United States
Department of
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Forest
Service

Environmental Assessment

Lance Oil & Gas Company
Thunderhead Project

Douglas Ranger District, Medicine Bow-Routt National Forests and Thunder Basin National Grassland, Campbell County, Wyoming

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INTRODUCTION

1.1 SUMMARY

This Environmental Assessment (EA) discusses the purpose, need, and potential short and long-term environmental impacts of the Thunderhead Coalbed Natural Gas (CBNG) Project. Lance Oil and Gas Company, Inc. (Lance) proposes drilling and operating 32 CBNG wells and associated facilities on federal gas leases on federal lands administered by the United States Forest Service (USFS) as part of the Thunder Basin National Grassland (TBNG), Douglas Ranger District. The BLM would administer the federally owned minerals.

Lance holds valid federal oil and gas leases on a portion of the TBNG located in the Powder River Basin of Wyoming (Figure 1.2-1). These leases created contractual and property rights between Lance and the government of the United States to develop oil and natural gas resources. Lance proposes to extract and transport CBNG from its federal leases in the USFS TBNG, an administrative unit of the Medicine Bow/Routt National Forest. Federal mineral ownership within the Project Area is administered by the U.S. Department of the Interior Bureau of Land Management (BLM).

The proposed project is located approximately three miles southeast of Wright, Wyoming, and approximately 40 miles south of Gillette, Wyoming, in southern Campbell County within the Little Thunder Creek watershed in the Powder River Basin. The project boundaries include approximately 2,829 acres located on portions of noncontiguous TBNG lands and portions of the private lands that lie between them. All of the proposed wells are located on USFS lands within the TBNG; however, the project would require the construction of some new associated facilities on non-USFS lands. Affected TBNG lands are located in T43N/R71W, including:

- All of Section 8 except the NENE quarter, and the SWSW quarter of Section 9;
- The east half of Section 10, the west half of Section 11, the west half of the east half of Section 14; and
- The south half of Section 18, all of Section 20 except the NWNW quarter, and the northwest quarter and west half of the southwest quarter of Section 21.

In addition, the project includes minimal adjacent private lands where linear features, such as roads, connect project wells to existing shared gas and water collection facilities. The existing facilities are located on privately owned surface in NENW Section 14; NESW Section 10; NWNW Section 13; SENE Section 9; SWNW Section 18; SWNE Section 21, all in T43N/R71W; and NESE Section 13 in T43N/R72W.

Private, state, and TBNG lands would provide access to the proposed wells. The proposed wells would be located immediately adjacent to property owned by the Thunder Basin Coal Company to the east, the State of Wyoming, and local ranchers. Leakage of CBNG through active mine

highwalls and drainage of federal gas by adjacent non-federal wells represents a loss of revenue to the United States. Development of the Proposed Action would capture these revenues and would contribute to the maintenance of an available natural gas supply for the national market.

Lance has submitted 32 Applications for Permits to Drill (APDs) to the BLM, Buffalo Area Field Office, which has forwarded the APDs to the Douglas Ranger District for review and approval of a surface use plan of operations (SUPO). The locations of the wells comprise three separate areas known as Thunderhead 1, 2, and 3. The wells would produce CBNG from the Wyodak-Anderson coal seam and would be drilled on 80-acre spacing to a depth of less than 1,000 feet. The productive life of the wells is expected to be approximately 10 years.

The associated facilities required by the proposed project would include new roads, gas and water pipelines, electrical utility (power) lines, buildings that house the central gathering points for gas and produced water, produced water discharge points, stock tanks, and culverts. Project development would require the use of similar existing facilities, located near the proposed wells. Project development would result in the use of roads previously constructed and currently in use in addition to the new roads required for access to the proposed wells.

This EA includes a detailed description of the Proposed Action and two alternatives to the Proposed Action, including the No Action alternative. The No Action alternative, Alternative A, assumes that development of the proposed 32 CBNG wells is precluded. The Proposed Action, Alternative B, considers the development of 32 CBNG wells within the TBNG. Alternative C, the modified development scenario, considers the development of 28 CBNG wells within the TBNG.

Although Thunderhead 1, 2, and 3 each has its own Plan of Development (POD), this EA analyzes the effects of developing all three areas. Impacts from the proposed project would principally involve surface disturbances from construction or improvement of roads, construction of well sites, installation of pipelines, installation of buried and overhead utilities, and construction of associated production facilities.

Issues identified during scoping include the effects to wildlife, including sage grouse, and the effects of discharging produced water to surface drainages. Discharge of produced water into local ephemeral drainages would increase downstream water volumes and effect water quality. Produced water would also be beneficially used for wildlife and stock watering.

Direct, indirect and cumulative effects were addressed for each resource area potentially affected by the project. Effects of implementing this project are summarized in the following discussion. Surface disturbance will result from construction of well sites, collection facilities, roads, and pipelines. These activities are expected to effect about 2 percent of the Project Area in the short term and about 0.2 percent in the long term.

Figure 1.2-1 General Location Map

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Some species of wildlife may be disturbed by implementation of the project. Effects include additional noise, activity, human presence, habitat loss, and an increased risk of mortality. Effects are expected to be greatest during the construction phase of the project. Long term effects are expected to be much less disruptive. Alternative C was designed to protect high value wildlife sites. Both Alternative B and C could add to cumulative effects occurring in the Powder River Basin.

Water to be discharged to surface drainages is of good quality and is not expected to adversely affected water quality in downstream channels or soil properties on adjacent lands. Additional amounts of discharged water would be used to water livestock and wildlife. Flow augmentation is not expected to reach more than 13 miles downstream where Little Thunder Creek is still ephemeral. Additional flows are not expected to have adverse impacts on downstream channels, reservoirs, or water rights. Ground water depletions are not expected but water well agreements will be offered to nearby well owners in case such an event does occur.

All effects are expected to be within the range of effects analyzed in the Final Environmental Impact Statement and Proposed Plan Amendment for the Powder River Basin Oil and Gas Project (PRB O&G FEIS, BLM, 2003).

1.2 DOCUMENT STRUCTURE

The document is organized as follows:

Introduction (Chapter 1): Chapter 1 provides a short description of the project background, the purpose of and need for the project, a summary of the Proposed Action, and a description of the framework under which this document will be evaluated. The decision framework includes a description of the relationship among the decision-making agencies, a summary of laws and regulations that apply to mineral development, a description of the Proposed Action's conformance with U.S. Department of Agriculture Forest Service (USFS) management directives, and the types of decisions to be made by the federal agencies with respect to this EA and the Proposed Action. This section also details how the USFS informed the public of the proposal and how the public responded.

Alternatives, including the Proposed Action (Chapter 2): Chapter 2 provides a detailed description of the Proposed Action and alternatives to the Proposed Action. Environmental mitigation measures are discussed as they would apply to the Proposed Action. The chapter includes a comparison of the evaluated alternatives. Other alternatives that were considered but not included in this EA are also discussed.

Affected Environment and Environmental Effects (Chapter 3): Chapter 3 describes the environmental resources that characterize the Project Area and the effects of implementing the Proposed Action and other alternatives. The analyses are organized by resource area. Within each resource area section, the affected environment is described, followed by the effects and cumulative effects of implementing each alternative.

Consultation and Coordination (Chapter 4): Chapter 4 provides a list of preparers and agencies consulted during the development of this EA.

References (Chapter 5): Chapter 5 includes a complete list of the documents and communications used to develop this EA.

Appendices: The appendices provide detailed information used to support the analyses developed in the EA.

1.3 BACKGROUND

In 1999, Barrett Resources Corporation (Barrett) proposed development in the Project Area to the BLM under several different drilling scenarios. Changes to its proposal were subsequently driven by changing BLM concepts of efficient POD size, mineral drainage position, and potential effects of combining USFS lands with other lands under the same POD. On March 8, 2001, the PODs, which included 48 wells, were proposed to the BLM and USFS as Thunderhead 1 (7 wells), Thunderhead 2 (17 wells), and Thunderhead 3 (24 wells). In May 2001, Barrett was purchased by Williams Production RMT Company (Williams), and the wells were transferred to Williams. Prior to October 2002, some of the proposed wells became the property of Westport Resources Corporation. At that time, the total well count dropped to the current proposed number of 32 wells. On November 1, 2003, properties that included the proposed Thunderhead PODs became the property of Lance.

Although some CBNG drilling in the Powder River Basin was initiated in the late 1980s, it was in the late 1990s that the potential of the Fort Union CBNG play was recognized. CBNG development continued uninterrupted on private and state lands, with more than 10,000 CBNG wells producing in Wyoming at the end of 2002. Most of these wells were located in the Powder River Basin (WOGCC, 2003). The Powder River Basin is currently the most active area of CBNG drilling in the United States. Several successive environmental documents were completed under the auspices of the National Environmental Policy Act (NEPA) that addressed CBNG development in the Powder River Basin on federal lands. The most recent analysis of CBNG development, the PRB O&G FEIS, authorized the development of 39,400 additional CBNG wells on federal lands. The CBNG wells proposed by Lance to be drilled were analyzed in the PRB O&G FEIS. That analysis (BLM, 2003) is incorporated by reference.

1.4 PURPOSE AND NEED

The purpose of this EA is to authorize the BLM to permit drilling under an appropriate SUPO and Conditions of Approval (COAs).

Implementation of the Proposed Action would:

- Contribute to available natural gas supply for the national market;
- Prevent drainage of the federally owned gas resource to adjacent, nonfederal wells; and
- Allow Lance to develop natural gas (methane) from coalbeds pursuant to Lance's rights under existing oil and gas leases granted by the BLM.

Natural gas is an integral part of the U.S. energy future due to its ready availability from domestic sources, the presence of an existing market delivery infrastructure, and the environmental advantages associated with this clean-burning fuel. Developing the domestic reserves of natural gas helps to reduce national dependence on potentially unstable foreign suppliers and ensures an adequate, stable supply. Production of domestic natural gas has helped to ensure that the U.S. will maintain its economic well-being and promotes national security. The environmental advantages of natural gas combustion versus other conventional fuels are emphasized in the 1990 Clean Air Act amendments (42 United States Code [USC] 7671 *et seq*.).

The increasing fraction of natural gas production represented by CBNG is an important part of national efforts to maintain a stable domestic supply. In 1999, CBNG represented approximately 6.7 percent of total U.S. dry gas production. As of the end of 2002, national CBNG production reached nearly 4 billion cubic feet (bcf) daily. Powder River Basin wells supplied approximately 20 percent of the total CBNG production and approximately 7.4 percent of the total national dry gas production. At present, CBNG development in the Powder River Basin is the most active onshore oil and gas development within the continental U.S. and is making an increasingly important contribution to its energy security. CBNG development constituted 57 percent of U.S. natural gas production growth during the 1990s (Energy Information Administration, 2003).

Development of Project Area CBNG wells would prevent drainage of federal gas from loss to nearby non-federal wells. Loss of natural gas to adjacent developed leases represents a loss of revenue as well as the energy resource to the U.S. In addition, producing CBNG through wellbores on offset leases often results in small amounts of residual gas left in the coal seam. The remaining gas may not be economical or practical to recover, thus resulting in a net loss of the mineral resource. The proposed wells lie within areas where the BLM estimates drainage has occurred but where an estimated 40 to 70 percent of the CBNG remains (Stenger, 2001).

Finally, national mineral leasing policies recognize the statutory rights of lessees to develop federal mineral resources to meet continuing national needs and economic demands so long as undue and unnecessary environmental degradation is avoided. The Record of Decision (ROD) for the most recent TBNG resource management document, the *Final Environmental Impact Statement and Land and Resource Management Plan Revision - Thunder Basin National Grassland* (TBNG LRMP, USFS, 2002), states (page 43) that existing lease rights will be honored.

Development and production of non-federally owned gas in the vicinity of the Project Area would almost certainly continue regardless of Project Area development.

1.5 DECISION FRAMEWORK

1.5.1 Relationships Between Agencies

The Federal Onshore Oil and Gas Leasing and Reform Act (FOOGLRA) of 1988 authorizes the USFS to consent to SUPOs. As the surface management agency for the lands that would be affected by the implementation of the Proposed Action, the USFS Douglas Ranger District Office in Douglas, Wyoming, is the lead agency for this EA.

According to the terms of the 1920 Mineral Leasing Act, the BLM is the agency authorized to manage federal mineral interests on federal or split estate lands. The wells planned under the Proposed Action would be drilled into federal minerals and, therefore, the BLM is a cooperating agency in this process. The Buffalo Field Office of the BLM in Buffalo, Wyoming, manages federal mineral interests in the Project Area. The BLM is responsible for permitting, inspection, and enforcement programs related to oil and gas production in the Project Area. Its responsibilities include processing APDs; conducting pre-drill inspections of the proposed drill sites; assessing the status of cultural and threatened or endangered species clearances; conducting compliance inspections and enforcement actions for lease terms and conditions, safety, production verification, and site maintenance; and well abandonment inspections.

For mineral licenses, permits, and leases, the USFS cooperates with the BLM to ensure that its management goals and objectives are achieved, that impacts upon the surface are mitigated to the maximum degree possible, and that the land affected is rehabilitated. The USFS responds to BLM proposals to issue mineral leases and permits after reviewing the TBNG land management plan. Under FOOGLRA, the USFS has statutory responsibility for consenting to leasing decisions and makes recommendations to the BLM to protect surface resources and to prevent conflicts with other plans, activities, and programs of the TBNG.

A number of other federal, state, and local governmental agencies have authority over various aspects of oil and gas development in the Project Area. A list of possible regulatory authorities for the Proposed Action can be found in Section 1.5.2, *Applicable Laws Relating to Minerals Development*. All relevant agencies and the public have been invited to participate in this environmental analysis process.

1.5.2 Applicable Laws Relating To Minerals Development

The development of oil and gas resources on federal lands is managed by numerous laws and regulations affecting the recovery of resources as well as management of the surface. Among the more important regulations relating to minerals development are:

- *Mineral Leasing Act (1920) (30 USC 181-263, as amended)* – Authorizing the Secretary of the Interior to issue leases for the disposal of certain minerals (currently coal, phosphate, sodium, potassium, oil, oil shale, gilsonite, and gas), including leases beneath National Forest surface.

- *Mineral Leasing Act for Acquired Lands (1947)(30 USC 351-359 as amended)* - Stating that all deposits of coal, phosphate, oil, oil shale, gas, sodium, potassium, and sulfur that are owned or may be acquired by the United States shall be leased by the Secretary of the Interior under the same provisions as contained in the mineral leasing laws.

- *Mining and Minerals Policy Act (1970) (30 USC 21)* - Emphasizing the need for the ongoing development of stable domestic mining and minerals industries.

- *National Materials and Minerals Policy Research and Development Act of 1980 (30 USC 1601 et seq.)* - Directing the Secretary of Agriculture, regardless of current management plan status, to process applications for leases and permits to explore, drill, and develop resources on National Forest System (NFS) lands in a timely manner.

- *Federal Onshore Oil and Gas Leasing Reform Act (1987) (30 USC 195, 226-3)* - Granting the Secretary of Agriculture expanded authority over oil and gas leasing decisions on USFS lands and requiring USFS approval of BLM issued leases and approval of surface disturbance.

The following applicable BLM regulations, orders, notices, standard conditions of approval, and general requirements constitute the range of standard procedures and environmental protection measures that are applied to individual operators and projects and are authorized by 43 CFR 3160.

Onshore Oil and Gas Orders:

- Onshore Order No.1 - Approval of Operations
- Onshore Order No. 2 - Drilling Operations
- Onshore Order No. 3 - Site Security
- Onshore Order No. 4 - Measurement of Oil
- Onshore Order No. 5 - Measurement of Gas
- Onshore Order No. 6 - Hydrogen Sulfide Operations
- Onshore Order No. 7 - Disposal of Produced Water
- Onshore Order No. 8 - Well Completions/Workovers/Abandonment (Proposed Rule)
- Onshore Order No. 9 - Waste Prevention and Beneficial Use of Oil and Gas (Not Published)
- Notices to Lessees
- BLM Conditions of Approval for Coalbed Methane Completions
- BLM General Requirements for Oil and Gas Operations on Federal and Indian Lands.

The State of Wyoming would play a significant role in the regulatory oversight of the Proposed Action. The Wyoming Department of Environmental Quality (WDEQ) exercises jurisdiction over issues relating to air and water quality. In 1972, the Clean Water Act (CWA) was enacted, requiring that any discharge of potential pollutants from a point source to surface waters of the United States be regulated through issuance of a National Pollutant Discharge Elimination System (NPDES) permit. The NPDES permit process would apply to the surface discharge of CBNG-produced water. The state would also administer Section 402(p) of the CWA requiring permits for the discharges of storm water associated industrial activity. The office of the Wyoming State Engineer (WSEO) would be responsible for regulating the appropriation of water when a coal seam is de-watered. The WDEQ also administers the Clean Air Act (CAA), which regulates emissions of air pollutants. The Wyoming State Historic Preservation Office (SHPO) would supervise the management and disposition of cultural resource properties on state lands.

A general listing of agencies that could be involved in the Proposed Action and their respective regulatory authorities is shown in Table 1.5-1. Not all of these agencies would have authority over the Proposed Action. The regulations listed in Table 1.5-1 include those that include protection of surface resources.

Table 1.5-1 Federal, State, and County Permits, Approvals, and Authorizing Actions

Agency	Permit, Approval or Action	Authority
U.S. Forest Service (USFS)	Approval of Plan of Development for surface use of well pad	Forest Service Manual (FSM) 1950
	Cooperation with BLM's APD approval process on USFS administered land	FSM 1500
	Special Use Permit for access road right-of-way (ROW), road decommissioning, and pipeline	Forest Service Handbook (FSH) 1509.11
	Special Use Permit to utility company for installation and operation of powerline	Federal Register Notice 5-22-95
	Antiquities and cultural resource permits on USFS-administered 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. Sections 470aa-470ll); Preservation of American Antiquities, as amended (43 C.F.R. 3)
Bureau of Land Management (BLM)	Permit to drill, deepen, or plug back on BLM-managed land or minerals (APD process)	*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)

Agency	Permit, Approval or Action	Authority
	Authorization for flaring and venting of natural gas on BLM-managed land or minerals	*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 or minerals	*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)
U.S. Army Corps of Engineers (COE)	Section 404 permits and coordination regarding placement of dredged or fill material in area waters and adjacent wetlands	Section 404 of the *Clean Water Act of 1972*, as amended (33 U.S.C. 1344); EPA-administered Permit Programs: The National Pollutant Discharge Elimination System (NPDES), as amended (40 C.F.R. 122); state program requirements (40 C.F.R. 123); Section 404(b)(1) Guidelines for Specific Disposal Sites for Dredged or Filled Material, as amended (40 C.F.R. 230)
U.S. Fish and Wildlife Service (USFWS)	Coordination, consultation and impact review on federally listed threatened and endangered 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)
U.S. Department of Transportation (DOT)	Control pipeline maintenance and operation	Transportation of natural and Other Gas by Pipeline, Annual Reports, Incident Reports, and Safety Related Condition Reports, as amended (49 C.F.R. 191); Transportation of Natural and Other Gases by Pipeline: Minimum Safety Standards, as amended (49 C.F.R. 192)
Wyoming Department of Environmental Quality - Water Quality Division (WDEQ-WQD)	Permits to construct settling ponds and waste water systems, including ground water injection and disposal wells	*Wyoming Environmental Quality Act*, Article 3, Water Quality, as amended (W.S. 35-11-301 through 35-11-311)
	Regulate disposal of drilling fluids from abandoned reserve pits	*Wyoming Environmental Quality Act*, Article 3, Water Quality, as amended (W.S. 35-11-301 through 35-11-311)
	NPDES permits for discharging produced 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

Agency	Permit, Approval or Action	Authority
		U.S.C. 1345); EPA-administered Permit Programs: NPDES, as amended (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)
Wyoming Department of Environmental Quality - Air Quality Division (WDEQ-AQD)	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 Department of Environmental Quality - Land Quality Division (WDEQ-LQD)	Mine permits, impoundments, and drill hole plugging on state lands	*Wyoming Environmental Quality Act*, Article 4, Land Quality, as amended (W.S. 35-11-401 through 35-11-437)
Wyoming Department of Environmental Quality - Solid Waste Division (WDEQ-SWD)	Construction fill permits and industrial waste facility permits for solid waste disposal during construction and operations	*Wyoming Environmental Quality Act*, Article 5, Solid Waste Management, as amended (W.S. 35-11-501 through 35-11-520)
Wyoming Department of Transportation (WDOT)	Permits for oversize, overlength, and overweight loads	Chapters 17 and 20 of the Wyoming Highway Department Rules and Regulations
	Access permits to state highways	Chapter 13 of the Wyoming Highway Department Rules and Regulations
Wyoming Oil and Gas Conservation Commission (WOGCC)/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 developments on state lands	Public Utilities, W.S. 37-1-101 et seq.
WOGCC	Permit to drill, deepen, or plug back (APD process)	WOGCC Regulations, Chapter 3, Operational and Drilling Rules, Section 2 Location of Wells
	Permit to use earthen pit (reserve pits)	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

Agency	Permit, Approval or Action	Authority
	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 Tests, Core, or Other Exploratory Holes (Form 4)
	Change in depletion plans	*Wyoming Oil and Gas Act*, as amended (Form W.S. 30-5-110)
Wyoming State Engineer's Office (WSEO)	Permits to appropriate ground water (use, storage, wells, dewatering)	W.S. 41-3-901 through 41-3-938, as amended (Form U.W. 5)
	Permits to construct dams and reservoirs	W.S. 41-3-301 et seq., as amended (Forms SW3, SW4)
Wyoming State Historic 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 seq.) and Advisory Council Regulations on the Protection of Historic and Cultural Properties, as amended (36 C.F.R. 800)
Campbell County	Construction/use permits	County Code and Zoning Resolution
	Conditional use permits	County Code and Zoning Resolution
	Road use agreements/oversize trip permits	County Code
	County road crossing/access permits	County Code/Engineering Department
	Small wastewater permits	County Health Department
	Hazardous material recordation and storage	County Code
	Zone changes	Zoning Resolution
	Filing Fees	County Code
	Noxious weed control	County Code

1.5.3 Management Plan Conformance

The USFS contributes to the nation's demand for minerals by encouraging responsible mineral development. The USFS and BLM administer the mineral laws and regulations to minimize surface resource impacts while supporting sound energy and minerals exploration and development. Programmatic environmental concerns are addressed during USFS and BLM land and resource management planning processes. The objective of a land and resource management plan is to guide all natural resource management activities and establish management standards and guidelines. Decisions on this EA will be made in the context of relevant programmatic NEPA actions, as described in this section.

Resource management in the TBNG was updated with the 2002 issuance of the ROD for the 2002 FEIS for the Northern Great Plains Management Plans Revision (USFS, 2001b) and the and TBNG LRMP (USFS, 2002). This EA tiers to these two documents.

The *Northern Great Plains Management Plans Revision* was developed to be an ecosystem approach to revising grassland management plans in Wyoming, North Dakota, and South Dakota. Although the analysis contained in this FEIS incorporated the similarities among each planning area, each planning unit used the analysis and participated in developing a management plan specific to that unit. One resulting document was the TBNG LRMP.

The TBNG LRMP describes, in general terms, the desired condition of the Grassland and allocates land into Management Areas. Management Areas are defined by the resources that could be optimally administered to achieve a particular emphasis or theme. Each Management Area is characterized by a prescription that facilitates the achievement of the desired conditions consistent with the theme. Resource goals, objectives, standards, and guidelines provide land managers a set of parameters that guide implementation of projects on the surface. The mix of Management Area prescriptions in the TBNG LRMP provides for continued coal, oil and gas development, livestock grazing, and other uses.

The Proposed Action is consistent with Management Area Prescriptions as outlined in the TBNG LRMP. The Project Area is entirely contained within what the TBNG LRMP terms the Hilight Bill Geographic Area (100,780 acres). Dominant Management Area Prescription allocations for this area are Category 6.1, *Rangeland with Broad Resource Emphasis* (51,440 acres) and Category 8.4, *Mineral Production and Development* (47,993 acres). Activities in the Hilight Bill area include recreational big game hunting and the extraction of coal, uranium, oil, and gas. Areas classified as Category 6.1 "display low to high levels of livestock grazing developments (such as fences and water developments), oil and gas facilities, and roads (USFS, 2001, page 3-25)." Areas classified as Category 8.4 emphasize "mineral operations of all types" "to effectively remove available commercial mineral resources, concurrent with other ongoing resource uses and activities (USFS 2001, page 3-26)."

Oil and gas extraction in the TBNG is also guided by the decisions made in applicable BLM NEPA documents. The BLM operates in accordance with the Federal Land Policy and Management Act of 1976 (FLPMA), which mandates that the BLM consider multiple uses for the lands it administers. FLPMA specifies that the BLM considers the land's inherent natural

resources as well as its mineral resources when making land management decisions. The BLM's responsibility extends to environmental protection, public health, and safety associated with oil and gas operations on public lands. Pursuant to FLPMA, the BLM has the authority to protect the environmental resources associated with federal oil and gas leases; therefore, environmental protections may be imposed as lease conditions. Mineral leasing decisions made by the BLM result in a contractual commitment from the United States to allow for development by Lance in accordance with stipulations and restrictions incorporated within the leases.

In accordance with the FOOGLRA of 1987 and its implementing regulations, leasing and specific lands decisions were made in the 1990s on all the high and moderate oil and gas potential lands in the TBNG. On April 22, 1994, the ROD for the *Oil and Gas Leasing on the Thunder Basin National Grassland FEIS* was issued. This document authorized the BLM to lease federal oil and gas resources in the TBNG subject to certain stipulations described in the ROD and pertinent to the surface use of USFS lands.

Development of CBNG from federal, state, and private leases within the Powder River Basin has been occurring for a number of years. In November 1999, the BLM issued its ROD on the *Final EIS for the Wyodak Coal Bed Methane Project*. The Wyodak Project Area encompasses the TBNG and the Project Area. This EIS authorized the development and production of CBNG on federal lands within the Wyodak Project Area. The total level of development authorized in the ROD was 5,000 new productive CBNG wells (Pierson, 1999).

By August 2000, the number of new productive CBNG wells reached the level of development authorized in the ROD for the Wyodak Coal Bed Methane Project, and the BLM discontinued the approval of new federal permits to drill CBNG wells (Stenger, 2000). However, interest in and demand for CBNG in the Powder River Basin continued to increase, and oil and gas companies continued to develop new CBNG wells on state and private leases. The BLM and the USFS determined this development was draining CBNG from federal leases. The BLM subsequently conducted a drainage analysis in the *Wyodak Drainage Coal Bed Methane Environmental Assessment* (Wyodak Drainage EA). The decision for this EA, released on March 26, 2001, authorized the development of 2,500 additional CBNG wells on federal leases within the Wyodak Project Area (Stenger, 2001). Permitting of CBNG wells located on federal surface or minerals continued under terms of the Wyodak Drainage EA until February 28, 2003, at which time all wells authorized had been allocated.

To analyze the effects of CBNG development in the Powder River Basin, the BLM and USFS completed another NEPA evaluation assessing continued development of CBNG from federal leases in that area. The PRB O&G FEIS was released on January 17, 2003. A ROD for this EIS was issued April 30, 2003. The PRB O&G FEIS is the current programmatic NEPA document that addresses CBNG development within the Powder River Basin, including the TBNG and the Project Area.

1.5.4 Decisions To Be Made

Federal jurisdiction of the project is divided between the USFS and the BLM. Decisions for this EA will be separately issued by each agency. The decision makers will determine:

- Whether the analysis contained within this document is adequate for the purposes of reaching informed decisions regarding Project development;
- Whether the Proposed Action involves the potential for significant impacts;
- Whether the Proposed Action is in conformance with applicable land and resource management plans and programmatic plans developed under NEPA; and
- What Conditions of Approval (COAs) may be attached to project authorization.

The USFS District Ranger will decide whether to approve the SUPO as described in the Proposed Action or select a different alternative. The decision on this EA will pertain to those areas in the Proposed Action where there are federal minerals, federal surface, or both. Although private lands may be included in the analyses to the extent that they are included within the Proposed Action, they are not bound by the decision that results from these analyses.

If the result of this EA is a Finding of No Significant Impact (FONSI), development as described in the Proposed Action will be allowed to proceed, possibly with additional activities, mitigating measures and monitoring requirements, consistent with lease stipulations.

1.6 PUBLIC INVOLVEMENT

A Scoping Statement (Appendix A) and request for public comment was mailed to 72 organizations, agencies, and individuals known as parties interested in proposed activities in the TBNG. Notice of the Proposed Action was also published in the Casper Star-Tribune on July 5, 2001. The list of potentially interested parties to whom the Scoping Statement was sent is presented in Appendix B.

Eight comment letters were received in response to this solicitation and are part of the public record. Four of the scoping responses were from State of Wyoming agencies, one was a letter of support, two were from individuals, and one was from an environmental organization. A summary of the comments received, the comment source, and a reference to the section number in the EA in which the comment is addressed is contained in Appendix C.

1.7 ISSUES

The USFS separated scoping issues into two groups:

- Issues that drive alternatives development and/or issues that are analyzed as environmental consequences; and
- Other issues.

Issues that drive alternatives development were defined as those directly or indirectly caused by implementing the Proposed Action.

Other issues were identified as those:

- Outside the scope of the Proposed Action;
- Already decided by law, regulation, Forest Plan, or other higher level decision;
- Irrelevant to the decision to be made; or
- Conjectural and not supported by scientific or factual evidence.

The Council for Environmental Quality (CEQ) NEPA regulations require this delineation: "…identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review (Sec. 1506.3)…" Determination of significance is included in the comments summary in Appendix C.

The issues and concerns that drive alternatives development and/or are analyzed as environmental consequences were identified during the scoping period ending on August 6, 2001. These issues are summarized in Table 1.7-1. Those issues that did not result in alternatives analyzed in this EA are discussed in Section 2.7. Issues that are analyzed in the EA as environmental consequences or through mitigation are discussed in their appropriate resource area sections in Chapter 3.

Table 1.7-1 Issues That Drive Alternatives Development and/or Are Analyzed as Environmental Consequences

Issues That Drive Alternatives Development		
Resource Area	**Issue**	**Indicators that can measure whether the issue can be remedied by implementing different alternatives**
Wildlife	Adverse impacts to sage grouse and ferruginous hawks would result from the connecting routes and well sites for the wells 14-8 and 23-8 in Thunderhead POD 1 and 21-11 and 12-11 in Thunderhead POD 2, Township 43 North, Range 71 West.	Consideration of this issue resulted in the development of Alternative C.
	No ground disturbance within big game winter habitat, parturition areas, and migration routes or within one mile of any ranked species by the Wyoming Natural Diversity Database or Wyoming Game and Fish Department.	Restriction of ground disturbing activities in these areas would be enabled through the designation of No Surface Occupancy (NSO) areas but would not allow development of the leases. This potential alternative was not considered in this EA. For further discussion, see Section 2.7.
Land use and access	Consider alternative routes or the use of helicopters to minimize crossing Forest Service lands.	The use of helicopters to transport personnel to and from project facilities was eliminated from detailed analysis for reasons discussed in Section 2.7.

Issues That Drive Alternatives Development		
Resource Area	**Issue**	**Indicators that can measure whether the issue can be remedied by implementing different alternatives**
	Drill only in existing and maintained roads.	Requiring the operator to drill in areas accessible only by existing and maintained roads would require the operator to be able to access the leased minerals from directional well bores. Consideration of mandated directional drilling was eliminated from consideration analysis for reasons discussed in Section 2.7.
	Designate new Research Natural Areas (RNAs).	The Project Area and the area surrounding it are modified by previous oil and gas development as well as grazing. The Project Area does not exhibit the characteristics of a pristine area and therefore, this issue was not considered further. Designation of RNAs is a forest planning issue and is addressed in the Northern Great Plains Management Plans Revision. Additional discussion is located in Section 2.7.
Geology	Mass wasting may occur in unstable or potentially unstable slopes.	Typical slope of Project Area terrain; types of soils on the surface and amount of moisture retention.
Groundwater	Underground fires may affect ground water quality.	Evaluation of geologic characteristics of the coal seams in the Powder River Basin that may lend themselves to spontaneous combustion.
	Effect of extracting water to produce CBNG on water table levels, well production, and production of CBNG from water wells.	Precautionary agreements between the applicant and owners of water wells in the vicinity of the Project Area.
	Leaks, spills, or dumping of chemicals may affect ground water.	Precautions taken by the applicant to ensure that chemical releases would not occur.
Surface water	Effects to wetlands.	Changes to water quality, water quantity, vegetative and wildlife habitat.
	Effects of discharged produced water on erosion and icing at road crossings.	Anticipated volumes of CBNG produced water, channel sizes, applicant-committed engineering measures used to manage the produced water.
	Effects to water quality of Little Thunder Reservoir.	Differences between current water quality in the Little Thunder Reservoir and CBNG produced water that would be released in the drainage.
	Mandate that all produced water from CBM wells be injected or retained in reservoirs or pits.	Re-injection of produced water was eliminated from detailed analysis for reasons discussed in Section 2.7.

Issues That Drive Alternatives Development		
Resource Area	**Issue**	**Indicators that can measure whether the issue can be remedied by implementing different alternatives**
Air quality	Effects of above ground fires.	Changes in visibility due to fine particulates from fires in or near the Project Area.
Soils	Effects of chemicals on soils.	Types of chemicals to be used in project development and precautions taken by the applicant that limit soil exposure to chemicals.
	Effects of produced water to soil characteristics.	Analytical measurements of quality of produced water.
Vegetation	Possible infestation of noxious weeds.	Precautions taken by the applicant to ensure that noxious weed infestation would not occur.
	Effects of surface disturbance to vegetation.	Length of time required for vegetation to re-establish; whether the disturbed area would be re-seeded.
	Effects of using defoliants and other chemicals to native plants.	Anticipated use of defoliants and their chemical characteristics; effects on re-establishment of vegetation.
Wildlife and fisheries	Effects of increased traffic on wildlife mortality.	Presence of roads in wildlife habitat; anticipated road use; vehicle speeds.
	Possible habitat fragmentation due to fencing.	Amount of kinds of fencing that would be installed for project use.
	Possible effects to the black-footed ferrets, sage grouse, passerine, and raptors.	Determination of existence of appropriate wildlife habitat in Project Area; results of surveys to determine whether these species are present; proximity of project development and facilities to known occurrences of these species in the Project Area.
	Effects of produced waters and chemical spills to aquatic biota.	Analytical measurements of quality of produced water.
	Effects of increased flows on native prairie fish.	Determination of anticipated flows of produced water; effects of increased flows on stream channels, vegetation, and other required elements of habitat for this species.
Recreation	Possible effects of new permanent and temporary roads on off-road vehicle and recreational use.	Evaluation of current off-road vehicle use in and near the Project Area; determination of likelihood of increased road usage for these vehicles if additional roads are built in or near the Project Area.

Issues That Drive Alternatives Development		
Resource Area	**Issue**	**Indicators that can measure whether the issue can be remedied by implementing different alternatives**
Cultural resources	Possible effects to cultural and historic sites/properties.	Evaluation of current status, including location, condition, and significance, of cultural properties in or near the Project Area as a result of Class III survey; determination of likelihood of adverse effects to identified cultural properties by comparing location of proposed project facilities to the cultural properties.
Noise	Effects on habitat and sage grouse, passerine, and raptor reproduction.	Determination of existence of appropriate wildlife habitat in Project Area; results of surveys to determine whether these species are present; proximity of project development and facilities to known occurrences of these species in the Project Area.

CHAPTER 2
ALTERNATIVES, INCLUDING THE PROPOSED ACTION

2.1 INTRODUCTION

Alternatives are required in a NEPA analysis, but alternatives must be "reasonable" and must accommodate the purpose and need of the project. Alternatives must be technically and economically feasible (CEQ, 1981). Alternatives should explore the range of potential issues and, thus, alternatives development is strongly influenced by the results of the scoping process.

Chapter 2 describes the Proposed Action and two alternatives to the Proposed Action, including the No Action alternative. The No Action alternative, Alternative A, assumes that development of the proposed 32 CBNG wells is precluded. The Proposed Action, Alternative B, considers the development of 32 CBNG wells within the TBNG. Alternative C, the modified development scenario, considers the development of 28 CBNG wells within the TBNG. A comparison among the alternatives is included at the end of this chapter.

2.2 ALTERNATIVE A - NO ACTION ALTERNATIVE

A No Action alternative is intended to provide a benchmark that enables the decision-maker to compare the magnitude of environmental effects among alternatives to existing management conditions. Consideration of the No Action alternative is required by 40 CFR 1502.14 (d).

Under the No Action alternative, the BLM or USFS would deny the proposal as currently described in the Proposed Action. The decision would apply only to federal surface and/or minerals. A decision for the No Action alternative could be considered under the following circumstances:

- If there were no acceptable means of mitigating significant adverse impacts to surface resources values; or
- If the USFWS were to conclude that the Proposed Action would likely jeopardize the continued existence of any threatened, endangered, proposed, or candidate species.

The ability of a decision-maker to select the No Action alternative is severely constrained by Lance’s contractual rights to develop its mineral leases. Although the BLM can deny approval of a particular APD, it cannot, in general, deny approval of an APD that proposes to drill a well to federal minerals that have been leased. An oil and gas lease grants the lessee the "right to drill for, extract, remove, and dispose of all oil and gas deposits" from the leased lands, subject to the terms and conditions of the respective leases (BLM, 1992). The denial of the right to develop a valid lease would violate the lessee's contractual rights, as well as result in the loss of federal royalties. Authority for denial can be granted only by Congress (United States Constitution,

Article IV, Section 3, Clause 2). The BLM, therefore, can only suspend the lease pursuant to Section 39 of the Mineral Leasing Act pending consultation with the Congress for a grant of authority to preclude drilling and provide required compensation to the lessee.

The selection of the No Action alternative would not allow existing leases to be developed. Implementation of the No Action alternative, as presented in this hypothetical analysis, would preclude all drilling, construction, production, and reclamation activities as planned by the Proposed Action. Selection of the No Action alternative would allow land uses to continue in their presently existing condition. Existing surface management activities, such as surface coal mining, livestock grazing, and wildlife habitat, would continue as they are currently implemented. CBNG development would continue in the general area of the project on other federal, state, and private lands. The No Action alternative is illustrated on a map (Figure 2.2-1).

2.3 ALTERNATIVE B - PROPOSED ACTION

Lance proposes drilling and operating 32 CBNG wells and associated facilities on federal gas leases on federal lands administered by the USFS as part of the TBNG, Douglas Ranger District. The TBNG includes over 553,000 acres of public land intermingled with other ownerships dispersed among plateaus and rolling foothills in northeast Wyoming. The project would occupy portions of noncontiguous TBNG lands and portions of the private lands that lie between them. All of the proposed wells are located on USFS lands within the TBNG; however, the project would require the construction of some new associated facilities on non-USFS lands. Project wells would require the use of roads that cross state-owned surface. The BLM would administer the federally owned minerals. Lance submitted 32 APDs to the BLM, Buffalo Area Field Office, which has forwarded the APDs to the Douglas Ranger District for review and concurrence. The locations of the wells comprise three separate areas known as Thunderhead 1, 2, and 3. Although each area has its own POD, this EA analyzes the effects of developing all three areas. The wells would produce CBNG from the Wyodak-Anderson coal seam and would be drilled on 80-acre spacing to a depth of less than 1,000 feet. Construction operations for the project are expected to require three to six months. Approximately one to three drilling rigs would be utilized to complete the project. The productive life of the wells is expected to be approximately 10 years.

The associated facilities required by the proposed project would include roads, gas and water pipelines, electrical utility (power) lines, buildings that house the central gathering facilities for gas, produced water discharge points, stock tanks, and culverts. Project development would require the construction of approximately 10.6 miles of new roads, approximately 12.4 miles of underground utility corridors, one central gathering facility, and two discharge points on TBNG lands. Project development would require the use of similar existing facilities currently located near the proposed well locations. It would result in the use of roads previously constructed and currently used on State of Wyoming land southeast of Thunderhead 1. The wells and facilities that would be constructed and used for the project are shown on Figure 2.3-1.

Figure 2.2-1 No Action Map

Insert No Action map here. 8.5x11” map

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Figure 2.3-1 Project Map

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Agency officials and Lance personnel conducted onsite inspections on July 18, 19, and 20 in 2001 in preparation for the development of the proposed wells. The purpose of the inspections was to assess the suitability of locations of proposed access roads, project-associated facilities, and utility trenches with respect to site-specific environmental resources. Potential problem areas where environmental mitigation measures may be required were identified. Private land owners were not present at the onsites but were invited and encouraged to attend. They were consulted throughout the planning process to determine how the CBNG produced water may be put to beneficial use. Requests from the landowners resulted in mitigation measures that are incorporated into the Proposed Action.

The following sections summarize the project location and access, the facilities proposed for the three PODs, stipulations that would be applied to project development, the CBNG development process, estimated ground disturbance associated with the Proposed Action, and reclamation procedures. Implementation of the Proposed Action would occur in three primary phases: drilling and construction of facilities; production and maintenance; and decommissioning and reclamation. Detailed procedures for CBNG drilling and production operations are described in the PRB O&G FEIS (BLM, 2003).

2.3.1 Project Location

The proposed project is located approximately three miles southeast of Wright, Wyoming and approximately 40 miles south of Gillette, Wyoming. The wells would be located in southern Campbell County, Wyoming within the Little Thunder Creek watershed in the Powder River Basin. The proposed wells would be located immediately adjacent to property owned by the Thunder Basin Coal Company, the State of Wyoming, and local ranchers. Private, state, and TBNG lands would provide access to the proposed wells.

In the Buffalo Field Office-issued Part I - Basic CBNG APD/POD Guidebook Components of a POD, Part B (BLM, 2003a), BLM guidance is given with respect to the definition of a POD size. The guidelines suggest using lease lines to define POD boundaries. Using this guideline, boundaries surrounding the PODs coincide with federal oil and gas lease boundaries, all within Township 43 North/Range 71 West (T43N/R71W). The POD boundaries include approximately 2,829 acres on TBNG surface:

- Thunderhead 1: All of Section 8 except the NENE quarter, and the SWSW quarter of Section 9;
- Thunderhead 2: The east half of Section 10, the west half of Section 11, the west half of the east half of Section 14; and
- Thunderhead 3: The south half of Section 18, all of Section 20 except the NWNW quarter, and the northwest quarter and west half of the southwest quarter of Section 21.

In addition, the project includes minimal adjacent private lands where linear features, such as roads, connect project wells to existing shared gas and water collection facilities. The existing facilities are located on privately owned surface in NENW Section 14; NESW Section 10; NWNW Section 13; SENE Section 9; SWNW Section 18; SWNE Section 21, all in T43N/R71W; and NESE Section 13 in T43N/R72W. The Proposed Action includes

approximately 23 acres on private surface. Surface ownership affected by the Proposed Action is shown in Figure 2.3-2.

The Project Area, as referenced in this document, refers to the area within the lease boundaries, as described in the preceding paragraphs.

2.3.2 POD Descriptions

Thunderhead 1 would consist of seven wells in Section 8 of T43N/R71W. These wells would be served by a new central gathering facility (sometimes referred to as a header), located in the northeast quarter of Section 8. The wells would be served by approximately 2.3 miles of new roads. One stock tank with a valve would be installed on Section 8, and another valve would be installed along the water line on privately owned surface on Section 9. The north boundary of Section 8 is State Highway (SH) 450.

Thunderhead 2 would consist of four wells in the east half of Section 10, four wells in the west half of Section 11, and two wells in the west half of the eastern half of Section 14 in T43N/R71W. Section 10 wells would be served by a new header in Section 10. Produced water from the wells in Section 10 would be discharged from a proposed discharge point located in Section 10. A previously approved existing header on private land in the northwest quarter of Section 14 would serve the wells in Sections 11 and 14. Produced water from the wells in Sections 11 and 14 would be discharged from an existing discharge point on private land in Section 13. One stock tank with a valve would be installed on Section 10, and another would be installed in Section 11. Thunderhead 2 would utilize approximately 3.5 miles of new roads and 0.3 mile of reconstructed roads.

Thunderhead 3 would consist of 15 wells, eight of which would be in Section 20, four of which would be in the southern half of Section 18, and three of which would be in the western half of Section 21, T43N/R71W. The wells in Section 18 would be served by an existing header on private land to the west of the project. This header serves other previously drilled wells. The wells in Section 20 would be served by a new header located in southwest quarter of that section. The wells in Section 21 would be served by an existing header located in northeast quarter of that section. The Section 21 header also serves other previously drilled wells. A stock tank with a valve would be installed in each of the three sections. Produced water would be discharged to new discharge points in Sections 18, 20, and 21. The wells in Thunderhead 3 would be served by approximately 4.8 miles of new roads and 9.2 miles of existing roads, including 7.8 miles of existing crown and ditch road on private surface.

Figure 2.3-2 Lease and Surface Ownership Map

8.5x11” map.

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2.3.3 Lease Stipulations and Conditions of Approval

The CBNG wells and related facilities would be located on portions of eight federal leases held by Lance. The number of wells that could be drilled on the leased acreage is dictated by spacing rules. The oil and gas leases associated with the proposed wells include approximately 5,090 acres; however, the amount of surface directly affected by the proposed development of the 32 CBNG wells would require disturbance of a small portion of total acreage within the Project Area and an even smaller amount of acreage within the TBNG. The well names, associated leases, and well locations are listed in Table 2.3-1.

Table 2.3-1 Proposed Well Locations and Associated Leases

POD	Well Name	Well Location	Lease	Effective Date of Lease
Thunderhead 1	Federal 21-8-4371	T43N/R71W, Section 8: Lot 03 (NENW)	WYW-36006	4/1/81
	Federal 12-8-4371	T43N/R71W, Section 8: Lot 05 (SWNW)	WYW-36006	4/1/81
	Federal 23-8-4371	T43N/R71W, Section 8: Lot 11 (NESW)	WYW-36006	4/1/81
	Federal 14-8-4371	T43N/R71W, Section 8: Lot 13 (SWSW)	WYW-36006	4/1/81
	Federal 32-8-4371	T43N/R71W, Section 8:Lot 07 (SWNE)	WYW-143686	12/1/97
	Federal 43-8-4371	T43N/R71W, Section 8:Lot 09 (NESE)	WYW-143686	12/1/97
	Federal 34-8-4371	T43N/R71W, Section 8:Lot 15 (SWSE)	WYW-143686	12/1/97
Thunderhead 2	Stuart Federal 41-10-4371	T43N/R71W, Section 10:Lot 01 (NENE)	WYW-95702	12/1/85
	Stuart Federal 32-10-4371	T43N/R71W, Section 10:Lot 07 (SWNE)	WYW-140772	1/1/97
	Stuart Federal 43-10-4371	T43N/R71W, Section 10:Lot 09 (NESE)	WYW-140772	1/1/97
	Stuart Federal 34-10-4371	T43N/R71W, Section 10:Lot 15 (SWSE)	WYW-140772	1/1/97
	Federal 32-14-4371	T43N/R71W, Section 14:Lot 06 (SWNE)	WYW-140772	1/1/97
	Federal 34-14-4371	T43N/R71W, Section 14:Lot 14 (SWSE)	WYW-140772	1/1/97
	Federal 21-11-4371	T43N/R71W, Section 11: Lot 03 (NENW)	WYW-36006	4/1/81
	Federal 12-11-4371	T43N/R71W, Section 11: Lot 05 (SWNW)	WYW-36006	4/1/81
	Federal 23-11-4371	T43N/R71W, Section 11: Lot 11 (NESW)	WYW-36006	4/1/81
	Federal 14-11-4371	T43N/R71W, Section 11: Lot 13 (SWSW)	WYW-36006	4/1/81
Thunderhead 3	Federal 43-18-4371	T43N/R71W, Section 18: Lot 13 (NESE)	WYW-140773	1/1/97
	Federal 14-18-4371	T43N/R71W, Section 18: Lot 17 (SWSW)	WYW-140773	1/1/97

POD	Well Name	Well Location	Lease	Effective Date of Lease
	Federal 34-18-4371	T43N/R71W, Section 18: Lot 18 (SWSE)	WYW-140773	1/1/97
	Federal 21-21-4371	T43N/R71W, Section 21: Lot 03 (NENW)	WYW-140773	1/1/97
	Federal 12-20-4371	T43N/R71W, Section 20: Lot 05 (SWNW)	WYW-140773	1/1/97
	Federal 14-20-4371	T43N/R71W, Section 20: Lot 13 (SWSW)	WYW-140773	1/1/97
	Federal 23-18-4371	T43N/R71W, Section 18: Lot 15 (NESW)	WYW-141207	3/1/97
	Federal 41-20-4371	T43N/R71W, Section 20: Lot 01 (NENE)	WYW-36006	4/1/81
	Federal 32-20-4371	T43N/R71W, Section 20: Lot 07 (SWNE)	WYW-36006	4/1/81
	Federal 43-20-4371	T43N/R71W, Section 20: Lot 09 (NESE)	WYW-36006	4/1/81
	Federal 34-20-4371	T43N/R71W, Section 20: Lot 15 (SWSE)	WYW-36006	4/1/81
	Federal 12-21	T43N/R71W, Section 21: Lot 05 (SWNW)	WYW-143062	10/1/97
	Federal 14-21	T43N/R71W, Section 21: Lot 13 (SWSW)	WYW-143062	10/1/97
	Federal 21-20	T43N/R71W, Section 20: Lot 03 (NENW)	WYW-143686	12/1/97
	Federal 23-20-4371	T43N/R71W, Section 20: Lot 11 (NESW)	WYW-140939	2/1/97

2.3.4 Drilling and Construction of Facilities

2.3.4.1 Roads and Trenches

Existing roadways would be used where possible, and new roads would be constructed where needed. The project roads have been designed and modified to meet the long-range USFS road management plans for the area, as described in the Final Williams Thunderhead Coalbed Methane Project Roads Analysis (Road Management Plan) (USFS, 2002). Details relating to road construction and usage can be found in the Transportation Plan (Greystone, 2002). The road design for new project roads has been approved by the USFS. Road use by Lance personnel is intended to be light and limited. Vehicle traffic would be confined to established roads at all times. Vehicle use would be restricted if such use could result in rutting. Roads on privately owned surface would be used or constructed only after agreement is reached between Lance and the landowner.

Roadways would typically serve as common routes for vehicle access and rights-of-ways (ROWs) for buried gas, water, and electric lines. Trenches would be excavated, wherever possible, along the access routes to minimize ground disturbance. Single trenches for gas and water pipelines and electric lines would link a header building to its associated producing wells.

USFS short-term roads would be used for access from the headers to the wells. Short-term roads are native surface, two-track roads that may be surfaced with concurrence by the USFS. Initial disturbance for two-track roads would include brush-hogging the route to a width of 25 feet. After construction, actual road width would be approximately 12 feet. Where a two-track road would be paralleled by a utility trench, disturbance would be included in the 25-foot ROW. The area not needed for vehicular travel would be reclaimed following construction. The limited use of these roads would not necessitate further improvement beyond establishment of the track; however, drainage crossings or some spot upgrades may require the application of crushed scoria to harden soft or excessively erosive surfaces. Some areas may require additional blading to maintain the road surface and prevent drive-arounds. Total length of the road segments that require additional blading would be approximately 5,100 feet. Areas where blading up to the 25-foot width of the ROW are identified in the project Transportation Plan (Greystone, 2002) and the site-specific COAs developed during the 2001 onsites. Additional improvements would be addressed on a case-specific basis.

USFS local roads would be used to access the headers. These roads are single lane roads that typically provide primary access to central gathering facilities and may be reclaimed after wells cease to produce. The roads are 12 to 14 feet wide, crowned and ditched (C&D), and may be surfaced with six inches of crushed scoria, drained, and maintained. Disturbance width for local roads is approximately 40 feet, including disturbance for buried utilities, if present.

Access road construction is typically completed over a period of approximately four to six weeks. Construction activities would require use of these roads several times daily; however, after construction, roads would be used once daily until telemetry equipment is installed. After telemetry equipment installation, the PODs would be visited approximately twice weekly, and each well would be visited once per week.

Maintenance on project roads during drilling and construction would be the responsibility of Lance and would be consistent with USFS specifications. During the duration of the project, Lance would monitor the project roads and perform appropriate repairs. Such maintenance may include procedures required to correct excessive soil movement, rutting, and/or braiding around problem areas. Maintenance activities are expected to be infrequent and may require use of a two-ton truck. If Lance personnel were to observe deteriorating road conditions resulting from use by vehicles outside their control, USFS would be notified.

In some cases, new roads would duplicate existing access. Current roads not necessary for other USFS management activities or public needs would be decommissioned. The USFS and Lance would assume the responsibility for obliterating duplicative roadways. Lance would decommission the roads to USFS standards at the time of construction of the new roads.

Table 2.3-2 summarizes the types of existing roads that would be used for project development. These roads would be used in the current condition. There would be no additional surface disturbance associated with the use of roads in their current state.

Table 2.3-2 Existing Roads For Project Use

Road Type	USFS surface			Private Surface		
	feet	miles	disturbed area (acres)[1]	feet	miles	disturbed area (acres)[1]
Existing 2-track roads to be used for Project, to be used as is	5,200	1.0	NA	1,589	0.3	NA
Existing C&D roads to be used for Project, to be used as is	1,923	0.4	NA	41,140	7.8	NA
Total Existing Roads To Be Used	7,123	1.4	NA	42,729	8.1	NA
2-track roads to be decommissioned	47,157	8.9	13.0	0	0	0

Source: Adapted from Greystone, 2003

[1] No additional disturbance is associated with the use of existing roads

Table 2.3-3 summarizes the types, length, surface ownership, and disturbance associated with proposed new roads. Short-term disturbance includes the entire ROW including the part that is reclaimed after road construction (25-foot ROW for 2-track roads and 40-foot ROW for C&D roads). Long-term disturbance was calculated using the amount of road surface used for vehicle access because the remainder of the area within the ROW used for road construction would be reclaimed (12 feet for 2-track roads and 14 feet for C&D roads). Some existing 2-track roads would be upgraded to C&D to allow access for project development. New road construction linking the proposed wells and disturbance resulting from upgrades are illustrated on Figure 2.3-1.

Table 2.3-3 Disturbance Associated Proposed New Roads

Road Type	USFS Surface				Private Surface			
	Feet	Miles	Short-Term Disturbance (acres)	Long-Term Disturbance (acres)	Feet	Miles	Short Term Disturbance (acres)	Long Term Disturbance (acres)
Proposed 2-track roads	48,236	9.2	27.7	13.3	2,553	0.5	1.5	0.7
Proposed C&D roads	5,311	1.0	4.9	1.7	952	0.2	0.8	0.3
2-track roads to be upgraded to C&D for Project	2,159	0.4	1.4	0.1	1,687	0.3	0.6	0.1
Total New Roads	55,706	10.6	34.0	15.1	5,192	1.0	2.9	1.1

Source: Adapted from Greystone, 2003

A total of approximately 11.6 miles would be constructed on both TBNG and private lands, resulting in a short-term disturbance of approximately 34 acres and 2.9 acres, respectively.

Under the Proposed Action, approximately 8.9 miles of existing 2-track roads would be decommissioned on TBNG lands, approximately equivalent to 13 acres. The additional long-term disturbance associated with the upgrading of 2-track roads would amount to approximately 0.1 acre each for both USFS and private surfaces. Total long-term disturbance on both USFS and private surface is approximately 16.2 acres, 15.1 of which lies on USFS surface. Therefore, the amount of USFS land disturbed by the construction of new roads, 15.1 acres, would be offset by the reclamation of 13 acres of roads, resulting in a net new disturbance of only 2.1 acres on TBNG lands over the long term. Approximately 1.1 acres of private land would be affected by road disturbance over the life of the project.

