exhibit vegetation or physical characteristics reflective of permanent surface or subsurface water influence. Lands along, adjacent to, or contiguous with perennially and intermittently flowing rivers and streams, glacial potholes, playas, and the shores

of lakes and reservoirs with stable water levels, are typical riparian areas. Excluded are such sites as ephemeral streams or washes that do not exhibit the presence of vegetation dependent upon free water in the soil.

Seasonal Ranges: The Wyoming Game and Fish Department has identified various ranges for big game species. These ranges are defined as follows: Summer or Spring-Summer-Fall, Severe Winter Relief, Winter, Winter/Year-long, Year-long, and Parturition or birthing areas. The classification of each area is dependent on the season of use, the severity of weather/forage conditions and life phase.

Section 106 of National Historic Preservation Act: “The head of any federal agency having direct or indirect jurisdiction over a proposed federal or federally assisted undertaking in any state and the head of any federal department or independent agency having authority to license any undertaking shall, prior to the approval of the expenditure of any federal funds on the undertaking or prior to the issuance of any license, as the case may be, take into account the effect of the undertaking on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register of Historic Places. The head of any such federal agency shall afford the Advisory Council on Historic Preservation established under Title II of this Act a reasonable opportunity to comment with regard to such undertaking” (16 United States Code 47 df).

Sensitive Sites or Resources: Sensitive sites or resources refer to significant cultural resources that are, or may be eligible, for nomination to the National Register of Historic Places.

Sensitive Species: Species designated as sensitive by the BLM State Director include species that are under status review, have small or declining populations, live in unique habitats, or require special management. BLM Manual 6840 provides policy and guidance for special status species management. The BLM Wyoming Sensitive Species Policy and List are provided in a memorandum updated annually. Primary goals of the BLM Wyoming policy include maintaining vulnerable species and habitat components in functional BLM ecosystems and preventing a need for species listing under the Endangered Species Act.

Special Status Species: Special status species are species proposed for listing, officially listed as threatened or endangered, or are candidates for listing as threatened or endangered under the provisions of the Endangered Species Act; those listed by a state in a category such as threatened or endangered, implying potential endangerment or extinction; and those designated by the State Director as sensitive (BLM 2008e).

Split-estate: Surface land and mineral estate of a given area under different ownerships. Frequently, the surface will be privately owned and the minerals federally owned.

Standards for Healthy Rangelands: A description of the physical and biological conditions or degree of function required for healthy, sustainable lands (e.g., land health standards).

Surface-disturbing Activities (or Surface Disturbance): The physical disturbance and movement or removal of land surface and vegetation. These activities range from the very minimal to the maximum types of surface disturbance associated with such things as OHV travel or use of mechanized, rubber-tired, or tracked equipment and vehicles; some timber cutting and

forest silvicultural practices; excavation and development activities associated with use of heavy equipment for road, pipeline, powerline and other types of construction; blasting; strip, pit, and underground mining and related activities, including ancillary facility construction; oil and gas well drilling and field construction or development and related activities; range improvement project construction; and recreation site construction.

Surface Water Classes and Uses: The following water classes are a hierarchical categorization of waters according to existing and designated uses.

Class 3, Aquatic Life Other than Fish. Class 3 waters are waters other than those designated as Class 1 that are intermittent, ephemeral, or isolated waters, and because of natural habitat conditions, do not support nor have the potential to support fish populations or spawning or certain perennial waters that lack the natural water quality to support fish (e.g., geothermal areas). Class 3 waters provide support for invertebrates, amphibians, or other flora and fauna that inhabit waters of the state at some stage of their life-cycles. Uses designated on Class 3 waters include aquatic life other than fish, recreation, wildlife, industry, agriculture, and scenic value. Generally, waters suitable for this classification have wetland characteristics; and such characteristics will be a primary indicator used in identifying Class 3 waters. There are four subcategories of Class 3 waters.

Visual Resource Management Classes: *Class IV.* The objective of this class is to provide for management activities that require major modification of the existing character of the landscape. Contrasts may attract attention and be a dominant feature of the landscape in terms of scale; however, changes should repeat the basic elements (form, line, color, and texture) inherent in the characteristic landscape.

Visual Resources: The visible physical features of a landscape (topography, water, vegetation, animals, structures, and other features) that constitute the scenery of an area.

Waiver: A permanent exemption of a stipulation.

Wetlands: Wetlands are areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and which, under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. BLM Manual 1737, Riparian-Wetland Area Management, includes marshes, shallow swamps, lakeshores, bogs, muskegs, wet meadows, estuaries, and riparian areas as wetlands.

Wildfire: An unplanned ignition of a wildland fire (such as a fire caused by lightning, volcanoes, unauthorized and accidental human-caused fires) and escaped prescribed fires.

Wildlife-disturbing Activity: BLM-authorized activities other than routine maintenance that may cause displacement of or excessive stress to wildlife during critical life stages. Wildlife-disturbing activities include human presence, noise, and activities using motorized vehicles or equipment.