2.3.4.2 Drilling Operations and Well Completion Program

Construction activities at well sites would be kept to a minimum to limit disturbance to vegetation and underlying soils. Because the natural terrain at all the well sites is nearly level, no leveling would be required. Only small amounts of vegetation would be mowed or cleared. Construction, drilling, and completion operations would take place during daylight hours.

The area affected by well site construction would typically be approximately 100 by 100 feet (approximately 0.23 acre) for each well. A temporary mud/reserve pit approximately four to six feet deep, 10 feet wide and up to 20 feet long would be excavated for use during drilling and completion operations. Vehicles at the well site typically include the truck-mounted, shallow water well-type drilling rig, one backhoe, a water truck, and a truck mounted pulling unit that operates the down-hole production equipment. Drilling operations would require about one to three days with a crew of approximately 14 persons. If surface water were to be used for drilling purposes, the required surface water appropriation permit would be obtained from the WSEO.

If a well is not put into production, the drill rig would be used to plug the well. If a well were productive, completion operations would commence immediately after drilling is finished. Completion operations stimulate gas production and determine gas and water production characteristics. Completion operations require a mobile completion rig and approximately 15 people for approximately one to three days for each well. After the drilling and completion operations are finished, the reserve pit would be allowed to dry sufficiently long enough for the water in the drilling fluid to evaporate. The liner, if present, would be ripped before being backfilled and covered. Cuttings and mud would be buried approximately three feet. The pit would be backfilled such that no surface depression would remain after the soil has compacted. A telemetry system would then be installed so that Lance could monitor CBNG production remotely. Following well completion, portions of the well site that are not needed for surface production activities would be reclaimed and reseeded in compliance with USFS requirements. Re-vegetation and reclamation of the site would be completed within six months of drilling the well, weather permitting. Long-term disturbance would be less than 0.1 acre at each well site. Surface disturbance associated with well site construction for the project is shown in Table 2.3-4.

Table 2.3-4 Surface Disturbance Associated with Well Site Development

Well Location	Number of Wells	Initial Disturbance (acres)	Disturbance After Interim Reclamation (acres)
Thunderhead 1	7	1.6	0.7
Thunderhead 2	10	2.3	1.0
Thunderhead 3	15	3.5	1.5
Total	32	7.4	3.2

2.3.5 Production and Maintenance

2.3.5.1 Wellhead Facilities

If a well were productive, an electric submersible pump would be installed below ground level, and an insulated wellhead covering would be placed over the wellhead. The submersible pump dewaters the coal seam to reduce pressure in the seam and promote recovery of the CBNG. A ground water appropriation permit would be obtained from the WSEO in order to withdraw water from the producing coal seam during the dewatering phase. The production facilities at the well would consist of the wellhead and an insulated wellhead cover. The wellhead cover would consist of a fiberglass box (approximately four feet by four feet by four feet) placed over the wellhead. A power panel would be placed adjacent to the wellhead cover, and a four-sided pipe fence would surround the cover and panel. The installation and use of telemetry equipment will allow Lance to minimize travel to the wellhead. These facilities would occupy the estimated 0.1 acre for each well after interim reclamation.

2.3.5.2 Water, Gas, and Electric Lines

Produced water and gas from operational wells would be delivered to central gathering facilities through buried water lines and polyethylene gas lines. The water, gas, and electric lines would occupy common trenches adjacent to roads where feasible. Underground electric lines would be installed in trenches to provide electricity from overhead power lines to the headers. There would be two new overhead power lines constructed on private surface in association with the project. Approximately 0.25 mile of overhead line would be located in the southwest quarter of Section 14, T43N/R71W, and approximately one mile of overhead line would be located in Sections 28 and 29. There would be no generators installed for long term use; however, Lance typically uses generators until the well is completed and the electric lines are installed.

Utility trenches that are constructed adjacent to two-track roads and USFS local roads would require four feet of width for construction within the road ROW. Utility trenches that must be constructed independently of roads would require a disturbance width of 14 feet. The larger 12-inch gas lines would require a 50-foot ROW. After pipeline construction, all disturbed areas would be reseeded in accordance with the reclamation procedures described in Sections 2.3.4.1 and 2.3.6. Therefore, there would be no long-term disturbance associated with the construction of pipelines and utility trenches. A summary of short-term disturbance associated with pipeline/utility trench construction is shown in Table 2.3-5.

Table 2.3-5 Short-Term Disturbance Associated with Pipelines/Utility Trenches

Road Type	Trench Status	USFS			Private		
		feet	miles	Short term disturbance (acres)	feet	miles	Short term disturbance (acres)
2-track[1]	Proposed	46,508	8.8	4.3	2,553	0.5	0.2
C&D[1]	Proposed	6,046	1.2	0.5	952	0.2	0.1
None- Stand Alone Pipeline/Utility Trench	Proposed	3,912	0.7	1.3	37,197	7.0	12.0
Possibly none- 12" gas line with or without access or additional pipelines	Proposed	8,811	1.7	10.1	6,742	1.2	7.7
	Total	65,277	12.4	16.2	47,444	8.99	20.0

Source: Adapted from Greystone, 2003

[1] Short-term disturbance for pipelines constructed adjacent to roads would occur within ROW disturbances.

In addition to new pipelines, existing pipelines and overhead electric lines would also be utilized to transport gas and electricity. Approximately 44,285 feet of existing co-located pipelines would be used by project wells, 1,923 feet of which would be located within the TBNG. There would be no new disturbed surface associated with the use of these pipelines or electric lines.

2.3.5.3 Central Gathering Facilities

Produced water and gas from project wells would be transported to six central gathering facilities. Three central gathering facilities would be constructed for this project. Three central gathering facilities exist and are in use by other non-project wells. Gas would be metered at each facility. Each central gathering facility requires approximately 0.25 acre of disturbance. The total amount of new disturbance associated with construction of all the headers would be 0.25 acre on USFS land and 0.5 acre on private land. Details pertaining to the central gathering facilities are shown in Table 2.3-6.

Table 2.3-6 Central Gathering Facilities

POD	Status	Surface Owner	Location	Number of Project Wells Served	New Disturbance (acres)
Thunderhead 1	Proposed	USFS	NE/4 Section 8, T43N/R71W	7	0.25
Thunderhead 2	Proposed	Private	SW/4 Section 10, T43N/R71W	4	0.25
	Existing	Private	NW/4 Section 14, T43N/R71W	6	NA
Thunderhead 3	Existing	USFS	SE/4 Section 13, T43N/R72W	4	NA
	Proposed	Private	SW/4 Section 20, T43N/R71W	8	0.25
	Existing	USFS	NE/4 Section 21, T43N/R71W	3	NA

2.3.5.4 Water Discharge Points

Produced water from project wells would be metered at the wellhead and then piped to six discharge points where produced water would be released into channels. All discharge points have been or would be permitted through the WDEQ-Water Quality Division (WQD) with NPDES permits. Three discharge points exist and are in use. An additional three discharge points are proposed to distribute the water. Two of the proposed new discharge points would be located on TBNG lands, and one would be located on private land. Each discharge point would require approximately 0.25 acre for construction purposes. New discharge points would require approximately 0.5 acre on USFS land and 0.25 acre on private land.

Maximum produced water discharge from the project wells is expected to be 14 gallons per minute (gpm) per well and would result in 448 gpm (1.0 cubic feet per second [cfs]) being discharged into the Little Thunder Creek watershed. Details describing discharge point construction can be found in the Hydrology Report (Greystone, 2002a) developed to support this project.

Existing and proposed discharge points are located on tributaries to Little Thunder Creek rather than the main creek channel to promote evaporation and infiltration. Suggestions were solicited from agencies and landowners during the onsite inspections and during project planning with respect to discharge point locations and improved design. Most discharge points are located in stable, well-defined, low-gradient ephemeral channels away from significant downstream head cuts or other major erosion features. These types of locations minimize the possibility of creating large "boggy" areas. All channels are able to accommodate the water proposed for discharge in addition to precipitation associated with naturally occurring storm events. Table 2.3-7 provides details of the produced water discharge points that would be utilized by project wells.

Table 2.3-7 Produced Water Discharge Points

POD	Status	Surface Owner	Location (T43N/R71W)	Number of Wells Served	Permit Number	New Disturbance (acres)
Thunderhead 1	Existing	Private	NE/4 Section 9	7	WY0037338-001	NA
Thunderhead 2	Proposed	Private	SW/4 Section 10	4	TBD[1]	0.25
	Existing	Private	NW/4 Section 13	6	WY0038211-001	NA
Thunderhead 3	Proposed	USFS	NW/4 Section 20	8	WY0042285-006	0.25
	Existing	Private	NW/4 Section 18	4	WY0042285-007	NA
	Proposed	USFS	NE/4 Section 21	3	WY0042315-003	0.25

[1] To be determined

The existing discharge points were inspected during the July 2001 onsites, are structurally sound, and would adequately manage the anticipated increase in flow. The existing discharge point in Section 9 would service wells in Section 8. This discharge point and associated water lines from

the NENE quarter of Section 8 were constructed after the approval of a separate project. Produced water from proposed wells in Sections 11 and 14 would be piped to the existing discharge point in Section 13. This discharge point and associated water lines, up to the USFS land boundaries, were constructed and approved as part of a separate project. Wells in Section 18 would be discharged to a facility in the northwest quarter of Section 18 on private land. This discharge point and associated water lines, up to the USFS land boundaries, were constructed after approval of a separate project.

New discharge points would be located in Sections 10, 20, and 21. The proposed locations were inspected during the July 2001 onsites and were found to discharge into channels adequate to handle the expected flow. Water from wells in Section 10 would be piped to a discharge point located on private surface in the east half of the southwest quarter of the section. A naturally defined channel does not exist. A channel would be constructed with a ditcher or similar machine to the northwest of the discharge point to provide a flow path to the defined channel in the northwest quarter of the section. Water from wells in Section 20 would be discharged to a permitted location in the northwest quarter of Section 20. Water from wells in Section 21 would be discharged to a permitted location in the northwest quarter of Section 21.

Each discharge point would have a splash pad/water discharge structure installed to bring water to channel grade. The splash pad would consist of a 12-inch polyethylene pipe positioned vertically and armored at ground level by rock surrounding the discharge pipe. Where the discharge structure would be accompanied by a stock tank, the vertical section of polyethylene pipe would be positioned centrally inside the tank, allowing water to fill the tank. The splash pads below produced water discharge points would be armored using up to 10 cubic yards of clinker or gravel in the channel bottom to dissipate energy, covering the channel bottom to a depth of approximately one foot over a distance of 15 feet. The size of the rocks used would vary from three to six inches. Outfall design may include discharge aprons and downstream stabilization of channel side slopes to prevent accelerated erosion.

Erosion control methods would follow the guidelines described in Section 2.3.8. If increased erosion related to the release of produced water were observed in the channel of Little Thunder Creek or its tributaries, engineering measures, such as armoring the channel, would be applied in the impacted areas to prevent further erosion.

2.3.5.5 Culverts

All stream crossings would be handled by drainage structures incorporating culverts and drainage dips. Five new culverts and three existing culverts would be utilized to facilitate the flow of discharged water produced from project wells. Existing culverts were found to be in good condition during the July 2001 inspections. New culverts would be located at existing crossings of perennial channels or channels anticipated to have flows from produced water discharges. New culverts would be constructed in accordance with USFS guidelines and as detailed in the BLM and USFS Gold Book (BLM and USFS, 1989). Normal drainage is currently being accommodated by the use of 18-inch, 24-inch, and 36-inch culverts that are sufficiently sized to allow flood flow without degradation to roads or adjacent channel slopes. Similarly sized culverts have been installed under area roads and have sufficiently

accommodated anticipated flows. Each culvert would discharge produced water from its outfall across a galvanized steel, concrete, or rock splash pad to the channel bottom. More detail with respect to culverts can be found in the Hydrology Report (Greystone, 2002a).

Lance would minimize surface disturbance at stream crossings during construction to prevent erosion and sediment movement. Culverts would be covered with scoria over fill. A road dip would be constructed at the culvert, resulting in a combination of low water crossing and culvert drainage. The road dip would facilitate storm water drainage and would also minimize surface disturbance during construction. Native vegetation would remain undisturbed to the extent possible to help stabilize slopes and soils. Filled areas would be re-seeded in the spring or fall during the first growing season following development.

Retrofitting to upgrade existing culverts would be completed prior to project construction. Culverts or fords that require remedial work would follow the guidelines described in this section and in Section 2.3.8. The locations of the proposed new culverts are shown on Figure 2.3-1. No fords, drainage dips, or low water crossings are planned for this project.

2.3.5.6 Gates and Cattle Guards

In general, a cattle guard and metal gate would be installed where access to USFS lands crosses a fence line, between private and public lands, or between different grazing allotments. In one case, however, the gate between the north and south halves of Section 18 would not be installed at the request of a surface owner. Approximately six new gates and six new cattle guards would be installed for range management. The locations for the currently identified proposed gates and cattle guards are shown on Figure 2.3-1.

2.3.5.7 Stock Tanks

Facilities that would enable the CBNG produced water to be used for beneficial use include flow-through and valved stock tanks. Site-specific designs that employ best management practices were developed to accommodate livestock access to water, control erosion, and limit sedimentation. Several valved stock tanks would be constructed to allow "at-will" access to water by the leaseholder for stock watering.

Six stock tanks would be installed during project development. Plans for flow-through stock tanks were reviewed during the July 2001 onsite inspections. The last four tanks in the list below have been requested by surface lessees or private landowners:

- A tank would be located near the Federal 23-11-4371 in Section 11 on TBNG surface.
- A tank would be located near the Federal 21-21-4371 in Section 21 on TBNG surface.
- A tire tank would be located at the Federal 23-8-4371 well in Section 8 on TBNG surface. The tank would be a closed-system stock tank with pressure flow and shutoff valves.
- A closed-system tank with pressure flow and shutoff valves would be installed at the fence line just northwest of the Stuart Federal 34-10-4371 well site in Section 10 on TBNG surface. This would be a flow-through system with the water line ending on the

west side of the fence on private property. A trench would be dug pass through the natural swale, then to an established watercourse in the SWNW of Section 10.

- A closed-system stock tank would be located near the discharge point for Thunderhead 3 in Section 18 on privately owned surface, located above a small reservoir just southwest of the previously approved Federal 12-18-4371 well site.
- A closed-system stock tank would be located at the playa east of the Federal 34-20-4371 well in Section 20 on TBNG surface.

To meet a lessee's request, a closed-system stock tank would be used to receive produced waters from project wells in Section 8 at a privately owned reservoir in the SWSWNW of Section 9, T43N/R71W. The reservoir is on a tributary to Rochelle Lake, which is a playa and defined as a closed basin. A valved connection on a lateral line would provide water to this private reservoir. The locations for the proposed stock tanks are shown on Figure 2.3-1.

2.3.6 Reclamation

Surface disturbance associated with the removal of well site facilities would be reclaimed in accordance with the APD COAs, Special Use Permits, or the SUPO. All disturbed areas would be reseeded in order to re-establish native vegetation.

Depleted well bores would be plugged and abandoned in accordance with Onshore Oil and Gas Order No. 2. A pipe monument including the location, lease number, operator, and well name would be required unless waived by the BLM or USFS. If waived, the casing may be cut off and capped below ground level. All other surface facilities associated with a well would be removed. The well site would be scarified to a depth of six inches. Disturbed surfaces would be returned to the original contours of the land prior to reseeding.

A seed drill would be used to plant a seed mix of perennial species to allow their establishment and the encroachment of other native species. Access would be restricted to reseeded areas to ensure a successful reclamation effort. The seed mix will be approved by the USFS at the time of reclamation.

If the well were assigned, all rights and responsibilities, including reclamation would pass to the USFS unless otherwise specified. The USFS would then permit the well for beneficial use according to WSEO procedures and policies.

The Road Management Plan (USFS, May 2002) for the project would determine which project roads would be reclaimed and which roads would be incorporated into the existing roads network. The two-track roads from the production facilities to the well sites would be scarified to a depth of six inches. Scoria and drainage culverts would be removed prior to reseeding. Disturbed surfaces would be returned to the original contours of the land.

Buried pipelines and utilities would be left in place. The pipelines would be flushed with water at post-production and prior to abandonment. Surface disturbance associated with their removal would be reclaimed in accordance with the APD COAs, Special Use Permits, or the SUPO.

2.3.7 Surface Disturbance Summary

Implementation of the Proposed Action would result in short and long-term new disturbances to the surface. These disturbances represent construction upon previously undeveloped land. Long-term disturbance consists of roads, well sites, water discharge points, and central collection facilities and would be present for the life of the project. Short-term disturbance associated with underground utility corridors and portions of the road ROWs would occur during a portion of the project life and would be reclaimed immediately following construction, typically prior to establishment of vegetation associated with interim reclamation.

Approximately 77 acres would be initially disturbed with the implementation of the Proposed Action, including 54 acres on TBNG lands and 23 acres on private lands. After interim reclamation, a large part of each well site and the surface where utility trenches were constructed would be returned to their natural states after the native vegetation has had time to re-establish. Some roads would be decommissioned and reclaimed in association with project development. Approximately 13 acres of roads would be decommissioned by Lance and the USFS. Long-term disturbance would, therefore, consist of well sites after interim reclamation, travel surfaces of new roads, central gathering facilities, and discharge points. This amount would be reduced by the acreage corresponding to the decommissioned roads. The residual long-term disturbance would consist of the difference between the acreage initially disturbed and the acreage revegetated during interim reclamation plus the acreage corresponding to decommissioned roads. Therefore, long-term disturbance would consist of approximately eight acres, including approximately six acres on TBNG lands and two acres on private lands. This amount represents approximately 0.28 percent of the Project Area and 0.001 percent of the acreage in the TBNG.

A summary of short- and long-term disturbance associated with the project is indicated in Table 2.3-8. The disturbance figures shown for utility trenches include both stand-alone trenches and the incremental amount of disturbance incurred when trenches would be installed adjacent to roads.

Table 2.3-8 Disturbance Associated with the Proposed Action; Thunderhead 1, 2, and 3[1]

Facility	Short-Term Maximum Disturbance (Acres)			Long-Term Maximum Disturbance (Acres)		
Surface Ownership	**USFS**	**Private**	**Total**	**USFS**	**Private**	**Total**
Well Sites	7.3	0	7.3	3.2	0	3.2
Central Gathering Facilities	0.25	0.5	0.75	0.25	0.5	0.75
Discharge Points	0.5	0.25	0.75	0.5	0.25	0.75
Roads	33.9	2.9	36.9	15.1	1.1	16.2
Pipelines/Utility (stand alone)	11.4	19.7	31.1	0	0	0
Sub-Total	53.4	23.4	76.8	19.0	1.8	20.9
Decommissioned Roads	-	-	-	13.0	0	13.0
Total Disturbance	53.4	23.4	76.8	6.0	1.8	7.9

[1] Minor discrepancies in totals due to rounding

In addition to disturbance associated with construction and project development, the Proposed Action would also utilize existing facilities, such as roads, pipelines, and central gathering facilities.

2.3.8 Conditions of Approval and Mitigation Measures

Project development and operation would be subject to the CBNG COAs implemented by the TBNG and site-specific mitigation measures developed during the July 2001 onsite inspections conducted by representatives of Lance, the USFS, and the BLM. A complete listing of the TBNG CBNG COAs is included in Appendix D. These and other measures have been incorporated by Lance into the Proposed Action, and their legal bases are indicated in Table 2.3-9.

Table 2.3-9 Mitigation Measures Incorporated Within the Proposed Action

Federal Requirements	
Drilling and Construction	
General	
The disposal of trash, sewage, and other waste materials would be mitigated through defined procedures.	Onshore Oil and Gas Order No. 1 - Approval of Operations on Onshore Federal and Indian Oil and Gas Leases, III.G.4(b)(7); Forest Service Manual (FSM) 2100 Environmental Management and FSM 2800 Minerals and Geology
Noise and odor would be minimized by the use of effective muffling of equipment engines and regular engine maintenance.	Noise Control Act of 1972 (42 USC 4901 et seq., as amended)
If previously undiscovered cultural resources were found, Lance would notify the USFS or BLM, as appropriate, and cease operations at the site pending agency evaluation.	Archeological Resources Protection Act of 1979 (16 USC 470), FSM 2361.21
Lance would instruct its employees and contractors in procedures to be followed in the event of discovery of human remains as required by applicable regulations. Lance has conducted a Class III cultural resource survey of the Project Area and has prepared a monitoring and mitigation plan.	Native American Graves Protection and Repatriation Act of 1990 (25 USC 3001, 43 CFR 10)
Roads	
Most new roads to well sites would be roughed in as two-track roads to minimize disturbance.	30 USC Section 226(g), Mineral Leasing Act of 1920; 43 CFR 3162.3-1(f); 43 CFR 3162.5-1; Onshore Oil and Gas Order No. 1 - Approval of Operations on Onshore Federal and Indian Oil and Gas Leases, III.G.4.(b)(2); BLM Gold Book; FSM 2100 Environmental Management and FSM 2800 Minerals and Geology

If the well were completed, the access road would be maintained as necessary to prevent soil erosion and accommodate year-round use.	30 USC Section 226(g), Mineral Leasing Act of 1920; 43 CFR 3162.3-1(f); 43 CFR 3162.5-1; Onshore Oil and Gas Order No. 1 - Approval of Operations on Onshore Federal and Indian Oil and Gas Leases, III.G.4.(b)(2); BLM Gold Book; FSM 2100 Environmental Management and FSM 2800 Minerals and Geology
Lance would prohibit off-road travel by its employees or contractors except in emergency situations.	30 USC Section 226(g), Mineral Leasing Act of 1920; 43 CFR 3162.3-1(f); 43 CFR 3162.5-1; Onshore Oil and Gas Order No. 1 - Approval of Operations on Onshore Federal and Indian Oil and Gas Leases, III.G.4.(b)(2); BLM Gold Book; FSM 2100 Environmental Management and FSM 2800 Minerals and Geology
No road construction is expected to occur on slopes greater than 8% and no surface disturbance or occupancy would occur on slopes in excess of 25%.	30 USC Section 226(g), Mineral Leasing Act of 1920; 43 CFR 3162.3-1(f); 43 CFR 3162.5-1; Onshore Oil and Gas Order No. 1 - Approval of Operations on Onshore Federal and Indian Oil and Gas Leases, III.G.4.(b)(2); BLM Gold Book; FSM 2100 Environmental Management and FSM 2800 Minerals and Geology
Gravel or scoria may be applied to soft, rut-prone areas. Travel on two-track roads would be rescheduled or postponed during infrequent periods of wet weather when vehicular traffic could cause rutting. Only if necessary, access would be via four-wheel all terrain vehicles or on foot.	30 USC Section 226(g), Mineral Leasing Act of 1920; 43 CFR 3162.3-1(f); 43 CFR 3162.5-1; Onshore Oil and Gas Order No. 1 - Approval of Operations on Onshore Federal and Indian Oil and Gas Leases, III.G.4.(b)(2); BLM Gold Book; FSM 2100 Environmental Management and FSM 2800 Minerals and Geology
Completion	
Surface casing would be installed to protect fresh water aquifers.	Onshore Oil and Gas Order No. 1 - Approval of Operations on Onshore Federal and Indian Oil and Gas Leases,, III.G.4.(a)(2); Onshore Order No. 2 Drilling III.B
When a well is completed, all disturbed areas that are not needed for production facilities would be restored as soon as practical and typically within six months.	30 USC Section 226(g), Mineral Leasing Act of 1920; 43 CFR 3162.3-1(f); 43 CFR 3162.5-1; FSM 2100 Environmental Management and FSM 2800 Minerals and Geology
Well Sites	
Construction activities at well sites would be kept to a minimum to limit disturbance of vegetation and underlying soils, significant wildlife habitat, recreational value, wetlands, or riparian areas. Surface disturbance within 100 feet of ephemeral drainages would be avoided.	30 USC Section 226(g), Mineral Leasing Act of 1920; 43 CFR 3162.3-1(f); 43 CFR 3162.5-1; FSM 2100 Environmental Management and FSM 2800 Minerals and Geology; Executive Order 11990
Lance would employ the following mitigation measures in relation to wetlands: Wetland and flood-prone areas would be crossed only during dry conditions. Winter construction activities would occur only when soils are not frozen. As soon as possible following construction, wetland or drainage channels would be reclaimed as closely	30 USC Section 226(g), Mineral Leasing Act of 1920; 43 CFR 3162.3-1(f); 43 CFR 3162.5-1; FSM 2100 Environmental Management and FSM 2800 Minerals and Geology

as feasible to pre-construction conditions. Where impermeable soils contributed to wetland formation, soil compaction would be used to reduce permeability. Streams and ephemeral drainages would be crossed perpendicular to flow direction, wherever practical. Wetland topsoil would be selectively handled. Recontouring and UFSF-approved native species would be used for revegetation and soil stabilization.	
Pipelines	
Gas and produced water gathering pipelines would be placed together in the same trench/ditch wherever possible to minimize surface disturbance.	30 USC Section 226(g), Mineral Leasing Act of 1920; 43 CFR 3162.3-1(f); 43 CFR 3162.5-1; FSM 2100 Environmental Management and FSM 2800 Minerals and Geology
All pipelines would be installed in ROWs along access roads or in utility corridors wherever possible to minimize disturbance.	30 USC Section 226(g), Mineral Leasing Act of 1920; 43 CFR 3162.3-1(f); 43 CFR 3162.5-1; FSM 2100 Environmental Management and FSM 2800 Minerals and Geology
Produced Water	
Produced water outfall points would be stabilized with concrete, rock, or other appropriate materials to reduce discharge velocities and minimize splash and erosion between the outfalls and the channels.	30 USC Section 226(g), Mineral Leasing Act of 1920; 43 CFR 3162.3-1(f); 43 CFR 3162.5-1; Onshore No. 7 Disposal of Produced Water III.G
Electrical Power Utilities	
Secondary electric power lines would usually be co-located in common trenches with gathering and produced water pipelines, eliminating additional surface disturbance.	30 USC Section 226(g), Mineral Leasing Act of 1920; 43 CFR 3162.3-1(f); 43 CFR 3162.5-1; FSM 2100 Environmental Management and FSM 2800 Minerals and Geology
Construction Resource Requirements	
Construction water would be obtained from approved local sources, typically from a nearby producing CBNG well.	Onshore Oil and Gas Order No. 1 - Approval of Operations on Onshore Federal and Indian Oil and Gas Leases, III.G.4.(b)(2)
Production and Maintenance Operations	
General	
A field-wide Spill Prevention Control and Countermeasures Plan (SPCCP) would be developed, if necessary, to mitigate unplanned spills.	40 CFR 112.1(b), 112.1(d), 112.1(f), 112.3(a) through 112.3(c), 112.3(f), and 112.4
Automated well telemetry equipment would remotely monitor project wells, eliminating the need for daily routine inspections by lease operators and reducing the amount of field traffic.	30 USC Section 226(g), Mineral Leasing Act of 1920; 43 CFR 3162.3-1(f); 43 CFR 3162.5-1; FSM 2100 Environmental Management and FSM 2800 Minerals and Geology; Forest Service Handbook 7709.55 – Transportation Handbook
Roads	
The maintenance program would be consistent with standard maintenance operations in the area and would include postponing travel on two-track roads	30 USC Section 226(g), Mineral Leasing Act of 1920; 43 CFR 3162.3-1(f); 43 CFR 3162.5-1; Onshore Oil and Gas Order No. 1 - Approval of Operations on Onshore

during and immediately after wet weather when rutting could occur.	Federal and Indian Oil and Gas Leases, III.G.4.(b)(2); FSM 2100 Environmental Management and FSM 2800 Minerals and Geology
Noxious weeds along roads would be subject to control measures.	30 USC Section 226(g), Mineral Leasing Act of 1920; 43 CFR 3162.3-1(f); 43 CFR 3162.5-1; FSM 2100 Environmental Management and FSM 2800 Minerals and Geology; Executive Order 13112-Invasive Species
Herbicides would not be stored within 500 feet of any special status plant species.	30 USC Section 226(g), Mineral Leasing Act of 1920; 43 CFR 3162.3-1(f); 43 CFR 3162.5-1; FSM 2100 Environmental Management and FSM 2800 Minerals and Geology; Executive Order 13112-Invasive Species
Decommissioning and Reclamation	
General	
Lance would follow agency procedures or surface owner specifications designed to reclaim disturbed areas as close to pre-development conditions as feasible.	43 CFR 3162.3-1(f); Onshore Oil and Gas Order No. 1 - Approval of Operations on Onshore Federal and Indian Oil and Gas Leases, III.C., V.; FSM 2100 Environmental Management and FSM 2800 Minerals and Geology
Lance would plug and abandon each well according to BLM and USFS requirements.	43 CFR 3162.3-4; Onshore Oil and Gas Order No. 2, Section III.G; Onshore Order No. 1, Section V; Mineral Leasing Act of 1920
Roads	
Reclaimed roads on federal lands would be reseeded with a seed mixture approved by the appropriate agency.	43 CFR 3162.3-1(f); Onshore Oil and Gas Order No. 1 - Approval of Operations on Onshore Federal and Indian Oil and Gas Leases, III.C., V.; BLM Gold Book; FSM 2100 Environmental Management and FSM 2800 Minerals and Geology
Pipelines and Electric Utilities	
Underground pipelines would be cleaned, disconnected, and abandoned to avoid unnecessary surface disturbance.	43 CFR 3162.3-1(f); Onshore Oil and Gas Order No. 1 - Approval of Operations on Onshore Federal and Indian Oil and Gas Leases, III.C., V.; FSM 2100 Environmental Management and FSM 2800 Minerals and Geology
Underground electric lines would be disconnected and abandoned in place to avoid unnecessary surface disturbance.	43 CFR 3162.3-1(f); Onshore Oil and Gas Order No. 1 - Approval of Operations on Onshore Federal and Indian Oil and Gas Leases, III.C., V.; FSM 2100 Environmental Management and FSM 2800 Minerals and Geology
State Requirements	
General	
Lance would adhere to applicable national ambient air quality standards (NAAQS) and Wyoming ambient air quality standards (WAAQS) as required by WDEQ.	WDEQ, Air Quality, Chapter 3, Section 2(f)); Clean Air Act, 42 USC 7401 et seq.
Noise and odor would be minimized by the use of effective muffling of equipment engines and regular engine maintenance.	WDEQ, Air Quality, Chapter 2, Section 11(a)(ii) Ambient Standards; EPA environmental noise guidelines

Drilling and Construction	
Pipelines	
Pipelines would cross streams according to the requirements of permitting under Section 404 of the Clean Water Act.	WDEQ, Water Quality, Chapter II, Sections 1 and 2(a); Clean Water Act, 33 USC 1251 et seq.
At least 30 days prior to construction, Lance would prepare a Stormwater Pollution Prevention Plan and file a Notice of Intent with the WDEQ.	WDEQ, Water Quality, Chapter II, Sections 9(c), 10(a)(6), and 12(b) through (d); Clean Water Act, 33 USC 1251 et seq.
Produced Water	
The produced water outfall points would be discharged on the surface for beneficial use. Lance would monitor discharge points in accordance with WDEQ NPDES permit requirements.	WDEQ, Water Quality, Chapter II, Section 3(a)(1) and (2); Clean Water Act, 33 USC 1251 et seq.
Lance has committed to a sampling and analysis program as well production results in produced water discharges. Details of the sampling program are contained in the Hydrology Report (Greystone, 2002a, p. 10).	WDEQ, Water Quality, Chapter II, Section 3(a)(1) and (2); Clean Water Act, 33 USC 1251 et seq.
Decommissioning and Reclamation	
Lance would plug and abandon each well according to WOGCC requirements.	WOGCC regulations, Chapter 3, Section 14
Applicant-Committed Mitigation Measures	
Drilling and Construction	
General	
Onsite inspections of USFS portions of the Proposed Action have been conducted by representatives of the USFS, BLM, and Lance, and resultant mitigation measures have been incorporated into this EA	NEPA, 42 USC 4321 et seq; 40 CFR Parts 1500-1508; 43 CFR 3162.3-1(f); 43 CFR 3162.5-1; Onshore Oil and Gas Order No. 1 - Approval of Operations on Onshore Federal and Indian Oil and Gas Leases, III.C., III.G.5
Lance has offered a water well agreement to nearby landowners to ensure that water wells would be protected all from unintentional effects of CBNG development associated with the proposed project. The agreement would apply to all wells that lie within 0.5 mile of the wells proposed for the Thunderhead 1, 2, and 3 PODs. A list of all water wells that are located within those limits is included in the Hydrology Report (Greystone, 2002a). A typical water well agreement is included in Appendix E.	Onshore Oil and Gas Order No. 1 - Approval of Operations on Onshore Federal and Indian Oil and Gas Leases, III.G.4.(a)(2); Onshore Order No. 2 Drilling III.B.; Safe Water Drinking Act 42 USC 300 et seq; WDEQ, Water Quality, Chapter II, Section 3(a)(1) and (2); Clean Water Act, 33 USC 1251 et seq.
Lance would require staff and contractors to safely operate motor vehicles to minimize the risk of collisions with wildlife, would acquaint staff and contractors with applicable wildlife laws, and would discipline workers violating such policies and laws.	Occupational Safety and Health Act, OSHA, 20 USC 651 et seq.

Lance would use watering or other dust control techniques to reduce fugitive dust emissions from traffic on unpaved roads.	WDEQ, Air Quality, Chapter 3, Section 2(f)); Clean Air Act, 42 USC 7401 et seq.
Lance would prohibit staff and contractors from illegal collection or destruction of cultural resources and would discipline workers violating such policies and laws.	Company policy
Firearms and dogs would not be allowed within the Project Area and Lance drug, alcohol, and firearms policies would be rigorously enforced.	Company policy
Lance would implement hiring policies that would encourage the employment of area residents and, to the extent feasible, would purchase equipment and materials from local area merchants.	Company policy
Lance would monitor and remove carrion along roads to minimize the attraction of scavenging raptors.	Company policy
Paleontological Resources	
Lance has conducted a pedestrian paleontological survey of portions of the Project Area with high potential for discovery of vertebrate fossils and has prepared a monitoring and mitigation plan.	30 USC Section 226(g), Mineral Leasing Act of 1920; 43 CFR 3162.3-1(f); 43 CFR 3162.5-1; FSM 2100 Environmental Management and FSM 2800 Minerals and Geology
Roads	
Lance submitted a Transportation Plan that assists the USFS in the completion a Roads Analysis Plan for efficient transportation management.	Forest Service Handbook 7709.55 – Transportation Handbook; 30 USC Section 226(g), Mineral Leasing Act of 1920; 43 CFR 3162.3-1(f); Onshore Order #1, III.G.4.(b)(2); BLM Gold Book; FSM 2100 Environmental Management and FSM 2800 Minerals and Geology
Lance will limit access from public to private lands at the request of private landowners.	Company policy
Produced Water	
Prior to the discharge of any proponent produced CBNG water, Lance will fill the holes behind the Little Thunder Dam spillway walls with compatible materials located on site or a bentonite mixture.	30 USC Section 226(g), Mineral Leasing Act of 1920; 43 CFR 3162.3-1(f); 43 CFR 3162.5-1; Onshore No. 7 Disposal of Produced Water III.G
Prior to the discharge of any proponent produced CBNG water, Lance will submit plans to armor the area between the embankment and the spillway on Little Thunder Reservoir, and after the plans are approved by the Forest Service official, implement the armoring.	30 USC Section 226(g), Mineral Leasing Act of 1920; 43 CFR 3162.3-1(f); 43 CFR 3162.5-1; Onshore No. 7 Disposal of Produced Water III.G

Production Facilities	
A metal fence or rail may be placed around well houses and electrical panels to protect them from livestock or big game animals.	30 USC Section 226(g), Mineral Leasing Act of 1920; 43 CFR 3162.3-1(f); Onshore Oil and Gas Order No. 1 – Approval of Operations on Onshore Federal and Indian Oil and Gas Leases 48 FR 48916 (1983). VII.; FSM 2100 Environmental Management and FSM 2800 Minerals and Geology
Well houses would be painted in a color specified by the USFS and/or BLM to minimize visual impact. The facilities would be painted within six months after being installed. Any facility requiring safety colors to meet the Wyoming Occupation Health and Safety (WOSH) Standards would be painted to meet WOSH standards.	30 USC Section 226(g), Mineral Leasing Act of 1920; 43 CFR 3162.3-1(f); FSM 2100 Environmental Management and FSM 2800 Minerals and Geology; WY OSHA Development Plan, 40CFR 1910 and 1926
Pipelines	
Lance would prohibit construction or routine maintenance activities during periods when soil is too wet to adequately support construction equipment. Pipe would be buried and open trenches closed as soon as practical.	30 USC Section 226(g), Mineral Leasing Act of 1920; 43 CFR 3162.3-1(f); FSM 2100 Environmental Management and FSM 2800 Minerals and Geology
Construction of pipelines would be planned to minimize impact to public use of existing roads and trails, or inhibit wildlife or livestock movement.	30 USC Section 226(g), Mineral Leasing Act of 1920; 43 CFR 3162.3-1(f); FSM 2100 Environmental Management and FSM 2800 Minerals and Geology
Trees would be avoided during construction. Disturbance to areas of heavy sagebrush cover would be avoided as planned in on-site inspections. Soils would be left undisturbed over most of the construction work area.	30 USC Section 226(g), Mineral Leasing Act of 1920; 43 CFR 3162.3-1(f)
Reclamation would begin immediately after the pipeline is buried, weather permitting.	30 USC Section 226(g), Mineral Leasing Act of 1920; 43 CFR 3162.3-1(f); Onshore Oil and Gas Order No. 1 – Approval of Operations on Onshore Federal and Indian Oil and Gas Leases 48 FR 48916 (1983). VII.; FSM 2100 Environmental Management and FSM 2800 Minerals and Geology
Production and Maintenance Operations	
General	
Lance routinely performs monitoring and treatment of weed infestations on its properties. Identified populations of weeds will be brought to the attention of the Forest Service and corrective actions will be determined and performed.	30 USC Section 226(g), Mineral Leasing Act of 1920; 43 CFR 3162.3-1(f); 43 CFR 3162.5-1; FSM 2100 Environmental Management and FSM 2800 Minerals and Geology; Executive Order 13112-Invasive Species
Lance would repair/replace required fences as necessary in order to prevent cattle access to project facilities.	Company policy
Produced Water	
Produced water would be beneficially used for stock and livestock watering where possible.	WDEQ, Water Quality, Chapter II, Section 3(a)(1) and (2); WDEQ, Water Quality, Chapter II, Section 3(a)(1) and (2); Clean Water Act, 33 USC 1251 et seq.; 43 CFR 3162.3-1(f)

A project Water Management Plan (Hydrology Report, Greystone, 2002a) was developed and submitted to the USFS to anticipate produced water volumes and effectively manage its disposition.	Final Environmental Impact Statement and Proposed Plan Amendment for the Powder River Basin Oil and Gas Project; 43 CFR 3162.3-1(f); Forest Service Manual (FSM) 2100 Environmental Management and FSM 2800 Minerals and Geology
At the request of local landowners or surface lessees, Lance would install stock tanks to receive produced water. The stock tanks will be designed site-specifically, using best management practices, to accommodate livestock access to water, control erosion, and limit sedimentation. Plans for flow-through stock tanks were reviewed during the onsite inspection.	Onshore Oil and Gas Order No. 1 – Approval of Operations on Onshore Federal and Indian Oil and Gas Leases 48 FR 48916 (1983). VII
Lance would monitor each discharge point on a monthly basis during the first year of operation. Inspectors would note the condition of the discharge point, check for evidence of accelerated erosion due to continuous discharge of produced water, and schedule any remedial work if required. After the first year of operation, inspections would only occur annually, unless specific sites have required remedial action. Monthly monitoring of sites requiring remedial action would continue until no further remedial action involving the redesign of the discharge point has been required for a period of one year. Dam outlets (spillways and pipes) and culvert outlets would be checked quarterly or after major storm events for the first year of operation. Erosion stabilization measures (headcuts, etc.) would be inspected for signs of erosion or structural failure. Inspectors would note condition and schedule any remedial work if required. Downstream channel (below the well(s)/project) would be inspected for signs of accelerated erosion due to the continuous flow of produced water. After the first year of operation, inspections would occur annually unless specific sites have required remedial action.	30 USC Section 226(g), Mineral Leasing Act of 1920; 43 CFR 3162.3-1(f); 43 CFR 3162.5-1; Onshore No. 7 Disposal of Produced Water III.G
If increased erosion is observed in the channel of Little Thunder Creek or its tributaries related to the discharge of CBNG produced water, engineering measures would be applied in the impacted areas to prevent further erosion	30 USC Section 226(g), Mineral Leasing Act of 1920; 43 CFR 3162.3-1(f); 43 CFR 3162.5-1; Onshore No. 7 Disposal of Produced Water III.G
Decommissioning and Reclamation	
General	
Lance would follow agency procedures or surface owner specifications designed to reclaim disturbed areas as close to pre-development conditions as possible.	30 USC Section 226(g), Mineral Leasing Act of 1920; 43 CFR 3162.3-1(f); Forest Service Manual (FSM) 2100 Environmental Management and FSM 2800 Minerals and Geology

Roads	
Unneeded constructed roads would be blocked, re-contoured, reclaimed, and revegetated consistent with the requirements of the BLM, USFS, and the State of Wyoming.	30 USC Section 226(g), Mineral Leasing Act of 1920; 43 CFR 3162.3-1(f); Onshore Order #1, III.G.4.(b)(2); Onshore Oil and Gas Order No. 1 – Approval of Operations on Onshore Federal and Indian Oil and Gas Leases 48 FR 48916 (1983); Forest Service Manual (FSM) 2100 Environmental Management and FSM 2800 Minerals and Geology
Two-track roads scheduled for decommissioning would be reclaimed by ripping or plowing and drill seeding if deemed necessary by the USFS.	30 USC Section 226(g), Mineral Leasing Act of 1920; 43 CFR 3162.3-1(f); Onshore Order #1, III.G.4.(b)(2); Onshore Oil and Gas Order No. 1 – Approval of Operations on Onshore Federal and Indian Oil and Gas Leases 48 FR 48916 (1983). VII.; Forest Service Manual (FSM) 2100 Environmental Management and FSM 2800 Minerals and Geology
Well Sites	
Well sites would be re-contoured, plowed, and seeded consistent with the procedures described in the APD SUPO or COAs.	30 USC Section 226(g), Mineral Leasing Act of 1920; 43 CFR 3162.3-1(f); Onshore Oil and Gas Order No. 1 – Approval of Operations on Onshore Federal and Indian Oil and Gas Leases 48 FR 48916 (1983). VII.; Forest Service Manual (FSM) 2100 Environmental Management and FSM 2800 Minerals and Geology

The actions described in Alternative B are consistent with the oil and gas lease standards and guidelines, stipulations described in the TBNG LRMP, and standard COAs for CBNG wells on USFS lands, as detailed in the 1994 ROD for the TBNG LRMP/FEIS. Most of the leases were issued prior to the finalization of the TBNG LRMP, and lease stipulations reflect management policies in practice when the 1987 *Medicine Bow National Forest Land and Resource Management Plan* was effective; however, at the behest of the USFS, Lance agreed that all operations performed in association with the Proposed Action would be subject to standards and guidelines described in the TBNG LRMP. Standard COAs for CBNG wells on the TBNG would also apply and are listed in Appendix D of this EA. In addition, site-specific COAs were developed by the TBNG for each of the proposed wells. Site-specific COAs are listed in Appendix D.

Most of the TBNG LRMP standards and guidelines that would affect the Proposed Action are biological in nature and are more extensive than those contained in the leases. Other lease stipulations include the requirements for conducting surveys for cultural and paleontological surveys prior to undertaking any surface disturbing activities. The TBNG LRMP biological standards and guidelines are summarized in Table 2.3-10.

Table 2.3-10 TBNG LRMP Biological Oil and Gas Standards and Guidelines

Timing Limitations (TL)	Start	End	TBNG LRMP	Waivers and Exceptions
Ferruginous and Swainson's hawk nests	3/1	7/31	0.5-mile radius (LOS)	No nesting activity past 7 years
Golden eagle nests	2/1	7/31	0.5-mile radius(LOS)	No nesting activity past 7 years
Merlin nests	4/1	8/15	0.5-mile radius(LOS)	No nesting activity past 7 years
Sharp-tailed grouse leks	3/1	6/15	1.0-mile radius(LOS)	No display activity past 2 years or no current activity by May 1
Sage grouse leks	3/1	6/15	2.0-mile radius(LOS)	No display activity past 5 years or no current activity by May 2, max noise 49 dBA
Mountain Plover nest areas	3/15	7/31	0.25-mile radius(LOS)	No nests or no active nesting by 6/10
Black-footed Ferret habitat	3/1	8/31	0.125-mile radius of prairie dog colonies potentially inhabited by BFF(LOS)	Survey clearances
Swift fox dens	3/1	8/31	0.25 mile radius(LOS)	No dens or demonstration of acceptable impacts
Controlled Surface Use (CSU)	**TBNG LRMP**			**Waivers and Exceptions**
Black-footed Ferret habitat	80-ac spacing, lost habitat replace 1 yr, minimize new roads, daylight operations			Unlikely
Mt. Plover habitat	80-ac spacing, lost habitat replace 1 yr, minimize new roads, 9am-5pm operations			Unlikely
No Surface Occupancy (NSO)	**TBNG LRMP**			**Waivers and Exceptions**
Mountain Plover nests and nest areas	0.25-mile known nests			Unlikely
Bald Eagle nests	1.0-mile known nests(LOS)			Demonstration of non-occupation last 7 years
Bald Eagle winter roosts	1.0-mile known roosts(LOS)			Roost no longer active or acceptable impact
Golden eagle, burrowing owl, merlin, Ferruginous hawk, Swainson's hawk nests	0.25-mile known nests(LOS)			Demonstration of non-occupation last 7 years
Sharp-tailed and Sage grouse leks	0.25-mile active leks(LOS)			Demonstration of non-activity last 2 seasons (sharp-tailed) or 5 seasons (sage), or acceptable impacts

LOS - Line of Sight

2.4 ALTERNATIVE C - MODIFIED DEVELOPMENT SCENARIO

Alternative C is nearly identical to Alternative B, the Proposed Action. Alternative C was developed in response an issue identified during the scoping process:

Adverse impacts to sage grouse and ferruginous hawks could result from the connecting routes and well sites for the wells 14-8 and 23-8 in Thunderhead POD 1 and 21-11 and 12-11 in Thunderhead POD 2, Township 43 North, Range 71 West.

Alternative C was developed to eliminate proposed wells and the roads that could possibly adversely impact sage grouse leks and ferruginous hawk nests. One or more ferruginous hawk nests in Section 11 were reported as active within the last seven years. During the biological surveys conducted in association with the proposed project, the exact location and current status of the nest(s) could not be verified. Alternative C was developed, in part, to avoid possible disturbance to ferruginous hawk habitat. The two well locations removed from Alternative C could not be moved outside of the ¼-mile (line-of-sight) buffer of the two most recently identified nest sites. The Stuart II sage grouse lek is located in Section 8 within ¼-mile of the proposed Federal 14-8-4371 and Federal 23-8-4371 wells. Although activity has not been reported on this lek since 1992 (Greystone, 2002, page 13), these wells were omitted in this alternative.

Under Alternative C, Lance would drill and operate 28 CBNG wells within Thunderhead 1, 2, and 3. Four of the wells proposed under Alternative B would not be drilled, and the routes that would connect them would not be constructed. All of the omitted wells and roads would have been located on TBNG surface. Additional infrastructure not included under Alternative B but present in this alternative includes the construction of a two-track access road, designated as W0811 in the Transportation Plan (Greystone, 2002). This road would be constructed in Thunderhead 1 and would be approximately 1,668 feet in length, or approximately 0.32 mile long. The road would connect wells Federal 34-8-4371 and Federal 43-8-4371 in the SE quarter of Section 8. Major facilities that would be constructed under Alternative C are shown in Figure 2.4-1. A summary of short and long-term disturbance associated with the 28 wells considered in Alternative C is indicated in Table 2.4-1.

Table 2.4-1 Disturbance Associated with the Alternative C; Thunderhead 1, 2, and 3[1]

Facility		Short-Term Maximum Disturbance (Acres)			Long-Term Maximum Disturbance (Acres)		
		USFS	Private	Total	USFS	Private	Total
Well Sites	28	6.4	0	6.4	2.8	0	2.8
Central Gathering Facilities	3	0.25	0.5	0.75	0.25	0.5	0.75
Discharge Points	3	0.5	0.25	0.75	0.5	0.25	0.75
Roads	10.5 miles	30.7	2.9	33.6	13.5	1.1	14.6
Pipelines/Utility	10.7 miles	11.4	19.7	31.1	0	0	0
Sub-Total	-	49.3	23.4	72.6	17.1	1.8	18.9

Facility		Short-Term Maximum Disturbance (Acres)			Long-Term Maximum Disturbance (Acres)		
		USFS	Private	Total	USFS	Private	Total
Reclaimed roads	8.9 miles	-	-	-	13.0	0	13.0
Total	-	49.3	23.4	72.6	4.1	1.8	5.9

Adapted from Greystone, 2003
[1] Minor discrepancies in totals due to rounding

Facilities, including wells and roads, included under the Proposed Action that would not be developed or constructed under this alternative are shown in Table 2.4-2.

Table 2.4-2 Facilities Not Included in Alternative C

POD	Facility Name	Location	Well Site Disturbance (acres)		Road Length and Disturbance			
			Short Term	Long Term	Feet	Miles	Short Term[1] (acres)	Long Term (acres)
Thunderhead 1	Federal 23-8-4371	T43N/R71W, Section 8: Lot 11 (NESW)	0.23	0.1	-	-		
	Federal 14-8-4371	T43N/R71W, Section 8: Lot 13 (SWSW)	0.23	0.1	-	-		
	Roads 932A6 (2T); 932A6A[2](2T) and adjacent pipeline	T43N/R71W, SW and NE quarter of Section 8			3,649	0.7	2.1	1.0
	Tire tank	Federal 23-8-4371 well in Section 8	NA	NA	-	-		
Thunderhead 2	Federal 21-11-4371	T43N/R71W, Section 11: Lot 03 (NENW)	0.23	0.1	-	-		
	Federal 12-11-4371	T43N/R71W, Section 11: Lot 05 (SWNW)	0.23	0.1	-	-		
	Road W1112 (2T) and adjacent pipeline	T43N/R71W, W half of Section 11			3,688	0.7	2.1	1.0
Total[3]			0.9	0.4	7,337	1.4	4.2	2.0

Source: Adapted from Greystone, 2002 and 2003
[1] Includes road and pipeline disturbance
[2] Transportation Plan designations (Greystone, 2002)
[3] Minor discrepancies in totals due to rounding

If Alternative C were implemented, total short-term disturbance would be approximately 73 acres, including 49 acres on TBNG lands, or approximately 4 acres fewer than the short term disturbance associated with Alternative B. After interim reclamation, the total long-term disturbance would be approximately six acres, four acres of which would be on TBNG land. Alternative C would result in two fewer acres of long-term disturbance than that associated with Alternative B.

Figure 2.4-1 Modified Development Scenario Map

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All COAs and mitigation measures that would be applied to the 32 wells described in the Proposed Action would also apply to the development of the 28 wells in Alternative C. The actions included in this alternative are consistent with the lease stipulations, the TBNG COAs, and the standards and guidelines in the TBNG LRMP.

2.5 IMPACT AND MITIGATION MONITORING AND REPORTING

The Mitigation and Monitoring Plan is considered "strategic" for purposes of the Project's monitoring and evaluation effort. It is strategic in that it provides a conceptual framework within which specific monitoring and evaluation criteria can be built. The plan is intended to be a flexible component that could change as new methodologies and techniques are developed throughout the life of this project. This section does not display all of the specific monitoring and evaluation criteria for any particular resource. Other criteria are found throughout this EA, in the COAs, the SUPO, the APDs, and the TBNG LRMP. The measures outlined below are not exclusive of other measures but are detailed to provide guidance to those persons who are obligated to carry out this task and produce the required documentation.

Lance, in cooperation with the USFS, will develop a specific monitoring program to:

- Verify implementation of mitigation measures adopted in the Decision Notice;
- Measure the success of implemented mitigation measures;
- Modify measures as needed based on observed performance;
- Allow for peer review of measures effectiveness; and
- Provide feedback to interested public.

The following resources are of particular concern; however, this plan may be amended, as determined by the authorized officer, at any time when it is warranted.

- Air Quality
- Wildlife, including raptors
- Water – groundwater, surface water, wetlands, and riparian areas
- Aquatics
- Surface disturbance/revegetation/noxious weed spread.

The following table will be utilized and added to or otherwise amended to meet specific requirements as analyzed in the EA. The USFS will require a buy-off on the program, the tasks to be implemented and monitored, and the acceptance of a final plan prior to commencement of activity on the part of the operator.

Table 2.5-1 Mitigation and Monitoring Plan for the Thunderhead PODs

Resource to be Monitored	Person or position Responsible for accomplishment	Frequency/timing	Reason for Monitoring	Notes
Air quality	Operator will maintain contact with and abide by all regulations imposed by EPA and WYDEQ.	Prior to construction activities and during routine operations.	To ensure air quality remains within state specified air quality constraints.	Operator will maintain documentation of all required permits and notifications.
Sage grouse lek locations	USFS Wildlife Biologist will review all new site locations and concur or not.	During or after survey/staking and prior to activity commencing.	To protect individuals, or their habitat from encroachment or disturbance.	Operator will maintain close contact with Project Manager and /or Biologist for review and concurrence.
Raptor nest locations	USFS Wildlife Biologist will review all new site locations and concur or not.	During or after survey/staking and prior to activity commencing.	To protect individuals, or their habitat from encroachment or disturbance.	Operator will maintain close contact with Project Manager and /or Biologist to determine schedule.
Raptor protection or perch inhibitors on power lines	USFS Surface Protection Specialist or Lands Officer will verify installation.	During or after installation of all inhibitors or protections.	To protect individuals from electrocution or prevent them from utilizing power lines as hunting perches.	Operator will report installation of power lines to USFS Project Manager for field review and sign-off.
Water quality - groundwater	Operator will offer a water well agreement to nearby landowners to ensure that water wells would be protected all from unintentional effects of CBNG develop-ment associated with the proposed project. The agreement would apply to all wells that lie within 0.5 mile of the wells proposed for the Thunderhead 1, 2, and 3 PODs.	Prior to initiating construction activities.	To ensure nearby landowners with water wells have legal safeguards with respect to the water quality of their wells.	Operator will maintain documentation of all water well agreements, subsequent associated correspondence/docu ments if they/as they occur, and will submit documention to the USFS upon request.
Water quality – surface water	Operator will monitor each discharge point. Inspectors would note the condition of the discharge point, check for evidence of accelerated erosion due to continuous discharge of produced water, and schedule any remedial work if	Monthly during the first year after produced water is initially discharged to the surface. After the first year of operation, inspections would only occur annually, unless specific sites have required remedial action.	To maintain surface water quality.	Operator will maintain documentation of all inspection forms, will inform the USFS if remedial action is necessary, and will submit documention to the USFS upon request.

Resource to be Monitored	Person or position Responsible for accomplishment	Frequency/timing	Reason for Monitoring	Notes
	required.	Monthly monitoring of sites requiring remedial action would continue until no further remedial action involving the redesign of the discharge point has been required for a period of one year. WDEQ NPDES monitoring requirements will also be met.		
	As long as Operator produced CBNG water from the project is reaching Little Thunder Reservoir, Operator will monitor seepage downstream of the Little Thunder Reservoir dam to (a) determine if seepage is increasing and/or whether seepage water is cloudy and/or carrying suspended solids and (b) check for sandboils and/or the formation of sinkholes on the embankment slopes/ crest, for whirlpools in the reservoir and for instability on the slopes.	Every three years and after significant (>10 year) storm events and be conducted by personnel familiar with dam inspections.	To maintain surface water quality and ensure reservoir integrity.	Monitoring results will be submitted to the USFS within 30 days after each inspection or within 2 days if problems are noted.
	Operator will check dam (spillways and pipes) and culvert outlets.	Quarterly, or after major storm events for the first year of operation.		Operator will maintain document-tation of all inspection forms, inform the USFS if remedial action is necessary, and submit document-tation to the USFS upon request.

Resource to be Monitored	Person or position Responsible for accomplishment	Frequency/timing	Reason for Monitoring	Notes
	Operator will inspect erosion stabilization measures (headcuts, etc.) for signs of erosion or structural failure. Inspectors will note condition and schedule any remedial work if required. Down-stream channels (below the well(s)/ project) will be inspected for signs of accelerated erosion due to the continuous flow of produced water. If increased erosion is observed in the channel of Little Thunder Creek or its tributaries related to the discharge of CBNG produced water, engineering measures would be applied in the impacted areas to prevent further erosion. Operator will submit plans to armor the area between the embankment and the spillway on Little Thunder Reservoir, and after the plans are approved by the FS official, implement the monitoring.	Monthly during the first year after produced water is initially discharged to the surface. After the first year of operation, inspections would only occur annually, unless specific sites have required remedial action. Monthly monitoring of sites requiring remedial action would continue until no further remedial action involving the redesign of the discharge point has been required for a period of one year.	To maintain surface water quality.	Operator will maintain documentation of all inspection forms, will inform the USFS if remedial action is necessary, and will submit documentation to the USFS upon request.
	Operator will commit to a sampling and analysis program as well production results in produced water discharges.	As specified in NPDES discharge permit requirements.	To ensure that surface water quality is not compromised with the discharge of CBNG produced water discharge.	Details of the sampling program are contained in the Hydrology Report (Greystone, 2002a, p. 10).

Resource to be Monitored	Person or position Responsible for accomplishment	Frequency/timing	Reason for Monitoring	Notes
Noxious weed control	Operator will routinely perform monitoring and treatment of weed infestations on its properties. Identified populations of weeds will be brought to the attention of the Forest Service and corrective actions will be determined and performed.	Annually.	To prevent the spread of noxious vegetation.	Operator will submit receipts for all herbicides, document their application and submit annually to USFS Project Manager.
Road and disturbed surface reclamation	Unneeded constructed roads will be blocked, re-contoured, reclaimed, and revegetated by the Operator consistent with the requirements of the BLM, USFS, and the State of Wyoming.	Subsequent to interim and final reclamation of any disturbed area.	To ensure that the landscape is returned to its original condition as much as possible.	Operator will submit receipts for all seed mix to verify "weed free" mixes are being used, and verify appropriate application rate for seed
Road use and Maintenance	The "maintenance program" will be submitted to the USFS by the Operator.	Prior to Project initiation.	To ensure that the construction and maintenance of roads will be performed to USFS standards.	Operator will submit a Transportation Plan to the USFS and secure its approval prior to construction.
Paleontological resources	Operator has conducted a pedestrian paleontological survey of portions of the Project Area with high potential for discovery of vertebrate fossils and will prepare a monitoring and mitigation plan.	Prior to Project initiation.	To protect paleontological resources from disturbance or destruction.	Operator will submit a Paleontological Monitoring Plan to the USFS and secure its approval prior to construction.
Cultural Resources	Operator will instruct its employees and contractors in procedures to be followed in the event of discovery of human remains as required by applicable regulations. Operator has conducted a Class III cultural resource survey of the Project Area and has prepared	Prior to Project initiation.	To protect cultural resources, including human remains, from disturbance or destruction.	Operator will submit a Cultural Resource Monitoring Plan to the USFS and secure its approval prior to construction.

Resource to be Monitored	Person or position Responsible for accomplishment	Frequency/timing	Reason for Monitoring	Notes
	a monitoring and mitigation plan.			

Where the Operator (Lance) is obliged to submit a monthly report, it will be assembled within the last week of each month and submitted within the first week of the next month. Where the Operator is obliged to submit an annual report, it will be assembled within the last week of the year and submitted within the first week of the next year.

2.6 COMPARISON OF ALTERNATIVES

Table 2.6-1 displays a quantitative comparison of the proposed new facilities among the alternatives. The quantitative comparison necessarily reflects the differences in the projected amounts of surface disturbance. A summary of the more substantial differences, as related to each alternative, is included in the column labeled "Comments." Qualitative and quantitative descriptions of the impacts to environmental resources under each alternative are discussed in detail in Chapter 3 under distinct resource area sections.

Existing facilities in and around the CBNG wells proposed for this project would continue to be used in their current capacity under all alternatives. Their use might be expanded as a result of ongoing hydrocarbon development and coal mining in the region. Five new culverts, six stock tanks, six gates, and six cattle guards would be installed be installed as part of the Proposed Action; however, their installation would not result in additional surface disturbance. Only five new stock tanks would be installed under Alternative C.

2.7 ALTERNATIVES CONSIDERED BUT NOT ANALYZED

Some of the issues originating from the scoping process suggested potential alternatives to the Proposed Action. Proposed alternatives are required to be technically and economically feasible and to provide the opportunity to achieve the Proposed Project (CEQ, Forty Questions, 2a). Alternatives considered but not analyzed in detail and the rationale for their exclusion in this document are described below.

Issue:
Restrict activities within one mile of any species habitat ranked by WYNDD G1-G3 or S1-S2, species ranked NSS or SSC 1, 2, or 3 by WG&F, black-footed ferret habitat, prairie dog communities, mountain plover nests, northern sage grouse leks and other types of habitats, raptor nests, permanent bodies of water and riparian area, wetlands, and area with special biological values.

Response:
Alternative C incorporates No Surface Occupancy (NSO) areas and timing limitations (TLs) as specified in the TBNG LRMP for sage grouse and ferruginous hawks. The USFS has incorporated other TBNG LRMP standards and guidelines for sensitive, threatened and endangered (T&E), and management indicator species in both alternatives.

Table 2.6-1 Comparison of New, Long-Term Disturbance among the Alternatives

Project Component	Alternative A No Action		Alternative B Proposed Action		Alternative C Modified Development		Comments
	number	acres	number	acres	number	acres	
Well Sites	0	0	32 wells	3.2	28 wells	2.8	Although no wells would be drilled under the No Action alternative, existing wells in the vicinity would continue to be produced and new wells would almost certainly be drilled on nearby non-federal and possibly federal leases.
Central Gathering Facilities	0	0	3	0.75	3	0.75	Three existing headers would also be used by the project and would continue to be used in their current capacity.
Discharge Points	0	0	3	0.75	3	0.75	Two existing discharge points would also be used by the project and would continue to be used in their current capacity.
New Roads	0	0	11.6 miles	16.2	10.5 miles	14.4	Under the No Action alternative, 16.7 miles of existing roads in the Project Area would continue to be used in their current capacity. Under Alternatives B and C, approximately 9.5 miles of existing roads would be used for project operations an 0.4 mile of existing road would be upgraded. Under Alternatives B and C, 8.9 miles of roads would be decommissioned.
Pipelines/Utility	0	0	0	0	0	0	Immediate reclamation of the utility and pipeline trenches after their construction would result in no long term surface disturbance.
Sub-Total	-	0	-	20.9	-	18.9	
Decommissioned Roads	0	0	8.9 miles	13.0	8.9 miles	13.0	
Total[1]	0	0	2.6 miles	7.9	1.5 miles	5.9	Amount of acreage disturbed after interim reclamation and road decommissioning

[1] Minor discrepancies in totals due to rounding

Issue:
No ground disturbing activities within big game winter range, parturition areas, and migration routes.

Response:
Restriction of ground disturbing activities in these areas would be enabled through the designation of NSO areas. Designation of an NSO area on the surface of a previously leased parcel would violate an operator's legal right to develop its leases, in accordance with its contractual agreement with the federal government. An oil and gas lease grants the lessee the "right to drill for, extract, remove, and dispose of all oil and gas deposits" from the leased lands, subject to the terms and conditions of the respective leases (BLM, 1992). The denial of the right to develop a valid lease would also result in the loss of federal royalties. The TBNG LRMP does not designate NSO areas for big game winter range in the Project Area.

Issue:
Mandate that all produced water from coalbed methane wells be re-injected.

Response:
Injection has been found to be technically and economically unfeasible for most CBNG production (BLM, 2003, pp. 2-65 through 2-67). Project Area produced water lacks appropriate receiving formations, would cause additional surface disturbance, and would result in water volumes sufficient to be adequately managed by discharge on to the surface.

Injection of produced water was eliminated from detailed analysis because a lack of suitable receiving formations. Produced water can only be injected into an aquifer that does not contain fresh and potable water (BLM, 1999, p. 5-16). Water quality of potential receiving aquifers has been determined to be too fresh. Injection into the producing coal seam would eliminate gas production since the coal needs to be de-watered to reduce formation pressure sufficiently to allow gas to flow to the surface. Potential deep aquifers examined for possible injection in the Project Area have been determined to be sufficiently saturated and of such low permeability that the anticipated volumes of produced water were insufficient to be economically and technologically handled. In addition, the receiving aquifer must be at least partially depleted to avoid over-pressuring the receiving aquifer (BLM 2003, pp. 3-54 through 3-55). Injection into deep formations, if it were technically feasible, would also remove good quality water from beneficial use on the surface.

Other considerations include the creation of additional surface disturbance and the lack of adverse effects resulting from the discharge of the projected volumes of water. Additional surface disturbance would be generated in order to develop the injection wells and associated pipelines and pumping facilities. The volumes of produced water associated with the project are small compared to those from episodic storm events and would be lost to conveyance within a relatively short distance from the discharge points. Lance has committed to mitigation measures designed to reduce erosion effects. Detailed discussion of the effects of discharging produced water to surface water quality and quantity are included in Section 3.4.2.

A detailed discussion of the potential for re-injecting produced water in the Powder River Basin is contained in the PRB O&G FEIS (BLM, 2003).

Issue:
Consider alternative routes into Thunderhead Plans of Development 2 and 3 that avoid or minimize crossing Forest Service lands.

Response:
Routes were developed for Thunderhead 2 and 3 PODs that would minimize the amount of road building/improvement needed on USFS land. The USFS July 2001 inspection of the 32 proposed routes determined that the routes chosen for the Proposed Action, Alternative B, were the least disruptive to USFS lands. Lance submitted a detailed roads plan (Greystone, 2002) to the USFS, which approved the plan.

Issue:
Consider the use of helicopters to provide transportation of personnel and equipment to construct and maintain header facilities.

Response:
The dominant Management Area Prescription allocations for the Project Area are 6.1 Rangeland with Broad Resource Emphasis and 8.4 Mineral Production and Development. Development of the project would be in compliance with the directives contained in Management Area Prescription 8.4. The description of the desired conditions includes: "Mineral operations of all types are emphasized to effectively and efficiently remove available commercial mineral resources, concurrent with other ongoing resource uses and activities……Restrictions on public use occur to ensure public safety and to avoid unreasonable interference with mineral operations. Visitors can experience frequent encounters with people, heavy equipment, and noise (TBNG LRMP p.3-26)."

The area is currently extensively developed for oil and gas exploration and production. The use of helicopters to transport personnel to and from headers would place unnecessary economic hardship on the operator for no reasonable cause.

Issue:
Require the use of directional drilling technologies by drilling only in areas with existing and maintained roads.

Response:
Requiring the operator to drill in areas accessible only by existing and maintained roads would require the operator to be able to access the leased minerals from directional well bores. Directional and horizontal drilling was eliminated from detailed analysis in this EA because of the shallow depth of the proposed wells (less than 1,000 feet). Any amount of offset from the vertical to that depth would require drilling a directional or horizontal well bore. These types of well bores can discourage or prevent efficient gas production by preventing the installation of well bore casing and disallowing efficient de-watering. The lower grade coals found in the Powder River Basin may not be competent enough to keep the well bore from collapsing in the

horizontal or deviated portion of the hole. Despite efforts to develop high capacity down hole pumps to de-water the coal seam, pumps have not been developed to operate in a horizontal well bore. Submersible pumps are limited in their placement in deviated well bores. Placement of pumps in nearly vertical sections of the well bore results in hydrostatic pressures that would reduce gas recovery.

Directional and horizontal drilling was also eliminated from detailed analysis due to the increased drilling costs, which could more than double total development costs from the mandatory use of specialized equipment and specially trained personnel.

Issue:
Designate new Research Natural Areas.

Response:
The designation of RNAs is a forest planning issue. RNAs are designated during revisions of forest plans. The revised TBNG LRMP is the appropriate level of analysis for RNA designation. RNAs were analyzed during the revision of the TBNG LRMP. No new RNAs were selected in the vicinity of the Project Area. Re-consideration of RNA designation is outside the scope of this analysis.

CHAPTER 3 - AFFECTED ENVIRONMENT AND ENVIRONMENTAL EFFECTS

This chapter summarizes the physical, biological, social, and economic environments of the Project Area and the potential changes to those environments due to the implementation of the alternatives. Environmental consequences are discussed in terms of the relationship of the alternative being discussed to the Project Area. Determination of the resources analyzed in this EA resulted from input received during the scoping process.

Cumulative effects of the proposed CNBG project were analyzed with respect to additional CBNG development, conventional oil and gas development, coal mining, livestock grazing, and dispersed recreation, primarily hunting. These activities may not affect every resource but were considered, as appropriate. The scope of each cumulative effects analysis is based upon guidance received from the TBNG. The areas considered for each resource under cumulative effects differs according to the TBNG guidance. The cumulative effects analysis for water resources encompasses the Little Thunder Creek watershed. Cumulative effects to minerals development (including additional CBNG development, conventional oil and gas development, and coal mining), noise, and land use (including dispersed recreation, primarily hunting) and wildlife were considered with respect to a two-mile buffer from the boundaries of the Project Area. The two-mile boundary was chosen because it reflects the maximum distance for which direct and indirect effects to various wildlife species are considered important as indicated by the Standards and Guidelines in the TBNG LRMP. A thorough discussion of the potential cumulative effects of CBNG development in conjunction with other past, present and reasonably foreseeable activities in the Powder River Basin Project Area is included in the PRB O&G FEIS (BLM, 2003), Chapter 4. Those activities include conventional oil and gas exploration and development, agriculture, urban and rural housing development, coal mining, livestock grazing, construction of roads and railroads, and gravel mining.

Mitigation measures that apply to Alternative B throughout the following analyses would also apply to Alternative C unless otherwise noted.

3.1 GEOLOGY, MINERALS, AND PALEONTOLOGY

3.1.1 Affected Environment

3.1.1.1 Physiography and Topography

The Project Area is in the southeastern portion of the large structural feature known as the Powder River Basin (PRB). The PRB is bounded by the Black Hills on the east, the Big Horn Mountains on the west, the Hartville Uplift, Casper Arch, and Laramie Mountains on the south, and the Miles City Arch on the north. These features are the source of basin sediments.

Elevations in the Powder River Basin range from 2,500 feet to greater than 6,000 feet above mean sea level. The major river valleys have flat floors and broad floodplains (BLM, 2003, pp. 3-56 to 3-57).

The Project Area lies within the portion of the TBNG designated by the USFS as the Hilight Bill Geographic Area, which contains approximately 100,000 acres. Topographic features are shown in Figure 2.2-1. The proposed project lies within the Little Thunder Creek watershed, a low gradient drainage basin with an average slope between four to six percent. Rolling hills, scattered scoria buttes, and gentle slopes characterize the area. Topographic highs of around 5,000 feet occur in buttes and hills flanking the watershed's perimeter and along the central to southern portion of the watershed; however, the Project Area itself displays little variation in elevation. Elevations in the Project Area average about 4,800 feet with an approximate high of 4,900 feet and a low of 4,770 feet. A small exposure of badlands is located in Section 14 to the east of POD 2. The drainages in the Project Area are incised, ephemeral or intermittent, and do not provide year-round water sources. The Project Area is principally drained by the ephemeral Little Thunder Creek which flows to Black Thunder Creek approximately 25 miles to the east. Black Thunder Creek is a tributary of the Cheyenne River approximately 12 miles further downstream (Greystone, 2002a). Rochelle Lake, a large playa, is located between the three PODs at the lowest elevation.

3.1.1.2 Geology

The PRB is a northwest-southeast trending asymmetric structural basin filled with Cenozoic sediments of continental origin that were derived from surrounding uplifted areas. The basin was formed during the Laramide Orogeny (mountain building era) about 60 million years ago (Glass and Blackstone, 1999). Basin sediments attain a maximum thickness of more than 6,500 feet along the basin axis. The basin exhibits steeply dipping beds on the western flank and a broad area of more gently dipping strata on the eastern flank. Subsurface anticlines and synclines were formed by tectonic and compressive forces on coal seams. The westward dip and subsurface structure result in different depths for wells drilled to the same stratum. They are also the causes of different water recharge rates and water production rates associated with different levels of the same stratum.

The deeply buried synclinal structure of the PRB is not directly reflected in the landscape of Campbell County. Individual topographic features are the result of differences in the erosional characteristics of the flat-lying Tertiary bedrock layers, downward and lateral cutting by streams through rocks of uniform erosional character, and minor subsidence associated with the natural burning of coal seams.

The stratigraphy beneath the Project Area is discussed with respect to the formations that would be impacted by project development. A stratigraphic column showing formations that are sources of hydrocarbons in and near the Project Area is shown in Figure 3.1-1.

Figure 3.1-1 Stratigraphic Column Showing Main Producing Formations

Era	Period		Powder River Basin East		Producing Formations In and Near the Project Area
Cenozoic	Tertiary	Eocene	Wasatch		
		Paleocene	Fort Union	Tongue River	■
				Lebo	
				Tullock	
Mesozoic	Cretaceous	Upper	Lance		
			Fox Hills		
			Pierre		
				Teapot	■
				Parkman	■
				Sussex	■
			Niobrara		■
				Sage Breaks	
			Carlile		
				Turner Sd	■
			Greenhorn		
			Belle Fourche		
		Lower	Mowry		
				Newcastle - Muddy	■
				Skull Creek	
			Inyan Kara Group	Fall River - Dakota	■
				Fuson	
				Lakota	
	Jurassic	Upper	Morrison		
			Sundance	Upper Sundance	
				Lower Sundance	
		Middle	Gypsum Spring		
		Lower			
	Triassic				
			Spearfish		
Paleozic	Permian		Goose Egg		
			Minnekahta		
			Opeche		
	Pennsylvanian		Minnelusa		
	Mississippian		Bell		
			Pahasapa		
	Devonian	Upper	Englewood		
		Middle			
		Lower			
	Silurian				
	Ordovician	Upper	Whitewood		
		Middle	Roughlock- Ice Box - Aladdin		
		Lower			
	Cambrian	Upper	Deadwood		
		Middle			
		Lower			

Source: Modified from, Kinnison, P. T., 1970, Future Petroleum Potential of Powder River Basin, Southeastern Montana and Northeastern Wyoming, in Future petroleum provinces of the United States, a summary; National Petroleum Council's Committee on Possible Future Petroleum Provinces of the U.S., Washington, D.C.

Surficial outcrops occur primarily along drainages and consist of a thin veneer of Quaternary alluvial deposits overlying Tertiary geologic formations. The youngest geologic formations exposed on the surface consist of Holocene and Pleistocene age sands, silts, clays, and gravels deposited by in-situ erosion, surface flows, or wind. The deposits vary in depth from approximately one to 25 feet (USGS, 1978). Permeable layers form shallow aquifers.

Below the surficial deposits, and next youngest in age, is the Wasatch Formation. The Wasatch Formation (Eocene Epoch) is drab-brown and gray claystone and siltstone with thick lenses of coarse sandstone and thin layers of coal (Love et al., 1987). The Wasatch varies in thickness from approximately 45 to 140 feet, averaging about 110 feet under the Project Area. The Wasatch Formation's shallow aquifers are used for stock water. Near-surface burning of the Wasatch coalbeds burned and baked the coal and surrounding rock layers during the Quaternary or Upper Tertiary Period. The altered rock, referred to as scoria or clinker, collects water and feeds springs and underlying aquifers. In the eastern part of the Little Thunder watershed and in areas along the perimeter of the watershed, the altered layers cap several buttes.

The Fort Union Formation lies below the Wasatch. It is a light-brown and gray sandstone and shale that contains thick coal beds and is considered a major aquifer. The Fort Union contains an abundance of low concentrations of biogenic methane. The Tongue River Member of the Fort Union Formation (Paleocene Epoch) contains the Wyodak coal seam, which is the formation objective for the proposed project. The coal seam varies from approximately six to 169 feet in thickness and provides water for nearby stock water wells. The Fort Union Formation is exposed throughout the central and eastern portions of the Little Thunder Creek watershed, while the Wasatch Formation outcrops primarily to the west (USGS, 1992). The division between the two outcrops occurs approximately four miles east of Little Thunder Reservoir.

3.1.1.3 Minerals

Mineral resources extracted near the Project Area include leasable minerals such as conventional oil and gas, CBNG, and coal and salable minerals such as sand and gravel.

Oil and Gas. Wyoming ranks seventh among states nationally in oil production and fourth in gas production, accounting for 2.8 percent and 3.5 percent of national production, respectively (BLM, 2002). Campbell County is a major contributor to Wyoming's petroleum production. According to 2000 Wyoming Oil and Gas Conservation Commission (WOGCC) production statistics, Campbell County is the states' leading oil producer, accounting for 22.3 percent of total Wyoming production. The county ranks fourth in gas production, at 12.3 percent of state totals. Wyoming's annual oil production increased during the 1950s and 1960s, peaking at nearly 160 million barrels in the early 1970s. Production of oil has been declining since, while gas production has continued to increase. During 2002, Wyoming produced approximately 55.5 million barrels of oil and 1,765 bcf of gas.

Conventional oil and gas exploration and production, defined in this EA as traditional, non-CBNG production, have occurred for many years within Campbell County, pre-dating the

current interest in CBNG development. The first commercial production in Campbell County was discovered at Adon Field in 1948 (Breckenridge et al., 1974). Conventional oil and gas production comes from a variety of Cretaceous strata. The principal reservoirs are formed by stratigraphic traps. Producing formations include the sandstones of the Lower Cretaceous Muddy and Dakota and the Upper Cretaceous Turner, Parkman, Sussex and Teapot, in addition to sandstone lenses within the Niobrara Shale (Breckenridge et al., 1974). Conventional oil and gas production in the county declined by about eight percent from 2001 to 2002 (CCEDC, 2001). Extensive conventional oil and gas development is not expected in the foreseeable future

CBNG is formed differently from conventional oil and gas. In the PRB, CBNG was formed as buried plant material subjected to bacterial activity during emplacement of ground water and conversion to coal. CBNG in the basin is composed almost entirely of methane and nitrogen (BLM, 2003, p. 3-68).

Although CBNG development began in the basin in 1976, CBNG drilling increased dramatically beginning in 1997. By January, 2003, Wyoming produced nearly 30 bcf of CBNG monthly. PRB CBNG represented 18.5 percent of total Wyoming gas production in 2002 (WOGCC, 2003). Approximately 217 wells are currently active within an approximate two-mile radius of the proposed project wells (WOGCC, 2003). Most of these well produce CBNG. CBNG production occurs near the Thunderhead PODs in the Sager, Rochelle Lake, Little Thunder, South Thunderhead, Black Thunder, and East Black Thunder development projects.

Most CBNG wells are relatively shallow and can be less than 1,000 feet deep. Project wells are expected to produce from the relatively shallow Wyodak-Anderson coal seam of the Tongue River Member of the Fort Union Formation. High-rate low-volume water flush stimulation is sometimes required to facilitate production. Average gas production of typical wells ranges from 130 to 350 thousand cubic feet gas per day (mcfd) after the well has been depressurized for several months. Gas production is not constant during a life of a well and is typically highest during its early life, declining steadily thereafter. The average amount of water produced from a typical CBNG well ranges from approximately 200 barrels to 500 barrels of water daily (Ayers, 2002). An average amount of 400 mmcf of CBNG is estimated to be available per well during its productive life (BLM, 2003, p. 4-127).

Coal. The PRB contains some of the largest accumulations of low sulfur sub-bituminous coal in the world. A coal bed has strippable potential if it is five feet or more thick and overlain by 500 feet or less overburden. Coal from the basin is valued for its low sulfur content and clean-burning properties.

Wyoming surface mines supply the nation with approximately one-third of its steam coal needs and result in Wyoming ranking as the number one coal producing state (Lyman and Volkmer, 2001). In 2000, Campbell county mines produced approximately 300 million tons of coal, 88.4 percent of Wyoming's total coal production (CCEDC, 2003). The largest surface coal mining operations produce more than 100 million tons of coal annually (Bleizeffer, 2003).

Thick coal deposits occur at or near the surface all along eastern Campbell County where the Wyodak coal outcrops (BLM, 2003, pp. 3-66 - 3-68). There are 15 coal mines along a north-

south line that parallels Highway 59, starting north of Gillette, Wyoming and extending south for approximately 75 miles. The Wyodak coal seam is mined east of Hilight Road at the Black Thunder Mine and Jacobs Ranch Mine, about three and six miles east, respectively, of the Project Area. The Black Thunder Mine is operated by Thunder Basin Coal Company, which is owned by Arch Coal. At approximately 60 million tons per year, the Black Thunder Mine is the largest surface coal mining operation in North America. The Black Thunder Mine produces 4,000 pounds of coal every second, every day of the year (Arch Coal, 2004). The Jacobs Ranch Mine is operated by Kennecott Energy. The Jacobs Ranch mine is permitted to produce 50 million tons of coal a year and has averaged approximately 28 to 29 million tons of coal a year since 1998. Production in 2001 was 29.3 million tons (Kennecott Energy, 2002). Other coal mines in the vicinity include the North Rochelle Mine to the southeast.

The Thunder Basin Coal Company holds leases at the following locations that are either near or adjacent to the Project Area:

- T43N/R71W, Section 8, NENE;
- T43N/R71W, West ½ Section 9, excluding the SWSW;
- T43N/R71W, Section 17;
- T43N/R71W, Section 19, NENE; and
- T43N/R71W, Section 20, NWNW.

At this time, the company has no coal leases for the coal underlying the Project Area (O&G, 2003). It does, however, hold leases adjacent to the northwest portion of T43N/R72W in the west half of Section 12 and the east half of Section 11. Leases are also held north of these sections.

In March 2000, ALC, another subsidiary of Arch Coal, filed an application with the BLM for leasing some areas to the east of the Project Area that include some protions for the area considered for CBNG development in Thunderhead 2. Areas of potential overlap between coal mining and CBNG development include Sections 11 and 14. The application was analyzed in the South Powder River Basin Coal EIS (BLM, 2003b). A decision is expected to be rendered in 2004.

Salable Minerals. Federal minerals such as sand, gravel, and rock are governed by the Materials Act of 1947, as amended (30 USC 601 et seq.) and promulgating regulations found in 43 CFR 3610. These regulations authorize the government to sell federal mineral materials at fair market value. Sand and gravel deposits, consisting of alluvium and colluvium, may be found in alluvial fans or terrace deposits in the county. Scoria deposits have been mined at numerous locations throughout Campbell County. Sand and gravel are produced from terrace and alluvial deposits occurring near rivers and larger tributary streams. A gravel pit in Section 25, T43N/R72W is about one mile southwest of Thunderhead 3.

3.1.1.4 Paleontological Resources

Paleontological or fossil resources would be found, if present, where bedrock occurs at or near the surface. Alluvial sediments of the Wasatch and Fort Union formations are the only formations that are exposed in the Project Area. Abundant fossil vertebrates have been recovered from Paleocene strata in Wyoming, including the Fort Union Formation; however, few, if any, fossil vertebrates have been recovered from the Fort Union in the PRB (Winterfeld, 1982; Lillegraven, 1993). Within the TBNG, occurrences of scientifically significant fossils have been sporadic, consisting principally of reptilian remains (EVG, 2003; Winterfeld, 2003). Alluvial sediments in the Project Area are not likely to contain vertebrate fossils or scientifically significant nonvertebrate fossils (USFS, 2001a). Alluvium may contain fossil wood in surficial deposits overlying the Wasatch Formation (USGS, 1978b).

The USFS Rocky Mountain Region is cooperating with the BLM and the University of Wyoming in an experimental program to classify geological formations according to their probability of containing vertebrate fossil resources. The paleontological classification system is designed to provide USFS management with a way to prioritize protection of paleontological resources. Under this system, surficial formations are classified on a scale of 1 (lowest) to 5 (highest) to reflect the likelihood of containing vertebrate fossils. Paleo Class 5 formations include highly fossiliferous geologic units that regularly and predictably produce either vertebrate fossils or scientifically significant non-vertebrate fossils or both. For formations classified at levels 3 to 5, a pedestrian survey by a USFS-approved vertebrate paleontologist of potentially productive portions of a project area is required. Depending upon the results of the survey, monitoring and mitigation plans may be developed. The Wasatch Formation is ranked as Paleo Class 5. Vertebrate fossils have been found in the lower part of the Wasatch Formation in the southwestern part of the PRB (Delson, 1971). The Fort Union is ranked Paleo Class 3.

A paleontological resource evaluation of Thunderhead 1, 2, and 3 was conducted by Erathem-Vanir Geological (EVG) during July 2002. The evaluation consisted of a literature and records review followed by a field survey. The literature and records review indicated that although the types of Wasatch deposits found near the Project Area have yielded fossils, there are no known localities. Unpublished reports noted the sporadic occurrence of vertebrate fossils. The field survey found limited exposures of bedrock that yielded vertebrate fossil material at three locations in the vicinity of Little Thunder Reservoir and downstream along Little Thunder Creek. Fossil material included soft shell turtle shell fragments, crocodile scutes, and gar scales. Such remains are widespread and have little scientific significance (EVG, 2003).

3.1.1.5 Geologic Hazards

Seismic activity has occurred most recently in western Wyoming near Jackson. Nearer to the Project Area, a magnitude 3.5 earthquake occurred in February 2004 in central Converse County, adjacent to and south of Campbell County (WSGS, 2004). There are no known exposed active faults with surficial expression in Campbell County. Two historic earthquakes of magnitude 2.5 and greater have been recorded in southwestern Campbell County. The first recorded earthquake occurred in May 1967, and had a magnitude of 4.8. Its epicenter was approximately 15 miles to the southwest of the Project Area near Pine Tree Junction. In February 1993, a magnitude 3.6

earthquake occurred approximately 10 miles east of Reno Junction or approximately eight miles northeast of the Project Area. Probabilistic seismic hazard analyses indicate that area near Wright, Wyoming near the Project area may be subject to intensity VII earthquakes. In intensity VII earthquakes, damage is negligible in buildings of good design and construction (Case et al., 2002, p. 12).

Landslides are the slow or rapid down slope movement of rock and surficial materials. Conditions that contribute to landslides include steep slopes, exposure of shales or clays, exposure of brittle sandstones, and sandy, permeable materials on slopes underlain by clayey layers. Slope gradients in the Project Area are generally mild thereby reducing the likelihood that unstable soils may move. No landslide hazards have been documented in the Project Area. The nearest major landslide hazard areas are located on buttes approximately 22 miles west of the Project Area (WSGS, no date, map).

The Fort Union Formation is a consolidated rock unit that is not substantially dewatered during CBNG production. Minor aquifer compression up to ½-inch may have occurred in the coal beds that are being developed for CBNG in the Gillette area. To date, no surface subsidence has been associated with significant municipal water withdrawals in the Gillette area (Case et al., 2000, p. 3; Edgar and Case, 2000, p. 8). The compressibility of an aquifer decreases with increasing depth. Most regional settlement problems occur where shallow aquifers in sedimentary deposits exist close to the ground surface (Edgar and Case, 2000, p.8).

Some wind blown deposits occur near or within the Project Area (WGISC, 2002). Wind blown deposits present a potential hazard because they are subject to continuing migration unless they are stabilized by a good vegetative cover.

Abandoned underground mines have not been located in the vicinity of the Proposed Action.

Natural coal fires along coal outcrops in the PRB have occurred throughout the more recent geologic history of the area. Spontaneous combustion of coal is known to occur in both surface and underground mines, stockpiles and other coal storage facilities, along natural outcrops of coal, and where fine-sized coal particles are present. Spontaneous combustion of coal can be caused by its low temperature of oxidation in combination with absorption of moisture by dried or partially dried coal. The most vulnerable area in a PRB surface mine is at the foot of a coal highwall. Although spontaneous ignition of coal is common within the large surface mines of the PRB, the most dominant cause of fires along coal outcrops is now recognized as wildfires (Lyman and Volkmer, 2001, p. 3).

Historically, methane has been reported flowing from shallow water wells and coal exploration holes in parts of the PRB. Most the documented incidents occurred in the northern part of the basin (BLM, 2003, p. 3-7).

No other known geologic hazards are present within the Project Area.

3.1.2 Environmental Consequences

Concerns identified in the scoping process that relate to geological characteristics of the Project Area include:

- The identification and description of unstable or potentially mass-wasting slopes
- The effects of underground fires

3.1.2.1 Alternative A - No Action Alternative

No impacts to topography and physiography would occur as a result of project activities. Topography and physiography would continue to be modified by natural processes and may be otherwise impacted by nearby coal mining operations.

Under the No Action alternative, the natural gas reserves on federal lands in the Project Area would not be developed and thus would not be available to meet national energy demands. Lance's rights to develop their leases would be denied, which would violate the contractual agreements between the government and the leaseholders. Development of adjacent private and state leases may result in the incidental drainage and loss of federal natural gas reserves. The federal government would not benefit from royalties and taxes from the adjacent activities, although state and local governments would. Project-related economic activity, employment, and income would not be generated.

Under the No Action alternative, paleontological resources would not be adversely affected or potentially discovered as a result of project CBNG development. The surface coal mining near the Project Area could potentially excavate and destroy fossiliferous rocks.

Geologic hazards associated with the area would continue to exist in their current capacity.

3.1.2.2 Alternative B - Proposed Action

Impacts to topography and physiography from the Proposed Action would occur from the alteration of existing landscape features during construction of roads and well pads; however, because the Project Area is characterized by slight changes in slope and generally nondistinctive landscape features, it should retain its essential topographic characteristics. Reclamation procedures would restore disturbed surfaces to their original contours, further minimizing the impacts. Although short-term project-related disturbance totals approximately 77 acres, reclamation of roads and pipeline routes in addition to interim reclamation of the well sites would initiate restoration of the disturbed surfaces to current conditions almost immediately. Long-term disturbance consisting of eight acres comprises approximately 0.3 percent of the Project Area. Erosion could increase as a result of the construction of well locations, facilities, and pipelines during the time prior to the re-establishment of vegetation after reclamation is initiated.

The possibility of loss of potentially recoverable salable mineral resources is remote because only a small amount of surface would be impacted by development of the 32 proposed wells.

Locations of potentially salable minerals would have been identified during the July 2001 onsite inspections; therefore, no adverse impacts are expected to these resources.

Implementation of the Proposed Action would result in the irretrievable loss of the subsurface natural gas resource associated with the affected federal leases. Using an average life of well production rate per well of 400 mmcf, 32 wells would produce approximately 12.8 bcf of CBNG over the life of the project.

Adverse effects associated with geologic hazards could occur if they resulted from violation of federal and/or state construction regulations and standards. In addition, the BLM and USFS complete site-specific environmental analyses prior to the approval of ground disturbing activities. The agencies require site-specific information on landslide and slope stability for all areas where ground-disturbing activities are proposed. A small part of Section 14 in the proposed Thunderhead 2 POD exhibits areas of exposed bedrock with slopes of 15 to 20 percent; however, the small change in elevation results in no potential for mass wasting. The low, gentle slopes that characterize most of the Project Area are not predisposed to slumpage.

Impacts to project facilities on federal lands from earthquakes would also be mitigated by APD COAs. If similar construction standards are not employed on fee or state lands, there is a possibility that project facilities may be adversely affected by the occurrence of an earthquake.

Removal of ground water during CBNG dewatering could lead to surface subsidence and associated structural damage; however, the PRB Fort Union coal strata are compacted, consolidated, and lack porosity. Therefore, dewatering the coal is less likely to facilitate subsidence. Based upon known rock parameters in the PRB, modeling by the Wyoming State Geological Survey suggests that the maximum subsidence associated with CBNG production would be less than 1/2 inch. This small amount of subsidence would be unlikely to be fully transmitted to the surface (Case, et al., 2000).

Underground coal fires could potentially lead to surface fires and land subsidence. Conditions for spontaneous combustion associated with CBNG development, however, is unlikely for the following reasons:

- CBNG production results in reduction of oxygen necessary for spontaneous combustion within the coal. Any airflow is directed out of the coal seam, rather than into it. CBNG well design results in heat being vented away from the coal seam, reducing the possibility of combustion.

- Coal reacts with oxygen when temperatures are high; however, well bore construction effectively vents heat such that ignition is not expected to occur.

- Wetting of dried coal increases the risk of combustion (heat of wetting effect), but very seldom are CBNG target coals dewatered. Water is removed from the rocks above the coals only sufficiently to reduce hydrostatic pressure on the coal seam. The Wyoming State Geological Survey rates the likelihood of completely dewatering a coal seam and

exposing large areas of fine coal particles to oxygen to facilitate CBNG-associated underground coal fires as "extremely remote" (Lyman and Volkmer, 2001, p. 10).

- The small particle sizes most commonly associated with spontaneous coal combustion are not present in CBNG wells.

Limited information is available for use in characterizing methane mobility and anticipated movements in the PRB over time. Gas migration and seepage are naturally occurring processes where coal beds are extremely close to the surface. Methane would be controlled through BLM-issued APD COAs addressing well control, casing, ventilation, and plugging procedures appropriate to the site-specific CNBG development plans (BLM, 2003, pp. 4-132 - 4-133).

There is the possibility of conflicts arising from overlapping coal mining and CBNG leases. It is USFS policy to allow companies that compete for these resources to settle possible conflicts among themselves. Where coal leases conflict with CBNG leases, coal mining companies have occasionally acquired “competing” CBNG leases and developed the wells themselves prior to coal extraction (Allen, 2003).

Project excavation activities may result in discoveries of potentially important vertebrate fossils. Possible exposures of potentially fossiliferous rock units would only occur where backhoe excavation or pit construction activities were located in areas of thin soil bedrock cover. Impacts to paleontological resources could occur if scientifically significant fossils were destroyed during project activities, were discovered but not properly curated, or were lost through vandalism. Impacts would be minimized due to the co-location of buried pipelines and electrical lines in narrow trenches adjacent to well access roads.

Mitigation Measures

Mitigation measures included in the monitoring and mitigation plan for paleontological resources (Erathem-Vanir Geological, 2003) would effectively prevent the destruction of fossil resources:

- Conducting a construction monitoring program for surface excavations of six reserve pits serving as test sites where the excavation would extend into consolidated bedrock of the Wasatch Formation and for portions of pipeline trenches where excavation would require the use of backhoes. The discovery of significant paleontological resources in the test pits would require the development of a more inclusive monitoring program for reserve pits;
- Reporting to the Authorized Officer immediately and suspending construction if large or conspicuous and/or fossils of significant value were discovered during the drilling and construction of roads and facilities;
- Working with the USFS to ensure the curation of significant fossil specimens; and
- Developing a letter report of findings if fossils are recovered.

3.1.2.3 Alternative C - Modified Development Alternative

Impacts resulting from the implementation of Alternative C would be nearly identical to those described for Alternative B with application of mitigation measures. Although short-term project-related disturbance totals approximately 73 acres, reclamation of roads and pipeline routes in addition to interim reclamation of the well sites would initiate restoration of the disturbed surfaces to current conditions almost immediately. Long-term disturbance consisting of six acres comprises approximately 0.2 percent of the Project Area.

Implementation of Alternative C would result in the depletion of the natural gas resource associated with the federal leases. Using an estimated lifetime production rate per well of 400 mmcf, the average total production associated with 28 wells would be 11.3 bcf of CBNG.

Mitigation measures described for the protection of paleontological resources in Alternative B would ensure that significant fossils are identified and preserved under Alternative C.

3.1.3 Cumulative Effects

3.1.3.1 Alternative B – Proposed Action

Cumulative impacts to physiography and geologic resources would result mainly from the construction of roads and, to a lesser extent, well pads in the vicinity of the Project Area. The generally low-relief topography in the Project Area would minimize the necessity for cut-and-fill construction methods. Impacts to topography resulting from surface coal mines would continue near the Project Area.

The TBNG near the Project Area appears to be in a mature development phase with respect to conventional oil and gas. Considerable drilling for CBNG has also occurred near the Project Area. The incremental amount of disturbance associated with the proposed 32 wells is small compared to previous disturbance associated with the 217 wells drilled within two miles of the proposed PODs (WOGCC, 2003). Project wells represent 0.06 percent of the total CBNG well construction analyzed in the PRB O&G FEIS (51,391 total CBNG wells). Long-term cumulative surface disturbance would impact approximately eight acres, which corresponds to approximately 0.001 percent of the acreage administered in the TBNG. The percentage of land disturbed for this project with respect to the eight million acres comprising the PRB is infinitesimal. USFS-required reclamation procedures would minimize the immediate effects of this disturbance on federal lands after project construction is complete.

Irreplaceable loss of the CBNG resource as a result of lease development would occur as a result of implementing the Proposed Action. Development of the project would incrementally contribute to the loss of the CBNG resource as analyzed in the PRB O&G FEIS (BLM, 2003).

Loss of the CBNG resource to drainage by wells located on nearby fee and state leases would be prevented. CBNG and coal resources both exist in and near the Project Area. The Thunder Basin Coal Company has leases in and adjacent to the Project Area, which would likely be developed as the demand for energy from coal continues. If coal mining occurs before the

methane is extracted, the methane held in the coal would be lost; however, if CBNG is extracted before coal is mined in a particular location, there would be no loss of the gas resource.

Development of additional CBNG or conventional oil and gas wells in the general vicinity of the Project Area is unlikely to increase the risk of geological hazards resulting from implementation of the Proposed Action for the reasons detailed in Section 3.1.2.2.

Surface disturbance associated with construction of CBNG well sites and pipelines could result in some permanent loss of paleontological information unless the mitigation measures described in Section 3.1.2.2 were employed. Paleontological resources may continue to be discovered and/or destroyed as a result of coal mining advances to the east of the Project Area.

3.1.3.2 Alternative C – Modified Development Alternative

Cumulative impacts to physiography and geologic resources would be similar to those associated with Alternative B, but slightly less in magnitude. They would result primarily from the construction of roads and, to a lesser extent, well pads in the vicinity of the Project Area. The generally low-relief topography in the Project Area would minimize the necessity for cut-and-fill construction methods. Impacts to topography resulting from surface coal mines would continue near the Project Area.

The TBNG near the Project Area appears to be in a mature development phase with respect to conventional oil and gas. The reduction in the amount of disturbance associated with the 28 wells compared to the Proposed Action's 32 wells is five acres of short-term disturbance and two acares of long-term disturbance. Considerable drilling for CBNG has also occurred near the Project Area. Aprpoximately 217 wells have been drilled within roughly two miles of the proposed PODs (WOGCC, 2003). Wells drilled under this alternative would represent 0.06 percent of the total CBNG well construction analyzed in the PRB O&G FEIS (51,391 total CBNG wells). Long-term cumulative surface disturbance would impact approximately six acres, which corresponds to approximately 0.001 percent of the acreage administered in the TBNG. The percentage of land disturbed for this project with respect to the eight million acres comprising the PRB is infinitesimal. USFS-required reclamation procedures would minimize the immediate effects of this disturbance on federal lands after project construction is complete.

Irreplaceable loss of the CBNG resource would result from developing the leases under Alternative C. Development under Alternative C would incrementally contribute to the loss of the CBNG resource as analyzed in the PRB O&G FEIS (BLM, 2003).

Loss of the CBNG resource to drainage by wells located on nearby fee and state leases would not occur. CBNG and coal resources both exist in and near the Project Area. The Thunder Basin Coal Company has leases in and adjacent to the Project Area, which would likely be developed as the demand for energy from coal continues. If coal mining were to occur before the methane is extracted, the methane held in the coal would be lost; however, if CBNG is extracted before coal is mined in a particular location, there would be no loss of the gas resource.

Development of additional CBNG or conventional oil and gas wells in the general vicinity of the Project Area is unlikely to increase the risk of geological hazards resulting from implementation of the Proposed Action.

Surface disturbance associated with construction of CBNG well sites and pipelines could result in some permanent loss of paleontological information unless the mitigation measures described in Section 3.1.2.2 were employed. Paleontological resources may continue to be discovered and/or destroyed as a result of coal mining advances to the east of the Project Area.

3.2 SOILS

3.2.1 Affected Environment

Soils in the Project Area are developing in mostly residuum of the nearly level to gently sloping (0-6 percent) upland high plains that dominate the Project Area and in alluvium of the gently sloping drainage bottoms [Campbell County Conservation District (CCCD), 2001].

Approximately 17 soil units have been mapped by the Natural Resources Conservation Service (NRCS) in the Project Area (CCCD, 2001)(Appendix F). The upland plains are dissected by the ephemeral Little Thunder Creek and its tributaries and are broken in places with low, red-colored, clinker-capped buttes and hills. Slopes up to 45 percent are located in small areas associated with these buttes and hills and in local, more heavily dissected valley sides and stream banks. Also present in the upland plains landscape are a number of internally-drained playas. Sandstones, siltstones, mudstones, and shales of the Wasatch Formation are the principal parent materials.

The dominant soils of the upland plains are predominantly sandy loam to loam/clay loam surface soils or topsoils over loam to clay loam, to clay subsoils, respectively, that are moderately deep to deep, well-drained, and nearly level to gently sloping (1 to 6 percent) (Table 3.2-1) (NRCS, 1998). Soils of the dissected valley sides and upland buttes and hills are mostly sandy loams to loams over loams to clay loams to clays, respectively, exhibiting soil depths (soil thickness over bedrock) that are shallow (0-20 inches to bedrock) to moderately deep (20-40 inches to bedrock), well-drained, and gently sloping to steep (6-45 percent). The alluvial drainage bottoms of Little Thunder Creek and several drainages tributary to playas are occupied by loams to clay loams over clay loams to clay that are deep (40 to 60 inches to bedrock), well drained, and nearly level to gently sloping (0-6 percent). Soils of most of the playa bottoms within the Project Area are not differentiated from soils of the adjacent landscapes, and therefore do not necessarily elicit characteristics representative of confined evaporation conditions, such as elevated salt and sodium levels.

The potential for high/severe water erosion hazard is limited to the mostly moderately deep to shallow soils of the steeper valley sides, buttes, and hills. Approximately 512 acres of the 2,609-acre Project Area (19.6 percent) could, if disturbed and not stabilized with proper mitigation measures, be subject to accelerated rates of water erosion. Factors contributing to high water erosion hazards are slope, soil erodibility factor (k-factor), and soil permeability (rate of water infiltration) (BLM, 2003, p. 3-82) (Appendix F). The potential for severe wind erosion hazard

within the Project Area following soil disturbance (BLM, 2003, p. 3-81) (Table 3.2-1, Appendix F) is limited to a single soil map unit of 709 acres (27.2 percent of the Project Area). The remaining 53.2 percent of the Project Area would be subject to slight to moderate potentials for accelerated water and wind erosion if disturbed.

Table 3.2-1 Limiting Factors for Soil Mapping Units in the PODs 1, 2, and 3 Project Area[1]

Soil Mapping Unit Symbol	Mapping Unit Name	Slope Range (%)	Acreage within Project Area	Percent-age of Project Area	Depth Class	Water Erosion Hazard	Wind Erosion Hazard	Limitations for Reclamation
102	Arvada, Thick Surface-Arvada-Slickspots Complex	0-6	709		Deep		X	High salinity and SAR levels in subsoils
111	Bidman-Parmleed Loams	0-6	528		Deep, Moderately Deep			Clayey, low permeability, high shrink/swell potential
112	Bidman-Parmleed Loams	6-15	63		Deep, Moderately Deep			Clayey, low permeability, high shrink/swell potential
113	Bidman-Ulm Loams	0-6	138		Deep			
143	Felix Clay, Ponded	0-2	12		Deep			Clayey, low permeability, high shrink/swell potential
151	Haverdad Loam	0-3	25		Deep			
154	Heldt Clay Loam	0-6	85		Deep			Clayey, low permeability, high shrink/swell potential
156	Hiland Fine Sandy Loom	0-6	62		Deep			
157	Hiland-Bowbac Sandy Loams	0-6	217		Deep, Moderately Deep			
158	Hiland-Bowbac Sandy Loams	6-15	204		Deep, Moderately Deep			
179	Maysdorf-Pugsley Complex	0-6	2		Deep, Moderately Deep			

Soil Mapping Unit Symbol	Mapping Unit Name	Slope Range (%)	Acreage within Project Area	Percent-age of Project Area	Depth Class	Water Erosion Hazard	Wind Erosion Hazard	Limitations for Reclamation
180	Maysdorf-Pugsley Sandy Loams	6-15	54		Deep, Moderately Deep			
190	Parmleed-Renohill Complex	3-15	122		Moderately Deep	X		
200	Renohill-Savageton Clay Loams	6-15	140		Moderately Deep	X		High water erosion hazard, clayey
201	Renohill-Shingle-Worf Complex	3-15	43	0.20	Moderately Deep, Shallow			Slope, shallow soils, moderate water erosion hazard, low permeability, high shrink/swell potential
206	Samday-Shingle-Rock Outcrop Complex	10-45	10		Shallow	X		Slope, shallow soils, high water erosion hazard, low permeability, high shrink/swell potential
228	Ulm-Renohill Complex	0-6	1,158	5.48	Deep, Moderately Deep			

[1]Determination of limiting factors was based on evaluation of soils characteristics within upper 6 inches of topsoil and/or upper subsoil combination (Appendix F). The most restrictive value representing soil materials present in the upper 6 inches was used in characterizing the limiting factor for the soil mapping unit.

Deep, saline and sodic soils (same as those soils discussed above that are susceptible to wind erosion) occupy approximately 709 acres (27.2 percent of the Project Area) in alluvial bottom lands associated with Little Thunder Creek, its tributaries, and several drainages tributary to playas in the Project Area. These soils have elevated salinity and exchangeable sodium, measured as Sodium Adsorption Ratio (SAR), levels in subsoil horizons below the topsoil layers (Appendix F).

Approximately 1,436 additional acres (55 percent) of heavier textured, clayey soils (subsoils) that are susceptible to accumulating proportionally elevated sodium levels (in comparison to calcium and magnesium levels) in the subsoil and are most likely to exhibit adverse effects on soil conditions occur in the Project Area (BLM 2003, p. 3-86) (Appendix F; Table 3.2-1). Accumulation of sodium and the elevation of SAR levels in these soils could adversely affect vegetative productivity, should high SAR waters be added over time. In addition, clayey soils, particularly clayey soils whose clay fraction is comprised mostly of swelling, smectitic clay minerals, are also more susceptible to shrink-swell action and compaction that can affect a soil's ability to support construction and long-term operations of a facility. Compaction can adversely

affect both interim and final revegetation and associated reclamation potential (BLM 2003, p. 3-82).

Of the 1,436 acres of heavier textured soils, 284 acres of soils (11 percent) have elevated salinity levels (between 2 and 4 mmhos/cm) in their subsoils and are considered as slightly saline (BLM 2003, p. 3-86) (Appendix F; Table 3.2-1).

Approximately 1,909 acres of soils in the Project Area (73 percent) exhibit individual or combinations of characteristics that may pose difficulties to successful revegetation efforts. These soils occupy the steeper buttes and hills and saline and sodic bottom lands in the Project Area. Factors which would reduce revegetation success capability include:

- Steeper slopes;
- Shallower soil depths, resulting in insufficient soil material to provide physical support, nutrients, and moisture for plants;
- Higher k-factor;
- Higher shrink/swell potential (higher content of smectitic clay minerals);
- Higher compaction susceptibility, in which soil peds are insufficiently separated to allow air and moisture to penetrate into the soil;
- Lower permeability; and
- Elevated salinity and SAR levels in the subsoil (BLM 2003, pp. 3-82, 3-85, and 3-86).

Such conditions can prevent a disturbed soil from achieving a stable post-disturbance state. Soils which are assessed as posing potential difficulties to achieving successful revegetation are identified in Table 3.2-1.

Soils in the Project Area support vegetation/forage for livestock grazing and wildlife habitat. They have been disturbed by construction and operation of roads, railroad tracks, oil and gas wells, pipelines, electrical power lines and substations, and coal mine sediment- and water-control impoundments. Current soil productivity varies depending on local factors such as soil depth, texture, slope, topographic aspect, and permeability in combination with grazing pressure and precipitation.

3.2.2 Environmental Consequences

Soil-related issues raised during scoping included:

- Potential for soils in the Project Area to be adversely affected by surface disturbance from project implementation.
- Potential for soils in the Project Area to be adversely affected by the discharge and disposal of high sodium and saline water from coal bed natural gas well production.
- Potential for successful reclamation of disturbed soils/lands.
- Potential contamination of soils/subsoils by toxic substances in drilling muds and fluids.

3.2.2.1 Alternative A - No Action

Under the No Action alternative, none of the proposed activities would occur on USFS-administered federal lands. Disturbance of soils by CBNG well drilling and field development would not occur. Disturbances to soils by continuing conventional oil and gas development would potentially occur within the Project Area, and CBNG development would continue on adjacent state and private lands. Ranching-associated impacts from livestock management activities would likely continue at their current level. Soil disturbance from surface coal mining is likely to continue adjacent to the Project Area for the foreseeable future.

3.2.2.2 Alternative B - Proposed Action

Implementation of the Proposed Action would result in disturbance to soils from construction or roads, compressor stations, pipelines, water discharge pipelines, electrical utilities, and well sites. Anticipated impacts are:

- Clearing or mowing of protective vegetative cover at well sites and along pipeline and utilities corridors resulting in increased potential for accelerated soil erosion.
- Compaction of soils and damage to protective vegetative cover by initial and continuing use of two-track roads and well sites, and by construction of pipelines and buried and overhead electrical utility lines.
- Burial and loss of productivity beneath new compressor facilities and the all-season, graveled roads and associated parking areas adjacent to the facilities.
- Mixing of soil materials by gas pipeline, water pipeline, and electrical line underground installation, and by excavation of water reserve pits at each well site.

Total maximum, short-term soil disturbance would be approximately 77 acres (54, USFS-administered surface acres and 23 acres of private surface) (Table 2.3-8). Following near-term, post-construction reclamation of those disturbed areas and soils no longer subject to continuing use and disturbance, and decommissioning of unnecessary roads, remaining long-term surface disturbance would total approximately 8 acres (6 acres USFS-federal and 2 acres private) (Table 2.3-8). The long-term use of roads, well sites, central gathering facilities, and discharge points would make up 100 percent of the remaining 8 acres of disturbance. At the end of the Project, some Project-constructed roads that are not required for continuing USFS-management purposes would be reclaimed as part of decommissioning.

Erosion Hazard. Project implementation would disturb in the short-term approximately 77 acres of soils, including totals of approximately 15.8 (10.8 federal) and 20.8 (14.6 federal) acres of soils posing high water and severe wind erosion potentials and hazards, respectively (Table 3.2-2). These acreages of soils susceptible to water and wind erosion hazards represent 20 (20 federal) and 27 (27 federal) percent of the 77-acre total disturbance acreage (54-acre total disturbance of federal surface) for the Project, respectively.

Table 3.2-2 Disturbance of Sensitive Soil Types by Surface Ownership, Proposed Action

Soil Sensitivity	Short-Term Disturbance (Acres)				Long-Term Disturbance (Acres)			
	Federal	State	Private	Total	Federal	State	Private	Total
High Water Erosion Hazard	10.8	0.0	5.0	15.8	1.2	0.0	0.4	1.6
Severe Wind Erosion Hazard	14.6	0.0	6.2	20.8	1.6	0.0	0.5	2.1
Potential Limiting SAR Soil Levels	14.6	0.0	6.2	20.8	1.6	0.0	0.5	2.1
Potential Limiting Reclamation Factors	36.7	0.0	15.6	52.3	4.1	0.0	1.4	5.5

Source: NRCS SSURGO soils data.