6.3 LIST OF ACRONYMS USED IN THIS DOCUMENT

AADT	Annual average daily traffic
ACOE	U.S. Army Corps of Engineers
AIS	Aquatic Invasive Species
amsl	Above mean sea level
ALS	Artificial Lift Systems
APD	Application for Permit to Drill
AO	Authorized Officer
AQD	Air Quality Division
AQRV	Air Quality Related Values
AUM	Animal Unit Month
BA	Biological Assessment
BACT	Best Available Control Technology
BBL	Barrels(s)
BBS	Breeding Bird Survey
BCF	Billion Cubic Feet
BEA	U.S. Bureau of Economic Analysis
BGEPA	Bald and Golden Eagle Protection Act
Bgs	Below Ground Surface
BKS	BKS Environmental Consultants
BLM	Bureau of Land Management
BMP	Best Management Practices
BWPD	Barrels of Water per Day
CASTNET	Clean Air Status and Trends Network
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CEQ	Council on Environmental Quality
CFR.	Code of Federal Regulations
CIAA	Cumulative Impact Assessment Area
COA	Conditions of Approval
CO ₂	Carbon Dioxide
CO ₂ e	CO ₂ Equivalent
CO	Carbon monoxide
CR	Country Roads
CREG	Consensus Revenue Estimating Group
CSU	Controlled Surface Use
CWA	Clean Water Act
DATs	Deposition Analysis Thresholds
dBA	Decibels
DDCT	Density Disturbance Calculation Tool
DOT	United States Department of Transportation
DR	Decision Record
dv	Deciview
EA	Environmental Assessment

EIS	Environmental Impact Study
EO	Executive Order
EOR	Enhanced Oil Recovery
EP	Elk Petroleum Incorporated
EPA	Environmental Protection Agency
ERMA	Extensive Recreation Management Area
ESA	Endangered Species Act
ESD	Ecological Site Descriptions
°F	Degrees Fahrenheit
FLAG	Federal Land Managers' Air Quality Related Values Workgroup
FLM	Federal Land Managers
FLPMA	Federal Land Policy Management Act
FONSI	Finding Of No Significant Impact
FPA	Federal Power Act
FWS	United States Fish and Wildlife Service
GHG	Green House Gas
GHMU	Gas Hills Management Unit
GIS	Geographic Information System
GLO	General Land Office
GPS	Global Positioning System
GU	Grieve Unit
GUCO ₂ PA	Grieve Unit CO ₂ Project Area
GUPA	Grieve Unit Project Area
HMA	Her Management Area
H ₂ S	Hydrogen Sulfide
IM	Instruction Memorandum
IMPROVE	Interagency Monitoring of Protected Visual Environments
IDT	Interdisciplinary Team
kV	kilovolt
LFO	Lander Field Office
LN	Lease Notice
LOC	Levels of concern
LOP	Life of Project
LRMP	Lander Resource Management Plan
LRP	Limited Reclamation Potential
LT	Long Term
LUP	Land Use Plan
MBTA	Migratory Bird Treaty Act
mg/L	Milligrams per Liter
MLA	Mineral Leasing Act
MLRA	Major Land Resource Area
mph	miles per hour
MSUPO	Multipoint Surface Use Plan of Operations
N	Total Nitrogen
N ₂ O	Nitrous Oxide
Na ₂ SO ₄	Sodium Sulfate

NAAQS	National Ambient Air Quality Standard
NADP	National Acid Deposition Program
NCR 201	Natrona County Road 201 (Poison Spider Road)
NCR 320	Natrona County Road 320 (Forest Oil Road)
NEPA	National Environmental Policy Act
NH ₄	Ammonium
NO ₂	Nitrogen dioxide
NO ₃	Nitrate
HNO ₃	Nitric acid
NO _x	Nitrogen oxide
NRCS	Natural Resource Conservation Service
NRHP	National Register of Historic Places
ns	No Standard
NSO	No Surface Occupancy
NTN	National Trends Network
NWI	National Wetland Inventory
NWP	Nation Wide Permits
O ₃	Ozone
OPS	U.S. Office of Pipeline Safety
OSHA	Occupational Safety and Health Administration
PCN	Pre-Construction Notification
PFC	Proper Functioning Condition
PFYC	Potential Fossil Yield Classification
PM ₁₀	Particulate Matter <10 microns in diameter
PM _{2.5}	Particulate Matter <2.5 microns in diameter
POD	Plan of Development
PSD	Prevention of Significant Deterioration
RCRA	Resource Conservation and Recovery Act
RMP	Resource Management Plan
ROD	Record Of Decision
ROW	Right Of Way
S	Total sulfur
SHPO	State Historic Preservation Office
SO ₂	Sulfur dioxide
SO ₄	Sulfate
SPCC	Spill Prevention and Control Countermeasure
SVR	Standard visual range
SPCC	Spill Prevention Countermeasure and Control
SWPPP	Storm Water Pollution Protection Plan
T&E	Threatened or Endangered
TDS	Total Dissolved Solids
TEPC	Threatened, Endangered, Proposed and Candidate
THPO	Tribal Historic Preservation Office
TL	Timing Limitations
TNW	Traditional Navigable Water
TPQ	Threshold Planning Quantity

ug/m ³	microgram per cubic meter
UIC	Underground Injection Control
USACE	U.S. Army Corps of Engineers
USCB	United States Census Bureau
USDOT	U.S. Department of Transportation
USDW	Underground Sources of Drinking Water
VOC	Volatile Organic Compounds
VRI	Visual Resource Inventory
VRM	Visual Resource Management
WAAQS	Wyoming Ambient Air Quality Systems
WAQSR	Wyoming Air Quality Standards and Regulations
WAS	Western Archaeological Service
WDEQ	Wyoming Department of Environmental Quality
WDEQ-AQD	Wyoming Department of Environmental Quality Air Quality Division
WDEQ-LQD	Wyoming Department of Environmental Quality Land Quality Division
WDEQ-WQD	Wyoming Department of Environmental Quality Water Quality Division
WDWS	Wyoming Department of Workforce Services
WGFD	Wyoming Game and Fish Department's
WOGCC	Wyoming Oil and Gas Conservation Commission
WOSHA	Workers Occupational Health and Safety Administration
WSEO	Wyoming State Engineers Office
WTPD	White tailed prairie dog
WYNDD	Wyoming Natural Diversity Data Base