Application of interim reclamation measures specified in the mitigation measures listed in Chapter 2 and those measures detailed in Appendix D would minimize soil loss due to accelerated erosion. Completed on-site inspections for the proposed wells and ancillary road, pipeline, utilities, and compressor facilities have finalized locations for all facilities with consideration for minimizing soil loss from Project implementation.

Following successful reclamation/revegetation of those disturbed lands to be reclaimed shortly after construction, well drilling, well completions, and road decommissioning are complete, remaining long-term disturbance to these soils posing water and wind erosion hazards would total approximately 1.6 (1.2 federal) and 2.1 (1.6 federal) acres, respectively (Table 3.2-2). These acreages of soils susceptible to water and wind erosion hazards represent 2.1 (2.2 federal) and 2.7 (3.0 federal) percent of the 77-acre total disturbance (54 acres total federal disturbance) for the Project, respectively. Accelerated soil erosion beneath the long-term facilities and graveled surfaces are expected to be minimal due to the protection provided to soils by the facilities and gravel-armored surfaces. Application of mitigation measures listed in Chapter 2 and those measures detailed in Appendix D would minimize soil loss due to accelerated erosion at the time of Project and road decommissioning.

Sodic and Saline Soils. Project implementation would disturb in the short-term approximately 21.6 (15.4 federal) acres of soils with elevated SAR values in the near-surface soil layer(s) (topsoil and upper subsoil) to a minimum depth of six inches (Table 3.2-2). The highest reported salinity levels of 4 mmhos per centimeter or less, as indicated by electrical conductivity measurements, for the soils in the Project Area (Appendix F) is considered slightly saline (BLM, 2003, p. 3-86) and would pose little if any limitations on soil conditions or re-establishment of vegetation during reclamation. The acreage for elevated SAR levels in the near-surface soil layers represents 27 (27 federal) percent of the 77-acre total disturbance (57 acres total federal disturbance) for the Project.

SAR levels in these soils may likely be posing some limitations on soil conditions and adverse impacts to vegetative productivity. As the Proposed Action would not involve the addition of high SAR waters to these soils or to any other soils in the Project Area, including the more

susceptible clayey soils (56 percent of the 77-acre total project disturbance) (Appendix F), the coal bed natural gas development would not cause any additional increases in the soils' SAR levels. The piped or channelized discharges of produced waters in the Project Area would be confined to established ephemeral stream channels. No other discharge or disposal methods or irrigation are proposed. In addition, the SAR levels of the produced water in the Project Area based on sampling in the area range from 5.2 to 6.3, as indicated in Section 3.4*)*. These values are considered low, and if they were to be added to soils with elevated SAR levels (Table 3.2-1**,** Appendix F), the produced waters would not increase current levels.

Direct discharge of produced waters into drainages would also avoid any addition of salts present in the produced waters to upland soils. Although no impacts to sodic-affected soils are expected from the Proposed Action, treatments for affected soils exist. These involve the incorporation of soil amendments, including various sources of soluble calcium, to reduce the potential from sodium ion toxicity on plant growth. Additional effects include mitigation of the deterioration of soil structure caused by slaking and the swelling and dispersion of clays in the soils resulting from excess exchangeable sodium relative to magnesium and potassium (BLM, 2003, p. 4-148).

Following successful reclamation/revegetation of those disturbed lands to be reclaimed shortly after construction, well drilling, and completion operations are complete, remaining long-term disturbance to soils with elevated salinity and/or SAR levels would total approximately 2.1 (1.6 federal) acres (Table 3.2-2). These salt/SAR-affected soil acreages represent 2.7 (3.0 federal) percent of the 77-acre total disturbance acreage (54 acres total federal disturbance) for the Project, respectively. Application of mitigation measures listed in Chapter 2 and those measures detailed in Appendix D would optimize re-establishment of protective vegetation in these soils at the time of Project decommissioning.

Limited Reclamation Potential. Implementation of the Proposed Action would disturb in the short-term approximately 52.3 (36.7 federal) acres of soils with characteristics that may pose difficulties to successful reclamation/revegetation (Table 3.2-2). This acreage of potentially difficult reclamation/revegetation represents 68 (68 federal) percent of the 77-acre total disturbance acreage (54 acres total federal disturbance) for the Project. Application of interim reclamation measures specified in the mitigation measures listed in Chapter 2 and those measures detailed in Appendix D would optimize soils stabilization and revegetation of the disturbed lands.

Following successful reclamation/revegetation of those disturbed lands to be reclaimed shortly after construction and well drilling and completion are complete, remaining long-term disturbance to soils posing difficulties to successful reclamation/revegetation would total approximately 5.5 (4.1 federal) acres (Table 3.2-2). These acreages represent 6.9 (7.2 federal) percent of the 80-acre total disturbance acreage (57 acres total federal disturbance) for the Project, respectively. Application of mitigation measures listed in Chapter 2 and those measures detailed in Appendix D would optimize re-establishment of protective vegetation in these soils at the time of Project decommissioning.

A summary of disturbance to sensitive soil types is indicated in Table 3.2-2.

Contamination of soils/subsoils by toxic substances during drilling would not occur due to the absence of toxic substances being used in the drilling process.

Mitigation

Specifications regarding mitigation of soils required by the USFS for approval of CBNG operations on the TBNG are detailed in Appendix D.

- The Company would reduce construction-associated disruption by minimizing the width of new roads and co-locating, to the extent feasible, pipelines and buried electrical lines into common utility corridors. Where excavations are necessary, sufficient topsoil to facilitate revegetation would be segregated from subsoils and returned to the surface upon the completion of operations. Where topsoils would be exposed for lengthy periods, the piles would be seeded or otherwise protected to prevent erosion and maintain soil microflora and microfauna.

- The Company would prohibit off-road travel by its employees or contractors except in emergency situations. Project-related travel would be minimized to the extent feasible during wet periods when excessive road rutting (rut depths greater than 4 inches) could occur.

- No road construction is expected to occur on slopes greater than 8 percent and no surface disturbance or occupancy would occur on slopes in excess of 25 percent. Construction would not occur during periods when the soil is frozen or when watershed damage is likely in the absence of a mitigation plan and approval from the USFS. Headcuts in channels of ephemeral streams used for discharge of produced water would be mitigated per specifications in the Company's Water Management Plan (Greystone, 2002a) to reduce erosion effects.

- Stabilization and revegetation would occur as soon as practical following disturbance using seed mixes approved by the USFS and/or BLM. Recommended mitigation measures relating to soils are presented in the PRB O&G FEIS (BLM, 2003, pp. 4-135 - 4-149).

3.2.2.3 Alternative C – Modified Development Alternative

Implementation of Alternative C would also result in similar but reduced disturbance to soils from construction or roads, compressor stations, pipelines, water discharge pipelines, electrical utilities, and well sites. Anticipated types of impact would be the same as those listed previously for the Proposed Action.

Total maximum, short-term soil disturbance would be approximately 72 acres (49 USFS-administered surface acres and 23 acres of private surface) (Table 2.4-2). Following reclamation of disturbed areas and soils, remaining long-term surface disturbance would total approximately 6 acres (4 acres USFS-federal and 2 acres private) (Table 2.4-1). At the end of the Project, some

Project-constructed roads that are not required for continuing USFS-management purposes would be reclaimed as part of decommissioning.

Erosion Hazard. Project implementation would disturb in the short-term approximately 72 acres of soils, including totals of approximately 14.8 (9.8 federal) and 19.4 (13.2 federal) acres of soils posing high water and severe wind erosion potentials and hazards, respectively (Table 3.2-3). These acreages of soils susceptible to water and wind erosion hazards represent 20 (20 federal) and 27 (27 federal) percent of the 72-acre total disturbance acreage (49-acre total disturbance of federal surface) for the Project, respectively.

Table 3.2-3 Disturbance of Sensitive Soil Types by Surface Ownership, Alternative C

Soil Sensitivity	Short-Term Disturbance (Acres)				Long-Term Disturbance (Acres)			
	Federal	State	Private	Total	Federal	State	Private	Total
High Water Erosion Hazard	9.8	0.0	5.0	14.8	0.8	0.0	0.4	1.2
Severe Wind Erosion Hazard	13.2	0.0	6.2	19.4	1.1	0.0	0.5	1.6
Potential Limiting SAR Soil Levels	13.2	0.0	6.2	19.4	1.1	0.0	0.5	1.6
Potential Limiting Reclamation Factors	33.3	0.0	15.6	48.9	2.7	0.0	1.4	4.1

Source: NRCS SSURGO soils data.

Application of interim reclamation measures specified in the mitigation measures listed in Chapter 2 and those measures detailed in Appendix D would minimize soil loss due to accelerated erosion. As previously noted for the Proposed Action, completed on-site inspections for the proposed facilities have finalized locations with consideration for minimizing soil loss from Project implementation.

Following successful interim reclamation/revegetation, remaining long-term disturbance to these soils posing water and wind erosion hazards would total approximately 1.2 (0.8 federal) and 1.6 (1.1 federal) acres, respectively (Table 3.2-3). These acreages of soils susceptible to water and wind erosion hazards represent 1.7 (1.6 federal) and 2.2 (2.2 federal) percent of the 72-acre total disturbance (49 acres total federal disturbance) for the Project, respectively. Accelerated soil erosion beneath the long-term facilities and graveled surfaces are expected to be minimal due to the protection provided to soils by the facilities and gravel-armored surfaces. Application of mitigation measures listed in Chapter 2 and those measures detailed in Appendix D would minimize soil loss due to accelerated erosion at the time of Project and road decommissioning.

Sodic and Saline Soils. Project implementation would disturb in the short-term approximately 19.4 (13.2 federal) acres of soils with elevated SAR values in the near-surface soil layer(s) (topsoil and upper subsoil) to a minimum depth of six inches (Table 3.2-3). As described for the Proposed Action, the highest reported salinity level of 4 mmhos per centimeter for the soils in the Project Area (Appendix F) is considered slightly saline (BLM, 2003, p. 3-86) and would pose

little if any limitations on soil conditions or re-establishment of vegetation during reclamation. The acreage for elevated SAR levels in the near-surface soil layers represents 27 (27 federal) percent of the 72-acre total disturbance (49 acres total federal disturbance) for the Project.

As noted previously, SAR levels in these soils may likely be posing some limitations on soil conditions and adverse impacts to vegetative productivity. As implementation of Alternative C would not involve the addition of high SAR waters to these soils or to any other soils in the Project Area, including the more susceptible clayey soils (56 percent of the 72-acre total project disturbance) (Appendix F), the coal bed natural gas development would not cause any additional increases in the soils' SAR levels. The piped or channelized discharges of produced waters in the Project Area would be confined to established ephemeral stream channels. No other discharge or disposal methods or irrigation are proposed. Again, the SAR levels of the produced water in the Project Area based on sampling in the area range from 5.2 to 6.3, as indicated in Section 3.4*)*. These values are considered low, and if they were to be added to soils with elevated SAR levels (Table 3.2-1**,** Appendix F), the produced waters would not increase current levels.

Direct discharge of produced waters into drainages would also avoid any addition of salts present in the produced waters to upland soils. Although no impacts to sodic-affected soils are expected from Alternative C, treatments for affected soils exist and were described previously under the Proposed Action.

Following successful interim reclamation/revegetation, remaining long-term disturbance to soils with elevated salinity and/or SAR levels would total approximately 2.2 (1.1 federal) acres (Table 3.2-3). These salt/SAR-affected soil acreages represent 2.9 (2.9 federal) percent of the 75-acre total disturbance acreage (52 federal) for the Project, respectively. Application of mitigation measures listed in Chapter 2 and those measures detailed in Appendix D would optimize re-establishment of protective vegetation in these soils at the time of Project decommissioning.

Limited Reclamation Potential. Implementation of the Proposed Action would disturb in the short-term approximately 48.8 (33.3 federal) acres of soils with characteristics that may pose difficulties to successful reclamation/revegetation (Table 3.2-3). This acreage of potentially difficult reclamation/revegetation represents 68 (68 federal) percent of the 72-acre total disturbance acreage (49 acres total federal disturbance) for the Project. Application of interim reclamation measures specified in the mitigation measures listed in Chapter 2 and those measures detailed in Appendix D would optimize soils stabilization and revegetation of the disturbed lands.

Following successful reclamation/revegetation of those disturbed lands to be reclaimed shortly after construction and well drilling and completion are complete, remaining long-term disturbance to soils posing difficulties to successful reclamation/revegetation would total approximately 4.1 (2.7 federal) acres (Table 3.2-3). These acreages represent 5.7 (5.5 federal) percent of the 72-acre total disturbance acreage (49 acres total federal disturbance) for the Project, respectively. Application of mitigation measures listed in Chapter 2 and those measures detailed in Appendix D would optimize re-establishment of protective vegetation in these soils at the time of Project decommissioning.

A summary of disturbance to sensitive soil types is indicated in Table 3.2-3.

Again, contamination of soils/subsoils by toxic substances during drilling would not occur due to the absence of toxic substances being used in the drilling process.

3.2.3 Cumulative Impacts

Cumulative impacts to soils from the proposed CBNG development plus other past, current, and foreseeable projects in the PRB, both direct/indirect impacts and cumulative, are addressed in the PRB O&G FEIS (BLM, 2003, p. 4-151). The FEIS cumulative impacts analysis for soils includes those impacts anticipated to result from implementation of the Proposed Action on the TBNG lands in the Project Area and the PRB.

The Project Area's Little Thunder Creek watershed is tributary to the Upper Cheyenne River watershed that is a subunit of the FEIS' project area for which impacts are quantified. Within that watershed, long-term cumulative impacts to soils would impact approximately 2.5 percent of the area. Within the TBNG, long-term cumulative impacts to soils would impact approximately 1.0 percent of the Upper Cheynne River watershed (BLM, 2003, p. 4-169).

3.2.3.1 Alternative B - Proposed Action

Analysis of the Proposed Action indicates that short-term and long-term surface and soil disturbances would amount to approximately 77 and 8 acres, respectively. These disturbance levels equate to 0.1 percent and 0.02 percent, respectively, of the total short-term and long-term surface and soil disturbances analyzed in the FEIS.

The dispersed nature of CBNG development suggests that concentrated impacts to soils from construction of the Proposed Action are unlikely, with the exception of pipeline construction (BLM, 2003, p. 4-151). Indirect impacts to soils may arise from increased traffic, arising from both commercial and recreational users, due to increased road access and some off-road use.

Cumulative impacts of soil disturbance from excavation and compaction, accelerated erosion, and loss of productivity within the Project Area and the FEIS' project area would result mainly from additional CBNG development, conventional oil and gas development, continuing coal mining activities, and livestock grazing and ranching operations. With respect to conventional oil and gas development, the Project Area is located in a relatively mature area which reached its developmental peak in the late 1960s and early 1970s, as previously discussed indicated in the Geology and Minerals section of this EA. The most recent APD for the nearby Porcupine Field was issued by the WOGCC in 1993 (WOGCC, 2003). Unless a new economically-attractive exploration target develops, a possibility which cannot be evaluated, it is probable that new surface disturbance from foreseeable conventional oil and gas development within the Project Area would be minimal. Livestock grazing activity is expected to continue at approximately current levels.

3.2.3.2 Alternative C - Modified Development Alternative

Cumulative impacts from the implementation of this alternative in combination with past, current, and reasonably foreseeable actions would result in similar but reduced impacts in comparison to cumulative impacts resulting from implementation of the Proposed Action. Analysis of this alternative indicates that short-term and long-term surface and soil disturbances would total approximately 72 and 6 acres, respectively. These acreages for Alternative C represent a reduction of soil disturbance of 5 acres for short-term disturbance and 2 acres for long-term disturbance in comparison to respective acreages of disturbance for the Proposed Action. Again, these disturbance levels equate to 0.1 percent and 0.02 percent, respectively, of the total short-term and long-term surface and soil disturbances analyzed in the FEIS.

3.3 AIR QUALITY

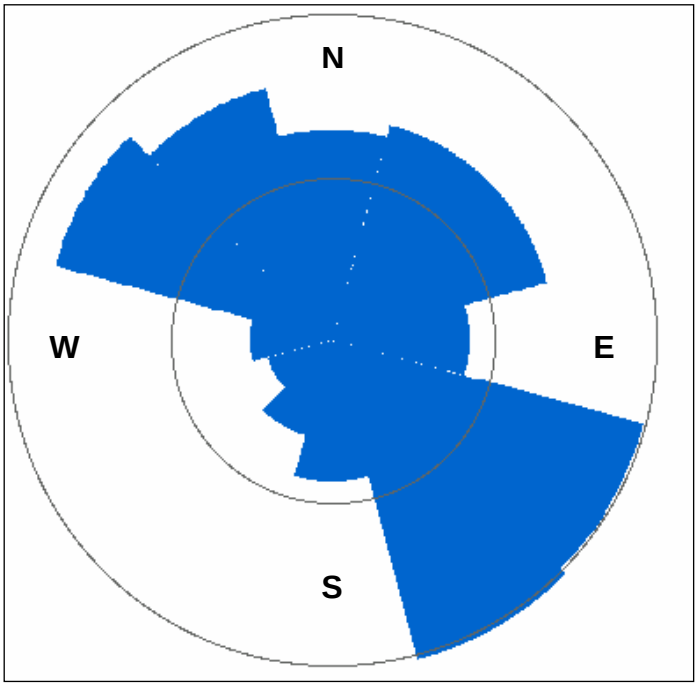
Detailed information describing the existing and projected air quality status of the Powder River Basin is contained in the PRB FEIS. Air quality near the Project Area is generally characteristic of that of rural areas; however, monitoring stations located near coal mining operations have noted measurements of particulate matter exceeding Wyoming air quality standards. The exceedances are of concern; however, mitigation measures are being employed and are discussed later in this section.

3.3.1 Climate

The climate of the Project Area is classified as a semi-arid cool steppe. Evaporation exceeds precipitation, and summers are relatively short and warm while winters are long and cold. Temperatures range from 80° to 100°F in the summer and -20° to 45°F in the winter. The area receives approximately 10 to 14 inches of precipitation annually, primarily in during the growing season from April through June. Lake and pan evaporation rates are 42 and 60 inches per year, respectively. Seventy-eight percent of this loss occurs between May and October. The area receives 36 to 60 inches of total annual snowfall. Snowfalls of six inches or less are typical in the winter. A wind rose is a polar graph that indicates the speed and relative duration of wind according to its direction. Wind roses are useful for determining the most prevalent direction of winds of desired strength. A wind rose, developed from data obtained from the WDEQ, Air Quality Division (WDAQ) Hampshire monitoring station located approximately 34 miles east of the Project Area, is displayed in Figure 3.3-1. The wind rose illustrates that winds around the Project Area are typically from the northwest and southeast, with wind speeds averaging 10 to 28 miles per hour (mph) throughout the year. Higher wind speeds occur in the winter and spring and average 30-40 mph. Data from the station are used by WDAQ for permitting purposes.

The air quality of any particular area is controlled primarily by regional climate, regional and local topography, and the magnitude and distribution of pollutant emissions. Topography is discussed in Section 3.1.1.1. The relatively featureless terrain and strong prevailing winds that characterize the Project Area facilitate dispersion of pollutants.

Figure 3.3-1 Typcial Wind Directions and Relative Wind Speeds near the Project Area



3.3.1.1 Air Quality Standards

The Clean Air Act (CAA) in Wyoming is administered by the Wyoming Division of Air Quality (WDAQ) through the Wyoming Air Quality Standards and Regulations, last updated February 7, 2003. Criteria pollutants consist of carbon monoxide (CO), nitrogen oxides (NO_X), sulfur dioxide (SO_2), particulate matter of 10 microns in effective diameter or less (PM_{10}), particulate matter of 2.5 microns in effective diameter or less ($PM_{2.5}$), and ozone. National ambient air quality standards (NAAQS) for the criteria pollutants were established by the Environmental Protection Agency (EPA) to quantify the absolute upper limits for specific air pollutant concentrations in order to protect human health or welfare and include a reasonable margin of safety to protect more sensitive individuals in the population. As adopted by the State of Wyoming, these standards are known as the Wyoming ambient air quality standards (WAAQS). Wyoming ambient air quality standards are identical to the national standards. Other pollutants of concern for which federal and state ambient air quality standards have been established include hazardous air pollutants (HAPs) and toxic air pollutants. The WDAQ has yet to establish HAPs standards (BLM, 2003, p. 4-380). Gas-fired engines associated with compressor operations emit formaldehyde, a toxic air pollutant.

If the concentration of any criteria pollutant falls below the WAAQS in a specific location, that location is considered to be "in attainment" for that pollutant. A geographic area that meets or exceeds the limit for a particular pollutant is called a "nonattainment" area. Prevention of Significant Deterioration (PSD) regulations limit emissions of pollutants from new sources in attainment areas.

Air Quality Related Values (AQRVs) include the potential air pollutant effects on visibility and the acidification of lakes and streams. They are applied to PSD Class I and sensitive Class II areas. Class I areas include federal lands such as national parks, national wilderness areas, and national monuments. These areas are granted special air quality protections under Section 162(a) of the federal CAA. Class II areas allow additional, well-controlled growth. The land management agency responsible for the Class I area sets a level of acceptable change for each AQRV. The AQRVs reflect the land management agency's policy and are not legally enforceable standards.

3.3.1.2 Air Quality

The Project Area is located in a PSD Class II area and is considered to be in attainment for all criteria pollutants. The primary air-borne pollutants near the Project Area are particulates from coal mine activities and airborne silt due to wind and traffic. Oil and gas drilling and production activities emit NO_x, SO_2, and CO as a result of the combustion of fossil fuels to power generators and compressors.

Air quality in a given location is defined by pollutant concentrations in the atmosphere and is generally expressed in units of parts per million or micrograms per cubic meter. The level of impacts can be determined by comparing a pollutant's concentration to the WAAQS. The WDAQ maintains an extensive network of air quality monitors throughout the state to detect changes in air quality and anticipate issues related to air quality. Some monitors are located to assess ambient air quality while others are located to measure impacts from specific sources. The data are used to determine air quality trends, provide sufficient information to arrest or reverse air quality degradation, and to monitor compliance. Air quality monitors located near the Project Area are found near Sheridan, Gillette, Arvada, Wright, and 14 miles west of Buffalo. Other monitoring stations are located nearer to the Project Area, generally source-oriented, and located near coal mining activity (EPA AirData, 2002).

Regional ambient air quality levels for northeastern Wyoming were estimated for the PRB O&G FEIS using monitoring data in northeastern Wyoming and southeastern Montana. Estimated background air pollutant concentrations fell well below national and state ambient air quality standards (BLM, 2003, pp. 3-293, 3-294). See Table 3.3-1.

Table 3.3-1 Estimated Background Air Pollutant Concentrations and Applicable Ambient Air Quality Standards (µg/m^3)

Pollutant	Averaging Time	Background Concent.	Primary NAAQS[1]	Secondary NAAQS[2]	Wyoming Standards	PSD Increments	
						Class I	Class II
Carbon monoxide	1-hour	3,500[3]	40,000	40,000	40,000		
	8-hour	1,500	10,000	10,000	10,000		
Nitrogen dioxide	Annual	16.5[4]	100	100	100	2.5	25
Ozone	1-hour	82[5]	235	235	235		
	8-hour	130[5]	157	157	157		
PM_{10}	24-hour	42[7]	150	150	150	8	30
	Annual	17[7]	50	50	50	4	17
$PM_{2.5}$	24-hour	19[7]	65	65	65		
	Annual	7.6[7]	15	15	15		
Sulfur dioxide	3-hour	8[6]	--	1,300	1,300	25	512
	24-hour	8[6]	365	--	260	5	91
	Annual	3[6]	80	--	60	2	20

Source: Adapted from BLM, 2003, p. 3-294
Notes:
[1]Annual standards are not to be exceeded; short-term standards are not to be exceeded more than once per year.
[2]Primary standards are designed to protect public health; secondary standards are designed to protect public welfare.
[3]Per Riley Ridge EIS (BLM, 1983)
[4]Data collected in Gillette, WY (1996 - 1997)
[5]Data collected in Pinedale, WY (1992 - 1994)
[6]Data collected at Devil's Tower, WY (1983)
[7]Data collected in Gillette, Wyoming (1999)
Source: (Argonne, 2002, p. 4-9)

Particulate matter, occurring as fugitive dust originating from natural sources, unpaved roads, surface disturbance associated with construction, recreation, and livestock grazing, can be a primary pollutant in rural areas. Industrial source PM_{10} data are accumulated by monitors located near coal mines in the Project Area. There are 15 coal mines along a north-south line that parallels Highway 59, starting north of Gillette, Wyoming and extending south for approximately 75 miles. PM_{10} monitoring data collected near and south of Gillette, north of the Project Area, have exceeded both the WAAQS and the available PSD Class II increment causing concern to EPA Region 8 staff (BLM, 2003, p. 3-298). Nearer to the Project Area, PM_{10} data are accumulated by monitors established near the Black Thunder and Jacobs Ranch mines, about three and six miles east, respectively, of the Project Area and by monitors immediately to the north. Monitor summary data for the Black Thunder Mine for the year 2002 indicate that PM_{10} values exceeded the air quality standard of 150µg/m^3 on one occasion with a measured value of 290 µg/ m^3 (24-hour 99th. percentile value) (EPA AirData, 2003). The annual mean value for PM_{10} at the Black Thunder Mine did not, however, exceed the air quality standard.

3.3.1.3 Emissions Receptors

The Project Area and its surroundings are rural and sparsely populated. Potential emissions receptors near the project include one residence approximately two miles to the west of Thunderhead 1 and two miles to the northwest of Thunderhead 2, personnel associated with CBNG operations, coal mining personnel, and hunters. The proposed project is located

approximately three miles southeast of Wright, Wyoming and approximately 40 miles south of Gillette, Wyoming. The nearest PSD Class I receptor to the Project Area is the Devils Tower National Monument located approximately 55 miles to the northeast (BLM, 2003). No air quality monitors are located near the monument (EPA AirData, 2002).

3.3.2 Environmental Consequences

Concerns identified in the scoping process that relate to air quality in the Project Area include:

- The effects of chemical emissions, spills, leaks, or dumping into the air.

3.3.2.1 Alternative A - No Action Alternative

Emissions associated with the Proposed Action would not occur if this alternative were chosen. The air emission impacts associated with existing CBNG operations, coal mines, conventional oil and gas operations, roads, and vehicles would still be present. As indicated in the Argonne Laboratory's Air Impact Assessment (2002) conducted in association with the development of the PRB O&G FEIS, the particulate emissions from the coal mines in the project area would increase as mining activities expand near the Project Area. Release of natural gas to the atmosphere near coal mining activities would occur if the natural gas were not produced by CBNG wells. Coal mining operations would continue to be primary sources of air pollutants in the Project Area.

3.3.2.2 Alternative B - Proposed Action

Impacts to air quality are limited by state and federal regulations, standards, and implementation plans established under the CAA and administered by the WDAQ. Air quality regulations require that proposed new air pollutant emissions sources undergo a permitting review before their construction can begin. Thus, the WDAQ would have the primary authority and responsibility to review permit applications and require emissions permits, fees, and control devices prior to construction and/or operation. Under the CAA, federal agencies cannot authorize any activity that does not comply with applicable local, state, and federal air quality laws, statutes, regulations, standards, and implementation plans. The significance criteria for potential air quality impacts include these legal requirements, which are enforced to ensure air pollutant concentrations will remain within specific allowable levels. Therefore, emissions associated with the Proposed Action would be evaluated by the WDAQ and subject to requirements imposed upon project sources by permit authorities such that project related emissions would not adversely affect human heath and the environment.

Impacts from Construction Activities

Air quality impacts from the implementation of the Proposed Action would occur during project construction and CBNG operations. Actual air quality impacts would depend on the amount, duration, location, and emission characteristics of potential emissions sources, as well as meteorological conditions such as wind speed and direction, precipitation, relative humidity, etc.

All emissions that would result from project wells were not modeled; however, AP-42 methodology was used to quantify impacts from some emissions sources.

Fugitive Dust. During construction, the primary adverse impact to air quality would result from fugitive dust arising from earth work during site preparation and construction. Fugitive dust emissions from vehicles on unpaved roads are calculated from the following formula, which is used in EPA emissions estimate methodology (BLM, 2003, Appendix F, p. F11; AP-42, Section 3.13.2):

$$\left(E\left[\frac{lb}{VMT}\right]\right) = 5.9 \times k \times \left(\frac{s}{12}\right) \times \left(\frac{S}{30}\right) \times \left(\frac{W}{3}\right)^{0.7} \times \left(\frac{w}{4}\right)^{0.5} \times \left(\frac{365-p}{365}\right)$$

"E" represents emissions of PM
VMT = Vehicle mile traveled; highest use estimated as 120 per day
k = particle size multiplier; 0.36 for PM_{10}
s = road silt content; 12 percent for a rural dirt road
S = average vehicle speed; 40 mph
W = vehicle weight; 3 tons for projected vehicles
w = number of wheels; 4 wheels for project vehicles
p = number of days with more than 0.01 inches of precipitation; 100 for the expanded project area

The expected fugitive PM emission factor would be 2.05 lbs/ VMT.

The assumptions used to estimate PM emissions associated with vehicle traffic are described below:

- Vehicle miles traveled would be greatest during the six-month (180 days) construction period; therefore, vehicle miles traveled are estimated for the highest expected use.
- To drill and complete 32 wells in six months, it is assumed that three drilling rigs would be required. Since the average time required to drill and complete a well is six days, each drilling rig would be active approximately 60 days during the construction period.
- Each drilling rig would require the use of 15 vehicles, each making one roundtrip to the well location per day.
- The average number of miles associated with each roundtrip was estimated to be twice the sum of the miles associated with all existing and proposed roads that would be used to complete the project, or 42.2 miles.
- One drilling operation requiring 15 vehicle trips at 42.2 miles per roundtrip each, would require 633 vehicle miles per day (1x15x42.2=633=VMT/day).

The estimated daily PM_{10} emissions from vehicles servicing one rig during the construction phase would be 1,298 pounds or 0.65 tons. These emissions would occur on roads throughout the Project Area. Watering of roads would be required during the construction phase. Based on information in AP-42 and the PRB O&G FEIS (BLM, 2003, Appendix F, p. F11; AP-42, Section 3.13.2), approximately 70 percent control efficiency would be achieved by watering the roads.

After considering the emissions reductions achieved by watering roads, the expected fugitive PM emission would be approximately 389 pounds or 0.19 tons of PM_{10} per day per drilling rig. Assuming 180 days of construction, total PM_{10} resulting from drilling by three rigs would be approximately 35 tons. The amount of fugitive dust generated by construction of the proposed wells would be less than major source criteria and would be subject to WDAQ regulation.

The results can be described as conservative. Actual vehicle speeds on unpaved roads would likely be less than the assumed 40 miles per hour, further reducing actual dust emissions. It is extremely unlikely that each vehicle would travel all project associated roads twice in each day, which would result in an overestimation of actual vehicle miles traveled. Fugitive dust could also be generated by vehicle traffic on the TBNG 2-track roads, which would comprise approximately 56 percent of existing Project access roads and more than 90 percent of constructed roads; however, most of the 2-track roads are covered with vegetation, reducing fugitive dust generation to a minimum.

Fugitive dust generated by vehicles at a given location would be localized, short-term, and not continuous from a stationary location. Road and well site construction would be conducted in various locations throughout the Project Area during different time periods. Fugitive dust emissions would also occur from wind blown erosion; however, these impacts would be negligible. Gravel and/or scoria covered county roads may act as the larger contributors to the generation of fugitive dust.

Exhaust Emissions. Temporary and localized increases in atmospheric concentrations of NO_2, CO, SO_2, and volatile organic compounds would result from exhaust emissions of worker's vehicles, heavy construction vehicles, drilling rigs, and other machinery, equipment and tools. Exhaust emissions from drilling rigs and other construction equipment would be temporary and localized. Emissions produced from each CBNG well would primarily occur during the six-day period of drilling and completion and would occur in relative isolation because each well is spaced on 80-acre parcels. Fugitive emissions are not subject to the WDAQ minor source program. Emissions from vehicle exhaust would occur primarily during the same period, the six days for well construction. Vehicle emissions are regulated through the implementation of standards for new vehicles and by state vehicle emissions testing programs.

The EPA regulates vehicle exhaust emissions through the implementation of standards for new vehicles. States may also impose vehicle emissions testing programs for vehicles registered in their state.

Vehicle exhaust emissions can be estimated for NO_x using the equation:

$$E = \frac{\left(1.5\frac{gm}{mile}\right)\times\left(VMT\frac{miles}{day}\right)}{\left(454\frac{gm}{lb}\right)}$$

"E" represents NO_x emissions in pounds/day

The assumptions used to estimate NO_x emissions associated with vehicle traffic are described below and are consistent with the assumptions used to estimate PM emissions:

- Vehicle miles traveled would be greatest during the six-month construction period; therefore, vehicle miles traveled will be estimated for the highest expected use.
- One drilling operation requiring 15 vehicle trips at 42.2 miles per roundtrip each, would require 633 vehicle miles per day (1x15x42.2=633=VMT/day).
- The NO_x emission factor of 1.5 gram (gm) NO_x per vehicle mile for project vehicles is taken from PRB FEIS (BLM, 2003, AP-42, Volume II, Table I.18; See also "*Wyodak CBM Project Air Quality Impact Analysis*" pp. 5-14 through 5-21.)

Calculation of the emissions using EPA methodology and a NO_x emission factor of 1.5 gm NO_x per vehicle mile results in an estimated 2.2 pounds of NO_x produced per day, or about 0.2 tons for the six-month construction period. These emissions would be distributed over the Project Area near project roads. The estimates represent emissions during the construction period, highest expected road use days. Mitigation measures other than compliance with federal and state vehicle emissions regulations are not needed for the small amount estimated.

Exhaust emissions from drilling rigs and other construction equipment was estimated assuming a NO_x emission rate of one gram per horsepower per hour (Argonne National Laboratory, 2002, page F-33) and the use of three rigs eight hours daily over a construction period of 60 days each. Approximately 1.2 tons of NO_x would be generated by all three rigs during the construction period. Exhaust emissions from drilling rigs and other construction equipment would be short term and localized near well sites. Mitigation measures other than compliance with federal and state emissions regulations are not needed for the small amount estimated.

Impacts to Receptors. The primarily air pollutant associated with the Proposed Action would be particulate emissions associated with construction activities. Wind direction is often from the southeast. It is possible but unlikely that the dust would be perceived in Wright, Wyoming just three miles away because average wind speeds are high, promoting dispersion. Estimated fugitive dust emissions were based on conservation assumptions. Not all PODs are likely to be visited by Lance personnel on a daily basis. Rather, vehicles would travel to the POD where construction is taking place for the day. Therefore, it is likely that the actual amount of fugitive dust generated would be as little as one-third of the estimated maximum dust amounts, or approximately 430 pounds per day or 11.3 tons per year.

Operational Impacts to Air Quality

Impacts to air quality from operational activities include emissions from well production equipment, compression engine exhausts, fugitive dust emissions, and vehicle exhaust emissions. Well production equipment can result in emissions from dehydrators, emissions from generators, and flashing losses at production tanks.

PM Emissions. Road use following the construction phase would be limited to the occasional recreation user and periodic maintenance activities. Control and monitoring of well production

by radio telemetry would typically result in weekly or bi-weekly visits to wells by maintenance personnel. Fugitive dust generated by vehicles at a given location would be localized, short-term, and extremely small.

Exhaust Emissions. The use of telemetry equipment would ensure that vehicle traffic subsequent to construction activities would be limited to travel necessary for well maintenance. After construction is completed, roads would be used once daily until telemetry equipment is installed. After telemetry equipment is installed, the PODs would be visited approximately twice weekly, and each well would be visited once per week. Well access roads would remain available for use by recreational users and hunters; both groups are occasional, temporary and transient users of the area and would not contribute noticeably to an alteration in current air quality.

Generator, Compressor, and Dehydrator Emissions. Power to the wells would be provided by the installation of electric utility lines. Compression necessary to transport the CBNG through the pipeline system would be supplied by existing compressor facilities. Dehydration units would not be installed to support the proposed wells. Dehydration units are typically installed adjacent to and in conjunction with compressors. Thus, emissions, including HAPs or toxic air pollutants, would not be generated by new installations of these types of equipment.

Fugitive Emissions from Wells. Fugitive emissions from wells would be minimal and would only occur during construction. Fugitive emissions from wells are not regulated by WDEQ and were not quantified.

Flashing Losses. Flashing losses of VOCs occur at a well site when hydrocarbon liquids are produced into an unpressurized stock tank. The pressure differential between that of the producing formation and that at the surface (atmospheric pressure) results in the offgassing of some of the produced liquid hydrocarbons. The amount of liquids that are volatized corresponds to the amount of the pressure differential and the volume of liquid hydrocarbons produced. Project CBNG wells are not expected to produce measurable or marketable amounts of liquid hydrocarbons. Hydrocarbon separation equipment would not be installed at the well sites. No stock tanks would be located at the well sites. No pipelines would be installed to transport liquid hydrocarbons. Therefore, flashing losses are not anticipated.

Emissions from Spills or Releases. CBNG wells do not typically produce quantities of liquid hydrocarbons; therefore, oily spills are not anticipated nor would they be expected to generate pollutant emissions. Project produced water would be released on the surface after state permitting requirements are met. There are no emissions associated with CBNG produced water. For more information on water quality, see Section 3.4.

Mitigation Measures

Several mitigation measures were identified in the PRB O&G FEIS, in addition to those carried forward into that document from the Wyodak FEIS and ROD and the Wyodak Drainage EA and Decision Notice, which can be applied by the USFS (BLM, 2003, pp. 4-404 - 4-405).

- Watering or other dust control techniques would reduce fugitive dust emissions from traffic on unpaved roads. Watering of access roads would occur as needed or required by the USFS both during the construction and operation phases of the project.
- Imposing reduced speed limits on unpaved roads and encouraged reduced vehicle usage by individual project personnel would also decrease fugitive dust emissions from vehicle traffic.

In addition to the mitigation measures included in the PRB EIS, standard COAs for CBM wells on TBNG specify:

- Common utility corridors and two-track roads will not be bladed. Only brushhogging will be allowed.
- All weather access roads will be constructed to have a 14-foot wide driving surface.

3.3.2.3 Alternative C - Modified Development Alternative

The impacts to air quality associated with Alternative C would be nearly identical to those described for the Proposed Action; however, the impacts would be of less magnitude because fewer wells would be drilled. Actual air quality impacts would depend on the amount, duration, location, and emission characteristics of potential emissions sources, as well as meteorological conditions such as wind speed and direction, precipitation, relative humidity, etc. Emissions sources would be nearly identical to those described for Alternative B.

Comparison of Estimated Emissions for Each Alternative

All emissions that would result from project wells were not modeled; however, AP-42 methodology was used to quantify impacts from some emissions sources for the 28 wells in this alternative. Table 3.3-2 provides qualitative and quantitative comparisons of the emissions anticipated for each alternative.

Table 3.3-2 Summary of Emissions by Alternative

	Alternative A - No Action	Alternative B - Proposed Action	Alternative C - Modified Development
Compressors	No new compressors would be built; therefore, no additional emissions from compressors would occur.	No new compressors would be built; therefore, no additional emissions from compressors would occur.	No new compressors would be built; therefore, no additional emissions from compressors would occur.
Generators	No new generators would be built; therefore, no additional emissions from generators would occur.	No new generators would be built; therefore, no additional emissions from generators would occur. Wells would utilize line power from existing infrastructure.	No new generators would be built; therefore, no additional emissions from generators would occur. Wells would utilize line power from existing infrastructure.

	Alternative A - No Action	Alternative B - Proposed Action	Alternative C - Modified Development
Fugitive Emissions from Wells	No new fugitive emissions from wells would occur.	Fugitive emissions from wells would be minimal and would only occur during construction. Fugitive emissions from wells are not regulated by WDEQ and were not quantified.	Fugitive emissions from wells would be minimal and would only occur during construction. Fugitive emissions from wells are not regulated by WDEQ and were not quantified.
Fugitive Dust (PM_{10})	Slight increases in traffic on existing roads may occur as trends in recreation use change over the years yielding slight increases in fugitive dust emissions.	1,298 pounds (0.65 tons) of PM_{10} emissions per day or 35 tons during the 6-month construction period are estimated to result from vehicle traffic on new and existing unpaved roads. This represents a conservative estimate during the highest use days. Actual emissions could be as little as 1/3 of the estimated value, or 430 pounds per day (0.22 tons). Actual emissions would definitely be lower after the construction phase is completed. These emissions are not considered significant.	1,135 pounds (0.57 tons) of PM_{10} emissions per day or 30.7 tons during the 6-month construction period are estimated to result from vehicle traffic on new and existing unpaved roads. This represents a conservative estimate during the highest use days. Actual emissions could be as little as 1/3 of the estimated value, or 378 pounds per day (0.19 tons). Actual emissions would definitely be lower after the construction phase is completed. These emissions are not considered significant.
Vehicle Exhaust	Slight increases in traffic on existing roads may occur as trends in recreation use change over the years yielding slight increases in vehicle exhaust emissions.	2.2 pounds of NO_x emissions per day or 0.2 tons during the 6-month construction period are estimated to result from vehicle traffic on new and existing roads. This represents a conservative estimate during the highest use days. Actual emissions would definitely be lower after the construction phase is completed. 13 pounds of NO_x emissions per day per rig are estimated to be emitted during construction operations, or 1.2 tons during during 6 months for 3 rigs. These emissions are not considered significant.	1.92 pounds of NO_x emissions per day or 0.17 tons during the 6-month construction period are estimated to result from vehicle traffic on new and existing roads. This represents a conservative estimate during the highest use days. Actual emissions would definitely be lower after the construction phase is completed. 11.3 pounds of NO_x emissions per day per rig are estimated to be emitted during construction operations, or 1 ton during during 6 months for 3 rigs. These emissions are not considered significant.

	Alternative A - No Action	Alternative B - Proposed Action	Alternative C - Modified Development
Dehydrator Emissions	Dehydrators would not be installed.	Dehydrators would not be installed.	Dehydrators would not be installed.
Flashing Losses	No liquid hydrocarbons would be produced. No flashing losses would occur.	No flashing losses are expected to occur. Liquid hydrocarbons would not be produced from project wells.	No flashing losses are expected to occur. Liquid hydrocarbons would not be produced from project wells.

3.3.3 Cumulative Effects

3.3.3.1 Alternative B - Proposed Action

Cumulative impacts to air quality could result from activities associated with well construction and field operations. Construction related emissions consist mainly of fugitive dust and would not cause a significant impact on regional pollutant levels because of their small quantities and limited duration (Argonne, 2002, p. B76-B90). Cumulative impacts to air quality from operational activities include emissions from well production equipment, compression engine exhausts, and vehicle emissions.

The PRB O&G FEIS (BLM, 2003) evaluated the cumulative impacts associated with all emission sources in the PRB. The sources considered included coal mines, CBNG wells, and conventional oil and gas wells. Modeling was performed to determine whether applicable ambient air quality standards and PSD increments would be exceeded as a result of developing CBNG wells in the PRB. The modeling results indicated that most PSD increments would not be exceeded (BLM, 2003, Appendix F, p. F-16, 17). In those cases where the modeling results indicated that it may be possible to exceed the increments, the WDAQ would ensure that the impacts would be limited by adhering to its standards, regulations, and implementation plans established under the CAA.

Wyoming air quality regulations require that proposed new or modified existing air pollutant sources undergo a permitting review before construction begins. The performance of a regulatory PSD increment consumption analysis would determine whether ambient air quality standards are in danger of exceedance as proposed new facilities are reviewed for conformance with air quality regulations (BLM, 2003, p. 4-382). Therefore, if this analysis were conducted, the WDEQ AQD would have the data necessary to monitor air quality impacts resulting from CBNG development as well as other industrial operations in the basin, ensuring that changes to air quality would not result in long-term human health and safety effects.

Table 3.3-3 Predicted Criteria Pollutant Impacts and Applicable Significance Thresholds (in µg/m^3): Powder River Basin

Pollutant	Averaging Time	Location	Background	Increment	Predicted Emissions	Cumulative Emissions	Total	WAAQS
CO	1 hour	near field	3,500	- - -	223	224	3724	40,000
		far field [1]	3,500	- - -	5	100	3600	40,000
	8 hours	near field	1,500	- - -	156	156	1656	10,000
		far field [2]	1,500	- - -	19	78	1578	10,000
NO_2	annual	near field	17	25	8.0	10.5	27	100
		far field [3]	17	25	0.4	5.4	22	100
		far field [2]	17	2.5	0.3	4.2 [b]	21	100
$PM_{2.5}$	24 hours	near field	19	- - -	16.0	24.4	43	65
		far field [3]	19	- - -	5.1	14.7	34	65
	annual	near field	8	- - -	1.7	2.3	10	15
		far field [3]	8	- - -	0.2	1.2	9	15
PM_{10}	24 hours	near field	42	30	20.2	30.8 [b]	73	150
		far field [4]	42	30	0.5	29.7	72	150
		far field [2]	42	8	3.9	12.8 B	55	150
		far field [5]	42	8	2.2	9.2 b	51	150
	annual	near field	17	17	3.3	4.1	21	50
		far field [4]	17	17	<0.1	2.7	20	50
SO_2	3 hours	near field	8	512	3.3	4.6	13	1,300
		far field [3]	8	512	0.7	17.1	25	1,300
	24 hours	near field	8	91	1.7	3.2	11	365
		far field [3]	8	91	0.3	5.3	13	365
	annual	near field	3	20	0.5	0.2	4	80
		far field [3]	3	20	<0.1	0.4	3	80

Source: Adapted from Argonne, 2002, p. F-16

Notes: [a] Annual impacts are the first maximum value; short-term impacts are the second maximum value.

[b] It is possible that **Other** and **Cum** emission sources could exceed the PSD Class I increment on the Northern Cheyenne Indian Reservation, and that **Cum** emission sources could exceed the PSD Class I increment in the Washakie Wilderness Area, and the PSD Class II increment near the maximum potential development; a regulatory "PSD Increment Consumption Analysis" should be conducted during permitting by the appropriate Air Quality Regulatory Agency.

Other - Direct modeled "Non-project" impacts. The impact from all air pollutant emission sources not included in **Alt 1**, including the Montana Final Statewide Oil and Gas EIS and Proposed Amendment of the Powder River and Billings Resource Management Plans DEIS Alternative B/C/E sources. Potential impacts from Montana Alternatives A and D would be less.

Cum - Cumulative modeled impacts. Since these values represent the maximum cumulative impact location, they may not be a simple sum of the maximum direct **Alt 1** and **Other** impacts, which can occur a different locations.

Total - The sum of the cumulative modeled impact and the assumed background concentration.

Locations:

[1] Absaroka-Beartooth Wilderness Area
[2] Northern Cheyenne Indian Reservation
[3] Crow Indian Reservation
[4] Fort Belknap Indian Reservation
[5] Washakie Wilderness Area

Criteria pollutant concentrations predicted in the PRB O&G FEIS for the Reasonable Foreseeable Development Scenario (Alternative 1) in the PRB O&G FEIS is displayed in Table 3.3-3. Cumulative emissions include emissions from other sources not related to oil and gas development. A complete cumulative impacts discussion is contained in the PRB O&G FEIS. Each of the modeled emissions values for a criteria pollutant falls far below the individual WAAQS. Emissions from the Thunderhead project would contribute a small amount to those emissions. Compressors emit the majority of the non-particulate emissions not associated with construction operations. New compressors would not be installed to facilitate project development at Thunderhead.

A principal concern associated with CBNG development is the increase in PM_{10} emissions resulting from fugitive dust. Fugitive dust is also one of the primary pollutants emitted as a result of surface coal mining activities. As industrial development continues to expand in the PRB, fugitive dust emissions will continue to be of concern. As CBNG development continues in the PRB, impacts to air quality from particulate emissions will likely continue to increase, approaching the levels estimated in the PRB O&G FEIS.

PM_{10} concentrations were estimated for the Proposed Action to represent approximately 0.05 per cent of those analyzed in the PRB O&G FEIS. This estimate was derived by comparing the number of road miles that would be constructed for the project to the total number of roads miles estimated for construction within the Wyoming portion of the PRB in the PRB O&G FEIS. The construction of roads results in the largest portion of disturbance related to Project development, and use of unpaved roads represents the largest long-term source of Project particulate emissions. The greatest portion of the amount of estimated particulates that would be generated by the project would result from road construction, however, not road use. As discussed in Section 2.3.4.1, road use for well operations and maintenance would be periodic and limited. Therefore, most of the particulate emissions generated by project operations would occur during construction operations and would dramatically decrease after construction is complete. When analyzing emissions sources within the PRB as a whole, most particulate emissions associated with oil and gas development would occur during those time periods when construction is occurring. Construction would occur intermittently and at locations throughout the PRB. In other words, the locations of the sources of particulate emissions associated with oil and gas activity would change temporarily and spatially. They would not be continuous at high levels over time after well development is initiated. Emissions from coal mining operations, however, would originate from defined locations and would result in emissions that reflect the level of mining activity, which can be assumed to be continuous over time. The estimated particulate emissions resulting from the project must be viewed, therefore, as conservative because the modeled emission concentrations for the PRB include emissions from other development activities not related to oil and gas development. The nature of these other development activities, especially coal mining, lends itself to the continuous production of particulate emissions, unlike the intermittent production of largest portion of particulate emissions associated with oil and gas development. These estimates are shown in Table 3.3-4.

Table 3.3-4 Predicted Particulate Criteria Pollutant Impacts and Applicable Significance Thresholds (in µg/m^3): Thunderhead Proposed Action (Estimated at 0.05 percent of Powder River Basin emissions)

Pollutant	Averaging Time	Location	Background	Increment	Predicted Emissions	Percent Of Background	Percent Of Increment	WAAQS
$PM_{2.5}$	24 hours	near field	19	- - -	0.002	0.011	- - -	65
		far field [3]	19	- - -	0.001	0.003	- - -	65
	annual	near field	8	- - -	0.000	0.003	- - -	15
		far field [3]	8	- - -	0.000	0.000	- - -	15
PM_{10}	24 hours	near field	42	30	0.003	0.006	0.009	150
		far field [4]	42	30	0.000	0.000	0.000	150
		far field [2]	42	8	0.000	0.001	0.005	150
		far field [5]	42	8	0.000	0.001	0.003	150
	annual	near field	17	17	0.000	0.003	0.003	50
		far field [4]	17	17	<0.000	0.00	0.00	50

Source: Adapted from Argonne, 2002, p. F-16

Notes: [a] Annual impacts are the first maximum value; short-term impacts are the second maximum value.

[b] It is possible that **Other** and **Cum** emission sources could exceed the PSD Class I increment on the Northern Cheyenne Indian Reservation, and that **Cum** emission sources could exceed the PSD Class I increment in the Washakie Wilderness Area, and the PSD Class II increment near the maximum potential development; a regulatory "PSD Increment Consumption Analysis" should be conducted during permitting by the appropriate Air Quality Regulatory Agency.

Other - Direct modeled "Non-project" impacts. The impact from all air pollutant emission sources not included in **Alt 1**, including the Montana Final Statewide Oil and Gas EIS and Proposed Amendment of the Powder River and Billings Resource Management Plans DEIS Alternative B/C/E sources. Potential impacts from Montana Alternatives A and D would be less.

Cum - Cumulative modeled impacts. Since these values represent the maximum cumulative impact location, they may not be a simple sum of the maximum direct **Alt 1** and **Other** impacts, which can occur a different locations.

Total - The sum of the cumulative modeled impact and the assumed background concentration.

Locations:

[2] Northern Cheyenne Indian Reservation

[3] Crow Indian Reservation

[4] Fort Belknap Indian Reservation

[5] Washakie Wilderness Area

The COAs applied by the TBNG to this project are more stringent than those used as assumptions by the PRB O&G FEIS modeling analysis; therefore, the TBNG COAs would further reduce PM emissions generated by the project. PM emissions generated by the construction of improved roads would be less than those that would be estimated using the PRB O&G FEIS model because improved road widths would be much smaller in the TBNG. Improved roads would be limited in this project to 14 feet after interim reclamation rather than the 40-foot disturbance assumed in the PRB O&G FEIS (BLM, 2003, Table 2-5). Also, the BLM Gold Book (BLM, 1989, page 10) standards allow for the blading of two-track roads where they serve as common corridors with utilities. Project road construction activities would be limited to the brush-hogging of vegetation, thereby decreasing the amount of ground disturbance and effects of subsequent wind erosion.

Project contributions to cumulative emissions would likely be less than those calculated in this analysis because the assumptions used were conservative, reflecting a scenario where PM emissions would be maximized. Actual vehicle speeds on unpaved roads would likely be less than the assumed 40 miles per hour, and it is extremely unlikely that each vehicle would travel all project associated roads twice in each day, further reducing actual dust emissions.

In order to minimize the effects of continued development of coal mining and oil and gas activity, the WDEQ AQD has proactively taken steps to ensure that increases of PM_{10} concentrations are minimized. The Final South Powder River Basin Coal EIS (BLM, 2003b) analyzed impacts to air quality from the expansion of coal mines near the Big Porcupine Project Area. As noted in that document, the WDEQ AQD continually reviews the data obtained from monitoring stations in the vicinity of the nearby coal mines and considers regulatory options to ensure that the standards are not exceeded. More intense monitoring and regulatory inspections have been implemented at all PRB coal mines. The Wyoming Air Quality Program requires the use of Best Available Control Technology (BACT) at all permitted facilities (BLM, 2003b, p. 3-25). BACT control measures that have been implemented on an area-wide basis include:

- Watering and chemical treatment of unpaved roads, including nearby county roads.
- Limiting the amount of surface area disturbed.
- Temporary revegetation of disturbed areas to reduce wind erosion.
- Timely final reclamation.

BACT technology applied to area coal mines includes:

- Use of baghouse dust collection systems and atomizers/foggers.
- Paving mine access roads.
- Imposition of speed limits.
- Limits on material drop heights for shovels and draglines.
- Use of stilling sheds on coal dump trucks (BLM, 2003, p. 3-22).

Air quality permits for the coal mines adjacent to the Project Area have been issued by WDEQ. A decision for additional coal leasing would act to extend the life of the coal impacts, not

increase them contemporaneously with forecast CBNG development (BLM, 2003b, p. 4-115 to 4-116).

Using the PRB O&G FEIS modeling results, air impacts to AQRVs are not anticipated to result from implementation of the Thunderhead CBNG project alone. The PRB O&G FEIS predicted minor changes in acid neutralizing capacity, exceeding the applicable significance level by less than one percent due to cumulative sources at the Cloud Peak Wilderness Area. The amount generated by CBNG development in the Powder River Basin contributed about 1/3 of the applicable threshold (BLM, 2002, Appendix F, p. F-18). CBNG operations associated with the Proposed Action would contribute to a portion of the minor change in acid neutralizing capacity but would not exceed the modeled amount for CBNG activities in the PRB.

The PRB O&G FEIS predicted that a "just noticeable change" in visibility would occur at 11 federal Class I areas. CBNG operations for over 50,000 existing and projected CBNG wells in the Powder River Basin are expected to impair visibility at the monument for up to nine days (BLM, 2002, Appendix F, p. F-19). CBNG operations associated with the Proposed Action would contribute to a portion of the just noticeable change in visibility but would not exceed the modeled amount for CBNG activities in the PRB.

As discussed in Section 3.1.1.3, the area near the Project Area is already extensively developed for oil and gas resources. Impacts from additional oil and gas development, ranching and livestock management, and recreational activities are expected to contribute minimally to cumulative air quality impacts in the vicinity of the Project Area.

In conclusion, the cumulative effects to air quality resulting from Project development are expected to be less than the emissions estimated to result from the development analyzed by the PRB O&G EIS.

3.3.3.2 Alternative C - Modified Development Alternative

Cumulative impacts to air quality would be similar and slightly smaller than the impacts described for Alternatrive B. Cumulative impacts to air quality could result from activities associated with well construction and field operations. Construction related emissions consist mainly of fugitive dust and would not cause a significant impact on regional pollutant levels because of their small quantities and limited duration (Argonne, 2002, p. B76-B90). Cumulative impacts to air quality from operational activities include emissions from well production equipment, compression engine exhausts, and vehicle emissions.

The results of the cumulative impacts analysis conducted for the PRB O&G FEIS would also apply to Alternative C. The sources considered included coal mines, CBNG wells, and conventional oil and gas wells. Modeling was performed to determine whether applicable ambient air quality standards and PSD increments would be exceeded as a result of developing CBNG wells in the PRB. The modeling results indicated that most PSD increments would not be exceeded (BLM, 2003, Appendix F, p. F-16, 17). In those cases where the modeling results indicated that it may be possible to exceed the increments, the WDAQ would ensure that the impacts would be limited by adhering to its standards, regulations, and implementation plans

established under the CAA. The emissions associated with Alternative C are nearly identical to those estimated for Alternative B, although they may be slightly less because there would be four fewer wells and one less mile of road constructed with this alternative. The impacts upon regional air quality, however, would be extremely small. Emissions associated with Alternative C would not significantly contribute to the degradation of air quality, nor would they significantly contribute to encroachment upon WAAQS. A complete cumulative impacts discussion is contained in the PRB O&G FEIS.

3.4 WATER RESOURCES

Water resources that could be affected by the project include surface and ground water resources. Project-specific information in this section draws from the project Hydrology Report (Greystone, 2002a). Additional details can be found in that report.

3.4.1 Affected Environment

3.4.1.1 Water Quality Standards

Regulations, guidelines, and procedures affecting management and protection of water resources include:

- The **Clean Water Act** (CWA) of 1948 (33 U.S.C. 1251 et seq.) specifies permitting requirements for discharges of wastewater and storm water to waters of the United States under the National Pollutant Discharge Elimination System (NPDES) and for the protection of ambient water quality. The State of Wyoming has primacy over the administration of the CWA.

- **Section 404 of the CWA** regulates the discharge of dredged or fill material into the navigable waters at specified sites, including wetlands, and all work or structures in, or affecting, the course, condition, or capacity of navigable waters of the United States. The federal program is administered by the U.S. Army Corps of Engineers (COE) with EPA oversight.

- **Section 402(p) of the CWA** requires states to issue permits for storm water discharges associated with industrial activity, including construction activities that could disturb one or more acres; however, the EPA has postponed storm water permit requirements for storm water discharges associated with small construction activities from oil and gas exploration, production, processing and treatment operations or transmission facilities until March 10, 2005. The postponement is effective in Wyoming. Oil and gas construction activities that are part of a larger common plan of development that would disturb five or more acres are considered a large construction activity and do not qualify for the postponement (WSEO, 2003).

- **40 CFR 122**.26(a), 122.26(c), 122.26(d), 122.26(g)(1) and 122.41(a) regulate storm water discharges.

- The **Federal Water Pollution Control Act (33 U.S.C. 1323)** of 2001 requires federal land managers to comply with all federal, state, and local requirements, administrative authorities, process, and sanctions regarding the control and abatement of water pollution in the same manner and to the same extent as any nongovernmental entity.

- The **Safe Drinking Water Act (SWDA, 42 U.S.C. 300f et seq.)** classifies ground water used for potable water supply and specifies requirements for the quality of ground water that can be used for water supply. Wyoming has not assumed primacy over the SWDA. The state drinking water quality program follows the EPA drinking water regulations. All enforcement for Wyoming is done by the Regional EPA office from Denver, Colorado.

- The **Watershed Protection and Flood Prevention Act (16 U.S.C. 1001-1009)** requires consultation and coordination with other federal, state, and local agencies.

- **USFS Region 2 (R2) Handbook 2509.25** establishes policies and requires the USFS to install measures to reduce erosion, stabilize land mass movement, mitigate adverse soil chemistry, provide favorable conditions for water flow; its goal is to protect the physical, chemical, biological and aesthetic quality of the water resource, and assure compliance with established state or national water quality goals.

- **EO 11988, Floodplain Management** requires federal agencies to avoid, when possible, adversely affecting floodplains with their actions and to avoid supporting floodplain development whenever there is a practicable alternative.

- **EO 11990, Protection of Wetlands** established a policy of no net loss of wetland for any federal action that may affect wetlands and to avoid activities in wetlands whenever there is a practicable alternative.

- **Wyoming Statutes** (W.S.) 35-11-103, 35-11-301 et seq., WDEQ Program, Chapters 1, 2, 7, 8, 18 provide state guidance with respect to the administration of water quality regulations.

The Wyoming DEQ, Water Quality Division (WQD), and the WSEO are responsible for regulating wells other than those drilled to produce hydrocarbons. The WOGCC is responsible for regulating wells that are drilled to produce hydrocarbons.

3.4.1.2 Wyoming Storm Water Regulation

The State of Wyoming has primacy over the administration of the CWA and storm water regulations within the state. The CWA requires agencies to comply with requirements regarding the discharge of pollutants into surface water bodies through NPDES permits. Section 402(p) requires states to issue permits for storm water discharges associated with industrial activity, which includes construction activities that could disturb one or more acres. The EPA has postponed storm water permit requirements for storm water discharges associated with small construction activities from oil and gas exploration, production, processing and treatment

operations or transmission facilities until March 10, 2005. The postponement is effective in Wyoming and affects only small construction activities from oil and gas related construction, including CBNG development. At this time small construction activities, those projects that will disturb at least one, but less than five (not necessarily contiguous) surface acres, do not need coverage under a storm water permit. Oil and gas construction activities that are part of a larger common plan of development that would disturb five or more acres are considered a large construction activity and do not qualify for the postponement. They require a storm water permit from the WDEQ WQD (WDEQ WQD, 2003).

3.4.1.3 Wyoming Water Quality Standards for Discharged Produced Water

Water that is produced during the production of CBNG is considered a "waste" under the Wyoming Environmental Quality Act and discharges to the surface are regulated through NPDES permits issued by the WDEQ WQD. The Wyoming surface water quality standards, Wyoming Water Quality Rules and Regulations Chapter 1 (WDEQ, 2001), classify water according to designated uses, provide numeric criteria for a wide range of pollutants, and include an antidegradation policy that is intended to maintain the existing quality of waters where the background concentrations of pollutants is better than the use-supported criteria.

Surface water quality standards were promulgated pursuant to W.S. 35-11-1-1 through 1507, specifically 302(a)(i) and 302(b)(i) and (ii) to disallow the violation of the surface water quality standards contained therein. The objectives of the program are designed to serve the interest of the state and achieve the related goals, objectives and policies of the Federal Water Pollution Control Act and amendments as of June 21, 2001.

As part of the Chapter 1 NPDES Application for Permit to Discharge Produced Water, Application Short Form C for Coal Bed Methane New Application or Renewals, an analysis for 36 parameters from a representative produced water sample must be submitted. The constituents include, among others, expected flow from each well, total dissolved solids (TDS), pH, sulfates, specific conductance, sodium, bicarbonate, and SAR. Typical NPDES requirements for CBNG produced water in the Project Area are contained in Table 3.4-2.

3.4.1.4 Surface Water

Hydrology. The Project Area lies within the Little Thunder Creek watershed, which extends from the headwaters of Little Thunder Creek in Townships 43 and 44 North, Ranges 71 and 72 West, to its confluence with Black Thunder Creek approximately 25 miles east of the Project Area. Black Thunder Creek enters the Cheyenne River approximately 12 miles below that confluence. The watershed contains approximately 155,000 acres, draining 242.2 square miles. It forms a low-gradient basin with slopes ranging between four to six percent. Maximum elevation in the watershed is 5,124 feet, and the minimum elevation is 4,199 feet. Approximately 22,340 acres of the watershed lie within the TBNG (Greystone, 2002a, p. 1).

Little Thunder Creek drains into Little Thunder Reservoir just east of Thunderhead 3 in T43N/R71W, Section 22. Water exits the reservoir over an uncontrolled spillway and then continues to its confluence with Black Thunder Creek. Other reservoirs and stock ponds have

been constructed along the drainages in the watershed to retain CBNG produced water flows. Permitted capacities for these reservoirs total approximately 1,200 acre-feet (Greystone, 2002a, p. 12).

Little Thunder Creek crosses Forest Development Road (FDR) 968, known as School Creek Road, in T43N/R69W, Section 30, approximately 11 miles downstream from the Project Area. A low water crossing was constructed at School Creek in 1998 to accommodate increased flows resulting from CBNG produced water discharges. Observations of the crossing through subsequent winters indicate that the crossing effectively and safely accommodates current flows (Greystone, 2002a, p. 17). Construction details for all proposed water management facilities and discussion of the current condition of the Little Thunder Reservoir is included in the project Hydrology Report (Greystone, 2002a).

Little Thunder Creek is a naturally ephemeral stream in the Project Area, flowing only in response to snowmelt and precipitation events. CBNG and mine dewatering wells near the Project Area have contributed to the natural flow when it occurs. The creek exhibits a sinuous, well-defined, well-vegetated main channel that reflects the typical channel slope of 0.68 percent found in the watershed (Greystone, 2002a, p. 6). Its tributary channels display similar characteristics but are less sinuous. A defined floodplain and tributary system exists in the lower reaches of Little Thunder Creek. No significant erosion features exist along the established channels (Greystone, 2002a, p. 3). The flow characteristics of Little Thunder Creek are defined by the slope gradient of the watershed, the amount of precipitation received, amount of CBNG produced water that is discharged into the watershed, evaporation, transpiration, and infiltration. The average annual precipitation for this area is approximately 13 inches. Approximately half the annual precipitation normally occurs during the growing season from April through June. The pan evaporation rate for the Project Area is approximately 42 inches. Seventy-eight percent of evaporative loss occurs between May and October in Campbell County. High winds and freezing temperatures affect winter evaporation rates.

The mean annual flow is estimated to be 5.06 cfs, with peak flow estimates ranging from 2,792 cfs every 10 years to 8,448 cfs every 100 years (Greystone, 2002a, p. 6). WOGCC records indicate that during the period 2000 to 2001, 371 producing wells discharged an average of 7.4 gallons per minute (gpm) per well (Greystone, 2002a, p. 4) into drainages in the Little Thunder Creek watershed. Three discharge points for CBNG produced water are located on private land near the proposed PODs in Sections 9, 13, and 18. These discharge points serve existing wells near the Project Area.

Surface water flows in the PRB are diminished by conveyance loss, which consists of both infiltration and evapotranspiration. Field observations by Greystone personnel of existing discharges in the Little Thunder Creek watershed indicated that a flow of 14 gpm would disappear within 850 to 1320 feet (Greystone, 2002a, p. 4). In order to estimate conveyance loss for the Little Thunder Creek watershed, this analysis relied upon studies conducted by Applied Hydrology Associates (AHA, 2001) in support of the PRB O&G FEIS (BLM, 2003). The study extrapolated data for drainages with a history of CBNG development to develop a model of channel and reservoir conveyance loss. The study was conducted on several hydrologic basins within the Powder River Basin that were considered representative of the basin (AHA, 2001, p.

1). Although none of the drainages studied were located in the Little Thunder Creek watershed, use of the data accumulated in the study results in an estimate of conveyance loss which is considered conservative when compared to the observations made by Greystone in and near the Project Area. The results of this study are displayed in Table 3.4-1. The average measured conveyance loss determined from the AHA study is considered representative of conveyance loss in the Little Thunder Creek watershed; therefore, conveyance loss in the Little Thunder Creek watershed is conservatively estimated to be 30 percent, reflecting the results of the AHA study.

Table 3.4-1 Ephemeral Stream Conveyance Loss Estimates

Ephemeral Stream	Length Analyzed (miles)	Conveyance Loss (percent)	Amount Lost (cfs)	Conveyance Loss/Mile (percent)
Caballo Creek	14.0	100	4.97	28
Pumpkin Creek	11.3	99	1.88	33
Spotted Horse Creek	3.8	62	0.626	22
Wildcat Creek	2.8	76	0.41	40
Average				31

Source: Applied Hydrology Associates (2001).

CBNG development has been ongoing near the Project Area since 1997. Water is produced during the coal seam dewatering process. The production of 1,000 cubic feet of natural gas is estimated to also produce approximately 105 gallons of water (HKM Engineering, 2002); however, the amount of water produced depends upon the area of production. There is little direct consumptive use of ground water in the CBNG industry. The area surrounding the Project Area is currently extensively developed for CBNG production. Water from these CBNG wells is released into the drainages of the Little Thunder Creek watershed.

Surface Water Quality. Stream segments in Wyoming are classified according to their characteristics and uses. Little Thunder Creek is classified as Class 2AB warm water (ww) below the juncture with the North Prong. Class 2 waters may be perennial, intermittent, or ephemeral and are protected for their designated uses. They are known to support fish or drinking water supplies or are considered to be candidates for those uses. Class 2AB waters are known to support warm water game fish populations or spawning and nursery areas at least seasonally. They include perennial tributaries and adjacent wetlands and where a game fishery and drinking water use is otherwise attainable. Unless it is shown otherwise, Class 2AB waters are presumed to have sufficient water quality and quantity to support drinking water supplies. Class 2AB waters are also protected for nongame fisheries, fish consumption, aquatic life other than fish, primary contact recreation, wildlife, industry, agriculture, and scenic value uses (WDEQ, 2003a Chapter 1, Section 4).

Black Thunder Creek, into which Little Thunder Creek flows, Little Thunder Creek above the North Prong, and the North Prong of Little Thunder Creek are classified 3B. Class 3B waters are 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 channels over their entire lengths. The Cheyenne River, into which Black Thunder Creek flows, is classified as 2AB ww water (WDEQ, 2003a Chapter 1, Section 4).

The key parameters for predicting the potential effects of CBNG development on water quality are sodicity (as measured by the sodium adsorption ratio, SAR) and salinity (as measured by electrical conductivity, EC). SAR is the proportion of sodium ions to calcium and magnesium ions and represents the potential for the water to impact soil structure. The effect of water quality on water infiltration, as necessary for effective irrigation, depends on the SAR and EC of the water. Wyoming's current permitting process for the Cheyenne River watershed incorporates the numeric water quality standards for SAR (10) and EC (2,000 micromhos/cm) considered protective of water bodies downstream in South Dakota (BLM, 2003, pp. 4-70 - 4-73). Furthermore, WDEQ applies its anti-degradation policy to all CBNG discharges. This policy results in effluent limitations in NPDES permits for discharges of CBNG produced water that equate to 20 percent of the available increment between low-flow pollutant concentrations and the relevant standards (assimilative capacity) for critical constituents. A separate basin-specific anti-degradation policy for barium is also applied to CBNG discharges. For the Cheyenne River watershed, in which this project lies, the end-of-pipe barium concentration is limited to 1,800 µg/l and the average in-stream concentration is limited to 560 µg/l, as measured at the USGS gaging station on the Cheyenne River at Riverview (station #06386400) (WDEQ, 2000). Barium was measured at 400 µg/l in produced water from a CBNG well (Barrett Resources Federal 32-35) located approximately 3 miles from the Project Area in the SWNE Section 35, T43N/R71W. This value is well below the end-of-pipe limit and below the stream concentration limits.

Baseline water quality and quantity in the Little Thunder Creek watershed have been altered by the addition of water associated with coal mine de-watering and CBNG produced water. Water quality data for Little Thunder Creek are presented in Table 3.4-2. Water was sampled at two different times from two different locations downstream from the Project Area. Samples taken near Rochelle, Wyoming, were collected at a location approximately 24 miles downstream from the Little Thunder Reservoir at a time prior to the addition of water from mining operations. The Black Thunder Mine, which discharges in the Little Thunder Creek watershed, initiated production in 1978. Measurements from the Hampshire station, approximately 34 miles downstream from Little Thunder Reservoir, were taken prior to CBNG production in the watershed but after water associated with mine de-watering was released into the watershed (Greystone, 2002a). Therefore, both sets of data represent conditions prior to the addition of CBNG produced water to the watershed. Differences in flow measurements between the two locations reflect the addition of water originating from mine de-watering operations at the two different times when the measurements were taken. Table 3.4-2 also lists effluent maximum concentration values typical for drainages of the Cheyenne River watershed, as included in an NPDES permit typical for the area.

Table 3.4-2 Little Thunder Creek Water Quality

Parameter	Typical Wyoming Effluent Standards for Cheyenne River Watershed Applicable to CBNG Discharges[1]	Little Thunder Creek WNW of Rochelle, WY WRDS-06524:0 May 1976 – Jan 1978			Little Thunder Creek near Hampshire, WY WRDS-06375600:0 Sept 1977 – May 1997		
		Mean	Standard Deviation	Sample Size	Mean	Standard Deviation	Sample Size
Flow (cfs)	Variable/site-specific	0.60	0.71	4	11.98	30.02	70
pH (s.u.)	6.5-8.5	7.77	0.47	6	8.00	0.31	53
Total dissolved solids (TDS) (mg/l)	5,000	NA	NA	NA	NA	NA	NA
EC/specific conductance(micromhos/cm)	2,000	1501.0	284.26	2	1628.57	1148.84	28
SAR	10	2.76	1.11	8	5.15	2.83	28
Sodium (mg/l)	--	164.13	75.04	8	235.16	198.82	47
Calcium (mg/l)	--	121.63	61.74	8	83.82	44.40	48
Chloride (mg/l)	46	10.29	4.82	8	32.99	59.57	48
Sulfate (mg/l)	3,000	735	316	8	651.97	511.03	48
Bicarbonate (mg/l)	--	NA	NA	NA	274.34	158.55	27
Dissolved oxygen (mg/l)	3.0-6.0	6.87	3.05	8	9.61	2.31	45
Dissolved iron (µg/l)	1,000	NA	NA	NA	NA	NA	NA
Dissolved manganese (µg/l)	910	NA	NA	NA	NA	NA	NA
Total arsenic	2.4	NA	NA	NA	NA	NA	NA
Total barium	1,800	NA	NA	NA	NA	NA	NA
Total radium 226 (pCi/l)	1	NA	NA	NA	NA	NA	NA
Total petroleum hydrocarbons (TPH) (mg/l)	10	NA	NA	NA	NA	NA	NA

Source: University of Wyoming WRDS, 2003a

[1] NPDES permit limit for CBNG produced water in Cheyenne River drainage, WY0037052

The data indicate that the creek waters are of good quality. The relatively low SAR values are well below the typical effluent limit of 10 and make the water suitable for irrigation, which has a standard of 8 (WDEQ WQD Chapter VIII, 1993). EC values lower than the typical effluent limit indicate that the excessive salinity would not impair downstream waters. Low mean values measured for sodium and chloride indicate that the water is not toxic. Low values for calcium and bicarbonate indicate that the water is not predisposed to mineral precipitation. Dissolved oxygen values indicate generally well-oxygenated water that approaches oxygen saturation when the flow is higher, as can be seen by comparing the measurement near Hampshire (9.61 mg/l) to that near Rochelle (6.87 mg/l). The mean values at both locations are above the Wyoming water quality standard minimum of 3.0 – 6.0 (WDEQ WQD, 2001 Chapter 1, Appendix D).

3.4.1.5 Ground Water

Ground water is discussed solely with respect to aquifers that are hydrologically associated with project-related activities. Other, deeper aquifers are not discussed. The three water-bearing units that could be affected by development of the proposed wells include, in descending order, recent Alluvium, the Wasatch Formation, and the Fort Union Formation.

Wyoming Ground Water Standards. Ground water regulations, Chapter VIII, were promulgated pursuant to W.S. 35-11-101 through 1104. Protection is afforded to all underground water bodies, including water in the vadose zone. Water used for a purpose identified in W.S. 35-11-102 and 103(c)(i) must be protected for its intended uses for which it is suitable. Water not being put to use must be protected for all uses for which it is suitable.

Alluvial Aquifers. Alluvial aquifers consist of very permeable unconsolidated coarse-grained sand and gravels that underlie floodplains and the adjacent stream terraces. Thicknesses are usually less than 50 feet. Recharge results from surface infiltration and discharge from underlying strata. Local ground water movement dominates these systems, and movement is along the drainage in a downstream direction. The ground water resources contained in alluvial aquifers are unconfined. Water yields of about five to 1,000 gpm have been reported from PRB alluvial aquifers (BLM, 2000, p. 3-29). Water quality in alluvium within the PRB is variable. Concentrations of TDS in alluvial aquifers ranged from 106 to 6,610 mg/l and averaged 2,128 mg/l for 38 samples taken from the PRB (BLM, 2003, p. 3-8).

The alluvial and colluvial deposits associated with drainages associated with the ephemeral streams in the Project Area are generally thin and very fine grained, exhibiting limited permeability. They are not laterally extensive enough to be considered aquifers. Porcupine Creek, approximately eight miles south of the Project Area, is the nearest alluvial aquifer (BLM, 2001a, pp. 3-31 - 3-32).

Wasatch Formation. The Wasatch Formation consists of interbedded sandstones, siltstones, and shales with occasional discontinuous coal stringers and clinker deposits. The yield of wells completed in the Wasatch aquifer is directly related to the number and thickness of sandstone lenses or beds penetrated by the well. Wells can yield as much as 500 gpm, although smaller rates are more typical (BLM, 1999, p. 3-2). Where the sandstone and coal stringers are saturated, wells yield water that is used primarily for stock watering.

Saturated strata are limited in areal extent and are typically thin, lenticular sandstones. Intervening shale layers effectively limit the hydraulic connection between sandstone lenses, restricting water movement. Because the water producing units are not continuous, the Wasatch is not considered to be a regional aquifer. Recharge of the Wasatch aquifer is through surface infiltration of precipitation and lateral movement of water from adjacent clinker, spoil, and alluvium. Ground water is discharged from the Wasatch by evaporation and transpiration where the formation outcrops, by pumping wells, and by seepage into the alluvium along stream drainages.

The discontinuous nature of the water bearing strata results in low overall hydraulic conductivity and low ground water flow rates. Ground water flow in the Wasatch aquifer is suspected to be primarily local and related to topography. The varied characteristics of the aquifer units within the Wasatch result in variable hydraulic properties. Hydraulic conductivities can vary from 10^{-4} feet per day to 10^{2} feet per day. The higher values indicate that more saturated sands are present among the low-permeability silts and clays (BLM, 2003, p. 3-22).

A 2002 study analyzed samples from several sources of Wasatch and Fort Union waters in order to determine water quality with respect to state standards (Bartos and Ogle, 2002). The study indicated that for public supply and domestic use, Wasatch waters can sometimes exceed State of Wyoming standards for TDS; however, exceedances are more likely to occur north of the Belle Fourche River. Wasatch waters can frequently exceed state irrigation standards for sulfate and, to a lesser extent, dissolved solids. Some samples of Wasatch waters exceed the state livestock standard for pH. Wasatch waters can be characterized as ranging from soft to very hard (Bartos and Ogle, 2002, p. 7). The EC and SAR values for the Wasatch Formation water indicate that a slight to moderate reduction in infiltration may result if this water is used for irrigation. The median SAR and median sodium concentration place this water in the category of medium sodium hazard (Hanson et al., 1999, p. 106). After the water is discharged, however, its EC would tend to rise as soil particles become entrained in the flow. The increase in EC would tend to allow the water to demonstrate no reduction in infiltration. Water quality data from the Wasatch aquifer are summarized in Table 3.4-3

Table 3.4-3 Water Quality for the Wasatch and Fort Union Coal Aquifers

Parameter	Wyoming Water Quality Standard			Wasatch Aquifer[1] (median of 7-8 samples)	Fort Union Coal Aquifer[1] (median of 13 samples)	Wyodak-Anderson Coal Seam[2] (one sample)
	Chapter VII Ground Water					
	DOM	AG	LS			
pH (s.u.)	6.5-9.0	4.5-9.0	6.5-8.5	7.8	7.2	7.7
EC (micromhos/cm)				1,382	1,070	707
SAR	--	8.0	--	9	7	5.8
Sodium (mg/l)				225	210	135
Calcium (mg/l)				15.5	36	24
Chloride (mg/l)	250	100	2,000	9.6	9.1	5
Sulfate (mg/l)	250	100	2,000	130	<0.3 – 1.8	1
Bicarbonate (mg/l)	250	200	3,000	461	712	458
Total dissolved solids (mg/L)	500	2,000	5,000	1,010	644	554

[1]Source: Bartos and Ogle, 2003 (pp. 28-29)
[2]Greystone, 2002a (p. 8)
-- No standard established
DOM = Domestic
AG = Agriculture (Irrigation)
LS = Livestock

Fort Union Aquifers. The Fort Union Formation consists of three hydrologic units: the Tongue River Member, which includes the Wyodak Coal, the Lebo Shale Member, and the Tullock Member. See Section 3.1.1.2 for a schematic drawing of a geologic column illustrating the hydrologic units in the Fort Union Formation. Water yields from the Fort Union aquifers range from 3 to 160 gpm (BLM, 2003, p. 3-29).

The Tongue River Member contains as many as 11 coal beds and many discontinuous, lenticular sandstone layers. The Wyodak coal occurs at the top of the Fort Union sequence and is considered a regional aquifer in the Powder River Basin. The Wyodak aquifer consists of multiple coal seams, interbedded sandstones, and clinker beds that form a sequence that ranges from 50 to 70 feet thick, dipping to the west at less than one percent. Hydraulic conductivity varies and reflects the amount of fracturing present in the coal seam. Prior to mining operations, flow direction generally followed the dip of the coal. Data collected by nearby mines indicate that local ground water flow within the coal aquifer in the vicinity of the mines is toward nearby mine pits. Hydraulic conductivity measured at the Jacobs Ranch Mine, to the east of the Project Area, ranges from 0.07 to 1.60 feet per day (BLM, 2003, p. 3-23). Recharge occurs primarily along clinker outcrop areas with a small amount of leakage from the overlying Wasatch aquifer. Recharge into the coal could also come from spoil and alluvial aquifers and from localities where coal underlies valley fill deposits.

Clinker aquifers consist of highly fractured rocks formed by the natural burning of coal beds. Clinker aquifers can store large amounts of water from rainfall and snowmelt. Clinker deposits may yield as much as 500 gpm water (BLM, 2000, p. 3-29). Areas of clinker crop out east and southeast of the Project Area. Recharge of the clinker occurs from precipitation, surface water infiltration, and lateral inflow from clinker deposits updip. Although recharge rates to the clinker are relatively high, the rate of recharge from the clinker units to coal seams is often limited by a relatively low-permeability, clay-rich zone that typically occurs at the contact between the clinker and the coal. Ground water stored in clinker is slowly discharged to springs, streams and coal aquifers downdip, helping to maintain perennial streams during dry periods. Springs that emerge from the base of clinker deposits form the headwaters of several perennial streams and provide wetland habitat for many species. Clinker may function locally as a confined aquifer, although it is normally unconfined.

The Lebo Member consists of sandstones grading to mudstone with depth. Wells in the Lebo unit may yield as much as 10 gpm of water for domestic and livestock use if a sufficient thickness of saturated sandstone is penetrated. As with other Fort Union aquifers, recharge is primarily from inflow at outcrop areas. Ground water generally flows north (BLM, 1999, p. 3-6). The Lebo Member is sometimes referred to as the "Lebo Confining Layer" as its fine-grained composition generally retards the movement of water. The Lebo is not directly disturbed by coal mining, but many mines use it for water supply wells (BLM, 2001a, p. 3-24).

The Tullock Member aquifer consists of fine to medium-grained sandstone layers and thin coal seams interbedded with siltstone, shale, and carbonaceous shale. The Tullock was deposited in river systems that flowed to the east and varies from 500 to 1,500 feet thick. Fine-grained sandstones and jointed coal beds may yield as much as 40 gpm, but yields of 15 gpm are more common. Where the aquifer is confined, wells generally flow less than 10 gpm. Recharge to the Tullock results from leakage through overlying strata and infiltration along the outcrop areas

(BLM, 1999, p. 3-7). Like the Lebo, the Tullock Member is not directly disturbed by coal mining, but many mines use it for water supply wells (BLM, 2001a, p. 3-24).

Analyses of Fort Union produced water indicate that concentrations of most constituents are generally less than the most restrictive Wyoming ground water quality standards (BLM, 2003, pp. 3-12 to 3-13). The domestic use standard for dissolved solids was the standard most frequently exceeded in the 2002 study. The irrigation standards for sulfate and TDS were exceeded by the sample Fort Union waters in only eight percent of the samples. Hardness ranges from 74 to 446 mg/l, making the water typically hard (Bartos and Ogle, 2002, p. 7). The EC and SAR values for the Fort Union Formation water indicate that a slight to moderate reduction in infiltration may result if this water is used for irrigation. The median SAR and median sodium concentration place this water in the category of medium sodium hazard (Hanson et al., 1999, p. 106). After the water is discharged, however, its EC would tend to rise as soil particles become entrained in the flow. The increase in EC would tend to allow the water to demonstrate no reduction in infiltration.

Water quality varies within clinker aquifers according to its proximity to unburned coal. Quality is poorer where water in clinker has ponded along a contact (burn line) with unburned coal downdip. TDS values range from 200 to 10,000 mg/l. On clinker-capped plateaus where burning has removed most or all of the coal, TDS values are commonly less than 400 mg/l. Water quality data from the Fort Union aquifer are shown in Table 3.4-3.

A summary of water quality parameters is shown in Table 3.4-3 The water quality of the Wyodak-Anderson coal seam, the target zone for the proposed wells, is shown in comparison with values for the Wasatch and Fort Union coal aquifers.

CBNG produced water from the Wyodak-Anderson coal seam exhibits, for most parameters, better quality than either the Wasatch or Fort Union aquifers. The measured concentrations of the analyzed constituents are lower in the Wyodak-Anderson than in the Wasatch or in the Fort Union. Bicarbonate and pH values are comparable in all three aquifers, while EC, SAR, sodium, chloride and total dissolved solids are less in the Wyodak-Anderson than in the other two aquifers. Its value as an irrigation water is expected to stay constant or increase as EC increases after discharge on the surface. Calcium in the Wyodak-Anderson coal seam is higher than in the Wasatch, but lower than in the Fort Union. Sulfate values in the Wyodak-Anderson (1 mg/l) are comparable to the Fort Union (<0.3 – 1.8 mg/l) and significantly less than the Wasatch Aquifer (130 mg/l).

Springs. Springs and seeps occur where ground water is discharged to the surface. They are most numerous where topographic relief is great and stratigraphic units are discontinuous. In addition, springs and seeps also emerge at the base of clinker deposits, along the contact between the permeable clinker and impermeable layers below. The primary source of recharge to springs and seeps is infiltration of precipitation and seepage from streams and rivers. A search of the WSEO (WSEO, 2003) database for permitted springs and the July 2001 onsite inspection did not reveal any springs in the Project Area.

Wells. Ground water levels in the area depend on the aquifer in which the well is completed and well depth. The Wasatch and Fort Union aquifers are the most important local sources of ground water in the PRB (BLM, 1999, p. 3-7). They are developed extensively for shallow domestic

and livestock wells. Water suitable for domestic and livestock uses typically can be found less than 1,000 feet below the surface. Domestic and livestock wells usually yield less than 25 gpm and are intermittent producers. Industrial water wells are used primarily to obtain water for use in subsurface injection that promotes secondary recovery of petroleum. Industrial use wells are used at coal mines for drinking water and dust abatement.

Ninety stock and one domestic water well permits (WSEO, 2003, online data) have been issued in the Project Area and within a one-mile radius of the project boundary. Completion depths range from -1 foot to -733 feet below ground level. Static ground water depths measured from wells in the vicinity range from -1 foot to -550 feet below surface grade. A search of the WSEO database indicates that there may be some artesian wells in or near the Project Area. Completion depths of -1, as listed in the WSEO database, indicate that the water is flowing at the surface. There are 21 permitted wells, possibly including artesian wells. Twelve of the 21 wells are permitted for domestic or stock use. The remaining wells are either permitted as miscellaneous, CBNG, or monitor wells. (WSEO, 2003).

3.4.2 Environmental Consequences

Surface water issues identified from scoping include:

- Effects of high volumes of discharged water with respect to increased sedimentation, channel erosion, morphology, including discharge timing and magnitude.
- NPDES requirements for surface discharge of CBNG produced waters.
- Necessity for NPDES storm water permit requirements for construction activities that would disturb five or more acres.
- Potential impacts of produced water quantity/quality to the Little Thunder Reservoir.
- Reservoir construction and operations.
- Evaluation of downstream enhancement projects where discharged produced water quality allows.
- Adverse effects to wetlands.
- Possiblity of icing at the School Creek crossing as a result of increased surface water discharge.

Ground water issues identified from scoping include:

- Potential depression of the water table and possible reduction of well capacities.
- Effects on wetlands due to diminished flows of seeps, and springs

3.4.2.1 Alternative A - No Action

If none of the proposed activities were to occur on federal lands as a result of implementing the No Action alternative, no additive impacts would occur as a result of project development. Conventional oil and gas development could continue within the Project Area, and CBNG development would continue on state and private lands near the Project Area. Surface and ground water resources would continue to be affected by continued surface coal mine development. Surface coal mining is likely to continue adjacent to and within the Project Area

for the foreseeable future, resulting in impacts to the coal aquifer and drainages in the vicinity of the mines.

3.4.2.2 Alternative B - Proposed Action

Surface Water

The Proposed Action could affect surface water resources by increasing the quantity of water discharged into the drainages of the Little Thunder Creek watershed, thereby potentially affecting the hydrologic regime, and altering surface water quality with the addition of CBNG produced water originating from the Wyodak-Anderson coal seam. The produced water would be released on the surface for beneficial uses under Wyoming NPDES permit requirements. The water would be used as livestock supply water, wildlife use and wildlife habitats, dust suppression on area roads, and industrial purposes by local coal mines. Stock (tire) tanks have been requested by surface lessees or private landowners at four locations in the Project Area. Wildlife would benefit from the presence of the water in channels. No irrigation rights exist in the area contained in T43N/R70W upstream through T43N/R72W (WSEO, 2004).

Hydrology. Potential effects from discharges of CBNG produced water to surface drainages within the Project Area include alteration of flow regimes, channel erosion, and channel sedimentation.

Release of CBNG produced water would increase stream flows in the Little Thunder Creek watershed. Data from operating fee CBNG wells near the Project Area indicate an average initial maximum discharge rate of 14 gpm (0.03 cfs) per well. The flow is expected to decrease at seven to 10 percent annually for two years and subsequently decline at a 20 percent annual rate until an equilibrium rate of four gpm (0.09 cfs) is reached. The four gpm discharge would remain constant for the remainder of the anticipated 10-year life of each project well (Greystone, 2002a, p. 1). Each well produces water at an average rate of 7.4 gpm (0.016 cfs) over its lifetime (Greystone, 2002a, p. 4). A decline curve showing the CBNG produced water production rate is shown in Figure 3.4-1. Maximum initial discharge from 32 project wells would result in 448 gpm (1.0 cfs) being discharged into various tributaries of Little Thunder Creek, declining to 224 gpm (0.5 cfs) from 32 wells at a well life of seven years.

A significant portion of the discharged produced water would be lost in conveyance along existing drainages as a result of infiltration and evapotranspiration. The water from the 32 proposed wells would be released into the watershed at three existing and three proposed discharge points. Existing and proposed discharge points are shown on Figure 2.3-1. The discharge points located in sections 9, 10, and 13 would discharge approximately 238 gpm (Greystone, 2002a, Table 2, p. 5) of produced water into drainages that would flow into the North Prong of the Little Thunder Creek approximately 10 miles before that tributary joins the main channel of Little Thunder Creek. The discharge points located in sections 18, 20, and 21 would discharge approximately 210 gpm (Greystone, 2002a, Table 2, p. 5) of produced water into drainages that would flow into the main channel of Little Thunder Creek upstream of the Little Thunder Reservoir. Approximate distances to the junction of the North Prong of Little Thunder Creek and the main channel of Little Thunder Creek were estimated from each discharge point. Using a conservative conveyance loss figure of 31 percent per mile, the amount of water flow remaining after conveyance loss at the junction was estimated using the average

maximum flow rate for each well distributed to each discharge point according to the number of wells each point serves (see Table 3.4-4).

Figure 3.4-1 Rate of Decline and Average Flow Rate of CBNG Produced Water for a Typical Well

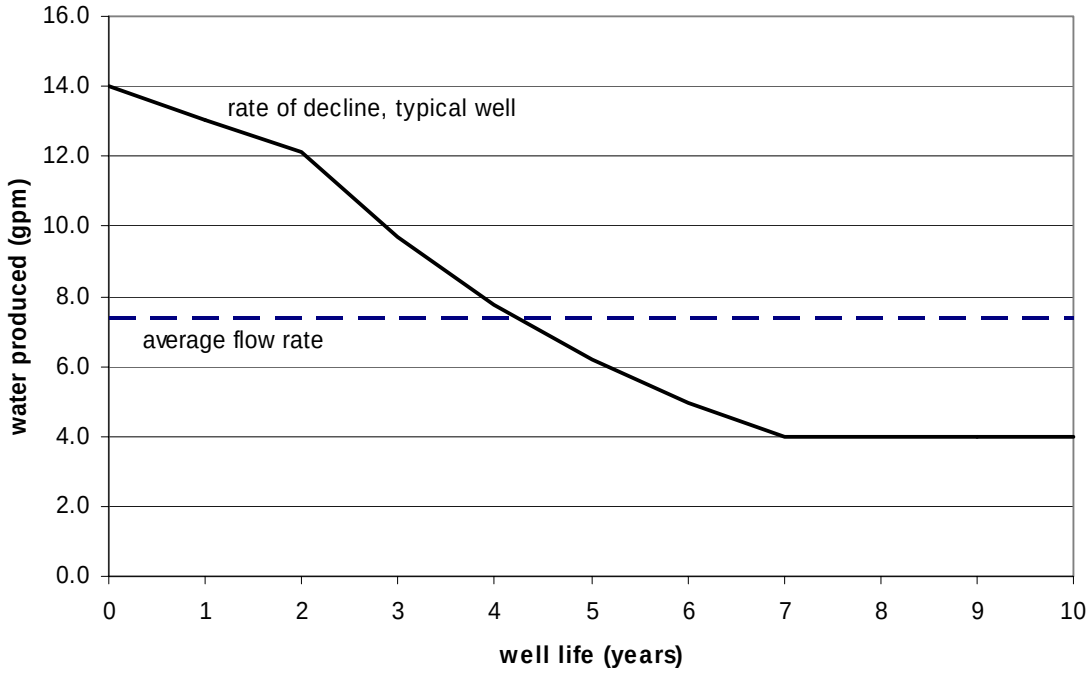


Table 3.4-4 Estimated Flow of Project-associated Produced Water Remaining After Conveyance Loss

Discharge Point Location (T43N/R71W)	Direction of Initial Produced Water Flow	Maximum Estimated Flow[1] (gpm/cfs)		Estimated Distance From Discharge Point To Junction of North Prong and Main Channel, Little Thunder Creek	Amount of Flow Remaining after 31% Per Mile Conveyance Loss (gpm/cfs)	
Section 9	North Prong of the Little Thunder Creek	98	0.22	9 miles	3.47	0.01
Section 10	North Prong of the Little Thunder Creek	56	0.12	9 miles	1.99	0
Section 13	North Prong of the Little Thunder Creek	84	0.19	7 miles	6.25	0.01
Section 18	Main channel of Little Thunder Creek	56	0.12	12 miles	0.65	0
Section 20	Main channel of Little Thunder Creek	112	0.27	10 miles	2.74	0.01
Section 21	Main channel of Little Thunder Creek	42	0.09	9.5 miles	1.26	0

[1] Source: Greystone, 2002a, Table 2, p. 5.

It is estimated that nearly 100 percent of the water discharged from project wells under maximum flow conditions would be lost through conveyance at the point where the junction of the North Prong and the main channel of Little Thunder Creek meet.

The conveyance loss estimate is conservative for the following reasons:

- The estimated conveyance loss for the discharge points in sections 18, 20, and 21 does not include estimated for conveyance loss associated with infiltration into the subsurface while the water is contained in Little Thunder Reservoir;
- Conveyance loss associated with pan evaporation is not included in the calculations;
- Recent studies conducted by the BLM (Meyer, 2000) support a figure for conveyance loss in the nearby Belle Fourche River Basin that is much higher than 31 percent. Use of the data provided in the BLM study in this analysis would result in a 100 percent loss of project associated produced water in a much shorter distance. Observations made by Greystone in 2001 support the BLM evaluation (Greystone, 2002a, p. 4); and
- As more CBNG wells come on line near the Project Area and nearby coal mines expand, de-watering is accelerated in the producing coal seam. It is likely that the average water production rate associated with each well estimated by Greystone in its Hydrology Report (2002a) have decreased.

Drainages near the discharge points that previously were ephemeral could become locally perennial due to the increased volume of channelized flow. Conveyance losses would be reduced when CBNG produced water is discharged into perennial waterways and during prolonged cold winters. Channel alluvium of creeks and draws receiving surface discharge of CBNG produced water would become more saturated, and runoff rates could increase. The possible reduction of average conveyance loss would be offset by the considerations listed above.

Despite these qualifications, it is highly likely that the discharged produced water would be lost through conveyance well upstream from the junction with the North Prong. There is expected to be, therefore, no measurable incremental flow resulting from the addition of CBNG produced water at the junction of Little Thunder Creek with the North Prong Little Thunder Creek. Natural processes would continue to have the dominant impact on stream flow, erosion, and sedimentation downstream from the confluence of Little Thunder Crrek and the North Prong.

Prior to CBNG development, stream flow volumes in Little Thunder Creek measured at the gaging station near Hampshire, Wyoming demonstrated a positive correlation to months of the year when precipitation is the greatest, April through June. Stream flow returned to near zero flow during periods of little or no precipitation (University of Wyoming, 2003a). Stream flow data for this station are not currently available; however, because all of the project produced water is anticipated to be lost to conveyance within 13 miles of the discharge points, it is anticipated that there would be no change to past flow regimes at this station.

Erosion and increased sediment load would be effectively minimized by the design features and construction techniques committed to by the applicant. The discharge of CBNG water would result in minimal additional downstream sediment transport because the low flows associated with CBNG discharges would not be highly erosive and much of the discharge would be lost to conveyance. The anticipated 14 gpm flow rate would begin to decline immediately after

production is commenced, continuing to decline until a well is approximately seven years old, at which point the four gpm flow rate would remain nearly constant for the remaining three years of well life.

Erosion would be further controlled by the construction of site-designed water management facilities and subsequent operational monitoring. Site-designed water management facilities that would be constructed include discharge points and stream crossings. The release of project produced water is not expected to add to sediment load in the drainages. The July 2001 onsite inspections of existing water management facilities and sites proposed for additional structures conducted by the USFS and Lance personnel considered the additional volumes of produced water with respect to the possible increase of existing flows as well as increased flows associated with storm events.

The increase in flow would not likely cause significant adverse downstream impacts because the flow attributable to CBNG produced water is small relative to storm flows in the Little Thunder Creek watershed. Peak flow estimates for the watershed range from 707 cfs for a 2-year storm event to 8,448 cfs for a 100-year storm event (Greystone, 2002a, p. 6). The storm peak flows represent only natural precipitation contributions. Actual flows, which would include contributions from drainages upstream of the Project Area, would add to the storm peak flows.

The expected flow rate allows many existing water management facilities to be used without modification; therefore, there is no need for new reservoirs or low water crossings. The onsite evaluation determined that the existing discharge sites were suitably designed and located to handle the increased flow from project wells. New discharge facilities would be designed to control erosion through energy dispersion elements and through appropriate location of the discharge points. The installation of culverts and construction of drainage dips would conform to USFS guidelines detailed in the BLM and USFS Gold Book (BLM and USFS, 1989) ensuring that the construction would meet agency standards. The drainage crossing design incorporates features that would facilitate minimal surface disturbance during construction, discouraging erosion and aiding the retention of native vegetation that helps to stabilize slopes. Re-seeding, as included in the Proposed Action, would further encourage vegetative growth. Details of the proposed water management structures, both design and location within the Project Area, are found in the Hydrology Report (Greystone, 2002a).

Since the project is located within the headwaters of Little Thunder Creek and does not include plans to create new impoundments or diversions, users downstream would not be deprived of natural runoff as a result of development of the proposed wells.

Effects to Surface Water Quality. Changes in water quality may occur as the CBNG produced water flows from discharge points in stream channels toward the higher order streams or as it infiltrates to shallow ground water systems and is discharged subsequently to surface flows. Beneficial effects of the discharge water include maintaining a more stable high water level in Little Thunder Reservoir that would enhance the recreational value of the reservoir, increasing riparian habitat, increasing water available for livestock and wildlife, and increasing water available for irrigation. In addition, the water quality of existing surface water would be improved with the addition of water that exhibits lower concentrations of chloride and sulfate. Other measured concentrations of constituents typically monitored by NPDES permits are consistent with values exhibited by Little Thunder Creek.

Downstream impacts to surface water quality are not anticipated from the project as discharges from the project area would result in a minimal increase in downstream flows. Because the quality of the water originating from the producing coal seam is considered "good" with respect to Wyoming discharge standards, produced water from project wells can be discharged on the surface in accordance with NPDES permit requirements without degrading existing surface water quality.

Long-term water quality and flow monitoring would comply with the NPDES permit requirements. To ensure that effluent limitations are met, monitoring would occur as specified by the NPDES permits. In addition, Lance has committed to a sampling and analysis program as well production results in produced water discharges. Details of the sampling program are contained in the Hydrology Report (Greystone, 2002a, p. 10).

All regulatory requirements would be satisfied prior to release of the produced water, ensuring that state water quality protective measures would be met. Regulatory requirements would include securing NPDES permits from the WDEQ and ground water or surface water appropriation permits from the WSEO.

Water quality results from representative CBNG wells in the area indicate that the addition of water should not impact the current and/or permitted surface water uses downstream. Values of critical parameters of the produced water are, in general, within or below the ranges of these same parameters in the native water of Little Thunder Creek, as shown in Table 3.4-3.

Ground Water

Effects to Ground Water Availability.

Alluvial Aquifers. Almost all of the ground water produced from project operations would be released to surface drainages and impoundments.

Alluvial infiltration rates would approach 31 percent per mile, at a minimum, and would reflect changes in produced water production and discharge rates. The thin, fine-grained alluvial deposits that characterize the Project Area exhibit limited permeability and, therefore, would, therefore, tend to discourage infiltration and encourage runoff. There would be no adverse effects from the discharge of produced water to the alluvium to alluvial aquifers because there are no alluvial aquifers in the Project Area. Most of the water loss through channel seepage is expected to recharge bedrock units because of the limited capacity of the alluvium to transmit flow (AHA, 2001, p. 2).

Increased water levels may cause standing water in areas not previously displaying this condition; however, use of the construction techniques described in the Hydrology Report (Greystone, 2002a) would prevent accumulation of water in drainages near road construction.

Wasatch Aquifer. Drawdown in the shallow Wasatch sands may occur near mines and areas where the underlying Fort Union coal is near the surface or where deep sand units occur within 100 feet of a developed coal. Domestic or industrial wells producing from the drawdown portion of the Wasatch would be adversely affected by a decrease in water production. Typically,

several years (BLM, 2003, p. 4-47) would pass before noticeable drawdown in the Wasatch would be apparent because of the limited hydraulic communication between it and the Fort Union. Drawdowns in deep sands that occur within 100 feet of developed coals may be between 5 to 10 percent of the projected drawdowns in the coal. Recovery in the deep Wasatch sands may occur after water levels in the coal recover substantially, and induced leakage from the deep Wasatch sands into the coal becomes minimal. Because the Wasatch sands would continue to recharge the coal after production of CBNG ceases, the recovery of water levels in the deep Wasatch sands would be slow.

Some of the ground water released by the project to surface drainages or impoundments may result in direct recharge of shallow Wasatch sands. Seepage loss through reservoir bottoms would be directly related to the surface area impounded (AHA, 2001, p. 3). The rate and extent of recharge would be directly related to the permeability of the Wasatch Formation under channels and impoundments.

Fort Union Aquifers. Development of the Wyodak-Anderson coal seam would cause the hydraulic head in the coal in the Tongue River Member to be drawn down. Initial production of CBNG would primarily be caused by redistribution of ground water stored in the aquifer as formation water is pumped out. After pumping is discontinued, ground water in adjacent formations and undeveloped areas of the Tongue River would re-saturate and re-pressurize the formation where water was withdrawn. Complete recovery of the water level would be a long-term process because most of the recharge would come from overlying and underlying sand and undeveloped coal units that, in turn, would be recharged from surface infiltration.

The amount of ground water storage within the coals and the sand units above the coals is quite large; however, the amount and rate of water migration from the overlying Wasatch aquifer into the Fort Union coals would be limited by the areal extent of sands within 100 feet of the coal and by variable thicknesses of claystone at the base of the Wasatch Formation. Recharge rates to near-surface formation members would increase temporarily as a result of infiltration of CBNG produced water discharged to impoundments and drainages; however, the effects of surface recharge to the coals would require a long time.

The Lebo and Tullock aquifers are partially isolated from impacts resulting from dewatering associated with mine activities and CBNG production in the Wyodak coal aquifers because they are essentially confined layers.

Springs. There are no springs in the Project Area, and, therefore, there would be no adverse effects. Increased availability of shallow ground water caused by the infiltration of CBNG produced water could cause new springs and seeps to develop downgradient of locations where infiltration is occurring; however, the limited permeability of alluvial deposits near the surface would tend to encourage runoff rather than infiltration.

Wells. Impacts to individual water wells completed within the coal and to sands above the coal would depend on their proximity to project wells, water well depth, the completion interval of the water well, and the yield required to maintain the well as a usable source. Changes in water levels in wells are not expected to be as significant in the aquifers immediately above or below the producing coal because low-permeability claystone aquitard layers would effectively prevent water withdrawal. The integrity of these confining layers may, however, be compromised

locally by water supply wells that are screened through both the coal and the overlying sands, by deteriorating well casings, or by poorly plugged oil and gas wells or exploratory drill holes.

While it is possible that the dewatering process could draw down the ground water and lower the water table, such effects are expected to be minimal. Impacts to well yield or availability are likely to be an issue only if the drawdown exceeds 20 to 30 percent of available drawdown at a particular location (BLM, 2003, p. 4-50). Well pumping rate may decrease as the hydraulic head decreases; however, yield may be restored by installing a larger pump if sufficient available drawdown remains in the well. In cases where the drawdown causes the water level in a well to drop below the intake, the pump may have to be lowered in the well if the wells are deep enough.

A mandatory mitigation for possible well productivity declines in areas of CBNG production is an agreement between the operating company and nearby well owners. The Water Well Agreement (Appendix E) is required by both the USFS and the BLM when federal minerals are developed. Water well owners within ½-mile of each permitted CBNG well would be notified, and water well agreements would be offered to the landowners. In the event an agreement can not be reached, the operator must certify that it will mitigate impacts of the CBNG well in accordance with Wyoming State Water Laws (BLM, 2002, p. 21).

The effects on flowing artesian wells would depend on whether the wells tap shallow local ground water or deeper ground water within the coal zone aquifer. Wells completed in shallow aquifers that flow locally would not likely be affected by drawdown of the coal zone aquifer during CBNG development. Deep flowing artesian wells completed in the producing coal zone aquifer or sandstone layers in hydraulic connection with the coal zone aquifer could be affected by drawdown of the coal zone aquifer during CBNG development. Decreased flows or no flow would be the likely effects on wells completed in deep aquifers.

Effects to Ground Water Quality

Leakage. Some ground water contained in Wasatch sandstones that directly overlie coal zones likely would leak into the Fort Union coal aquifer during development of CBNG. The depth of the leakage should be directly related to both the extent of reduction in hydraulic head and the permeability of the coal. Ground water in Wasatch sandstones and coals varies somewhat from the Fort Union coal aquifer, with the Wasatch exhibiting a slightly higher median pH, a higher SAR, and higher concentrations of TDS, sulfate, and manganese. Resulting changes in water quality in the Fort Union coal aquifer would be a function of the relative volumes of mixed water and concentrations of the various water quality parameters in the two waters.

Leakage and mixing between aquifers with differing water quality could also occur where aquifer zones are not isolated during well completion or abandonment. Leaking could result from a lack of mechanical integrity, which may include inadequate casing, cementing, or plugging. The well bore is isolated from surrounding formations by casing that is cemented into place during drilling and completion operations. Procedures for drilling and completing CBNG wells are strictly controlled by WOGCC and BLM requirements that ensure each formation remains as isolated as it is under natural conditions and the integrity of the well bore remains intact. Development in accordance with these requirements is not likely to allow any additional mixing of ground water by improperly drilled or completed wells.

Infiltration. CBNG produced water that is exposed at the surface typically undergoes immediate changes in chemical composition that are the result of introducing oxygen to the water. When oxygen is introduced at the surface, iron and manganese oxidize and precipitate, as evidenced by iron stains commonly observed at CBNG discharge outfalls. CBNG produced water that has infiltrated unsaturated alluvial materials resembles naturally-occurring alluvial water quality very near the surface (BLM, 2003, p. 4-54).

Wyodak-Anderson coal water is low in both sodium and salinity values and meets WDEQ agricultural standards. Evaporation or infiltration impoundments would not be constructed by the project; therefore, there would be no adverse effects to ground water resulting from infiltration of produced water from impoundments.

CBNG Drilling Fluids. Drilling fluids are generally a mixture of water, commonly obtained from a nearby producing CBNG well, native mud, and bentonite. Small amounts of biodegradable polymer additives or potassium chloride salts may be added to the mud to clean the hole and stabilize the clay. Drilling fluids do not contain constituents that would contaminate the formations surrounding the well bore of a CBNG well.

The drilling fluids would be in contact with the well bore for approximately one to three days while the well is being drilled, before the hole is cased, and before reaching the coal zone. The well bore is flushed with water before drilling to the coal seam continues using water or air as the drilling fluid. The finished hole may be flushed with water to remove coal fines.

Hydraulic Fracturing. Light water fracture stimulation is sometimes required to facilitate production of the CBNG. Only a limited area surrounding the CBNG well bore is affected by this activity. Fracturing fluids do not contain constituents that would contaminate the producing formation. Hydraulic fracturing, if used, is not likely to have any effect on ground water quality. A recent study by EPA concluded that the potential threats to underground sources of drinking water posed by hydraulic fracturing of CBNG wells appear to be low (BLM, 2003, p. 4-57).

Emissions of Methane. Gas migration and seepage are naturally occurring processes where coal beds are extremely close to the surface and can be exacerbated during CBNG development. Gas migration would be most likely to occur where CBNG production occurs along the coal outcrop. Dewatering the coal seam to release and produce CBNG through the well bore has also been known to release methane to the surface in areas where the coal seam is located relatively near the surface (Merschat, 1999). Shallow coalbeds are more likely to vent methane to the surface as the coalbeds are dewatered. Gas seepage can result in dead vegetation, an increase in the methane content of surface soils, and an apparent increase in the occurrence of methane in domestic water wells (BLM, 1999). Water wells frequently are screened over multiple aquifer zones, which would facilitate methane migration through the well bore between individual aquifer zones.

Completion procedures for CBNG wells are designed to direct methane toward the well bore to prevent migration toward existing water wells. Production of CBNG is contained within casing that is cemented to the wall of the well bore and is not likely to cause any release of methane into the ground water.

Migration or seepage may also occur where faults, fractures, or sandstone layers occur in an orientation that provides a conduit for methane movement; however, this type of migration could occur with or without project development.

Increased Sediment in Nearby Water Wells. The WSEO has received reports of increased sediment, fines, and odor in wells where water is being produced from a zone shallower than the target coal and CBNG wells are located nearby. These effects are usually associated with drilling and completion operations and would likely be temporary (BLM, 2003, p. 4-55).

Mitigation

Mitigation measures required by the USFS, BLM, and state are listed in Chapter 2. Applicant-committed mitigation measures are also detailed in this section as well as in the Hydrology Report (Greystone, 2002a). Recommended mitigation measures relating to water resources are also discussed in the PRB O&G FEIS (BLM, 2003, pp. 4-392 to 4-393).

- Observations of seepage at and near the downstream toe of the Little Thunder Reservoir for changes in conditions would ensure the structural integrity of the reservoir as water storage and release increases.
- If increased erosion is observed in the channel of Little Thunder Creek or its tributaries related to the discharge of CBNG produced water, engineering measures should be applied in the impacted areas to prevent further erosion.
- Prior to discharge of CBNG water, Lance will submit plans to armor the area between the embankment and spillway at Little Thunder Reservoir. After plans are approved by the Forest Service official, Lance will complete the armoring.
- Before discharge of any proponent produced CBNG water in the Little Thunder Creek drainage, the project proponent will fill the holes behind the buttress spillway walls with compatible materials located on site or a bentonite mixture.
- The proponent has committed to a sampling and analysis program as well production results in produced water discharges. Details of the sampling program are contained in the Hydrology Report (Greystone, 2002a, p. 10).

3.4.2.3 Alternative C: Modified Development Alternative

Impacts to surface water would be slightly less than those described as resulting from implementation of Alternative B. Impacts resulting from discharge of CBNG produced water to the surface are estimated to be similar in magnitude. Approximately 88 percent of the water estimated for Alternative B would be discharged to the surface, in proportional to the reduced number of wells associated with this alternative. Conveyance loss would continue to prevent downstream impacts resulting from the discharged water. Surface water quality would not be compromised by the addition of water produced from the target coal seam.

Impacts to ground water would be nearly identical to the impacts described under Alternative B. There may still be impacts to nearby water wells resulting from the draw down of the water table during CBNG production. Increased sediment in water wells remains a possibility.

3.4.3 Cumulative Effects

Cumulative impacts to water resources in and near the Project area could result in changes to current water quantity and water quality. The Proposed Action is located within the Little Thunder Creek drainage basin which, in turn, occupies a portion of the Cheyenne River watershed. Discussion of cumulative impacts to water resources is limited in this EA to effects to the Little Thunder Creek watershed. Cumulative impacts to the PRB are discussed in the PRB O&G FEIS (BLM, 2003).

3.4.3.1 Alternative B - Proposed Action

Surface coal mining and CBNG development impact ground and surface waters within the Little Thunder Creek watershed through the withdrawal of ground water and subsequent discharge of that water to the surface. Cumulative impacts to water resources resulting from the Proposed Action would necessarily include the impacts of current and future mining activities as well as current and future CBNG development.

Surface Water

Hydrology. The quantity of water contained in Little Thunder Creek at any particular point would be dependent upon the rate of upstream CBNG development, the amount of CBNG discharge released at outfalls, conveyance loss, available capacity in reservoirs, reservoir discharge rate, and mine usage for industrial purposes and reclamation.

Since the time that CBNG development was initiated in the area in 1998, approximately 64 percent (Greystone, 2002a, p. 4) of available CBNG well locations have been drilled. At the current rate of drilling, completion of development within the drainage basin is estimated to occur within five years. Assuming full basin development within about a five-year period, flow rates in Little Thunder Creek would be expected to peak within four years. Flow conditions would be expected to return to pre-development conditions within about 15 years, depending upon development rates, initial production rates, water production decline rates, and well life.

Cumulative discharge from CBNG produced water can be broadly estimated for the watershed. Maximum potential CBNG development for the watershed is estimated to be approximately 575 wells, based on a maximum development scenario based on WOGCC approved spacing of one well per 80 acres. This estimate excludes lands and lease areas not available for CBNG development. WOGCC records indicate that 371 wells are currently producing gas and water (Greystone, 2002a, p. 4). Thus, an additional 204 wells could be developed within the watershed. To estimate CBNG water discharge rates in the watershed, the following assumptions were made:

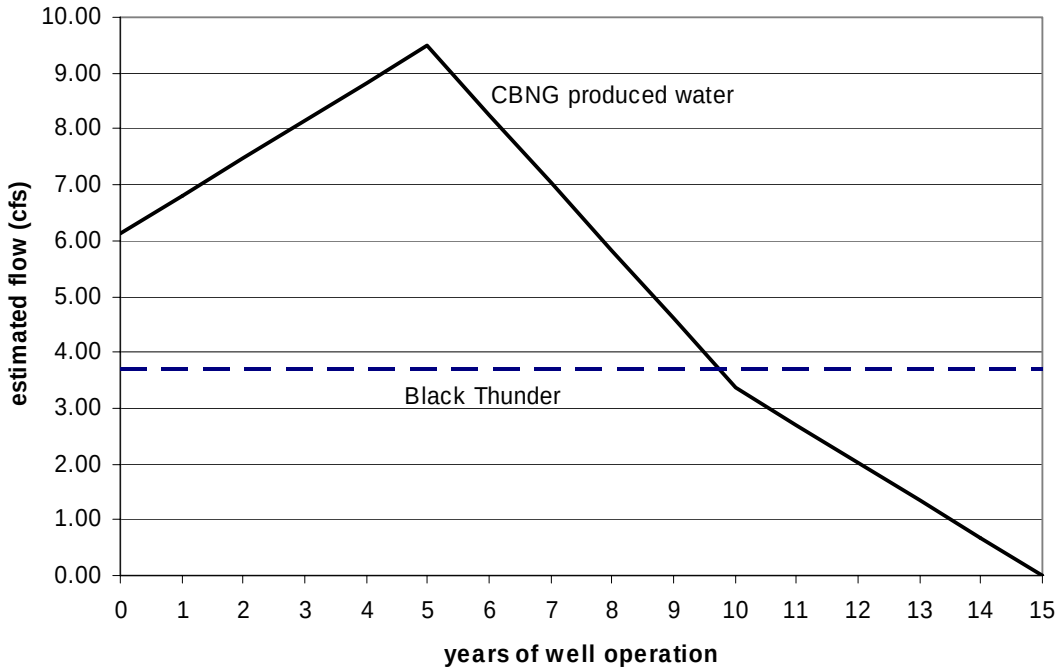
- 371 CBNG wells are currently operating in the watershed;
- Existing wells were developed over a period of approximately five years at a rate of approximately 74 wells per year;
- An additional 204 wells will be developed in the watershed over a period of five years at a rate of approximately 41 wells per year;
- Each well produces water at an average rate of 7.4 gpm (0.016 cfs) (Greystone, 2002a, p. 4); and

- Average well life is approximately 10 years.

Cumulative produced water production from the existing and projected future CBNG wells in the Little Thunder Creek watershed is illustrated in Figure 3.4-2. Year "zero" represents current development. Maximum discharge rate would correspond to the number of wells in operation. Therefore, maximum production and discharge of produced water would occur when all 575 wells are in operation, approximately five years from now. Using the average water production rate, approximately 9.5 cfs would be added to the watershed as a result of CBNG development. The current rate of CBNG produced water production is approximately 6 cfs. The average contribution of the 32 project wells would be approximately 0.5 cfs, approximately five percent of the maximum average discharge for all 575 wells.

Current estimated mean annual flow for Little Thunder Creek is approximately 5.06 cfs (Greystone, 2002a, p. 6). The addition of 9.5 cfs in various drainages of would nearly triple the amount of water carried in some parts of Little Thunder Creek. Decreases in flow due to a conveyance loss of approximately 31 percent per mile would remove substantial volumes of CBNG produced water such that the effective flow rate in any particular part of Little Thunder Creek would be much less than the sum of the mean creek flow and CBNG produced water flow.

Figure 3.4-2 Estimated CBNG Produced Water Production Rate



Discharge monitoring reports indicate that the Black Thunder Mine discharged approximately 865.5 million gallons (115.7 million cf or 3.7 cfs) to the Little Thunder Creek watershed during the year 2000 (HKM Engineering, 2002). Assuming that the discharge rate from the mine is constant throughout the years, released CBNG produced water and coal mining water would add approximately 13.2 cfs to the watershed when all 575 wells are operating, five years from now. With consideration of both sources, it may be possible that there would be perennial flow in

some parts of Little Thunder Creek. The increased flow may result in a need to resize existing culverts and diversion channels.

A beneficial effect would be the increase in volumes of water available for wildlife and stock watering during project life and CBNG development throughout the watershed. Increased surface water may result in more productive areas for livestock use, resulting in more viable land available for agricultural purposes.

Little Thunder Reservoir. Reservoirs downstream of the Project Area, notably the Little Thunder Creek Reservoir, located approximately one mile downstream of the Thunderhead 2, would probably receive more water as a consequence of CBNG development. Discharged CBNG produced water would be distributed in the drainages and subsequently temporarily retained by reservoirs that would capture the flow from each of the six discharge points. Little Thunder Reservoir and other reservoirs and stock ponds along the drainages would initially retain these flows. Water would continue down the drainages after release through the reservoir spillways. Because impoundments used to manage produced water would be designed as flow-through structures and would be permitted by WSEO, there would be no expected effects to existing surface water rights.

The Little Thunder Reservoir would retain flows of produced water discharged into Little Thunder Creek up-drainage of its location. Little Thunder Reservoir is located on Little Thunder Creek in Section 22, T43N/R71W east of Thunderhead 2. Impacts to Little Thunder Reservoir from the 204 future wells and 575 total wells were not determined with certainty because of the lack of information with respect to specific locations of each future well and the location of its associated discharge point; however, assuming that the released produced water from approximately 50 percent of the wells in the watershed would flow through the Little Thunder Reservoir and that each well produces water at the average rate of 7.4 gpm, estimates were made. The choice of 50 percent is a conservative one based on the fact that Little Thunder Creek is fed by one main tributary, the North Prong of Little Thunder Creek, and it is likely that 50 percent of released water would flow to drainages of the tributary and an additional volume would flow into Little Thunder Creek below the reservoir. If 50 percent of the released produced water from 204 future wells flowed through the Little Thunder Reservoir, approximately 1,217 acre-feet of water would flow through the reservoir annually, without considering conveyance loss. Approximately 3,430 acre-feet of water would flow through the reservoir from 575 wells, again not considering conveyance loss. Impacts to the reservoir as a result of total development of 575 wells would reach its maximum extent approximately five years from the current time if CBNG development continues as anticipated.

The volume of CBNG produced water from the 32 project wells that would enter the Little Thunder Reservoir was broadly ascertained by estimating the distance from each discharge point from the reservoir and calculating the amount of water lost through conveyance. Only water originating from the discharge points in Sections 18, 19, and 20 would possibly enter Little Thunder Reservoir. The estimated flow of project associated produced water is presented in Table 3.4-5.

Table 3.4-5 Estimated Flow of Project-associated Produced Water Remaining After Conveyance Loss at Little Thunder Reservoir and School Creek Crossing

Discharge Point Location (T43N/R71W)	Direction of Initial Produced Water Flow	Maximum Estimated Flow[1] (gpm/cfs)		Estimated Distance From Discharge Point To Little Thunder Reservoir	Amount of Flow Remaining after 31% Per Mile Conveyance Loss (gpm/cfs)		Estimated Distance From Discharge Point To School Creek Crossing	Amount of Flow Remaining after 31% Per Mile Conveyance Loss (gpm/cfs)	
Section 18	Main channel of Little Thunder Creek	56	0.1	3 miles	18.40	0.0	13.5 miles	0.4	0.0
Section 20	Main channel of Little Thunder Creek	112	0.3	1 mile	36.79	0.1	11.5 miles	1.6	0.0
Section 21	Main channel of Little Thunder Creek	42	0.1	0.5 mile	13.80	0.0	11.0 miles	0.7	0.0
Section 9	North Prong of the Little Thunder Creek	98	0.2	NA	NA	NA	10.5 miles	2.0	0.0
Section 10	North Prong of the Little Thunder Creek	56	0.1	NA	NA	NA	10.5 miles	1.1	0.0
Section 13	North Prong of the Little Thunder Creek	84	0.2	NA	NA	NA	8.5 miles	3.7	0.0
Total					68.99	0.1		9.5	0.0

1 Source: Greystone, 2002a, Table 2, p. 5.

Maximum flow of project CBNG produced water anticipated to reach Little Thunder Reservoir is estimated to be 0.1 cfs after conveyance loss from the 32 project wells, reflecting a decrease in volume of approximately 68 percent. Using a conservative assumption that 50 percent of all released produced water that flows through the reservoir is lost through conveyance, approximately 609 acre-feet of water would flow through the reservoir from 120 future wells and 1,716 acre-feet would flow through the reservoir from 575 wells five years from now at the time of peak well development.

CBNG produced water volume discharged in the Little Thunder watershed during the year 2001 was reported to be approximately 43.6 million barrels (1,831 million gallons) or 5,618 acre-feet (HKM Engineering, 2002). Assuming that 50 percent of the volume flows into the Little Thunder Reservoir and an additional 50 percent is lost through conveyance, approximately 1,405 acre-feet of produced CBNG water flowed into the reservoir in 2001.

Permitted capacities for reservoirs in the watershed total approximately 1,200 acre-feet (Greystone, 2002a, p. 12). Conveyance loss and pan evaporation loss were not considered in the preceding calculations, further supporting the description of the estimates of being conservative. The reservoirs are designed as flow through structures allowing the stored water to exit as necessary. A buttressed wall serves as an uncontrolled spillway for the dam overflow. When first constructed and for some time afterward, the reservoir levels likely did not reach the spillway top outside of storm events. USFS geotechnical engineers recently concluded that no obvious dam safety deficiencies exist at the reservoir. In addition, the channel below Little Thunder Reservoir could contain a maximum flow of 506.6 cfs without exceeding the existing banks (Greystone, 2002a, p. 16). Assuming an average flow rate of 7.4 gpm, that 50 percent of the wells in the watershed would release water into the reservoir, and 50 percent is lost through conveyance, the resulting maximum channel flow would be estimated at 2.4 cfs, well below the maximum flow the channel could support. The USFS concluded that neither economics nor the topography at the reservoir support consideration for raising the dam for additional storage.

Sediment deposition over the life of the Little Thunder Reservoir has undoubtedly decreased its initial capacity. The reservoir is maintained year-round to reduce or eliminate lag time for the reservoir to fill, leading to subsequent and immediate spillway discharges. Little Thunder Reservoir is usually full now due to the influx of CBNG-produced water. Armoring the spillway is included as part of the proposed project to mitigate the effects that may result from increased CBNG-produced water.

It is expected, therefore, that the reservoirs in the Little Thunder Creek watershed would be able to accommodate the anticipated future flow volumes. A beneficial result of increased released produced water would be the maintenance of a more stable high water level in Little Thunder Reservoir, possibly enhancing the its recreational value.

School Creek Crossing. Little Thunder Creek crosses School Creek Road, FDR 968, in Section 30, T43N/R69W, eight to 14 miles downstream of the project discharge points and approximately 1.5 miles downstream from the junction of Little Thunder Creek with its North Prong. Improvements, particularly the construction of a low water crossing, have been made to this crossing since 1998 to accommodate increased flows from CBNG discharges.

The estimated increase in flow at School Creek crossing attributable to the 32 project wells was calculated using the same set of assumptions used to calculate flow into Little Thunder Reservoir. The incremental flow resulting from project wells is estimated to be 0.02 cfs, a very small increase in volume. Similarly, the additional flow rate anticipated at the crossing from 575 wells is 0.36 cfs. Produced water from project wells is not expected to contribute to icing problems at the School Creek Crossing with consideration of the low volume of additional water resulting for CBNG development.

Surface Water Quality. The water quality analysis from the producing coal seam indicates that the addition of CBNG produced water from the Wyodak-Anderson should not impact the current and/or permitted surface water uses downstream. Values of critical parameters of the produced water are within or below the ranges of these same parameters in the native water of Little Thunder Creek.

Reservoirs throughout the watershed would trap additional sediment that may be transported downstream by the release of CBNG produced water and water from coal mining operations. Ground water encountered during coal mining is typically stored in sedimentation ponds. Discharges from the sedimentation ponds could contain increased concentrations of dissolved solids because of sediment mixing during precipitation and concentration through evaporation. All discharges from the mine reservoirs and produced water discharge points into the Little Thunderhead Creek watershed would be required to meet standards mandated by the mine's NPDES permits. Stored water is sometimes used for dust suppression, reclamation efforts and other industrial purposes.

Discharge from approximately 575 upstream wells would contribute to downstream sediment loads. In contrast to water produced from coal mining, CBNG produced water is essentially free of sediment, although discharge to surface drainages can increase sediment loading through increased stream erosion (BLM, 2003, p. 4-122). Conveyance losses in ephemeral streams and the limited duration of production-related discharge would limit the magnitude of downstream sediment transport. The effects of mine discharges to watershed drainages may not be distinguishable from the effects of increased sediment from CBNG discharges.

Ground Water

Coal mining along the eastern subcrop would result in minimal recharge to the coal while the mines are active because of the ground water sink caused by pit dewatering. Complete dewatering of the target coals must precede mining. As mines are reclaimed and eventually shut down, the backfilled areas would become long-term recharge zones for the coal aquifer. Infiltration through backfilled areas may be substantial because the permeability of the backfill materials tends to be much higher than in the original un-mined materials. In addition, most of the creeks would be diverted over these backfilled areas, providing an important source of recharge water. Recharge rates would increase temporarily as a result of infiltration of CBNG produced water discharged to impoundments and drainages; however, surface recharge would reappear in lower coal units in a matter of decades.

Cumulative water production associated with existing and projected future CBNG wells in the Little Thunder Creek watershed was estimated in order to determine the effects of its discharge to the surface (See the discussion of surface water hydrology earlier in this section). Ground water depletion was estimated to be approximately 5,600 acre-feet in 2001 (HKM Engineering, 2002) and will increase as more CBNG wells are drilled in the watershed. Ground water depletion from the 575 CBNG wells projected for the Little Thunder Creek watershed is estimated to peak approximately five years from now, exhibiting a flow rate of approximately 9.5 cfs on the surface (See Figure 3.4-2). During year five, approximately 6,900 acre-feet of water would be withdrawn by CBNG wells in the watershed. This amount will decrease abruptly thereafter as wells come to the end of their producing life spans. In approximately fifteen years the amount of ground water depleted will be reduced to nearly zero as most wells are abandoned. Because the relative number of wells involved with this project to the total projected for the watershed is small, this project would contribute a very minor amount to the estimated ground water depletion in the watershed.

Modeling conducted for the PRB O&G FEIS provided estimates of the time required for subsurface aquifers to recharge on a basin-wide basis as a result of CBNG development. Water

levels in the Wasatch would recover to within 25 feet of pre-operation levels over a period of 20 years after CBNG development ends in the PRB. Water levels would eventually recover to within less than 20 feet of pre-operation levels over the next 100 years (BLM, 2003, p. 4-49). The initial recovery period in the Fort Union would occur over 25 years (BLM, 2003, p. 4-38). The rate of recovery would then slow dramatically, eventually recovering to within 20 feet or less of pre-operation conditions over the next hundred years. Complete recovery of the water level would be a long-term process because most of the recharge would come from overlying and underlying sand and undeveloped coal units that, in turn, would be recharged from surface infiltration.

3.4.3.2 Alternative C - Modified Development Alternative

Surface coal mining and CBNG development impact ground and surface waters within the Little Thunder Creek watershed through the withdrawal of ground water and subsequent discharge of that water to the surface. Cumulative impacts to water resources resulting from the Proposed Action would necessarily include the impacts of current and future mining activities as well as current and future CBNG development.

Cumulative effects to the Little Thunder Creek watershed would remain nearly identical to those described for Alternative B. Impacts to the Little Thunder Reservoir would remain the same as previously described because the wells withdrawn from this alternative would dispose its produced water into the North Prong of Little Thunder Creek, avoiding the reservoir. The lack of adverse impacts to School Creek Crossing would continue to apply.

Similar beneficial effects would result from the implementation of Alternative C. Increased volumes of water may be available for wildlife and stock watering during project life and CBNG development throughout the watershed. Increased surface water may result in more productive areas for livestock use, resulting in more viable land available for agricultural purposes.

Impacts resulting from continued coal mining would affect ground water just as it would under Alternative B. Ground water recharge would be a very slow process. Complete recovery of the water level would be a long-term process because most of the recharge would come from overlying and underlying sand and undeveloped coal units that, in turn, would be recharged from surface infiltration.

3.5 VEGETATION AND WETLANDS

3.5.1 Affected Environment

3.5.1.1 Vegetation Cover Types

The Project Area occupies a mixed upland prairie grassland and sagebrush shrubland which is common in the Powder River Basin. Fourteen vegetation types have been identified within the Powder River Basin (BLM, 2003, pp. 3-92 to 3-103). Two of the three dominant cover types comprise nearly 100 percent of the Project Area:

- Approximately 75 percent of the Project Area consists of short-grass prairie, which is described as sparse to very sparse, thin, dry herbaceous rangeland types occurring on

drought-prone, mildly alkaline, medium- and fine-textured soils. Shrub growth is inconsistent, and annual precipitation is typically 10-16 inches. The two dominant species are blue grama (*Bouteloua gracilis*) and buffalo grass (*Buchloe dactyloides*).

- Approximately 25 percent of the Project Area consists of sagebrush shrubland, which is described as sparse to moderately dense and dense big sagebrush crown with a variety of understory forbs and grasses. Sagebrush shrublands are common throughout the Powder River Basin. Within the TBNG, sage height has been found to vary among low (less than 12 inches, 46 percent), moderate (12-23 inches, 49 percent), and high (over 23 inches, 5 percent) stands (USFS, 2001, p. 3-193). Dominant species may include Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*), silver sagebrush (*Artemisia cana*), and western wheatgrass (*Pascopyrum smithii*).

- Less than one percent of the Project Area consists of mixed-grass prairie, a mixture of low, medium, and high (based on chlorophyll content) herbaceous rangeland types. Common species include western wheatgrass, blue grama, prickly pear cactus (*Opuntia* spp.), and scarlet globemallow (*Sphaeralcea coccinea*).

Bare ground covers less than one percent of the Project Area. Threatened, endangered, proposed, candidate and sensitive plant species are discussed in Section 3.7. Modified vegetation types such as agricultural, open water, and disturbed surface types are also present within the Project Area.

Natural vegetation within the Project Area and in adjacent areas has been altered by surface disturbance resulting from ranching, oil and gas development, road and railroad construction, and coal mining. Three grazing allotments overlap with the Project Area (see Section 3.8 – Land Use). Cattle and sheep ranching represent the dominant forms of agriculture in the project vicinity. Disturbance from ranching activity has not been quantified (BLM, 2003, p. 3-108). Surface coal mining activity has begun to impinge upon the Project Area. The Wyodak coal seam is mined east of Hilight Road at the Black Thunder Mine and Jacobs Ranch Mine, about three and six miles east, respectively, of the Project Area. The Black Thunder Mine is the largest surface coal mining operation in North America (Roberts and Schaefer Company, 2003). Reservoir construction associated with coal mining activities and with ranching operations also removes some areas as habitat for natural vegetation.

Dust thrown up by passing vehicles can settle on nearby vegetation, damaging the plants (BLM, 2003, p. 3-108). Currently there are approximately 9.5 miles of existing roads within the project area, most being native-surfaced two track roads that serve oil and gas facilities. .

Finally, suppression of rangeland fires has caused changes in the types of vegetation prevalent in certain portions of the TBNG (BLM, 2003, p. 3-108).

3.5.1.2 Wetlands and Riparian Areas

Wetlands and riparian areas represent small, isolated ecosystems within the Project Area. Characterized by unique soils, vegetation, and hydrology, they occur as islands in the dominant expanse of high plains sagebrush and grassland communities. These areas represent habitat for plant and animal species that do not exist elsewhere in the Project Area.

Wetlands are areas transitional between strictly terrestrial and aquatic ecosystems. For the purpose of this EA, they are classified by the USFWS system (Cowardin et al., 1979) based upon vegetation, soil, and hydrologic conditions. Wetlands must exhibit at least one of the following characteristics (BLM, 2003, p. 3-109):

- At least periodically, the land supports hydrophytic vegetation.
- Substrates are predominantly undrained hydric soils.
- The substrate is non-soil and either saturated or covered by shallow water annually during the growth season.

Wetlands areas were identified within the Project Area using maps available from the National Wetlands Inventory (NWI) of the USFWS (USFWS, 2003, maps). Approximately 47.5 acres of wetlands are mapped within the Project Area, comprising approximately 1.8 percent of that area. Limited field checking of wetlands identification suggest that, in most cases, the linear features do not meet the complete requirements for wetlands classification. Ground verification of the identified wetlands in the Project Area reveal that most of them are not saturated by water long enough to allow the development of hydrophytic vegetation (Greystone, 2004).

All wetlands within the Project Area are classified as palustrine, which includes all non-tidal wetlands dominated by trees, shrubs, emergents, mosses, or lichens (USFWS, 2003, maps). Wetlands located on the Northern Great Plains typically belong to the palustrine system. Wetlands are found scattered throughout the Project Area. Five palustrine wetland types were identified:

- The Project Area contains approximately 46 acres of emergent, temporarily flooded wetlands. They are found throughout the Project Area. Naturally occurring playas, particularly common along the Little Thunder Creek drainage divide, belong to this type. Other occurrences are the result of constructed impoundments such as stock ponds. These wetlands are characterized by erect, rooted, herbaceous hydrophytes other than mosses and lichens. Vegetation is present for most of the growing season most years and is dominated by perennials. Surface water is present briefly during the growth season, but the water tables are usually significantly below the surface.

- Approximately 0.8 acre of aquatic bed, semi-permanently flooded, impounded wetlands are contained in the Project Area. In the Project Area, this type is found frequently along Little Thunder Creek and associated with stock ponds. These wetlands include those dominated by plants that grow in water typically less than six feet deep and remain below the water surface during most of the growth season. Surface water typically persists during most of the year, and the water table is near surface at all times.

- Approximately 0.3 acre of one unconsolidated bottom, semi-permanently flooded, excavated wetland is contained in the Project Area. This small wetland lies within a basin that was excavated by man. This type of wetland demonstrates at least 25 percent cover of particles of diameters less than 2.4 inches and less than 30 percent vegetative cover. Surface water is present most of the year, and the water table is near surface when surface water is absent.

- The Project Area contains one emergent, temporarily flooded, impounded wetland, consisting of approximately 0.2 acre. This type of wetland is similar to an emergent, temporarily flooded wetland. Its hydrology is modified by a man-made barrier or dam. Surface water is usually present for brief periods during the growing season, but the water table usually lies below the soil surface. This type of wetland may support facultative plants that can survive in wetland and upland conditions.

Riparian ecosystems occupy areas adjacent to water bodies and are characterized by high water tables and moist soils. Riparian areas are characterized by high species diversity, density, and productivity.

3.5.1.3 Non-Native, Invasive, and Noxious Weeds

Non-native invasive species are defined as alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health. Noxious weeds, are defined by Wyoming Statutes (WS 11-5-102.a.xi) as "the weeds, seeds or other plant parts that are considered detrimental, destructive, injurious or poisonous, either by virtue of their direct effect or as carriers of diseases or parasites that exist within this state, and are on the designated list" (State of Wyoming, 2003). Wyoming statutes designate 23 species of noxious weeds. In addition, under authority of the Wyoming Weed and Pest Control Act of 1973 (WS 11-5-119), counties may designate additional weeds of concern. A listing of noxious weeds for Campbell County is presented in Table 3.5-1.

Table 3.5-1 Campbell County Noxious Weeds

Common Name	Designee	Scientific Name	Occurrence in County
Skeletonleaf bursage	State	*Ambrosia tomentosa*	Present
Common burdock	State	*Arctium minus*	11-100 acres
Hoary cress	State	*Cardaria draba*	No data
Hairy whitetop	State	*Cardaria pubescens*	101-1,000 acres
Musk thistle	State	*Carduus nutans*	Present
Diffuse knapweed	State	*Centaurea diffusa*	Present
Spotted knapweed	State	*Centaurea maculosa*	Present
Russian knapweed	State	*Centaurea repens*	Present
Canada thistle	State	*Cirsium arvense*	Present
Field bindweed	State	*Convolvulus arvensis*	Present
Houndstongue	State	*Cynoglossum officinale*	11-100 acres
Quackgrass	State	*Elytrigia repens*	Present
Leafy Spurge	State	*Euphorbia esula*	Present
Wild licorice	County	*Glycyrrhiza lepidota*	Present
Dyer's woad	State	*Isatis tinctoria*	Present
Perennial pepperweed	State	*Lepidium latifolium*	Less than 10 acres

Common Name	Designee	Scientific Name	Occurrence in County
Dalmation toadflax	State	*Linaria dalmatica*	Present
Scotch thistle	State	*Onopordum acanthium*	11-100 acres
Perennial sowthistle	State	*Sonchus arvensis*	Present
Saltcedar	State	*Tamarix chinensis*	Present
Common cocklebur	County	*Xanthium strumarium*	Present

Source: 1995 CAPS Survey (University of Wyoming, 1999)

A consultation with Merv Griswold, Campbell County Noxious Weeds Control Supervisor (Griswold, 2003), indicates that the primary species of concern in the Project Area are black henbane (*Hyoscyamus niger*), skeleton leaf bursage, Canada thistle, scotch thistle, and yellow toadflax (*Linaria vulgaris*). Field bindweed is also a concern. A number of additional weed species is currently being monitored by the University of Wyoming's Cooperative Agricultural Pest Survey (University of Wyoming, 1999). A number of these additional species may occur in Campbell County.

The TBNG does not have a current inventory of noxious weed species and infestation levels (USFS, 2001, p. 3-160). Noxious weeds most likely to be encountered within the Project Area would likely be Canada thistle and possibly Russian thistle (*Salsola iberica*) (USFS, 2003d, p.3-62),

3.5.2 Environmental Consequences

Vegetation and land cover issues raised during scoping include:

- Possible effects of surface disturbance on vegetation and microclimates.
- Identification and description of plant species, wetlands, sand dunes, riparian, and other habitats, as well as T&E listed, candidate, and proposed species and rare or uncommon plants.
- Protection of endangered or sensitive plant species.

3.5.2.1 Alternative A - No Action Alternative

If none of the proposed activities were to occur, no negative impacts to vegetation or wetland areas additional to existing impacts would occur. Conventional oil and gas development would continue, and CBNG development would continue on state and private lands near the Project Area. Ranching-associated impacts would likely continue at their present magnitude. Wetland and riparian ecosystems are highly responsive to changes in hydrologic conditions. The absence of stream-sourced irrigation in the vicinity of the Project Area precludes their deleterious effects on associated wetlands communities. Surface coal mining is likely to continue adjacent to and within the Project Area for the foreseeable future.

3.5.2.2 Alternative B - Proposed Action

Surface disturbance to vegetative cover would result from construction of roads, pipelines, water discharge lines, and drilling of wells. Total maximum short-term surface disturbance resulting from construction of the Proposed Action would be approximately 77 acres, 54 acres of which would be on TBNG surface. Approximately 23 acres would be disturbed on private surface.

Following interim reclamation, long-term surface disturbance and loss of vegetative cover would consist of approximately eight acres, six acres of which would be on TBNG surface and two acres on private surface. Roads would comprise most of the long-term disturbance. Project-constructed roads not required for USFS management purposes would be reclaimed at the end of the project. Some permanent loss of vegetation cover would occur where roads are not reclaimed.

Possible indirect impacts on vegetative cover could include (BLM, 2003, p. 4-153):

- Increased potential for spread of noxious weeds associated with construction surface disturbance;
- Potential for changes in vegetation type and diversity associated with increased flow in ephemeral drainages and conversion of some ephemeral streams to perennial streams; and
- Alteration in wildlife food supply resulting from vegetation changes.

Potential for the spread of noxious weeds is a possibility for any ground disturbing activity. Lance has committed to mitigative measures which would reduce the possibility of introduction and spread of non-native invasive species as outlined in the TBNG LRMP. Following reclamation efforts, noxious weed populations would be managed using mechanical, chemical, or biological controls at the direction of USFS following the terms outlined in the TBNG LRMP.

Significant deleterious effects to wildlife food supply and to vegetation type and diversity are unlikely because the amount potential forage that would experience short-term disturbance would be approximately three percent of the Project Area. Long-term disturbance resulting from implementation of the Proposed Action would be less than one percent of the Project Area. Successful reestablishment of vegetation after construction is completed would depend upon climatic factors such as precipitation.

Proposed roads and pipelines were routed during onsite visits to minimize impacts to wetland resources. Comparison of the mapped areas that identify wetlands in the Project Area to a map of the Proposed Action indicates that impacts to wetlands may result in a disturbance of less than one acre, or approximately 0.03 percent of the Project Area. Impacts may occur where roads cross Little Thunder Creek. Impacts to wetlands and riparian areas from road construction would be minimized as a result of siting specifications developed during the July 2001 onsites with agency personnel.

Wetland and riparian ecosystems are sensitive to the quality and quantity of produced water. As indicated in Section 3.4, discharge of CBNG produced water into ephemeral drainages has the potential for raising water tables, possibly converting some ephemeral drainages to perennial, and altering soil saturation. All of these effects could alter wetlands along drainages within the Project Area. Effects to wetlands are expected to be minor and temporary, since the volumes of produced water discharge would decline rapidly, and infiltration and evapotransporation would rapidly remove water from channels below the discharge points. For the same reason, effects related to increased erosion or sedimentation would be minimal. Because of the expected high quality of produced water within the Project Area, it is not anticipated that water quality effects would result in negative impacts to these resource-sensitive areas. The wetlands that would not receive CBNG discharge would likely be unaffected by the Proposed Action.

Inventories of native plant species within the TBNG have been conducted by the USFS over many years. These data should be sufficient to detect any major alterations in plant communities during the temporary period of CBNG produced water discharge.

Mitigation Measures

By applying the USFS standard COAs listed in Appendix D and operator-committed mitigation measures listed in Chapter 2, impacts to vegetation would be lessened.

The following measures would further minimize impacts to vegetation, wetlands, and riparian areas:

- No waste material will be deposited below high water lines in riparian areas, floodplains, or in natural drainageways.
- The lower edge of soil or other material stockpiles will be located outside of the active floodplain.
- Drilling mud pits will be located outside of riparian areas, wetlands, and floodplains, where practicable.
- Stabilization and revegetation will occur as soon as practical following disturbance using seed mixes approved by the USFS and/or BLM.

3.5.2.3 Alternative C - Modified Development Alternative

Impacts to vegetation and wetlands from implementation of Alternative C would be similar to those impacts that would result from Alternative B. Total maximum short-term surface disturbance resulting from implementation of Alternative C would be approximately 73 acres, 49 acres of which would be on TBNG surface. Following interim reclamation, long-term surface disturbance would consist of approximately six acres, four acres of which would be on TBNG surface and two acres on private surface. The reduction of four acres for short-term disturbance and two acres for long-term disturbance from Alternative B to Alternative C would result from the reduced number of wells proposed in Alternative C.

Roads that were sited for Alternative C in the July 2001 onsites considered potential impacts to wetlands and were located such that potential impacts would be minimized. Comparison of the mapped areas that identify wetlands in the Project Area to a map of Alternative C indicates that impacts to wetlands may result in a disturbance of less than one acre, or approximately 0.03 percent of the Project Area. Impacts may occur where roads cross Little Thunder Creek.

3.5.3 Cumulative Effects

3.5.3.1 Alternative B – Proposed Action

The most serious indirect impact is likely the increased potential for spread of non-native invasive species along new roads supporting increased traffic levels. Once established, such plants can be extremely difficult to remove (BLM, 2003, p. 4-179). Increased grazing activity or attempts by Wyoming Game and Fish (WGF) to expand the sizes of existing pronghorn and/or mule deer herds could affect vegetative cover. Monitoring by USFS and WGF personnel would

minimize the potential for overgrazing. Increased CBNG development adjacent to the Project Area could result in some displacement of big game onto the Project Area with resultant increasing vegetation consumption, but such displacement would be a temporary effect lasting for the duration of the construction phase in neighboring areas. Expansion of existing surface coal mines would also destroy existing vegetative cover adjacent to the mines.

Expansion of oil and gas activity would result in additional removal of cover through expanded road construction, well pads, and production facilities. Extensive conventional oil and gas development is not expected in the foreseeable future. Cumulative impacts from full CBNG development (approximately 80 acre spacing of wells completed in the 2003-2008 time frame) within the Powder River Basin would affect wetland and riparian areas. Adverse impacts to vegetation could result if wells farther west in the basin encounter more saline ground water or if upstream produced water were to encounter saline soils or sediments.

Although oil and gas development has caused impacts to wetlands and riparian areas within the PRB, the principal adverse impacts to wetlands and riparian areas in the basin result from widespread ranching and agricultural water withdrawals. The Upper Cheyenne watershed, of which the Little Thunder Creek watershed is a part, comprises only 0.2 percent of the total stream-sourced irrigation in the basin (BLM, 2003, p. 3-52), indicating that impacts to wetlands within this watershed in the basin are very small.

Most effects would be expected to result from temporary increased flows as CBNG wells upstream of the Project Area come on production. As discussed in Section 3.4, water flows would be projected to peak within five years and return to pre-development conditions within about 10 years. Perennial flows could occur in drainages that were previously ephemeral. This would temporarily change the character of existing wetlands associated with drainages and could expand wetlands into new areas. Emergent, temporarily flooded wetlands, the most common type along creeks, could be transformed into types more tolerant of wetter conditions. If perennial flows were sufficient to increase sediment transport, this could also affect, and potentially cause temporary alterations to, existing wetlands. Effects would be ameliorated by being of limited duration. Increased flows could have the beneficial effect of flushing salts out of discharge channels (BLM, 2003, p. 4-171).

Within the Powder River Basin, riparian areas represent approximately 3 percent of the total area (BLM, 2003, p. 3-94). Approximately two-thirds of riparian areas are characterized as wet meadow types. Release of CBNG produced water to ephemeral drainages may result in the growth of vegetation associated with riparian area in the part of the drainages located nearest to the outfalls. The high conveyance loss characteristic of this part of the basin may not promote the growth of such vegetation farther away from the point of water release. It is unlikely that release of produced water would result in the development of wet meadow types of riparian areas.

3.5.3.2 Alternative C – Modified Development Alternative

With the exception of a minor reduction in disturbance from implementation of Alternative C in combination with other actions, the cumulative impacts described for Alternative B would apply to a cumulative impact assessment for Alternative C.

Slightly less CBNG produced water would be released on the surface; therefore, the possible development of riparian environments may be slightly less.

3.6 WILDLIFE RESOURCES

3.6.1 Affected Environment

The boundary of the Project Area encompasses more than 2,600 acres of grassland and sagebrush habitat suitable for a wide variety of terrestrial species. Wetlands and riparian vegetation corridors associated with certain ephemeral drainages and with Little Thunder Creek are less extensive but provide habitat for additional terrestrial and aquatic animals.

As discussed in Section 3.5, vegetative cover of the Project Area is divided almost entirely between short-grass prairie (approximately 75 percent of the area) and sagebrush shrubland (approximately 25 percent of the area). Mixed-grass prairie comprises less than 1 percent of ground cover. Approximately 47.5 acres of wetlands occur within the major vegetation type areas. Wetlands comprise approximately 1.8 percent of the Project Area. As indicated in Section 3.5, riparian ecosystems are not known to occur within the Project Area.

Common year-round or seasonal residents of short-grass and mixed-grass prairie environments known from within or near the Project Area include golden eagle (*Aquila chrysaetos*), ferruginous hawk (*Buteo regalis*), Swainson's hawk (*Buteo swainsoni*), lark bunting (*Calamospiza melanocorys*), horned lark (*Eremophila alpestris*), western meadowlark (*Sturnella neglecta*), lark sparrow (*Chondestes grammacus*), vesper sparrow (*Pooecetes gramineus*), chestnut-collared longspur (*Calcarius ornatus*), McCown's longspur (*Calcarius mccownii*), American badger (*Taxidea taxus*), coyote (*Canis latrans*), swift fox (*Vulpes velox*), thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*), black-tailed jackrabbit (*Lepus californicus*), plains pocket gopher (*Geomys bursarius*), black-tailed prairie dog (*Cynomys ludovicianus*), Ord's kangaroo rat (*Dipodomys ordii*), deer mouse (*Peromyscus maniculatus*), western harvest mouse (*Reithrodontomys megalotis*), prairie rattlesnake (*Crotalus viridis*), and pronghorn (*Antilocapra americana*).

Common year round or seasonal residents of sagebrush shrublands known from within or near the Project Area include Swainson's hawk, Say's phoebe (*Sayornis saya*), western kingbird (*Tyrannus verticalis*), horned lark, sage thrasher (*Oreoscoptes montanus*), Brewer's sparrow (*Spizella breweri*), vesper sparrow, sage sparrow (*Amphispiza belli*), western meadowlark, greater sage grouse (*Centrocercus urophasianus*), desert cottontail (*Sylvilagus audoboni*), black-tailed jackrabbit, thirteen-lined ground squirrel, northern pocket gopher (*Thomomys talpoides*), Ord's kangaroo rat, deer mouse, prairie vole (*Microtus orchrogaster*), eastern short-horned lizard (*Phrynosoma douglasii*), prairie rattlesnake, pronghorn, and mule deer (*Odocoileus hemionus*).

Common year round or seasonal residents of riparian areas near the Project Area include northern harrier, Virginia rail (*Rallus limicola*), sora (*Porzana carolina*), common snipe (*Gallinago gallinago*), short-eared owl (*Asio flammeus*), marsh wren (*Cistothorus palustris*), common yellowthroat (*Geothylpis trichas*), savannah sparrow (*Passerculus sandwichensis*), song sparrow (*Melospiza melodia*), red-winged blackbird (*Agelaius phoeniceus*), yellow-headed blackbird (*Xanthocephalus xanthocephalus*), meadow vole (*Microtus pennsylvanicus*), deer mouse, red fox (*Vulpes vulpes*), bull snake (*Pituophis catenifer*), tiger salamander (*Ambystoma*

tigrinum), northern leopard frog (*Rana pipiens*), pronghorn, and mule deer and white-tailed deer (*Odocoileus virginianus*) (BLM, 2003, pp. 3-113 - 3-114; Sauer, et al., 2002; Wyoming Gap Analysis, 2001, online data).

The Project Area is located within the Hilight Bill Geographic Area of the TBNG and lies approximately west of the Broken Hills Geographic Area. Both areas characteristically display populations of pronghorn, mule deer, and elk. Raptor nesting is common within the Hilight Bill area (USFS, 2001a, pp. 2-3 and 2-22).

3.6.1.1 Big Game Animals

In the vicinity of the Proposed Action, big game species consist of pronghorn, elk (*Cervus elaphus*), mule deer, and white-tailed deer. WGF has delineated various range types for big game animals (WGF, 2002). Types noted within or near the Project Area include:

- Yearlong - These are areas in which a population or portion of a population makes general use of a habitat on a year-round basis, except occasionally under severe winter or drought conditions.
- Winter/Yearlong - These are areas in which a population or portion of a population makes general use of a habitat on a year-round basis but in which during the winter (approximately December 1 through April 30) there is a significant influx of additional animals from other seasonal ranges.
- Crucial - These are seasonal habitat areas that have been documented as the determining factor in a population's ability to maintain itself at a certain level (typically a population objective) over the long term.

Only pronghorn and mule deer are found within the Project Area. Elk yearlong and winter/yearlong range occurs within a few miles of the Project Area to the east. Elk crucial winter range areas occur within about five miles northeast and southeast of the Project Area and birthing areas have been located about 10 miles to the east in the Broken Hills Geographic Area. White-tailed deer are known only from a small area in the vicinity of Porcupine Reservoir several miles south of the Project Area. Consequently, neither elk nor white-tailed deer are discussed further in this EA (WGF, 2002).

Pronghorn. Wyoming supports the largest pronghorn population in North America (Clark and Stromberg, 1987), and the species is known to inhabit the Project Area year-round. The species is most abundant in short and mixed-grass habitats such as those dominating the Project Area (BLM, 2003, p. 3-117). Approximately the eastern quarter of the area is considered winter/yearlong range while the western 75 percent is designated yearlong range. Pronghorn migration routes have been located 10 to 20 miles to the east in the general vicinity of the Cheyenne River. All of the Project Area is contained within WGF pronghorn herd unit 740, the Cheyenne River herd (WGF, 2002, GIS maps). During 1996-2000, the average population for the Cheyenne River herd has been estimated at 34,155 individuals. Estimated post-hunting season population in 2001 was 31,023. The population is considered stable, with adequate sexual and generational diversity but has been consistently below the WGF target population of 38,000 individuals. The population shortfall has been considered to result from harsh winter conditions Within the Cheyenne River herd, the population numbers are much higher than

average within Hunt Area 27, which encompasses the Project Area (BLM, 2003, p. 3-121; WGF, 1999, p. 154; WGF, 2001, pp. 1 - 17).

Mule Deer. Mule deer frequent habitats that include short and mixed-grass prairies, sagebrush shrublands, and shrubby riparian areas. The mule deer population within the PRB as a whole has exceeded WGF management goals. Populations in all but WGF herd unit 753 are stable or increasing. All of the Project Area is contained within WGF mule deer herd unit 752, the Thunder Basin herd, which exhibits a stable population trend. Estimated average population for this herd during 1996-2000 was 17,656 individuals. The population is currently 15 percent below the upwardly-revised WGF target population of 20,000. Previously, the herd was above population objectives, but expanded hunting and a harsh winter have resulted in current numbers. Herd sexual and generational diversity are considered to be adequate (WGF, 2001, pp. 129 to 149). Within and near the Project Area, mule deer habitat is generally restricted to the vicinity of major drainages, such as Porcupine Creek, Antelope Creek, and Little Thunder Creek. Yearlong habitat occurs over about 10 percent (262 acres) of the Project Area, mainly along Little Thunder Creek and in the northernmost portion of the area (WGF, 2002; WGF, 1999, p. 153).

3.6.1.2 Other Mammals

In addition to species listed above, less common residents of short and mixed-grass communities within or near the Project Area may include Merriam's shrew (*Sorex merriami*), northern grasshopper mouse (*Onychomys leucogaster*), olive-backed pocket mouse (*Perognathus fasciatus*), and long-tailed weasel (*Mustela frenata*). Additional sagebrush shrubland residents could include mountain (Nutall's) cottontail (*Sylvilagus nuttallii*), white-tailed jackrabbit (*Lepus townsendii*), olive-backed pocket mouse *(Perognathus fasciatus)*, sagebrush vole (*Lemmiscus curtatus*), gray fox (*Urocyon cinereoargenteus*), striped skunk (*Mephitis mephitis*), and bobcat (*Lynx rufus*). Additional residents which may occur in riparian shrublands could include mountain (Nuttall's) cottontail and common porcupine (*Erethizon dorsatum*) (WGF, 1999, pp. 125 - 154; Wyoming GAP Analysis, 2001).

Bat species which are widely distributed in Wyoming and which may occur in the vicinity of the Project Area include the western small-footed myotis (*Myotis ciliolabrum*), little brown myotis (*Myotis lucifugus*), hoary bat (*Lasiurus cinereus*), big brown bat (*Eptesicus fuscus*), and Townsend's big-eared bat (*Plecotus townsendii*) (WGF, 1999, pp. 128 - 131). Townsend's big-eared bat is discussed in Section 3.7.

3.6.1.3 Raptors

The Hilight Bill Geographic Area is noted for a high incidence of raptor nesting (USFS, 2001, p. 2-22). Various ongoing raptor surveys have located approximately 24 nest sites within one mile of and including the Project Area (USFS, 2003). The identified nests include 15 ferruginous hawk nests and three golden eagle nests. For bald eagle, golden eagle, merlin, ferruginous hawk, and Swainson's hawk, nests are considered active by the USFS unless they have not been occupied for seven consecutive years. For the burrowing owl and other raptor species, a nest is no longer considered active if it has been unoccupied during the current or most recent nesting season (USFS, 2001, p. 1-20). The ferruginous hawk and western burrowing owl are given special status by the USFS and are discussed further in Section 3.7.

Other raptors known or suspected to occur in the vicinity of the Project Area include bald eagle (*Haliaeetus leucocephalus*), Swainson's hawk, red-tailed hawk (*Buteo jamaicensis*), northern harrier *(Circus cyaneus)*, merlin (*Falco columbarius*), prairie falcon (*Falco mexicanus*), and great horned owl (*Bubo virginianus*).

Most of the raptors discussed in this section are extremely widespread throughout much of Wyoming. All inhabit a variety of habitats, but typically about half of their ranges consist of Wyoming big sagebrush and mixed-prairie grasslands (Wyoming GAP Analysis, 2001). Bald eagles, ferruginous hawks, northern harriers, and burrowing owls are special status species that are discussed in detail in Section 3.7.

Ferruginous Hawk. Ferruginous hawks are summer residents of the TBNG that nest in rock outcrops, in trees, and on the ground. They are known to occur within the Project Area. Historically, the majority of nests were on or near the ground (dirt/rock/chalk outcrops, riverbed mounds, mud buttes, and rock piles). More recently, many nests have been built in trees and large shrubs, on utility structures, artificial platforms, roofs of abandoned buildings, and vertical river banks. Territory and nest site re-occupancy is common for ferruginous hawks. Mammals are the primary prey during the breeding season, although birds, amphibians, reptiles, and insects also are taken (Dechant et al 1999 as cited in Byer et al., 2000, p. H-176). Ferruginous hawk habitat and nests have been documented within the analysis area of all three PODs. Two nests in Section 11 have been reported as active within the last seven years.

Golden Eagle. Golden eagles are common, widely distributed, year-round residents of Wyoming and the west in general. Their prey consists mainly of rabbits and larger rodents, and they are known to sometimes scavenge dead lambs (Udvardy, 1993, p. 543). They typically nest in trees or on cliff faces. Raptor surveys previously cited have located golden eagle nests throughout the Hilight Bill and northern portion of the Broken Hills geographic areas of the TBNG. No nests have been identified within the Project Area, but three are located within one mile of its boundary.

Red-tailed Hawk. Red-tailed hawks are common, widely distributed, year-round residents of Wyoming. They prefer trees, particularly cottonwoods, and cliff faces for nest sites (Wyoming GAP Analysis, 2001) and commonly perch atop fence posts and telephone poles. Dominant prey consists of rodents or other small mammals and occasionally lizards (Udvardy, 1993, p. 538). Surveys have not identified red-tailed hawk nests in the vicinity of the Project Area.

Swainson's Hawk. Swainson's hawks are common, widely distributed, summer residents of Wyoming. Nesting preferences are for isolated trees outside of riparian areas (Wyoming GAP Analysis, 2001). Main prey consists of rodents, although these hawks will occasionally feed on grasshoppers and locusts. The bird winters mainly in South America and migrates in large flocks (Udvardy, 1993, p. 538). Surveys have not identified nests of this species in the vicinity of the Project Area. Within the Hilight Bill Geographic Area, including the Project Area, Swainson's hawk nests are much less common than are those identified as belonging to ferruginous hawks or golden eagles.

Prairie Falcon. Prairie falcons are common, widely distributed, year-round residents of Wyoming. Nesting preferences are for cliff habitats. Nests are uncommon (BLM, 2003, p. 3-

147) but are commonly reused in subsequent years. Their principal prey consists of rodents, other small mammals, and ground birds (Udvardy, 1993, p. 776). Surveys have not identified nests in the vicinity of the Project Area.

Northern Harrier. The northern harrier (also known as the marsh hawk) is a common, widely distributed, summer resident of Wyoming. It nests on the ground, on cliffs, or talus associations (WGF, 1999, p. 38). Principal prey consists of small mammals, rodents, and sometimes young of other birds (Udvardy, 1993, p. 454). Raptor surveys have not identified northern harriers in the vicinity of the Project Area. As many as 250 breeding pairs may exist within the area analyzed by the PRB O&G FEIS (BLM, 2003, p. 3-145).

Great Horned Owl. Great horned owls are common, widely distributed, year-round residents of Wyoming. Nesting preferences are for trees, cliffs, and talus associations. When nesting in trees, there is a preference for solitary trees or the edge of a grove (WGF, 1999, p. 65). Their prey consists of rabbits, rodents, birds, and sometimes larger animals such as skunks. The species is tolerant of humans (BLM, 2003, p. 3-147). Raptor surveys have identified only a few nests within the TBNG and none in the vicinity of the Project Area. Between 310 and 670 breeding pairs may occupy the area analyzed by the PRB O&G FEIS (BLM, 2003, p. 3-148).

3.6.1.4 Upland Game Birds

Common year-round or seasonally resident upland game birds known from within or near the Project Area include mourning dove (*Zenaida macroura*), greater sage grouse, and sharp-tailed grouse (*Tympanuchus phasianellus*). Occurrences of any of these birds are possible in the vicinity of the Project Area, although the sharp-tailed grouse is more commonly found farther north in mid-grass prairie environments. No sharp-tailed grouse leks are currently known from the Upper Cheyenne watersheds (BLM, 2003, p. 3-148; WGF, 1999, p. 44).

Sage grouse are a special status species on the TBNG. They are discussed in more detail in Section 3.7. Scoping did not identify issues of concern relating to upland game birds other than sage grouse, and these species are not discussed further in this EA.

3.6.1.5 Other Birds

Land Birds. The USFWS has established a listing of birds of conservation concern. The Project Area is contained within Bird Conservation Region 17 (badlands and prairies). Non-raptors from the list that may occur in the vicinity of the Project Area include mountain plover (*Charadrius montanus*), upland sandpiper (*Bartramia longicauda*), long-billed curlew (*Numenius americanus*), Wilson's phalarope (*Phalaropus tricolor*), Brewer's sparrow (*Spizella breweri*), grasshopper sparrow (*Ammodramus savannarum*), McCown's longspur (*Calcarius mccownii*), and chestnut-collared longspur (*Calcarius ornatus*) (USFWS, 2002, Table 17). Wilson's phalarope is a summer resident of certain riparian areas. Brewer's sparrow is a summer resident primarily of sage communities. Grasshopper sparrow, McCown's longspur, and chestnut-collared longspur are summer residents of short and mixed-grass prairies. (Wyoming GAP Analysis, 2001).

Several land birds are also special status species within the TBNG. These species include mountain plover, loggerhead shrike, Brewer's sparrow, grasshopper sparrow, sage sparrow,

McCown's longspur, chestnut-collared longspur, long-billed curlew, and purple martin. These species are discussed in more detail in Section 3.7.

Waterfowl. A number of common migratory or resident waterfowl occur in the vicinity of the Project Area. In addition to the Canada goose (*Branta canadensis*), ducks and teal whose ranges include the Hilight Bill Geographic Area include the wood duck (*Aix spansa*), mallard (*Anas platyrhynchos*), gadwall (*Anas strepera*), green-winged teal (*Anas crecca*), American widgeon (*Anas americana*), northern pintail (*Anas acuta*), northern shoveler (*Anas clypeata*), blue-winged teal (*Anas discors*), and cinnamon teal (*Anas cyanoptera*). Summer resident wading and shore birds whose ranges encompass the Project Area include the great blue heron (*Ardia herodias*), killdeer (*Charadrius vociferus*), American avocet (*Recurvirostra americana*), black-necked stilt (*Himantopus mexicanus*), spotted sandpiper (*Actitis macularia*), and Wilson's phalarope. These birds could make use of appropriate habitat associated with mine reservoir margins, along Little Thunder Creek, including nearby Little Thunder Reservoir, or in other wetlands and riparian corridors (BLM, 2003, p. 3-150; WGF, 1999, pp. 26 - 33; Wyoming GAP Analysis, 2001). As indicated in Section 3.5, these habitats encompass approximately 1.8 percent of the Project Area.

3.6.1.6 Amphibians

Amphibians which may be found in wetland or riparian communities in the vicinity of the Project Area include tiger salamander (*Ambystoma tigrinum*), plains spadefoot (*Scaphiopus bombifroms*), Great Plains toad (*Bufo cognatus*), Woodhouse's toad (*Bufo woodhousei*), boreal chorus frog (*Pseudacris triseriata*), and northern leopard frog (*Rana pipiens*) (WGF, 1999, pp. 156 to 158). Northern leopard frog is considered a TBNG special status species and is discussed in more detail in Section 3.7.

3.6.1.7 Fisheries

Little Thunder Creek is an ephemeral stream which is a tributary of Black Thunder Creek, also an ephemeral stream. Under Chapter 1 of the Wyoming Water Quality Regulations, Little Thunder Creek is classified as 3B waters by WDEQ above North Prong of Little Thunder Creek (Project Area) and as 2ABWW waters below North Prong until it reaches Black Thunder Creek. Class 3B streams are intermittent or ephemeral tributary waters and adjacent wetlands which, because of natural habitat conditions, do not support, nor have the ability to support, fish populations or spawning. These streams have 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 in their life cycles. Class 3B waters are characterized by frequent linear wetland occurrences within or adjacent to the stream channel. Class 2 waters may be perennial, intermittent, or ephemeral and are protected for their designated uses. They are known to support fish or drinking water supplies or are considered to be candidates for those uses. Class 2AB waters are known to support warm water game fish populations or spawning and nursery areas at least seasonally. They include perennial tributaries and adjacent wetlands and where a game fishery and drinking water use is otherwise attainable. Unless it is shown otherwise, Class 2AB waters are presumed to have sufficient water quality and quantity to support drinking water supplies. Class 2AB waters are also protected for nongame fisheries, fish consumption, aquatic life other than fish, primary contact recreation, wildlife, industry, agriculture, and scenic value uses (WDEQ, 2003a Chapter 1, Section 4).

One managed fishery is located within two miles of the Project Area. The Little Thunder Reservoir is regularly stocked with rainbow trout and large-mouth bass. Prior to CBNG produced water discharges, the reservoir was subject to chronic low water conditions and frequently suffered winter kills. As a result of the increased flows, the reservoir's fish populations have improved. Recent aquatic surveys revealed the presence of rainbow trout and black bullheads (Greystone, 2004).

3.6.2 Environmental Consequences

Significant wildlife and fisheries issues raised during scoping include the following:

- Effects of increased fencing and associated habitat fragmentation.
- Identify and describe black-tailed prairie dog colonies, T&E listed, candidate, and proposed species, invertebrate species, big game habitats, raptor habitats, sage grouse habitats, and burrowing owl habitat.
- Potential for increased wildlife mortality due to collisions.
- Potential effects on black-footed ferret habitat.
- Protection measures for endangered and sensitive species.
- Potential effects from high levels of salts on fish reproduction.
- Potential effects of changing flows on habitat of amphibians and aquatic invertebrates.
- Potential effects of water discharge on causing further decline and extirpation of native prairie fish.

3.6.2.1 Alternative A - No Action

If none of the proposed activities were to occur on federal lands, no adverse impacts to wildlife resources additional to existing impacts would occur. Conventional oil and gas development would continue within the Project Area, and CBNG development would continue on state and private lands near the Project Area. Surface coal mining is likely to continue adjacent to and within the Project Area for the foreseeable future.

3.6.2.2 Alternative B – Proposed Action

Direct Impacts. Construction of the Proposed Action would result in the short-term disturbance of 77 acres of short-grass prairie and sagebrush shrubland habitat (2.9 percent of the Project Area). These areas would be reclaimed as soon as practical following construction. Direct, long-term disturbance to habitat would affect approximately eight acres (0.3 percent) of the 2623-acre Project Area. Reclaimed areas would likely produce less forage until mature vegetation is established after approximately three years. Grasses and forbs may initially dominate the reclaimed areas' communities; however, in areas of previous shrub/sage brush dominance, these communities would gradually become reestablished. The shrub communities would likely take eight to 20 years to completely recover (BLM, 2003, p. 4-180). Discharge of produced water to some ephemeral drainages could increase the amount of riparian and wetlands habitat available and result in increased occurrences of animals dependent on those habitats.

Implementation of the Proposed Action would result in disturbance of an historic sage grouse lek, as well as pronghorn and mule deer range, as indicated in Table 3.6-1. The sage grouse lek, located in the SW quarter of Section 8, T43N/R71W has been inactive since 1992; therefore, negative impacts to sage grouse are not anticipated. The sage grouse lek will be discussed further in Section 3.7. Crucial range for pronghorn and mule deer does not occur within the Project Area. Most of the long-term disturbance is associated with roads. The construction of new roads would be partially compensated by decommissioning and reclamation of some existing roads by the USFS (see Table 2.3-2).

Table 3.6-1 Maximum Disturbance of Big Game Range by Surface Ownership, Proposed Action

Species	Short-Term Disturbance (Acres)				Long-Term Disturbance (Acres)			
	Federal	State	Private	Totals	Federal	State	Private	Totals
Pronghorn								
Yearlong	40.0	17.5	57.6	115.2	4.5	1.4	5.9	11.8
Winter/Yearlong	13.4	5.8	19.2	38.4	1.5	0.5	2.0	4.0
Total Pronghorn	53.4	23.4	76.8	153.6	6.1	1.8	7.9	15.8
Mule Deer								
Yearlong	5.3	2.3	7.7	15.4	0.6	0.2	0.8	1.6

Source: Wyoming GAP Analysis, 2001, GIS Data. Rounding issues may affect totals.

The loss of some surface habitat and increased human activity would likely result in some increased mortality among small and relatively immobile species, particularly during, and in the vicinity of, construction activities. Impacts to small mammals would likely be masked by naturally-caused population variations. Many species possess a high reproductive capacity allowing a rapid recovery from increased mortality.

Increased wildlife mortality resulting from animal/vehicle collisions is a potential direct impact resulting from increased road mileage and traffic. The highest potential for road kills would exist during the construction phase, expected to last approximately six months. Remote monitoring of wells and facilities would minimize the need for onsite observations during the production phase. The great majority of construction and maintenance operations would occur during daylight hours, and vehicle speeds would be limited by the proponent, thereby decreasing the likelihood of inadvertent collisions.

Approximately 1.25 miles of new overhead power line will be constructed on private lands in association with this project. These power lines will be constructed in accordance with the Avian Power Line Interaction Committee's recommendations (APLIC 1996) designed to minimize raptor electrocutions. However, increased mortality of raptors resulting from development of above ground high voltage electrical distribution lines into the Project Area is a potential direct adverse impact. Construction of power poles could also provide additional hunting perches resulting in increased feeding efficiency for raptors but adverse impacts on prey species such as sage grouse and prairie dogs.

Most raptors tend to be intolerant of human activity and would avoid nesting in proximity to drilling or construction activity. Timing limitations would restrict construction activities during nesting season. Elevated noise levels have been shown to be a factor in raptor displacement (BLM, 2003, p. 4-219). There are no new compressor stations proposed as part of this Project. Long-term elevated noise levels would not result from construction associated with the Proposed Action.

Little Thunder Creek is classified as WDEQ Class 3B water that does not naturally support, nor have the ability to support, fish populations or spawning. The quality of produced water in the Project Area is good. No adverse impacts to water quality are expected. Water discharged to ephemeral drainages that are tributaries to Little Thunder Creek may expand wetland and riparian habitats within those drainages and expand opportunities for wildlife populations subsisting in those environments. Mitigation of existing erosion features in drainages receiving produced water would minimize increases in erosion and sedimentation. Major negative impacts to wildlife from produced water discharge are not anticipated.

The USFS, other federal agencies, the University of Wyoming, oil and gas companies, adjacent coal mines, and Lance have conducted extensive biological surveys in the past and support ongoing surveys in and near the Project Area. Data obtained from these surveys are sufficient to establish current baseline conditions and determine the level of impacts resulting from construction of the Proposed Action.

Indirect Impacts. Construction activities would likely result in reduction of habitat use by big game species. Big game species are known to avoid areas of human activity, at least temporarily, and it is possible that some long-term avoidance of habitat near construction areas could occur. Avoidance could result in under-use of suitable habitat and overuse of more stressed habitat (BLM, 2003, p. 4-180). Wildlife distribution patterns could change; however, observations of pronghorn in existing CBNG fields suggest that they become somewhat tolerant of human activities except during hunting season (BLM, 1999, p. 4-89). Mule deer may be even more tolerant than are pronghorn. Mule deer have been observed using areas adjacent to oilfield access roads (Easterly et al., 1991).

Fragmentation of habitat (particularly sagebrush communities) could result from construction. New fences will only be constructed around the wellheads. These small fenced areas (approximately 4 feet by 4 feet) would not contribute to fragmentation. Surface disturbance could also include reduction of forage and hiding cover, nesting and breeding cover, and thermal cover. Negative impacts to small mammal populations could potentially reduce raptor hunting success. However, it is unlikely that habitat fragmentation would pose a serious threat to raptor populations (BLM, 2003, p. 4-219).

Currently, roads exist throughout much of the Project Area. Approximately 9.5 miles of roads currently exist on USFS and private surface in the Project Area. An additional 11.6 miles of road would be constructed to support the project while approximately nine miles of exisiting roads would be decommissioned. Additional roads are not likely to cause a major impact due to the existing access to most of the Project Area. However, there is a possibility that construction of new roads could increase access for legal hunting and poaching of big game and increase habitat fragmentation.

Mitigation

By applying the USFS standard COAs listed in Appendix D and operator-committed mitigation measures listed in Chapter 2, impacts to wildlife resources would be lessened. Lance would comply with standard lease stipulations as well as wildlife NSO, CSU, and timing stipulations contained within the TBNG LRMP and summarized in Table 2.3-10

3.6.2.3 Alternative C – Modified Development Alternative

Implementation of Alternative C would result in similar but reduced direct and indirect impacts in comparison to Alterantive B – Proposed Action. Four wells, two roads, and one tire tank included as part of the Proposed Action would not be constructed as part of this alternative. These facilities have been dropped from the Project to avoid potential adverse impacts to the previously identified historic sage grouse leks and nearby historic ferruginous hawk nests. Again, short-term and long-term disturbance of pronghorn and mule deer non-crucial range would occur as indicated in Table 3.6-2

Table 3.6-2 Maximum Disturbance of Big Game Range by Surface Ownership, Modified Development

Species	Short-Term Disturbance (Acres)				Long-Term Disturbance (Acres)			
	Federal	State	Private	Totals	Federal	State	Private	Totals
Pronghorn								
Yearlong	36.9	17.5	54.5	108.9	3.1	1.4	4.4	8.9
Winter/Yearlong	12.3	5.8	18.2	36.3	1.0	0.5	1.5	3.0
Total Pronghorn	49.3	23.4	72.6	145.2	4.1	1.8	5.9	11.9
Mule Deer								
Yearlong	4.9	2.3	7.3	14.5	0.4	0.2	0.6	1.2

Source: Wyoming GAP Analysis, 2001, GIS Data. Rounding issues may affect totals.

Direct, long-term disturbance to habitat would affect approximately 6 acres (0.2 percent) of the 2623-acre Project Area. Short-term disturbance of 72 acres (2.7 percent) of the Project Area would be reclaimed as soon as practical following construction. Again, reclaimed areas would likely produce less forage until mature vegetation is established after approximately three years. Indirect impacts would be the same but reduced in comparison to the Proposed Action.

3.6.3 Cumulative Effects

3.6.3.1 Alternative B – Proposed Action

Cumulative impacts to wildlife within the Project Area would result mainly from additional CBNG development in the vicinity, conventional oil and gas development, ongoing coal mining activities, and expanded livestock grazing and ranching operations. Ongoing energy development or increased stock grazing could lead to declining numbers or changes in the sex ratios (BLM, 2003, p.4-187, 4-198) in pronghorn and mule deer populations. As indicated in Section 3.1.1.3, conventional oil and gas development within the Project Area appears to be in a mature phase and extensive additional development is not anticipated. Continued expansion of

existing coal mines is expected for the foreseeable future and grazing activity should continue near current levels as the mines re-establish vegetation behind the open pits. Other long-term effects on big game would be due to natural forces, such as severe winters, drought conditions, continued hunting pressure, affecting forage productivity, or loss of habitat through range fires.

Following construction and field development, most additional impacts to raptors and other birds would result from CBNG field operations (periodic well maintenance), conventional oil and gas development, and continued coal mining. Ferruginous hawks and sage grouse would be most impacted by this alternative due to the location of nests and a sage grouse lek. Again, other impacts to populations would result from natural forces. Increased road mileage within the Project Area could result in increased human interaction with various bird species.

The PRB O&G FEIS forecasts a 25 percent increase in traffic resulting from CBNG development (BLM, 2003, p. 4-216), most of which would occur during the construction phase. Collision-caused mortality of big game animals could increase by a comparable amount, particularly along paved roads capable of supporting higher vehicle speeds. Collisions with raptors and other bird species would tend to be less, although owls are particularly at risk (BLM, 2003, p. 4-216). Lance would monitor and remove carrion along roads to minimize the attraction of scavenging raptors.

Aquatic species or those associated with wetlands and riparian communities may experience cumulative impacts from CBNG development. It is estimated that complete CBNG development within the Little Thunder Creek basin would occur within approximately five to six years. During that period, discharge of produced water down Little Thunder Creek could temporarily transform portions of the creek into a perennial stream. Quality of CBNG produced water within the Little Thunder Creek watershed is, however, expected to be among the best in the entire PRB (BLM, 2003, Figure 3-1). It is anticipated that the WDEQ's NPDES permitting requirements (BLM, 2003, p. 4-83) will be met. Following completion of development in upstream portions of the Little Thunder Creek watershed, the decline in CBNG water production would result in a gradual return of pre-development conditions and return of Little Thunder Creek to ephemeral status.

Possible increases in sediment load associated with CBNG produced water discharge from upstream portions of the Little Thunder Creek drainage basin could affect aquatic invertebrate species in the vicinity of Little Thunder Creek. The presence of constructed naturally-surfaced roads would increase the potential for vehicle-generated dust and increases in the sediment load of waters reaching Little Thunder Creek. Streams within the Upper Cheyenne River watershed are expected to exhibit some increase in sediment loading (BLM, 2003, p. 4-239).

During the period of increased flow in Little Thunder Creek, expected to last somewhere between five and 10 years, existing wetlands and riparian environments could be affected and, to some degree, displaced. Wetland types typical of perennial streams could succeed those typical of ephemeral situations. Populations dependent upon these communities could likewise be somewhat displaced. Overall, it is probable that the acreage of wetlands and riparian communities would expand in response to higher flows within Little Thunder Creek. Based upon observations in mature CBNG development areas of the PRB, dramatic impacts are not expected.

3.6.3.2 Alternative C – Modified Development Alternative

Cumulative impacts to wildlife within the Project Area would remain essentially the same as Alternative B. The only change would be a reduced impact on ferruginous hawks and avoidance of impacts to a sage grouse lek. These are discussed further in Section 3.7.

3.7 T&E, SENSITIVE, AND MIS SPECIES

3.7.1 Affected Environment

For the purposes of this EA, special status species are those listed by the USFWS as threatened, endangered, proposed, or candidate species (USFWS, 2003); or species included by USFS Region 2 on the Regional Forester's sensitive species list (USFS, 2003a); or included on BLM's Wyoming state sensitive species list (BLM, 2002b); or on the WGF native status species list (Fertig et al., 1999, online data). The USFS TBNG-designated management indicator species are also included. Only those species that are known or suspected to occur within the vicinity of the Project Area (i.e. within the Hilight Bill Geographic Area), and only those officially listed by one of the four government agencies, are discussed. Occurrence probabilities were determined during informal consultations with USFS biologists while preparing the Biological Assessment, Biological Evaluation, and Management Indicator Species assessments in conjunction with this EA (Greystone, 2003a; 2003b; and 2003c). Different species may be included on the lists of the various agencies.

The USFWS, under terms of the Endangered Species Act, uses the following special status designations:

- Endangered species are those in danger of extinction throughout all or a significant portion of their range.
- Threatened species are those likely to become endangered within the foreseeable future throughout all or a significant portion of their range.
- Proposed species are those for which the USFWS has published a proposed rule for listing.
- Candidate species are those for which the USFWS has sufficient information on biological vulnerability and threats to warrant issuance of a proposed rule for listing, but for which publication of a proposed rule is precluded by other higher priority listing actions.

In addition to official agency listings, the Wyoming Natural Diversity Database (WYNDD), a participant in the Natural Heritage Program Network, maintains lists of species of concern (Fertig et al., 1999). Each of the official lists was examined, following consultation with the USFS, to select species of concern which might occur in the vicinity of the Project Area. Where WYNDD information was available, the Natural Heritage Program rankings were included. Also consulted was the USFWS listing of birds of conservation concern for Bird Conservation Region 17 (USFWS, 2002, p. 40). The species selected are indicated in Table 3.7-1.

Table 3.7-1 Special Status Species, Proposed Action

Common Name	Scientific Name	Agency Status	Heritage Program Status *
USFWS Listed Species			
Bald Eagle	*Haliaeetus leucocephalus*	Threatened	G4/S2B,S3N
Black-footed ferret	*Mustela nigripes*	Endangered	G1/S1
Ute ladies' tresses	*Spiranthes diluvialis*	Threatened	G3/S1
Agency Sensitive Species			
Birds			
American bittern	*Botuarus lentiginosus*	FSR2	G4/S3B
Ferruginous hawk	*Buteo regalis*	Forest Service Region 2 (FSR2), BLM	G4/S4B,S3N
Northern harrier	*Circus cyaneus*	FSR2	G5/S4B,S5N
Western burrowing owl	*Athene cunicularia*	FSR2, BLM	G4/S3B,SZN
Mountain plover	*Charadrius montanus*	FSR2	G2/S2B,SZN
Loggerhead shrike	*Lanius ludovicianus*	FSR2, BLM	G4/S4B
Brewer's sparrow	*Spizella breweri*	FSR2	G5/S3B,SZN
Grasshopper sparrow	*Ammodramus savannarum*	WYGF	G5/S3B,SZN
Sage sparrow	*Amphispiza belli*	FSR2, BLM	G5/S3B,SZN
McCown's Longspur	*Calcarius mccownii*	FSR2	G5/S3B,SZN
Chestnut-collared longspur	*Calcarius ornatus*	FSR2	G5/S2B,SZN
Purple martin	*Progne subis*	FSR2	G5/SHB
Greater sage grouse[1]	*Centrocercus urophasianus*	FSR2	G4/S3
Long-billed curlew	*Numenius americanus*	FSR2	G5/S3B
Mammals			
Black-tailed prairie dog	*Cynomys ludovicianus*	FSR2, USFWS Candidate	G4/S2S3
Swift fox	*Vulpes velox*	FSR2, BLM, WGF	G3/S2S3
Townsend's big-eared bat	*Plecotus townsendii*	FSR2, BLM, WGF	G4/S1B,S2N
Amphibians			
Northern leopard frog	*Rana pipiens*	FSR2, BLM	G5/S3
Fish			
Finescale dace	*Phoxinus neogaeus*	FSR2	G5/S1
Plains minnow	*Hybognathus placitus*	FSR2	G4/S3
Plants			
Barr's milkvetch	*Astragalus barrii*	FSR2, BLM	G3/S3
USFS TBNG Highlight Bill Geographic Area Management Indicator Species			
Greater sage grouse[1]	*Centrocercus urophasianus*	FSR2, BLM	G4/S3

[1]Both sensitive species and MIS

* Heritage Program Rankings

WYNDD uses a standardized ranking system developed by The Nature Conservancy's Natural Heritage Network to assess the global and statewide conservation status of each plant and animal species, subspecies, and variety. Each taxon is ranked on a scale of 1-5, from highest conservation concern to lowest. Codes are as follows:

G Global rank: Rank refers to the rangewide status of a species.

T Trinomial rank: Rank refers to the rangewide status of a subspecies or variety.

S State rank: Rank refers to the status of the taxon (species or subspecies) in Wyoming. State ranks differ from state to state.

1 Critically imperiled because of extreme rarity (often known from 5 or fewer extant occurrences or very few remaining individuals) or because some factor of a species' life history makes it vulnerable to extinction.

2 Imperiled because of rarity (often known from 6-20 occurrences) or because of factors demonstrably making a species vulnerable to extinction.

3 Rare or local throughout its range or found locally in a restricted range (usually known from 21-100 occurrences).
4 Apparently secure, although the species may be quite rare in parts of its range, especially at the periphery.
5 Demonstrably secure, although the **species** may be rare in parts of its range, especially at the periphery.
H Known only from historical records. 1950 is the cutoff for plants; 1970 is the cutoff date for animals.
X Believed to be extinct.
A Accidental or vagrant: A taxon that is not known to regularly breed in the state or which appears very infrequently (typically refers to birds and bats).
B Breeding rank: A state rank modifier indicating the status of a migratory species during the breeding season (used mostly for migratory birds and bats)
N Nonbreeding rank: A state rank modifier indicating the status of a migratory species during the non-breeding season (used mostly for migratory birds and bats)
ZN or ZB Taxa that are not of significant concern in Wyoming during breeding (ZB) or non-breeding (ZN) seasons. Such taxa often are not encountered in the same locations from year to year.
U Possibly in peril, but status uncertain; more information is needed.
Q Questions exist regarding the taxonomic validity of a species, subspecies, or variety.

3.7.1.1 USFWS Listed Species

The USFWS was informally consulted regarding threatened, endangered, proposed, and candidate species considered for listing under the terms of the Endangered Species Act (Long, 2001). Listed and proposed species are discussed in the following paragraphs.

Black-footed Ferret. The black-footed ferret is a secretive, nocturnal carnivore species that is found almost exclusively in prairie dog colonies. Its primary prey is the prairie dog, and abandoned prairie dog burrows are commonly used by the ferret for shelter. Once found throughout the Great Plains, the species is now considered by biologists to be one of the most endangered mammals in the U.S.

Black-footed ferret surveys have been conducted on all USFS lands where prairie dog poisoning has occurred in the past (Byer, et al., 2000). No recent observations of black-footed ferrets have been recorded on the TBNG, although the USFS has completed surveys in areas of suitable habitat. After 10 consecutive years of surveys in accordance with USFWS protocol for conducting black-footed ferret searches, beginning in 1981, no evidence was found to suggest black-footed ferrets occur on the TBNG (cited in USFS, 2001). The USFWS no longer requires black-footed ferret surveys in this area (Kelly, 2004).

One black-tailed prairie dog colony is present within ½-mile of the Project Area. This colony covers approximately 120 acres. According to the USFWS protocol, colonies larger than 79 acres may constitute suitable habitat (USFWS, 1989). Although the prairie dog colony near this project may constitute suitable habitat, this area is not considered as a possible ferret reintroduction area.

Bald Eagle. Habitat for the bald eagle is generally along lakes, large rivers, and coasts. The species feeds mostly on fish but also on carrion and mammals such as rabbits, and constructs a platform nest of sticks and vegetation on cliff ledges or in tree forks. Species-wide populations are recovering from earlier declines. The species was down-listed from endangered to threatened in 1995 and, as of July 6, 1999, has been proposed for delisting (BLM, 2003, p. 3-175).

Ute Ladies'-tresses. Ute ladies'-tresses is a perennial, terrestrial orchid that is endemic to moist soils near wetland meadows, springs, lakes, and perennial streams. It occurs generally in alluvial substrates along riparian edges, gravel bars, old oxbows, and moist to wet meadows at elevations

from 4,200 to 7,000 feet. The orchid colonizes early success ional riparian habitats such as point bars, sand bars, and low lying gravelly, sandy, or cobbly edges, persisting in those areas where the hydrology provides continual dampness in the root zone through the growing season.

The closest known occurrence of this species to the Project Area is located on a tributary of Antelope Creek more than 30 miles to the southwest of Little Thunder Reservoir. The known population is separated from the Project Area by at least seven major drainages. Antelope Creek does not flow into Little Thunder Creek. Both streams are tributaries of the Cheyenne River. Little Thunder Reservoir is located about ½ mile east and downstream of the Project Area. It is highly unlikely that seed from the population near Ross could be transported to the Little Thunder Creek drainage (Hazlett, 1998).

Surveys have been conducted in suitable habitat along Antelope Creek and School Creek in 1997 and 1998 by two separate efforts (Hazlett, 1998; BKS Environmental Associates, 1998). No populations were found. Based upon the negative results of nearby habitat surveys and the lack of any identified populations of Ute Ladies'-tresses in the Project Area, there would be no effect to this species, and it will not be discussed further in this document.

3.7.1.2 USFS, BLM, or WGF Sensitive Species

Raptors. Special status raptors include ferruginous hawk, northern harrier, and western burrowing owl. Ferruginous hawks are common, widely distributed summer Wyoming residents. Primary habitat includes grasslands and shrublands with abundant ground squirrels or other small mammals. Less important prey include birds, reptiles, and insects. The bird may occupy diverse nest locations (Wyoming GAP Analysis, 2001; Udvardy, 1993, p. 540). Ferruginous hawk nests are the most common located by USFS and coal mine raptor surveys (USFS, 2003), with 12 historic nest locations identified within one mile of the Project Area. Two ferruginous hawk nests in Section 11 were reported as active within the last seven years. During the biological surveys conducted in association with the proposed project, the exact location and current status of the nest(s) could not be verified. Most of these nesting locations were mapped in areas without trees or other landscape features usually associated with raptors. Counts of these and other raptor nests are not definitive as locational variances from different surveys may overestimate total nest sites (O&G, 2004). The species exhibits a positive population trend in Wyoming (Sauer et al., 2002).

The northern harrier (also known as the marsh hawk) is a common, widely distributed, summer resident of Wyoming. It nests on the ground, on cliffs, or talus associations (WGF, 1999, p. 38). Principal prey consists of small mammals, rodents, and sometimes young of other birds (Udvardy, 1993, p. 454). Raptor surveys have not identified northern harriers in the vicinity of the Project Area. As many as 250 breeding pairs may exist within the study area of the PRB O&G FEIS (BLM, 2003, p. 3-145).

Western burrowing owls are uncommon but widely-distributed Wyoming summer residents. The species nests in prairie dog and ground squirrel burrows and is found in prairie grasslands and shrublands. Prey preference includes insects, small birds, lizards, and rodents. It is known to breed in Wyoming (Wyoming GAP Analysis, 2001; Udvardy, 1993, p. 687; BLM, 2003, p. 3-186). In the vicinity of the Project Area, burrowing owl habitat is commonly associated with prairie dog colonies. USFS, WGF, and coal mine (WGF, 2002; Triton Coal Company, 2002)

data have located one burrowing owl nest within 1/2-mile of POD 3. No other nests have been located in the vicinity of the Project Area.

Other sensitive species raptors known from the TBNG include peregrine falcons and northern goshawks. Suitable habitat for these species is not found within the Project Area, and they have not been considered further in this EA.

Birds of Riparian Communities. Birds found in riparian communities that are known or suspected to occur within the general vicinity of the Project Area include American bittern, yellow-billed cuckoo, fox sparrow, Lewis' woodpecker, black tern, purple martin, and common loon. However, suitable habitat for these species is not found within the Project Area and they have not been considered further in this EA.

Birds of Prairie and Shrubland Communities. Birds found in prairie and shrubland communities that are known or suspected to occur within the vicinity of the Project Area include sage grouse, mountain plover, loggerhead shrike, Brewer's sparrow, grasshopper sparrow, sage sparrow, McCown's longspur, chestnut-collared longspur, and long-billed curlew. The sage grouse is also considered a MIS species and is discussed Section 3.7.1.3.

Mountain plover prefer dry, short-grass prairies. The birds frequently select areas modified by prairie dogs, grazing, and fire. Plovers feed primarily on insects, especially grasshoppers and nest in a depression on bare ground. The species-wide population trend is down dramatically, over 50 percent from 1966 to 1996, due primarily to habitat loss and some grazing and farming practices. In February, 1999, the mountain plover was proposed for listing as a threatened species under the Endangered Species Act. The USFWS determined in August 2003, that the plover would not be listed. USFS data indicate that there is no suitable habitat for mountain plover and no known occurrence within the Project Area. The species is a summer TBNG resident with several known nesting locations to the south and east of the Project Area (USFS 2003; Keinath et al., 2001). USFS personnel have conducted mountain plover surveys conforming to USFWS protocols on the TBNG since 1992.

The long-billed curlew is a sickle-billed shorebird whose large bill distinguishes it from other shorebirds. In summer, long-billed curlews use expansive, open, level to gently sloping or rolling grasslands with short vegetation such as shortgrass prairie or recently grazed mixed-grass prairie. Proximity to water may be an important factor in habitat selection. Long-billed curlew commonly nest in wet and dry prairie and in pastures on the ground in a shallow scrape. The long-billed curlew is fairly opportunistic, feeding on various insects (grasshoppers, beetles, caterpillars, etc.) and some berries. The long-billed curlew is known to occur in Campbell and Converse Counties (WYNDD 2003).

Loggerhead shrikes are common summer Wyoming residents often found in short- and mixed-grass prairie and shrubland environments. The species typically subsists on insects, particularly grasshoppers and crickets, as well as mice and small birds. It is known to breed throughout the state (Wyoming GAP Analysis, 2001; Udvardy, 1993, p. 549; BLM, 2003, p. 3-187).

Brewer's sparrows are common summer residents principally found in sage shrubland environments. They are known to inhabit Campbell County. The species subsists principally on seeds and insects (Udvardy, 1993, p. 609).

Grasshopper sparrows are common summer residents of mixed- and short-grass communities and sage-associated grasslands. They are known to exist in Campbell County. Diet consists mainly of seeds and insects (Wyoming GAP Analysis, 2001; Udvardy, 1993, p. 552).

Sage sparrow habitat includes sagebrush shrublands, chaparral, and dry foothills. The bird is a common summer resident, observed more frequently north of the Project Area (Wyoming GAP Analysis, 2001; Udvardy, 1993, p. 610).

McCown's longspur is a common summer resident of short-grass prairie communities, overgrazed pasturelands or newly-seeded fields, and mountain meadows. The bird is widespread in southern Campbell County, including the TBNG (Wyoming GAP Analysis, 2001; Udvardy, 1993, p. 559).

Chestnut-collared longspurs are uncommon summer residents known from short-grass and mixed-grass prairies. The bird prefers a thicker and taller growth than that characteristic of McCown's longspur habitat. The species is common in large flocks in southeastern Wyoming and is the most common of the plains longspurs (Wyoming GAP Analysis, 2001; Udvardy, 1993, p. 560).

Mammals. As of February 4, 2002, the black-tailed prairie dog is designated as a candidate species for listing under the Endangered Species Act. Listing has been precluded to date by higher priority actions. The species is a common resident of eastern Wyoming, most abundant in short-grass prairies. It is diurnally active and does not hibernate. The black-tailed prairie dog is a highly social animal living in colonies of up to 100 acres or larger. The species is important prey for other mammals and raptors (Wyoming GAP Analysis, 2001; Whitaker, 1992, p. 408; BLM, 2003, p. 3-179). There is one prairie dog colony of approximately 120 acres located within ¼ mile of the Project Area just to the east of Thunderhead 3.

The swift fox occurs over much of Wyoming where it is considered a common resident. It is a mostly nocturnal, solitary fox, excavating its own den or enlarging badger or marmot dens. The species exhibits a preference for flat to gently rolling terrain in short- and mixed-grassland environments. Principal prey includes rabbits, various rodents, and birds. In January 2002, the USFWS did not support listing this species as threatened (Wyoming GAP Analysis, 2001; Whitaker, 1992, p. 547; BLM, 2003, p. 3-189). USFS and WGF surveys (USFS, 2003) have located swift fox dens mostly north and west of the Project Area. No dens have been identified within the Project Area.

Bats of concern to one or more agencies include the fringe-tailed myotis and Townsend's big-eared bat. Habitat for these bat species encompasses vegetative communities that are present within the Project Area, although preferred habitats are forests, which are not present. Both species are extremely susceptible to disturbance during hibernation. Townsend's big-eared bat is a widely distributed, but rare species that forms nursing colonies. The species subsists almost exclusively on moths (Wyoming GAP Analysis, 2001; Whitaker, 1992, p. 327).

Amphibians. Northern leopard frogs are widespread, common inhabitants of various riparian and wetland communities. Cattail marshes and beaver ponds are particularly important habitats. Diet consists of insects, invertebrates, and small vertebrates (Wyoming GAP Analysis, 2001;

BLM, 2003, p. 3-181; WGF, 1999, p. 156). Wetland habitat sufficient to support amphibians is present within the Project Area. However, this habitat is limited primarily to Little Thunder Reservoir adjacent to the Project Area.

Fish. Finescale dace are widely distributed in glaciated regions of southern Canada and the northern United States, although no occurrences are known from Campbell County. Habitat includes bog ponds, streams, and lakes. The fish feeds mainly on insects, crustaceans, and plankton. The ephemeral waterways located in the Project Area are not likely to support this species. This species has not been documented to occur in Campbell County, Wyoming or in the Cheyenne River drainage. Aquatic species surveys in nearby Little Thunder Reservoir did not identify finescale dace or other special status species (USFS, 2003).

Plains minnow are medium-sized fish (to five inches in length), similar in appearance to silvery minnows that prefer the habitat of slower water and side pools of silty streams. The species becomes less common in clear streams and is replaced by silvery minnow in large rivers. It is commonly associated with flathead chub and river carpsucker and has been found with silvery minnow in Wyoming. The plains minnow is moderately widespread in streams in central North America. The species occurs in virtually all the rivers of the Powder River Basin. Populations are declining in the southern half of range and apparently stable in the northern portions of range (USFS, 2004). USFS biologists conducted surveys on the Grassland for fish and other aquatic species in May of 2003. Two specimen of this species were collected in Little Thunder Creek approimately 20 miles downstream from the Project Area, and one was found in the Cheyenne River at least 40 miles downstream (Guenther-Gloss, 2004).

Plants. Barr's milkvetch is a stemless, mat-forming perennial forb which forms low cushions less than 15 cm in height and up to 30 cm across. The species is found primarily on dry, sparsely vegetated rocky prairie breaks, hillsides, and ridges underlain by calcareous shales and silty sandstones. It is often found in mid-slope positions on north- and east-facing topography. The plant is widespread throughout the Great Plains (Fertig et al., 1999). Habitat for this species has not been identified within the Project Area.

3.7.1.3 USFS Management Indicator Species

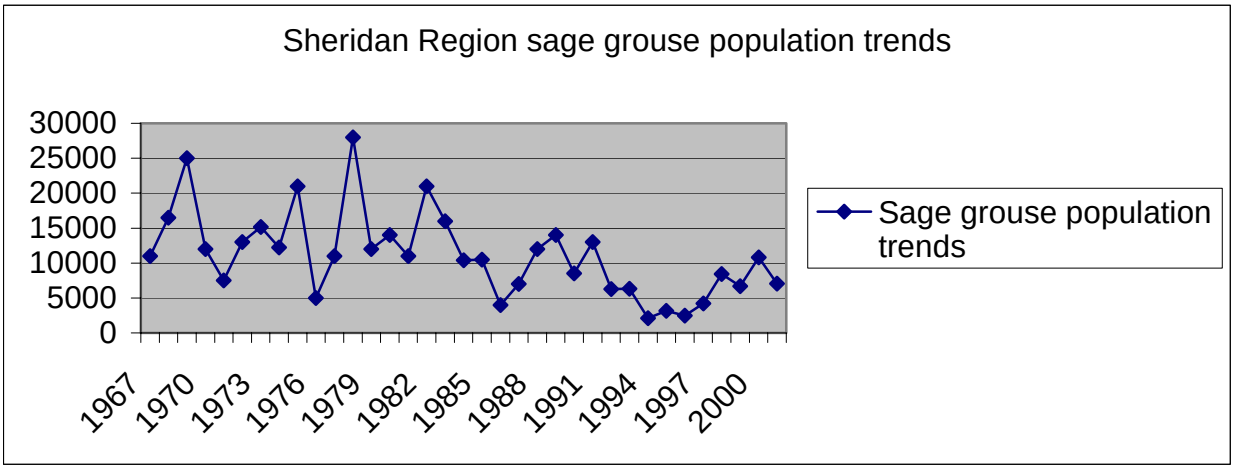
Greater Sage Grouse. Sage grouse are widespread, common residents of sagebrush shrubland communities and in sage-associated grasslands. Diet consists principally of the buds and leaves of sagebrush, and the species does not occur in the absence of substantial stands of sagebrush.

Sage grouse habitat in the Project Area is approximately 25 percent sagebrush shrubland and 75 percent short-grass prairie. The sagebrush shrubland is comprised of sparse, moderately dense and dense big sagebrush crown with a variety of understory forbs and grasses. The Project Area is grazed by livestock reducing amount and height of the understory vegetation. Ideal sage cover is between 10 percent and 50 percent, with average shrub height of 4 to 16 inches. The entire analysis area contains sage grouse habitat for all life phases. Although the Project Area supports suitable habitat requirements for the sage grouse, no sage grouse were observed during site visits to the Project Area. Within the Powder River Basin, the range of the species has not contracted, in contrast to the situation in other western states. Population estimates are based upon locations of male display grounds (leks) (Wyoming GAP Analysis, 2001; Udvardy, 1993, p. 606; BLM, 2003, p. 3-194). One sage grouse lek was located in Section 8 in the Project Area, but activity

has not been reported on this lek since 1992 (Greystone, 2002, page 13). Numerous leks have been identified outside of the Project boundary, mostly to the east and north. Lance conducted a survey for sage grouse leks in support of this EA; no new leks were discovered. Survey results are discussed in more detail in the Management Indicator Species Assessment supporting this EA (Greystone, 2003c) No active leks are known within the analysis area.

Sage grouse monitoring has occurred within the area since 1967. Sage grouse population trends (from Sheridan Region WGF annual reports) indicate a fluctuating population from 1967 to 1992. A general trend to increasing populations that began in 1997 was interrupted by drought conditions that, at the least, contributed to a retarded recovery rate. Population trends are shown in Figure 3.7-1

Figure 3.7-1 Sheridan Region Sage Grouse Population Trends



Source: Data from Wyoming Game and Fish Department

Two historic leks have been identified near the Project Area. There is one known lek in the Project Area, and there is one known lek within 2 miles of the Project Area. About 2056 acres (76%) of the Project Area are located within 2 miles of these leks. The leks, according to the TBNG LRMP standard 46, have not been active within the past 5 years and are considered inactive.

Approximately 1.25 miles of new overhead power line will be constructed on private lands in association with this project. No new power poles would be located within 3,000 feet of any identified lek. The construction of electrical support structures will include low profile design or anti-perch devices to discourage use by raptors. These mitigation measures would minimize sage grouse mortality related to the Proposed Action.

More detailed information regarding USFS management indicator species is included in the Management Indicator Species assessment.

Recommended mitigation measures relating to wildlife are also discussed in the PRB O&G FEIS (BLM, 2003, pp. 4-397 - 4-402).

3.7.2 Environmental Consequences

Significant issues raised during scoping relating to special status species include the following:

- Identification and description of T&E listed, candidate, and proposed species, including black-tailed prairie dog, sage grouse habitats, burrowing owl habitat, as well as rare and uncommon plants.
- Protection of T&E and sensitive species.

3.7.2.1 Alternative A - No Action Alternative

If none of the proposed activities were to occur on federal lands as a result of implementing the No Action Alternative, no negative impacts to special status species additional to existing impacts would occur. Conventional oil and gas development would continue within the Project Area, and CBNG development would continue on state and private lands near the Project Area. Surface coal mining is likely to continue adjacent to and within the Project Area for the foreseeable future.

Alternative A would not increase disturbances on USFS lands around the known sage grouse leks and ferruginous hawk nest sites. However, CBNG development has occurred and is likely to occur on adjacent private and state lands with some adverse effects to sage grouse and ferruginous hawks in the analysis area. Many of these activities do not include timing limitations and thus may have already resulted in adverse impacts to both species.

3.7.2.2 Alternative B - Proposed Action

USFW Listed Species. No adverse effects to black-footed ferrets are anticipated to occur as the species does not appear to exist in the vicinity of the Project Area. Surveys for this species are not currently required by the USFWS (Kelly, 2004). Potentially suitable habitat in the Project Area is not included in any future reintroduction areas (USFS, 2003).

Bald eagles are not known to nest within the Project Area, but nests have been observed in the general region of the Proposed Action. Proximal human activity or noise during breeding season could result in increased reproductive failure. Approximately 1.25 miles of new overhead power line will be constructed on private lands in association with this project. These power lines will be constructed in accordance with the Avian Power Line Interaction Committee's recommendations (APLIC 1996) designed to minimize raptor electrocutions. However there is still a possibility that these power lines could cause the electrocution of bald eagles. Construction of power poles could also provide additional hunting perches resulting in increased feeding efficiency. Increased vehicle traffic has the prospect of increasing collisions with carrion-feeding eagles. This project may effect, is likely to adversely affect bald eagles.

Agency-Designated Sensitive Species. The probability of negative impacts to bald eagles would also apply to other raptors and to ferruginous hawks in particular. No increase in direct injury or mortality is likely from vehicle collisions on roads in the Project Area since speeds on the roads would be limited to generally 25 mph or less. Wells and new above ground facilities will be located at least ¼ mile line-of-sight away from the known nests to minimize disturbance to ferruginous hawks. Alternative B includes two well locations within ¼ line-of-sight from

historic locations of two ferruginous hawk nests in Section 11. These nests could not be relocated during intensive ground surveys. One of the nests was reportedly destroyed by fire. If the nests have been moved to different locations, the project may cause some disturbance to the territory. However, the likelihood of direct impacts to nest locations is low.

Burrowing owl habitat, as indicated by the presence of prairie dog towns, is not present within ¼-mile of the Project Area. Merlin nests have not been identified in the vicinity of the Proposed Action. No impacts are expected to the northern harrier because of lack of known nest sites and appropriate habitat.

Bird species dependent upon prairie grassland or sage shrubland environments include mountain plover, loggerhead shrike, Baird's sparrow, Brewer's sparrow, grasshopper sparrow, sage sparrow, McCown's longspur, chestnut-collared longspur, long-billed curlew, and purple martin. All of these birds could undergo displacement during construction, but abundant replacement habitat exists within and surrounding the Project Area. Long-term disturbance of approximately of less than one percent of habitat in the Project Area required by these species suggests that long-term disruption of these populations is unlikely. Project development may adversely impact individuals of the grasshopper sparrow, McCown's longspur, chestnut-collared longspur, and Brewer's sparrow; however, direct effects may impact individuals but are not likely to cause a trend to federal listing or loss of viability (Greystone, 2004).

Mountain plover are not known to exist in the vicinity of the Project Area. Mountain plover habitat is not present within the Project Area. Approximately 1 percent of the Project Area would undergo long-term disruption due to construction of the Proposed Action. The lack of suitable habitat as well as the scattered nature and magnitude of disturbance would be unlikely to cause long-term displacement of plover populations.

Timing limitations for the ferruginous hawk and sage grouse should limit disturbances to nesting curlews. Also, the additional water in drainages generated by this project in the analysis area may improve habitat for the curlew.

Swift fox are not known to den within the Project Area, but may be infrequent visitors. The small amounts of short- and long-term disruption of vegetative cover within the vicinity would be unlikely to significantly adversely affect fox prey species. Similarly, neither the nesting habitats nor principal prey of bat species would be likely to suffer adverse effects due to construction of the Proposed Action. Long-term disruption of mammal species of concern is considered unlikely.

Disturbance to black-tailed prairie dogs would not occur as a result of the Proposed Action. One colony of approximately 120 acres (USFS, 2003) is located within 0.5 mile of project activities. No project activities will take place in the prairie dog town. Sylvatic plague is a major contributor to prairie dog mortality. Increased transmission of plague via human vectors during construction and production is considered unlikely (BLM, 2003, p. 4-256). Significant negative impacts to black-tailed prairie dogs are considered unlikely.

Northern leopard frogs could be directly affected by an increase in water flowing through the riparian communities in which the species, if present within or downstream of the Project Area, would occur. Since the likely result of increased discharge would be expansion of wetland and

riparian environments, any potential impacts are anticipated to be beneficial. No adverse effects to water quality are expected, as discussed in Section 3.4 Water Resources.

Streams within the Project Area do not support fish populations or spawning. The occurrence of finescale dace and plains minnow within the Project Area is considered unlikely. Little Thunder Creek does not have a large enough flow to provide suitable habitat for the plains minnow or the finescale dace. The additional flows resulting from CBNG development are not likely to reach downstream segments where either species is present. Most of the additional flows are expected to be lost to infiltration and evaporation.

Barr's Milkvetch has not been identified within the Project Area. Habitat for this species is not present within the Project Area. No effects to this species are expected.

USFS Management Indicator Species. This project is located within the Upper Cheyenne River sub-watershed. Possible adverse effects to sage grouse include increased legal and illegal hunting, vehicle collision, power line collision, collision with fences, increased predation by raptors, loss or degradation of habitat, harassment and/or displacement due to increased noise and human disturbance, and habitat fragmentation. Increased levels of water availability may improve some habitats.

It is likely that sage grouse do use portions of the Project Area for nesting, brood rearing and wintering because of its proximity to known leks. The Project may disturb up to 54 acres of suitable habitat on NFS lands over the short term during the construction phase. Because wells and utility corridors were laid out to avoid sagebrush wherever feasible, the actual amount of sage habitat disturbed is expected to be much less. Once reclamation of construction disturbances is accomplished the long term habitat disturbance or loss is expected to be less than one percent of all habitat types.

Disturbance and noise associated with the project are likely to be highest during the construction phase (about one year). After that the noise levels and project associated disturbance is expected to drop significantly except near compressor stations. Timing limitations on construction activities will help to mitigate disturbance to nesting sage grouse. Limitations on noise from compressors will help mitigate adverse impacts to sage grouse year round. However, there will still be some adverse impacts from higher levels of background noise and disturbance through the life of the project (10 years).

The Project also includes 1.25 miles of overhead power lines located throughout the Project. Power poles often serve as perches for raptors and could results in increased levels of predation.

The project includes 10.5 miles of new roads on NFS lands. The vast majority of these new roads (9.1 miles) will be native surface 2-track roads. The remaining will be improved surface gravel roads. Speeds on all of these roads are generally limited to 25 to 35 mph. Thus the risk of increased mortality to sage grouse from vehicle collisions is minimal. The increase in public access provided by these roads may increase mortality from legal and illegal hunting.

The project activities may impact habitat and sage grouse using the Project Area. Impacts may adversely affect population trends in the project area because the project is located in an area previously known to sustain breeding populations of sage grouse. Utility corridors and new

roads were laid out to avoid sagebrush stands to the extent feasible. Timing limitations will help prevent disturbance of breeding and nesting grouse. Alternative B includes those two wells and the access road and may render the lek unsuitable for breeding activities. This project has been mitigated to the full extent possible under the Proponent's existing leases.

Indirect Impacts. Discharge of produced water, particularly within Little Thunder Creek, could both positively and negatively affect different species as associated wetland and riparian environments are displaced, altered, or expanded. Since riparian environments will, in general, expand, it is likely that no long-term negative impacts to these populations would occur.

Construction of power poles would be accomplished with the intent of discouraging raptor use. New power poles would not provide perches for hunting raptors or negative impacts for prey species which includes other special status species.

Mitigation

Lance would comply with standard lease stipulations, wildlife NSO, CSU, and timing stipulations contained within the TBNG LRMP and summarized in Table 2.3-10.

3.7.2.3 Alternative C – Modified Development Alternative

Implementation of Alternative C would result in similar but reduced direct and indirect impacts in comparison to Alternative B. Alternative C was designed inpart to avoid direct impacts to the known sage grouse lek by dropping two wells and an access road originally proposed within ¼ mile of the lek. However, since there is not evidence of use at this lek site since 1992 the benefits to sage grouse from Alternative C are not certain.

Two additional wells in Section 11 were dropped to avoid the most likely locations of the two historic ferruginous hawk nests. The exact location of the nests could not be verified. This alternative may help to avoid additional disturbance to the territory. However other activities nearby may also be affecting the territory as discussed in the next section under cumulative effects.

Four wells, two roads, and one tire tank included as part of the Proposed Action would not be constructed as part of this alternative. Because the lack of recent use of the historic locations of both grouse and ferruginous hawks, the actual difference between the alternatives is uncertain. The alternative has been mitigated to the fullest extent possible under the existing leases.

3.7.3 Cumulative impacts

3.7.3.1 Alternative B – Proposed Action

A thorough discussion of the potential cumulative effects of CBNG development on wildlife in conjunction with other past, present and reasonably foreseeable activities in the PRB is included in the PRB O&G FEIS, pp. 4-271 through 4-273. Those activities include conventional oil and gas exploration and development, agriculture, urban and rural housing development, coal mining, livestock grazing, construction of roads and railroads, and gravel mining.

Although the project is not likely to adversely affect federally listed or USFS Sensitive species on a regional basis, the surface disturbance within the Project area would cumulatively add to the loss and fragmentation of wildlife habitats. Surface disturbance within the Project Area would also cumulatively add to the potential for the introduction and spread of noxious and invasive weeds. In general, the severity of the cumulative effects of their introduction would depend on factors such as the sensitivity of the species impacted, seasonal intensity of use, type of project activity, and physical parameters (e.g., topography, forage, and cover availability). The implementation of the project, and the resulting long-term disturbance of less than 20 acres, is not likely to have an adverse effect on sensitive wildlife and plant populations. However, in the context of cumulative impacts, the less than 20 acres proposed for long-term disturbance incrementally adds to wildlife and plant habitat losses and overall habitat fragmentation within the Powder River Basin.

CBNG development on adjacent state and private lands, dispersed recreation (usually hunting), livestock grazing, coal mining, conventional oil and gas development, railroads, and wildfire have the potential to further disturb, harass, or displace individuals. All of these activities are now ongoing but are not expected to increase as a result of this project.

Ongoing energy development or increased stock grazing could lead to declining numbers or sexual diversity in pronghorn and mule deer populations. As indicated in Section 3.1, Geology and Minerals, conventional oil and gas development within the Project Area appears to be in a mature phase and extensive additional development is not anticipated. Continued expansion of existing coal mines is expected for the foreseeable future. Other impacts to populations would result from natural forces.

Cumulative effects of ongoing activities may have already resulted in loss/displacement of some individuals. The additional 1.25 miles of new power lines to be built for this project but located on private lands would increase the likelihood of raptor electrocution associated with these structures. Two ferruginous hawk nests in Section 11 were destroyed by fire and the habitat around the nest sites was altered from sage brush to grasses. Another of the nest sites in Section 11 has likely been adversely affected by increased railroad traffic and highway noise from the Hilight Road and State Highway 450.

Increased road mileage within the Project Area could result in increased human interaction with various bird species, although the amount of additional long-term mileage would depend upon the degree of USFS-required reclamation of existing roads. The PRB O&G FEIS forecasts a 25 percent increase in traffic resulting from CBNG development (BLM, 2003, p. 4-216), most of which would occur during the construction phase. Collisions with special status raptors and other bird species would tend to be less, although owls are particularly at risk (BLM, 2003, p. 4-216). Although Lance would monitor and remove carrion along project roads to minimize the attraction of all scavenging raptors, not all roads would be monitored.

With respect to Sensitive bird species, the project may adversely impact individuals, but not likely to result in a loss of viability, nor cause a trend toward federal listing. The proposed project may have a beneficial effect on the grasshopper sparrow given the slight increase in lower vegetation and bare ground that would result from this Project. Nest predation of the McCown's longspur is exacerbated by their presence in heavily grazed pastures. Livestock grazing does take place in the Project Area; however, utilization levels are not normally heavy.

Restriction of fire may also reduce available shortgrass prairie by allowing growth of sagebrush. The impacts to the chestnut-collared longspur by livestock grazing have yet to be definitely determined. No intensive agricultural conversions are expected although nearby coal mining may reduce habitat for these two latter species similarly to agricultural development. Direct cause of widespread decline on Brewer's sparrow breeding grounds is uncertain, but possibly linked to widespread degradation of sagebrush habitats. Roads, powerlines, and coal mining are all occurring in the analysis area and these activities may be contributing to cumulative adverse effects on habitat.

West Nile virus (WNV) spread into Wyoming during 2002 and 2003. Researchers have seen high rates of mortality (~25%) in sage grouse populations due to WNV in the Powder River Basin of Wyoming and Montana (Walker et al., 2004). The disease can be expected to add to avian mortality until local bird populations develop immunity.

Ongoing activities and development occurring in the analysis area have already affected sage grouse habitats and populations and have the potential to further disturb, harass, or displace sage grouse, a Sensitive and MIS. Because hunting is regulated by the state to maintain sage grouse populations, it likely does not contribute to adverse impacts. Hunting success is used as a measure of population size and trend. Cumulative effects of ongoing activities may have already resulted in displacement of some sage grouse since timing limitations and other mitigation measures may not apply to these activities.

Aquatic species, including special status species, or those associated with wetlands and riparian communities may experience cumulative impacts from CBNG development. In addition to the potential impacts of grazing, toxic spills, and impoundments within the Little Thunder Creek watershed, the plains minnow and finescale dace may be impacted by changes in natural hydrologic regimes due to impoundments and dewatering. Increased stream flows from CBNG development will temporarily increase the amount of water in sections downstream where the species are known to exist. These improvements in stream flows may temporarily offset dewatering in other stream segments, but are not expected to have any long-term effects on the species. The quantity of discharged water is not expected to result in perennial flows in Little Thunder Creek. All of the discharged water is expected to be lost to conveyance within 10 miles downstream from the discharge points. The quality of the discharged water is within the range of natural flow streams and rivers in the area known to be occupied by the species, and so should not present a constraint to individuals or populations that may occupy waterbodies receiving discharged water. The proposed project is unlikely to adversely affect populations or habitats of these species.

Effects to wetlands are expected to be minor and temporary, since the volumes of produced water discharge would decline rapidly, and infiltration and evapotransporation would rapidly remove water from channels below the discharge points. Wetlands associated with Little Thunder Reservoir may expand somewhat but only to the capacity of the reservoir. Populations dependent upon these communities could benefit temporarily.

3.7.3.2 Alternative C – Modified Development Alternative

Cumulative impacts under Alternative C would be very similar to those discussed for Alternative B. As indicated earlier in Section 3.5, a very small difference in total area of disturbance would

result from implementation of Alternative C. The main difference in Alternative C would be the deletion of two wells to avoid the disturbance of two inactive sage grouse leks and one inactive ferruginous hawk nest.

3.8 LAND USE

3.8.1 Affected Environment

3.8.1.1 Surface Ownership and Management

The proposed wells would lie entirely within southeastern Campbell County in northeastern Wyoming, approximately 13 miles north of the Campbell County/Converse County line. Although the project wells would be located on USFS lands in the TBNG, the area is a mosaic of federal, state and private lands. County governments have jurisdiction over the development of non-public lands. Much of Campbell County is undeveloped and rural. Gillette, population 20,319, and Wright, population of 1,393, are the two incorporated communities located in the county (USCB, 2001). Wright is approximately three miles northwest of the Project Area. Livestock grazing, coal extraction, gas and oil production, and recreation are the primary land use activities.

Federal lands are managed in accordance with applicable laws and land use plans. The TBNG land use plan directs the use of its public lands for a variety of activities. Plans are updated periodically to respond to changing conditions and resource values. The most recent TBNG resource management plan is the TBNG LRMP. As designated by the TBNG LRMP, the Project Area is entirely contained within the 100,780 acres comprising the Hilight Bill Geographic Area. Dominant Management Area Prescription allocations for this area are Rangeland with Broad Resource Emphasis (51,440 acres) and Mineral Production and Development (47,993 acres). Other surface owners near the project Area include the State of Wyoming, which owns Section 16, and the Thunder Basin Coal Company, which owns Section 17, both of which are surrounded by the three PODs. The Thunder Basin Coal Company also owns sections to the east and south of the Project Area. A map showing surface ownership near the proposed wells is shown in Figure 2.3.2.

3.8.1.2 Oil and Gas Development and Coal Mining

Both conventional and CBNG oil and gas development is common throughout the area. Well access roads, pipelines and other production equipment have characterized the area since oil and gas production began in the late 1940s. With the beginning of CBNG development in the late 1990s, the vicinity of the Project Area now contains CBNG-associated facilities, such a reservoirs, water discharge points, and compressors. Within the Project Area, a pipeline constructed prior to 1971 runs north/south through the eastern half of Section 8, continuing through Section 17, the western half of Section 20, and the SE corner of Section 19. A discussion of oil and gas development in the area is contained in Section 3.1.

Coal mining is also common in the vicinity of the proposed project. Fifteen coal mines parallel Highway 59 to the northeast, east, and southeast of the Project Area along a shallow Wyodak Coal trend. The Black Thunder Mine and Jacobs Ranch Mine are located approximately three and six miles east, respectively, of the Project Area. The Black Thunder Mine is the largest

surface coal mining operation in North America. In 2002, Arch Coal, owner of the mine, won the "Prairie Partner Award" for the USFS in recognition of the company's environmental stewardship (Arch Coal, 2003). A lease acquired in 2002 is expected to extend the life of the Jacobs Ranch Mine up to 18 additional years at current production levels (Kennecott Energy, 2002). A discussion of coal mining in the area is contained in Section 3.1.

3.8.1.3 Livestock Grazing

Scattered ranches are located on privately owned lands adjacent to the PODs. Due to the arid climate and limited soil and water resources, livestock grazing represents the primary form of agriculture. Private pastures are intermingled with federal grazing leases throughout the area. The allotments are utilized by cattle and sheep and can be used year-round. Structural range improvements in and near the Project Area consist of allotment boundary fences and cross fences. Numerous stock dams/pits, federal stock water wells, and one spring provide water to livestock. Three stock water wells are located within the proposed PODs, and the remaining three wells and spring are within three miles of the proposed wells. Grazing permittees are members of the Thunder Basin Grazing Association. Ranchers on the TBNG have recently allied themselves with the oil and gas industry to maintain the status quo with respect to grazing and CBNG development activities in the TBNG (Bleizeffer, 2003), both of which are able to amicably co-exist.

Three grazing allotments (256, 266, and 275) would overlap portions of the Project Area. Section 8 is part of a grazing allotment in Thunderhead 1 that supports cattle through the summer to mid-winter. A water well used for livestock watering is located in the SWSW Section 8. Sections 10, 11, and 14 in Thunderhead 2 are part of a grazing allotment used for cattle grazing during three months in the fall and winter. A small stock dam is near the center of the eastern boundary of Section 10. A water well used for livestock watering is located in SENW of Section 11. Section 18 in Thunderhead 3 is part of a grazing allotment that supports cattle through the summer to mid-winter.

3.8.1.4 Access

Surface transportation in Campbell County is provided by a network of state, county, local, and primitive roads. Access to project wells would be primarily by one state highway and county roads that connect to a network of USFS roads. The Project Area is roughly contained within the area bounded by State Highway 450, known as the Clareton Highway, to the north; County Road 52, known as the Hilight Road to the east; County Road 30, known as the Edwards/Reno Road, to the south; and State Highway 59 to the west. State Highway 450 is an east-west route that forms the northern boundary of Thunderhead 1 and 2. Hilight Road is a north-south route that passes through Thunderhead 2 in Section 11. A Burlington Northern/Santa Fe Railroad railway line parallels the Hilight Road immediately east of the road. The railroad provides transportation to and from coal mines. Thunderhead 3 is approximately 2.5 miles north of the Edwards/Reno Road. State Highway 59 is a north-south route located approximately 1.5 miles west of Thunderhead 3. Primary access roads are shown in Figure 3.8-1.

Figure 3.8-1 Access Roads

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Traffic in and around the Project Area is primarily associated with coal mining and oil and gas activities. The USFS roads provide access for public use and surface lessees and are used intermittently by hunters and other recreational users. Approximately 1.35 miles of existing USFS roads would be utilized to develop the proposed wells within the Project Area. Approximately 0.41 mile of 2-track roads would be upgraded to C&D status, and approximately 8.9 miles of existing 2-track roads would be decommissioned. Details of the existing and proposed roads in the Project Area are contained in the Transportation Plan (Greystone, 2002).

3.8.1.5 Recreation

The TBNG offers a wide variety of recreational opportunities, with an emphasis on dispersed recreation. Recreational use throughout the TBNG generally consists of hunting, fishing, camping, and hiking. There are no developed recreation sites or developed trails in or near the Project Area (USFS, 2003b). The area in and around Thunderhead 3, west of the Little Thunder Reservoir, may experience some recreational use. The northeastern quarter of Section 8 may be used for target practice, as evidenced by spent shells. Fall hunting is limited by the interspersed fee and state acreages. Little Thunder Reservoir is stocked by the state, and fishing is a common activity.

3.8.1.6 Fire Management

The USFS and other public land management agencies recognize the problems associated with fuel build-up and the increased potential for wildfires due to fire exclusion. The National Fire Plan was created subsequent to the summer of 2000 when more than seven million acres of land were lost to wildfires. The Medicine Bow/Routt National Forests, of which the TBNG is an administrative unit, implemented the fire plan by thinning and burning to reduce hazardous fuel loads, especially in several urban interface areas. More appropriate to the TBNG, the USFS is working with Wyoming counties to prevent human-caused wildfires. TBNG can institute fire restrictions that do not allow open camp fires, smoking cigarettes outside of enclosed vehicles, or fireworks (USFS, 2003c) when conditions warrant.

Evidence of fire exists in the northern half of Section 10. The burned area has been disked and re-seeded in wheat grasses. The northern half of Section 11 has also been burned in the not too distant past, disked, and re-seeded in crested wheat (Greystone, 2003a, p. 12).

3.8.2 Environmental Consequences

Concerns identified in the scoping process that relate to land use in the Project Area include:

- Identification of roadless areas, potential wilderness, potential ACECs, potential National Monument, potential Wild & Scenic Rivers, undeveloped areas, existing roads/trails.
- Effects of permanent and temporary roads and traffic, poaching, ORV traffic, and fragmentation, and pathways for noxious weed infestation.

3.8.2.1 Alternative A - No Action

The absence of approval and implementation of the Proposed Action would not preclude other types of development in the Project Area. Adjacent surface coal mining activity is likely to continue and affect much of the Project Area in the foreseeable future.

No land use changes would occur on federal land as a result of project development if the No Action alternative were chosen. The limited recreational use of the affected TBNG lands would continue. No part of a grazing allotment would be lost due to well development on TBNG lands. CBNG development and coal mining would continue on adjacent private and state lands. Effects of CBNG development on non-TBNG lands would be similar to the effects that would result from implementing the Proposed Action.

3.8.2.2 Alternative B - Proposed Action

Impacts to land use as a result of implementing the Proposed Action would be small. Implementation of the proposed project would be consistent with land use policies developed in the TBNG LRMP (USFS, 2001). Each new well and/or associated facility would be subject to review under applicable USFS and BLM policies and procedures intended to avoid and/or minimize site-specific impacts. Site-specific mitigation measures were identified during the July 2001 onsites.

Project development would result in short and long-term disturbances to the surface. Short-term disturbance would affect approximately 54 acres of TBNG lands and 23 acres of private land. After interim reclamation, the resulting long term disturbance would be reduced to approximately six acres of USFS lands and two acres of private land, or 0.3 percent of the Project Area. Roads comprise most of the short and long-term disturbance. Existing land uses would be able to continue without much effect.

Grazing use should not be greatly affected. Grazing would continue to take place on the existing allotments. AUMs in the vicinity of the Project Area can range from four to seven acres per AUM. Conservatively assuming that each AUM in the Project Area requires four acres, the 54 acres of short-term disturbance on federal land would result in a temporary loss of approximately 13.5 AUMs to all grazing leases and six AUMs would be lost on private land. After interim reclamation and vegetation is re-established, approximately 1.5 AUMs would be lost for the life of the project to long-term disturbance on the TBNG and 0.5 AUM would be lost on private land. Reclamation after each well is plugged and abandoned would return disturbed lands to pre-disturbance production for livestock grazing. Livestock would be protected by the construction of fences. Fences would not be installed unless necessary and required by the USFS. In accordance with USFS COAs, fences would be temporarily installed during drilling operations to protect livestock from entering reserve pits. Fences would also be constructed to separate livestock from electric panels and production equipment near the wellhead. Use of the TBNG grazing allotments would be enhanced by the use of CBNG produced water to water livestock and the installation of cattleguards with which livestock control would be maintained. The impacts to grazing on private lands would remain the same under Alternative B and C.

Recreational activities, including off-road vehicle use and hunting, are not expected to substantially change. Some recreational activities, such as hunting, may not occur near active

well locations during drilling or completion operations due to increased human activity and noise. The Project Area may be more attractive to wildlife after construction and drilling are completed because of increased water availability resulting from produced water discharge. The possible attraction of game animals to the Project Area could increase the likelihood of poaching; however, game animals may not have been attracted to the vicinity because of previous nearby CBNG development. The incremental influx of additional animals because of increased water availability associated with project development is unlikely because the incremental increase of surface water would be diminished over a short distance by conveyance loss (see Section 3.4.2.2, Water Resources).

Evaluation of the Hilight Bill area of the TBNG by USFS planners determined that the Project Area and vicinity contain no resource areas worthy of special environmental protective measures. Specially designated resource areas could include roadless areas, national monuments, wild and scenic rivers, historic trails, etc. (USFS, 2002, p.2-21).

Access within the Project Area would remain essentially the same because net lengths of roads available for use would be approximately the same after some TBNG roads are decommissioned. Approximately 1.6 additional miles of net new road would be constructed on the TBNG as a result of project development, and approximately one mile would be constructed on private land. Intermittent and temporary increased use of county roads during the daylight hours to gain access to the wells during drilling and completion would result in increased traffic. There could be an associated increase in accidents on state highways and county roads. Vehicle traffic speeds would be kept low to facilitate travel on the unimproved Project Area roads. During the two to six-day period required for drilling and completion operations, approximately seven of vehicles and 15 people would be at a particular well pad. After well completion, traffic to the pad would consist of infrequent trips to perform maintenance. After the wells are drilled, project-associated traffic would subside as installation of telemetry equipment render trips to the well pads unnecessary for routine operations. Traffic on TBNG roads would be restricted to ROWs, preventing unnecessary disturbance, possible erosion or rutting, or transport of seeds that could facilitate the establishment of noxious weeds or plants.

The well pads would be cleared to accommodate drilling and production equipment, reducing the possibility of fires resulting from sparks. Limited vehicle traffic would diminish the possibility of fires being caused from sparks originating from vehicles.

3.8.2.3 Alternative C - Modified Development Alternative

Impacts to land use under Alternative would be nearly identical to those described for the Proposed Action. Although slightly more TBNG would remain in its natural state, the character of the Project Area would be similar as if the Proposed Action were implemented. Short-term disturbance associated with Alternative C would be approximately 49 acres on TBNG lands and 24 acres on private land. Long-term disturbance would be approximately four acres on TBNG land and two acres on private land, comprising approximately 0.2 percent of the Project Area. The length of new roads associated with the development of Alternative C would be slightly less than the amount of road construction needed for Alternative B. Alternative C would require the construction of approximately 1.53 miles of net new road after road decommissioning is accomplished.

Surface disturbance would affect the productivity of grazing allotments in the vicinity of the Project Area. Using the same assumptions as were presented under the Proposed Action where one AUM would require approximately four acres, approximately 12.25 AUMs would be temporarily displaced for short-term use on TBNG land and six AUMs on private land. Approximately one AUM would be displaced for the life of the project on the TBNG and 0.5 AUM on private land.

Impacts to other aspects of land use would be essentially the same as those described for Alternative B. Impacts to recreational activities such as hunting would not essentially change. Evaluation of the consideration of possible designation of special status environmental areas would yield identical results.

3.8.3 Cumulative Effects

3.8.3.1 Alternative B - Proposed Action

Cumulative impacts associated with surface disturbance resulting from the Proposed Action would not be expected to interfere with ongoing coal extraction, CBNG development, or conventional petroleum development outside of the Project Area. Adjacent surface coal mining activity is likely to continue and affect much of the Project Area in the foreseeable future. Where coal leases conflict with CBNG leases, coal mining companies have occasionally acquired "competing" CBNG leases and developed the wells themselves prior to coal extraction.

Surface coal mining of lands would result in the destruction of the land surface and would render it unusable for activities such as oil and gas development, livestock grazing, or recreation. CBNG is nearly fully developed within the 2-mile radius of the Project Area. Cumulative effects associated with the additional development represented by the project is small.

Surface disturbance would have very minor impacts upon the productivity of grazing allotments in the vicinity of the Project Area. Grazing carrying capacity would be slightly reduced in the affected grazing attotments. Gradual erosion in the existing grazing carrying capacity would result from increased oil and gas development, road construction, and coal mining.

Increased traffic associated with area CBNG development would add to existing levels of wear on state highways and county roads, probably resulting in some additional level of maintenance. Road wear would be greatest during the construction phase and decline significantly thereafter. Accident levels have increased on some county and state roads in areas of CBNG development (BLM, 2003, p. 4-302). Increased traffic would potentially result in increased numbers of vehicle accidents.

Project development may result in game leaving the Project Area for undeveloped or post-development areas outside of the Project Area. Long-term cumulative effects of possible increased wildlife movement on hunting success, however, are expected to be minimal.

3.8.3.2 Alternative C - Modified Development Alternative

Cumulative impacts associated with surface disturbance resulting from the Proposed Action would be nearly identical to those described for the Proposed Action. Development of Alternative C would not be expected to interfere with ongoing coal extraction, CBNG development, or conventional petroleum development outside of the Project Area. Where coal leases conflict with CBNG leases, coal mining companies have occasionally acquired "competing" CBNG leases and developed the wells themselves prior to coal extraction.

Surface disturbance would have very minor impacts upon the productivity of grazing allotments in the vicinity of the Project Area. Long-term disturbances would affect approximately 0.001 percent of the surface in the TBNG. Grazing carrying capacity would be slightly reduced in the TBNG.

Increased traffic associated with area CBNG development would add to existing levels of wear on state highways and county roads, probably resulting in some additional level of maintenance. Road wear would be greatest during the construction phase and decline significantly thereafter. Accident levels have increased on some county and state roads in areas of CBNG development (BLM, 2003, p. 4-302). Increased traffic would potentially result in increased numbers of vehicle accidents.

Project development may result in game leaving the Project Area for undeveloped or post-development areas outside of the Project Area. Long-term cumulative effects of possible increased wildlife movement on hunting success, however, are expected to be minimal.

3.9 CULTURAL RESOURCES

3.9.1 Affected Environment

Cultural sites are generally defined as discrete locations of past human activity. These can include artifacts, structures, works of art, landscape modifications, and natural features or resources important to tradition or history. Sites can also include trails, roads or railroads, broad areas considered as "cultural landscapes," and traditional use areas. Significant sites are defined as those that are listed or eligible for listing on the National Register of Historic Places (NRHP) under the criteria for eligibility (36 CFR §60.4), and include Traditional Cultural Properties.

In compliance with various regulatory requirements subsequently discussed, a Class I Inventory file/records search was completed by the Wyoming State Office of Historic Preservation in June of 2001. This file search identified 63 previous investigations had occurred within sections comprising the Project Area. Twenty-six of the previous surveys predate the 1983 revision of state standards for cultural resource investigations and reporting. Although a number of the previous surveys in the Project Area post-dated the 1983 revision of standards, Class III Inventory block surveys were completed in areas inclusive of the Project Area. Three Class III Inventory cultural resource surveys were conducted for portions of the Project Area between April and June 2003:

- West half of Section 21, T43N/ R71W (Newberry, 2002a)

- East half of Section 10, west half of Section 11, and west half of east half of Section 14; T43N/ R71W (Newberry, 2002b)
- Section 8, south half of Section 18, and Section 20; T43N/R71W (Newberry, 2002c)

Together, these three block surveys covered the portions of the Project Area that would be affected by the Proposed Action and complete block survey coverage of the entire Project Area. The data from these Class III inventories and the compiled data from the Class I inventories consulted as part of the records search were incorporated into the current Project inventory. Past and the recent studies indicate that the Project Area contains evidence of prehistoric and historic cultural activity.

3.9.1.1 Prehistoric Resources

Archeologists use a chronological system developed by Frison (1991) to date prehistoric cultural resources of the Northern Great Plains, including the area of the Powder River Basin and TBNG. This chronology is based on artifact type, principally spear points, associated with sites dated using radiocarbon techniques. The chronology varies by several hundred years among different authorities due to the limitations of precision of radiocarbon dates, but a commonly accepted version (BLM, 2003, p. 3-207) is indicated in Table 3.9-1.

Table 3.9-1 Cultural Resource Chronology for the Northern Great Plains

Age (Years Before Present [BP])	Cultural History Chronology Northern Great Plains
	Late Prehistoric and Protohistoric (to ca. 200 Years BP)
1,000	
2,000	Late Plains Archaic
3,000	Middle Plains Archaic
4,000	
5,000	
	Early Plains Archaic
6,000	
7,000	
8,000	
	Paleoindian
9,000	
10,000	
11,000	

Human activity has been recorded in Wyoming for more than 11,000 years. The earliest known cultural evidence is a find of Clovis spear points in association with at least seven mammoths from the Colby site in the Big Horn Basin. This site was dated at ca. 9250 BC (Meyer, 2002, p.

4-1). Paleoindian sites represent the initial occupation of what was then a high steppe environment by a hunter-gatherer economy. Sites from this period are uncommon because of the passage of time and various climatic changes (Meyer, 2002, p. 4-1).

The Archaic period opened with a climate generally drier than the present and ended with climatic conditions similar to those presently occurring in the area. Few sites from the Early Plains Archaic have been recognized. Climate stabilization around 5,500 years BP appears to have coincided with an increase in the human population as indicated by an increase in the number of cultural sites found. Stone rings have been dated to the Middle Plains Archaic.

Late Plains Archaic sites are very numerous and seem to indicate another increase in the human population. The culture appears to have relied heavily on bison, which were obtained in sophisticated communal kills. The pace of technological change increased as indicated by a succession of three cultural complexes. The youngest of these complexes, Besant, is sometimes associated with finds of Woodland ceramics (Meyer, 2002, p. 4-2).

The Besant culture represents a transition from the Late Prehistoric to the Protohistoric period. The technology is typified by use of the bow and arrow and increasing use of ceramics. The number of sites exceeds those of the Late Plains Archaic period and these sites are characterized by a wider variety of cultural types than those from earlier populations. During the latter portions of this time, evidence of numerous incursions of other cultural groups into the region has been discovered. The Protohistoric period is considered to have intended ca. 1800 AD, or with evidence of contact between native peoples and Euro-Americans.

Prehistoric sites are highly variable but are typified by lithic scatter, camp sites, bison kill sites, lithic procurement areas, and surface stone features. Lithic procurement sites may be either primary (quarries or outcrops) or secondary (redeposited materials).

3.9.1.2 Historic Resources

A number of Native American tribes occupied the grasslands of the Northern Great Plains during historic times. Tribes known to have frequented these areas include the Affiliated Tribes (Mandan, Hidatsa, and Arikara), Cheyenne, Assiniboin, Blackfoot, Crow, Lakota, Pawnee, Chippewa, and Kiowa. Although tribal reservations are maintained in close proximity to some management units of the Northern Great Plains national grasslands, no tribe is closely associated with the TBNG.

The earliest influx of Euro-Americans into the PRB consisted of small numbers of fur traders, government explorers, military expeditions, and hunting parties. The most heavily traveled routes skirted the western and southern flanks of the basin. The fur trade declined in the late 1830s, but several major emigrant trails passed along the southern edge of the basin. In 1868, the federal government negotiated the Ft. Laramie treaty with native peoples, prohibiting Euro-American settlement or travel through the Powder River Basin or within the Black Hills.

Gold discoveries in the Black Hills in 1874 resulted in an influx of Euro-Americans, breaking the Ft. Laramie treaty and initiating the military subjugation of the native tribes. The Homestead Act of 1862 encouraged settlement. Settlers began cattle grazing on open range in the area of the

TBNG during the late 1800s. The harsh winter of 1886-1887 devastated open range cattle herds, changed cattle ranching techniques, and resulted in the initiation of sheep ranching in the area.

Expansion of railroads into northeastern Wyoming brought major changes. Railway expansion resulted in the development of towns along the tracks, such as Lusk, Newcastle, Douglas, and Gillette. Population boomed with the arrival of the railroads and resulted in subdivision of the initial Wyoming counties into smaller, more local units. Campbell County was created from the western portions of Weston and Crook counties in 1911.

Unlike much of Wyoming, dry land farming, principally wheat and hay, was common in Campbell County in the early part of the last century. Drought followed by a severe winter in 1919-1920, brought depression to Wyoming a decade prior to the Great Depression. Many small farmers and ranchers went out of business and the period was marked by a consolidation of land into larger ranches more capable of economic operations. The financial collapse of 1929, followed by five years of drought, continued this consolidation. A number of programs under the Roosevelt administration resulted in repurchase of land from bankrupted settlers and assisted the transition away from farming to a dominantly ranch economy. Population dropped while prosperity improved and many of the older homesteads were abandoned.

Mineral resource development accelerated in the second half of the twentieth century. Coal mining had begun at Cambria near Newcastle in 1889 and continued until 1928. Some marginally economic underground coal mining occurred in the 1920s, to be succeeded by the current era of large surface mines which began in the 1970s. Oil and gas development began in the late 1940s and development of conventional oil and gas resources peaked in the early 1970s (Meyer, 2002, pp. 5-1 - 5-10; BLM, 2003, pp. 3-211 - 3-213).

3.9.1.3 Survey Results

The three PODs' Project Area is contained within the greater Upper Cheyenne River watershed. Cultural survey coverage is greater in the general area than the average for the PRB because of extensive Class III Inventory block surveys conducted by surface coal mines in the vicinity. Much of the area has a low to medium site density. Overall cultural resource site densities are approximately 5.2 sites per square mile within the Upper Cheynne River watershed. Average site density for the Powder River Basin is 6.1 sites per square mile. Prehistoric sites considered eligible for listing in the National Register of Historic Places (NRHP) comprised 9.4 percent of total sites known from the watershed. Prehistoric site eligibility probability for the PRB is 13.0 percent (BLM, 2003, p. 3-220, p. 4-282). Historic site eligibility for the basin is 9.6 percent (BLM, 2003, p. 3-220). As of 2001, approximately 1,200 sites have been discovered on the entire TBNG, of which about 160 (13.3 percent) have been determined eligible for listing in the NRHP (USFS, 2001a, p. 3-438).

Within the Project Area, approximately 60 cultural resource sites and 116 isolated finds have been identified. Of these, 10 were previously known and evaluated for listing. None of these previously evaluated sites were deemed eligible for listing in the NRHP. The current Class III Inventory surveys discovered 50 new sites. Of these sites, none has been recommended as eligible for listing (Newberry, 2001a, 2001b, and 2001c). Of the total of 60 sites contained within the Project boundary, 58 are exclusively prehistoric in age and one contains both prehistoric and historic artifacts.

Project Area prehistoric sites consist primarily of lithic scatter of variable density. The age of observed artifacts range from Paleoindian to Late Prehistoric (Newberry, 2001a, 2001b, and 2001c).

Historic sites considered eligible for listing in the NRHP comprise 7.9 percent of total sites within the Upper Cheynne River watershed. Average historic site eligibility probability for the PRB is 9.6 percent (BLM, 2003, p. 3-220, p. 4-282). Of 60 cultural sites located within the Project Area during the current or previous surveys, only one is solely historic, a homestead, and an additional single site contains both historic and prehistoric artifacts. Historic sites in the vicinity of the Project Area are dominantly homestead or ranch remains (Meyer, 2002, pp. 7-1 - 7-13).

3.9.2 Environmental Consequences

Impacts to cultural resources were analyzed with respect to the following criteria:

- The loss of NRHP values from sites that would otherwise be eligible for listing.
- Increase in unauthorized collection or destruction of artifacts through vandalism.
- Disturbance of sites of cultural and spiritual significance to Native Americans.

3.9.2.1 Alternative A - No Action Alternative

Possible adverse impacts to cultural resources on federally administered lands in the proposed Project Area from the proposed CBNG field development project would not occur if the proposed Project was not approved. Conversely, there would be not further documentation of cultural resource sites and materials that might be discovered as the Project was implemented and mitigation measures were applied. Oil and gas development would continue on state and private lands adjacent to and in the vicinity of the Project Area. Cultural resource sites and materials on state and private would be protected by state regulations, where applicable.

The absence of approval and implementation of the Proposed Action would not preclude other types of development in the Project Area. Adjacent surface coal mining activity is likely to continue and affect much of the Project Area in the foreseeable future. Surface coal mining of lands would result in the destruction of all sites and uncurated artifacts present in the Project Area within the extent of surface mining activity.

3.9.2.2 Alternative B - Proposed Action

Potential destructive impacts to eligible cultural resources would not occur from implementation of the Proposed Action due to the absence of eligible resources in the Project Area. Block surveys of the entire Project Area combined with existing file data for surveys previously conducted in the Project area did not identify any sites or finds evaluated as eligible; therefore, it is unlikely that construction in surveyed Project Area would disturb resources of significance (Newberry, 2001a, 2001b, and 2001c). Potential impacts from surface disturbance/soil mixing and possible dispersement of affected, non-eligible sites or isolated finds of artifacts, fragments, and/or debitage could result from primarily road and pipeline construction.

No historic trails or eligible historic sites have been identified within the Project Area; therefore, no impacts to historic resources of significance are anticipated (Newberry, 2001a, 2001b, and 2001c).

No impacts to Native American cultural values are expected. No concerns regarding the Project have been received from contacted Native American tribes. No sites of cultural or spiritual significance to Native Americans are known to occur within the Project Area.

The discovery and evaluation of 50 previously unknown cultural sites within the Project Area has had the beneficial effect of adding information to data base of cultural resources information for the area included in the Project Area.

The development of additional road mileage would increase access to areas previously more isolated, possibly resulting in an increased potential of indirect impacts of illegal collecting of artifacts or increased vandalism. These impacts would be reduced through enforcement of the Archeological Resource Protection Act of 1979 by the USFS.

Mitigation

By applying the USFS standard COAs listed in Appendix D and operator-committed mitigation measures listed in Chapter 2, impacts to cultural resources would be minimized.

- Avoidance of cultural sites is the preferred mitigation (BLM, 2003, p. 4-278).
- Surface disturbance would be minimized through the development of common utility corridors often co-located with road ROWs.
- In the unlikely event that surface disturbing activities uncover previously unknown cultural artifacts, Lance would cease operations at the site of the discovery and notify the USFS or BLM, as appropriate. An evaluation by the appropriate agency or by an agency-approved archeologist to determine the recommended course of action would be conducted.
- Lance would instruct all of its employees and contractors of the importance of protection of cultural resources, would discourage the illegal collection or destruction of antiquities, and would inform such employees and contractors that violations of Lance's policies in this matter could result in dismissal. Lance would instruct its employees and contractors in procedures to be followed in the event of discovery of human remains as required by applicable regulations.

3.9.2.3 Alternative C - Modified Development Alternative

Implementation of this alternative would result in impacts similar to those described for Alternative B with the exception that the reduced mileages of road and pipeline construction associated with the reduction in well numbers from 32 to 28 would likely reduce impacts to known non-eligible sites and isolated finds and yet undiscovered cultural resources not identified during the previous inventory surveys. The application of mitigations noted above for Alternative B would again minimize impacts to cultural resources from implementation of this alternative.

3.9.3 Cumulative Impacts

The absence of cultural resources of significance or eligible for listing on the NRHP based on inclusive block surveys of the Project Area indicates the implementation of either Alternative B or Alternative C would have minimal adverse impact to cultural resources in combination with other actions in the region. The inventory surveys completed in support of this proposed Project has contributed new information on the cultural resources of the Project Area and the PRB.

Other types of development in the Project Area, such as adjacent surface coal mining activity and livestock grazing, are likely to continue and affect much of the Project Area in the foreseeable future. Surface coal mining of lands would result in the destruction of all sites and uncurated artifacts present in the Project Area within the extent of surface mining activity. Livestock grazing can also adversely affect and may prossibly destroy cultural resources. Increased access may promote the incidental collecting of artifacts.

3.10 SOCIOECONOMIC RESOURCES

The discussion in this section refers to the socioeconomic climate in Campbell County. Wright and Gillette are the cities in closest proximity to the Project Area, approximately six and 42 miles to the north-northwest, respectively. Wright was founded in 1976 as a company town by Atlantic Richfield and developed through an agreement between a community development group and the corporation's Black Thunder Mine. Gillette is the county seat and is the largest incorporated city in Campbell County. Campbell County is primarily rural, and its economy is tied to traditional natural resource based industries. Agriculture provided the basis for community development during the nineteenth century; however, its importance has recently diminished. The mineral extraction industries of coal, oil, and gas, are primarily responsible for the county's current economic well being.

3.10.1 Affected Environment

3.10.1.1 Demographics

The population of Campbell County is primarily white and slightly over 50 percent is male. The county contains very small populations of Native Americans, Hispanics, and other minorities (FedStats, 2003). Approximately 63 percent of the population of Campbell County lived in Gillette and Wright in the year 2000.

Campbell County's population rose steeply in the late 1970s and peaked in 1984 at 34,864 residents. It dropped steeply in the late 1980s, only to increase in the 1990s at a growth rate of 14.7 percent for the decade. In 2000, the city of Gillette contained 58 percent, and Wright contained approximately four percent of the population of Campbell County. Approximately 80 percent of the county's 1990 to 2000 population growth was attributed to birth rates while approximately 20 percent was attributed to a migration influx, indicating that the county's population is stable and growing from within. The State of Wyoming also displayed a growing population in the 1990s, with a lower growth rate of 8.9 percent. Slightly more than half of Wyoming's population growth occurred outside incorporated cities, a trend reflected in Campbell County (Taylor, 2002, p. 4). Population changes usually directly reflect the growth

and decline of economic activities (University of Wyoming, 2003b). Recent population trends for Campbell County are shown in Table 3.10-1.

Table 3.10-1 Campbell County and Converse County Population Statistics, 1990-2000

County and City	1990	2000	Growth Rate 1990 - 2000 (percent)	Annual Change 1990-2000 (percent)
Campbell County	29,370	33,698	14.7	1.47
Gillette	17,635	19,646	11.4	1.14
Wright	1,236	1,347	9.0	0.90

Source: WDAI, 2002a.

3.10.1.2 Economic Activity

The primary economic activities in Campbell County are coal mining, oil and gas production, mining service activities, and agriculture. Although the manufacturing sector is growing, the county's economy is based upon the energy industry. While the nation's economy slowed in the year 2000, Campbell County's economy grew stronger. The sustained economic activity in 2000 and 2001 resulted in a boom in infrastructure building, commercial, industrial, and residential construction. Lower fuel and coal prices have slowed economic growth during 2002 (CCEDC, 2002.

Coal plays an important role in the state and county economy. In 2000, Campbell County coal mines produced approximately 88.4 percent of Wyoming's overall coal production. In 2001, Campbell County produced approximately 300 million tons of coal (CCEDC, 2001).

Campbell County represents approximately 25 percent of Wyoming's annual oil production and approximately 95 percent of its CBNG production (BLM, 2002a, figures 62, 68). In the year 2000, the state of Wyoming produced 58 million barrels of oil and 1.3 biollion mcf of both conventionally produced and CBNG gas. Conventional oil and gas production in the county declined by about eight percent from 2001 to 2002; however, CBNG production increased (CCEDC, 2001). Campbell County contained 3,390 producing CBNG wells in August 2000. An additional 1,953 wells had been drilled but were not yet in production. In 2001, Campbell County produced 13 million barrels of oil and 163 million mcf of gas (CCEDC, 2001).

Table 3.10-2 indicates the trends of earnings and employment for the mining sector, including coal, oil, and natural gas production, for the state and for Campbell County. It also displays earnings for solely for the oil and gas sector, from 1995 through 2000. The oil and gas portion of the mining sector economic activity in the state increased during the last five years of the millennium from approximately 50 to slightly over 60 percent. Oil and gas development in Campbell County, however, represents a lower portion of mining sector economic activity, averaging approximately 25 percent, not demonstrating a similar increase. Oil and gas economic activity has not exhibited the same slow growth in the county as it has for the state.

Table 3.10-2 Mining Sector Economic Activity

Industry Earnings (Thousands Of Dollars)						
	1995	1996	1997	1998	1999	2000
Wyoming Mining Sector	$1,093,728	$1,010,725	$1,129,845	$1,165,660	$1,110,345	$1,326,625
Wyoming Oil & Gas	$551,215	$500,213	$600,337	$640,300	$582,153	$809,715
State oil and gas as a % of total mining	50%	49%	53%	55%	52%	61%
Campbell County Mining Sector	$259,397	$263,694	$268,415	$282,129	$292,980	$337,164
Campbell County Oil & Gas	$68,870	$60,772	$64,688	$71,891	$68,881	NA
County oil and gas as a % of total mining	27%	23%	24%	26%	24%	NA

Source: WDAI, 2003.

Revenues obtained from CBNG development benefit the State of Wyoming and Campbell County through several taxes and royalty income. Revenues from project wells would be based on the value of the gas produced, which depends upon its selling price and ownership of the mineral estate, which in this case is the federal government. Revenues from project wells would be generated by:

- Severance taxes of six percent of the value of all gas produced, supplying the state's general fund;
- County ad valorem, or property, taxes (6.3 percent in Campbell County);
- Half of federal lease bonuses;
- Half of the royalty from gas produced from federal lands (half of the standard federal 12.5 percent royalty rate); and
- Sales and use taxes from the purchase of equipment associated with development activities (BLM, 2003, pp. 4-348 - 4-353).

The assessed value of Wyoming oil and gas production for the year 2000 was approximately $1.4 billion for oil and $3.3 billion for gas. The assessed valuation of hydrocarbon production increased in the year 2001 to approximately $5 billion from 824 oil and gas producers (WDR, 2003). In recent years, state tax revenues from Campbell County from coal and crude and stripper oil production have been the highest in Wyoming (BLM, 2003, p. 3-285).

The total mineral income to Wyoming for fiscal years 1997 through 2001 is shown in Table 3.10-3.

Table 3.10-3 Wyoming Mineral Income - Fiscal Years 1997 – 2001

Source	1997	1998	1999	2000	2001
Ad Valorem Taxes	$267,438,424	$263,271,161	$224,308,663	$265,433,379	$413,354,190
Severance Taxes	$232,779,079	$227,535,416	$196,459,204	$275,122,976	$447,973,278
Federal Mineral Royalties	$238,346,960	$223,251,695	$231,029,084	$309,092,848	$448,120,028
State Mineral Royalties	$29,800,814	$28,962,025	$27,720,888	$34,099,206	$56,020,765
Sales and Use Taxes	$35,515,973	$34,824,144	$28,800,218	$29,491,611	$44,024,305

Source	1997	1998	1999	2000	2001
State Rentals and Fees	$4,441,102	$5,720,602	$6,747,746	$8,434,827	$12,702,754
Total	$808,322,352	$783,565,043	$715,065,803	$921,674,847	$1,422,195,320

Source: WDAI, 2002b.

The total mineral taxable value for Campbell County was approximately $2.1 billion in 2001 (WDR, 2003). The projected mineral income for the period 2001 to 2002 was approximately $718 million from severance taxes and $785 million from federal mineral royalties (Wyoming Taxpayers Association, 2003).

Agriculture in the county consists of livestock production and dryland farming. Forage on the TBNG is utilized by local ranchers through grazing allotments. In 1998, the county livestock population was estimated at 86,000 cattle and 37,000 sheep. Acreage in crops was estimated at 91,800 acres, including hay, oats, wheat and barley (CCEDC, 2001).

3.10.1.3 Employment and Income

Wyoming has experienced an average labor force growth of 15 percent since 1990 (WDOE, 2001) and 8.6 percent during the period 2000 to 2001 (WDOE, 2003a). The State of Wyoming's average labor force in 2001 was 271,262 (WDOE, 2001). In the first quarter of 2002, 20,473 Campbell County residents were employed, comprising approximately eight percent of the state workforce. Its primary employment sector in 2001 was the mining sector, which includes the oil and gas industry, comprising approximately 27.7 percent of the total county workforce (WDOE, 2003a). The statistics in Table 3.10-4 indicate that a significant portion of the state's mining sector employees work in Campbell County.

Table 3.10-4 Mining Sector Employment

Total Employment in Mining Sector (Numbers Of Jobs)						
	1995	1996	1997	1998	1999	2000
Wyoming	19,096	17,749	18,914	18,802	18,182	19,286
Campbell County	4,430	4,407	4,485	4,610	4,858	5,677
County employment as a % of state	23%	25%	24%	25%	27%	29%

Source: WDAI, 2003.

The 2001 annual average rate of unemployment for Campbell County was 2.9 percent, lower than the state average of 3.9 percent (WDOE, 2003a); however, the proportion of Campbell County residents employed in the mining sector is projected to decline to 18.6 percent by 2005 (CCEDC, 2002a). The primary sub-sector expected to contribute to the projected loss in jobs is oil and gas extraction. The CBNG industry has slowed the development of additional wells in Campbell County, affecting employment in oil and gas companies (CCEDC, 2001). The diminished development is reflected by the comparatively flat industry earnings in recent years. Future contributions of the mining sector to the economy and job growth in Wyoming are

projected to be less significant as the state changes from a goods-producing to a service-producing economy (WDOE, 2003b).

Five of the county's top 10 employers are associated with coal mining operations and one with energy (natural gas) services. Table 3.10-5 shows the major employment sectors in Campbell County.

Table 3.10-5 Campbell County Employment, Average Monthly Employment Third Quarter 2002

Employment Sector	Number of Jobs	Percent of Total
Mining (including Oil and Gas Production)	6,306	29.7
Total Government (including Public Schools)	3,020	14.2
Wholesale and Retail Trade	2,940	13.8
Construction	2,453	11.5
Accommodation, Food Service	1,693	8.0
Administrative, Waste Services	794	3.7
Health Care and Social Services	772	3.6
Other Services	634	3.0
Professional, Technical Services	598	2.8
Transportation, Warehousing	580	2.7
Manufacturing	480	2.2
Finance, Insurance and Real Estate	483	2.2
Utilities	169	0.8
Arts, Entertainment, Recreation	64	0.3
Agriculture	34	0.2
Educational Services	70	0.2
Management of Companies	19	0.1
Total	21,252	100

Source: CCEDC, 2002b.

The average annual salary in Campbell County was $37,076 in 2002, based on first quarter statistics. The average annual salary for residents employed in the mining sector was $59,696, higher than any other major industry in the county. Per capita personal income for the county's major employment sectors is shown in Table 3.10-6. Wages in the mining sector are approximately 161 percent higher than the average Campbell County weekly wage.

Table 3.10-6 Campbell County Personal Income Third Quarter 2002

Employment Sector	Average Weekly Wage
Mining (including Oil and Gas Production)	$1,089
Total Government (including Public Schools)	$614
Wholesale Trade	$885
Retail Trade	$418
Construction	$676
Accommodation, Food Service	$196
Other Services	$529
Health Care and Social Services	$622
Administrative, Waste Services	$373
Professional, Technical Services	$647
Transportation, Warehousing	$575

Employment Sector	Average Weekly Wage
Manufacturing	$783
Finance and Insurance	$706
Real Estate	$380
Utilities	$1,137
Arts, Entertainment, Recreation	$156
Agriculture	$734
Educational Services	$191
Management of Companies	$945
Information	$599
Average Weekly Wage	$717

Source: CCEDC, 2002b.

3.10.2 Environmental Consequences

Concerns identified in the scoping process that relate to socioeconomic conditions in the vicinity of the Project Area include:

- The effects the Proposed Action to socioeconomic conditions.

3.10.2.1 Alternative A - No Action

Under the No Action Alternative, no new wells would be developed. Continuing employment opportunities in the oil and gas sub-sector may not be available to some local residents.

No tax revenues would be generated to support the county and state economies. Local communities would not receive beneficial economic returns associated with the sale of goods and materials to facilitate project development.

The No Action Alternative would result in a permanent loss of CBNG royalties to the United States. As coal mining continues adjacent to the Project Area, CBNG would be released to the atmosphere if wells were not drilled to produce the gas prior to mining. CBNG development would continue on private surface adjacent to the Project Area, increasing the possibility of drainage by offset state and private wells.

3.10.2.2 Alternative B - Proposed Action

Implementation of the Proposed Action would increase tax revenues generated for the municipal, county, state, and federal governments and would provide royalty payments to both the state and the nation. The estimates of revenues generated from the 32 wells that comprise the Proposed Action are based upon the discussions and assumptions presented in the PRB O&G FEIS (BLM, 2003, pp. 4-348 to 4-353). Taxes would be assessed on the purchase of equipment and supplies and valuation on development activities. Using the PRB O&G FEIS assumption of $36,000 taxable value per CBNG well (p. 4-350), Campbell County could receive approximately $57,600 from 32 wells, or approximately $1,800 per well, at a total tax and use rate of five percent. Ad valorem taxes generated in Campbell County for 32 CBNG wells are expected to generate approximately $1,113,000 at the county tax rate of 6.3 percent (p. 4-352). Based upon basin-wide calculations made for the PRB, severance taxes on 32 wells would be expected to generate an additional approximately $1.1 million for the state (p. 4-351). Federal royalties would be

generated by gas production project wells on the TBNG. The federal and state governments would each receive approximately $1,073,000 each in federal oil and gas royalties from the 32 wells (p. 4-348).

Most of the construction, operation, and maintenance workforce is expected to be drawn from local residents who work in the oil and gas industry. Therefore, the project would not place demands on schools, hospitals, or similar elements of the existing county infrastructure. Continued income made by project employees would benefit and support the local economy.

The minerals extraction industries provide employment opportunities for many county residents. Continued support of local employment opportunities and the increased generation of tax revenues are generally evaluated as positive impacts for an area. It is unlikely that construction of the proposed wells would generate high levels of concern, opposition, or dissatisfaction among local residents. This project is especially benign because of its proposed location within an area of the TBNG designated for such use.

3.10.2.3 Alternative C - Modified Development Alternative

The consequences of implementing Alternative C would be nearly the same as those described for the Proposed Action; however, the increased tax revenues and royalties generated by 28 wells would be slightly less than those associated with the Proposed Action. The estimates of revenues generated from the 28 wells that comprise the Alternative C are based upon the discussions and assumptions presented in the PRB O&G FEIS (BLM, 2003, pp. 4-348 to 4-353). Campbell County would receive approximately $50,400 from 28 wells, or approximately $1,800 per well, at a total tax and use rate of five percent (p. 4-350). Ad valorem taxes for 28 wells would generate approximately $973,875 for Campbell County (p. 4-352). Based upon basin-wide calculations made for the PRB, severance taxes on 28 wells would be expected to generate an additional $963,000 for the state (p. 4-351). Federal royalties would be generated by gas production project wells on the TBNG. The federal and state governments would each receive approximately $939,000 each in federal oil and gas royalties from the 28 wells (p. 4-348).

Continued support of local employment opportunities and increased generation of tax revenues are generally evaluated as positive impacts for an area. It is unlikely that construction of the proposed wells would generate high levels of concern, opposition, or dissatisfaction among local residents. The minerals extraction industries are the primary revenue-generating activities in the area. They provide employment opportunities for many local residents. This project is especially benign because of its proposed location within an area of the TBNG designated for such use.

3.10.3 Cumulative Effects

3.10.3.1 Alternative B - Proposed Action

Basin-wide cumulative impacts analysis of socioeconomic issues is described in the PRB O&G FEIS (BLM, 2003, pp. 4-364 - 4-370). Minerals development, including mining and oil and gas production, is the largest employer in Campbell County, and its employees earn the highest average salaries among industrial workers. Energy-related businesses dominate the county economy and provide the basis for a strong state economy.

In August 2000, the Wyoming Geological Survey estimated recoverable CBNG reserves in the PRB to be approximately 25 tcf and forecast 2-bcfd production rates from an estimated 35,000 future wells. The survey further estimated PRB CBNG production life at 35 to 37 years (CCEDC, 2001). Much of this development is expected to occur within Campbell County. CBNG development is important to the economic sustainability of the county as well as the state. As the largest CBNG producing county in Wyoming, Campbell County's minerals extraction industries make a major contribution to the economic well being of the state.

3.10.3.2 Alternative C - Modified Development Alternative

Cumulative impacts resulting from the implementation of Alternative C would be nearly identical to those that would be generated by the Proposed Action. Campbell County would remain the focus of oil and gas production, and employment would continue to be supported as they have in the past. CBNG development is important to the economic sustainability of the county as well as the state. As the largest CBNG producing county in Wyoming, Campbell County's minerals extraction industries make a major contribution to the economic well being of the state.

3.11 VISUAL RESOURCES

3.11.1 Affected Environment

3.11.1.1 Visual Quality of the Project Area

The Project Area is visually characterized by rolling hills, scattered scoria buttes, and gentle slopes that display an average range of four to six percent. Topographic highs occur in buttes and hills flanking the perimeter of the Little Thunder Creek watershed within which the Project Area is located; however, the Project Area itself displays little variation in elevation. The surface is a prairie covered primarily with native short and mid-grasses and sagebrush interspersed with patches of prickly pear cactus. There are no critical viewpoints within the Project Area.

Human modifications to the environment that define the current visual quality in and near the Project Area include highways, roads, railroads, pipeline ROWs, electrical transmission lines, oil and gas production facilities, and surface coal mines. Most of these modifications are linear features that are not immediately apparent on the relatively flat surface. Oil and gas facilities that are associated with conventional oil and gas production can include tanks and other large stationary pieces of equipment. This equipment is usually larger and more visible than equipment associated with CBNG development. Oil and gas facilities installed on well pads on federal lands are painted with standard colors approved by the appropriate surface management agency that are intended to allow the equipment to be less visually apparent. Facilities in various stages of reclamation may display immature vegetative forms.

3.11.1.2 Regulatory Environment, Policy, and Guidelines

Management of visual resources within the TBNG is determined by policy directives contained in the 2001 TBNG LRMP and the 2001 FEIS for the Northern Great Plains Management Plans Revision. Scenery management guidelines for the TBNG emphasize consistency with the Scenic

Integrity Objectives for a designated management area. As part of the Hilight Bill area in the TBNG, designated uses for the Project Area include Category 6.1, Rangeland with Broad Resource Emphasis, and Category 8.4, Mineral Production and Development. These use designations include recreational big game hunting and the extraction of coal, uranium, oil, and gas. Such areas can "display low to high levels of livestock grazing developments (such as fences and water developments), oil and gas facilities, and roads (USFS 2001, p. 3-25)" and can allow "mineral operations of all types" (USFS 2001, p. 3-26)."

The TBNG lands that contain the Project Area are classified using the USFS Scenery Management System (USFS, 2001b) as "low" in terms of scenic integrity level, meaning that the natural landscape appears moderately altered by oil and gas development, coal mining, and, to a lesser extent, by fences and stock water impoundments needed for livestock grazing (BLM, 2003, p. 3-258). The desired condition for landscapes in the Project Area is reasonable mitigation of planned visible facilities to blend and harmonize with natural features. Modifications to the visual landscape should be compatible or complementary to the character of the landscape.

Guidelines and policy directives that apply specifically to the management and protection of visual resources include:

- USFS Scenery Management System, 1996, Agricultural Handbook 710;
- Forest Service Manual 2380, National Forest Landscape Management Volume 2, Chapter 1 The Visual Management System (Agricultural Handbook 462); and
- The Built Environment Image Guide, 2001, Forest Service Manual 666.

3.11.2 Environmental Consequences

Concerns identified in the scoping process that relate to visual resources in the Project Area include:

- Identification and description of visual resources.
- The reduction in visual quality (as a result of project implementation).

3.11.2.1 Alternative A - No Action Alternative

Impacts to visual resources would not occur as a result of modifications to the landscape associated with the Proposed Action. Conventional oil and gas and CBNG development would, however, continue to take place on state and private lands near the Project Area. CBNG production facilities would be constructed on state and private lands near the Project Area that are consistent with facilities present on TBNG land near the Project Area. Conventional oil and gas development may occur within the Project Area itself. Modifications to the viewshed from grazing activities would continue to occur, including the installation of fences and stock tanks. Surface coal mining would continue near the Project Area for the foreseeable future.

3.11.2.2 Alternative B - Proposed Action

Implementation of the Proposed Action would result in short term impacts to visual resources during drilling and completion of each of the 32 wells. Truck-mounted drilling rigs would be easily discerned on the relatively flat landscape; however, drilling and completion operations would require a relatively short period of time, minimizing the amount of time when visual resources would be adversely affected.

Implementation of the Proposed Action would result in some long term adverse impacts to visual resources in or near the Project Area. The onsite inspections made for the proposed wells in July 2001 considered scenic integrity as part of the final siting of the proposed facilities. Additional facilities would be located at each of the 32 wells for the life of each well. Other facilities intended to facilitate use and disposal of CBNG produced water and linear features such as roads, utility corridor ROWs, and overhead power lines would also be constructed as part of the project. The construction of most of these facilities would not alter the existing landscape, which is extensively modified by the presence of 217 hydrocarbon-producing wells within two miles of the Project Area and fences and reservoirs used for livestock management. Approximately ¼-mile in Section 14 and approximately one mile south of Section 20 of overhead power line would be constructed on privately owned land adjacent to the Project Area. These power lines would be a continuation of existing overhead power lines.

Mitigation

By applying the USFS standard COAs listed in Appendix D and operator-committed mitigation measures listed in Chapter 2, impacts to visual resources would be lessened.

- Lance would paint the production facilities with the standard environmental colors approved by the USFS.
- Portions of disturbed areas not needed for CBNG production would be reclaimed with native vegetation as soon as practicable, minimizing visual impacts. Reclaimed areas would be less noticeable as the vegetation matures.

3.11.2.3 Alternative C - Modified Development Alternative

Implementation of the Modified Development Alternative would result in short term impacts to visual resources during drilling and completion of each of the 28 wells. Impacts to visual resources would be essentially the same under this alternative as they would by implementation of the Proposed Action.

3.11.3 Cumulative Effects

3.11.3.1 Alternative B - Proposed Action

Some cumulative impacts to visual resources would result from additional CBNG development within an area designated for such use. CBNG production facilities would be constructed on the Project Area that would be consistent with facilities present on TBNG land near the Project Area. The continued addition of linear features needed for CBNG development may result in the most

noticeable impacts to the visual character of the land, although adverse impacts would be minimized in areas with low topographic relief.

The density of CBNG development in combination with continued extensive surface coal mining and remnants of conventional oil and gas development may result in the modification of a predominantly rural area to one that could be described as rural/industrial. The area surrounding the Project Area is heavily modified as a result of extensive oil and gas development and coal mining operations. The PRB O&G FEIS projected that the Upper Cheyenne watershed, which contains the Project Area, would contain approximately 546 wells by the end of the year 2003 (PRB O&G FEIS, p. 2-14). Approximately 217 wells are currently active within a two-mile radius of the Project Area (WOGCC, 2003). Further CBNG development is not expected to fundamentally alter the current status of the visual character in and around the Project Area.

3.11.3.2 Alternative C - Modified Development Alternative

Cumulative effects to visual resources under Alternative C would be nearly identical to those associated with the Proposed Action. The difference in the number of wells that would be developed under each alternative is not different enough to result to significantly different impacts to perceived scenic values.

3.12 NOISE

Noise is defined as unwanted or annoying sound that is typically associated with human activities and that interferes with or disrupts normal activities. Sound and noise are measured as sound pressure levels in units of decibels (dB). Response to noise varies according to its type, its perceived importance, its appropriateness in the setting and time of day, and the sensitivity of the individual receptor. Human hearing is simulated by measurements in the A-weighting (dBA) network, which de-emphasizes lower frequency sounds to simulate the response of the human ear. Noise values are logarithmic measurements. Every 10-dBA increase is perceived by the human ear as approximately twice the previous noise level. Sound level intensity decreases by approximately 6 dBA for each doubling of distance from the source. Further reduction occurs when sound energy travels far enough to be appreciably reduced by absorption.

3.12.1 Affected Environment

Some typical sound levels from common noise sources that may be found near the Project Area or could be associated with the Proposed Action are listed in Table 3.12-1.

Table 3.12-1 Typical Sound Levels from Common Noise Sources

Noise Source (at 50 feet, unless noted)	Scale of A-weighted Sound Level (dBA)
Earthwork and excavation	95
Diesel truck, 40 mph	90
Gas compressor operations	89
Well drilling operations/ pumpjack operation	82 - 83
Normal conversation (5 feet)	60
Bird calls (distant)	40

Source: BLM, 2000; NRC, 2001

3.12.1.1 Acoustic Environment

The acoustic environment in and near the Project Area is typical of a rural location with day-night average sound levels ranging from 30 to 56 dBA (DOE, 1998; Day Design, 2003), depending on specific circumstances. Actual noise levels in and around the site are affected by specific noise events, proximity to noise sources, intervening topography, vegetation, and meteorological conditions, including wind speed and direction. The anticipated noise level in rural areas is approximately 40 dBA during the day and 30 dBA during the night. These noise levels assume that these rural areas are distant from transportation corridors (highways and railroads) and populated areas and that the wind speed is very low. However, the wind speed within the project area is generally high, raising the ambient noise level somewhat.

Noise in and near the Project Area consists of traffic noise from state highways and TBNG roads and noise emanating from existing production equipment. Traffic on well access roads contributes intermittently to traffic noise in their vicinity. A limited number of vehicles access the area, and vehicle speeds are restricted by the unimproved nature of the access roads. Figure 3.8-1 illustrates the location of USFS roads, county, and state roads in and near the Project Area. Because the access roads do not meet common standards for passenger vehicle travel, most of the road noise results from vehicles associated with oil and gas operations. There may also be intermittent, infrequent noise associated with road maintenance. Road noise could increase during hunting season (September to December) when TBNG roads may be used by hunters. Other recreational users may use the TBNG roads with ATVs, OHVs, and dirt bikes, all of which are associated with unmuffled engines. Well production equipment is general silent with the exception of compressor noise or pumpjacks. The nearest compressor to the Project Area is located approximately 0.5 mile away from the northwest corner of Thunderhead 3 in the NENE Section 13, R43N/R72W. No new compressors or pumpjacks would be installed as a result of implementation of the Proposed Action.

There are no sensitive human noise receptors, such as residences, schools, hospitals, or daycare centers located in the immediate vicinity of the Project Area. Human receptors would include well field workers and recreational users. These activities occur primarily during the day.

3.12.1.2 Noise Guidelines and Standards

Standards quantifying noise levels have not been established by the State of Wyoming. The US EPA provides guideline noise levels in relation to anticipated noise/human activity disturbance impacts in relation to industrial construction and operations, below which the general public would be protected from activity interference and annoyance. Outdoor locations “in which quiet is a basis for use” are assigned a maximum noise level of 55 dBA. In addition, the EPA (EPA, 1974) has established an average 24-hour noise level of 55 dBA as the maximum noise level that does not adversely affect public health and welfare.

Oil and gas activities are regulated by the Occupational Safety and Health Administration (OSHA) noise regulations and guidelines for worker exposure. These regulations and guidelines focus on noise from machinery, equipment and tools.

The TBNG has issued standards and guidelines with respect to specified varieties of wildlife (TBNG LRMP, 2001) that address noise limitations. The TBNG LRMP has also details distance offset requirements for development from certain types of wildlife activities and/or habitat, effectively reducing noise levels audible to wildlife. Some of these standards and guidelines are seasonally applied and are species-specific in order to maximize the protective measures. TBNG standards and guidelines have been established in the TBNG LRMP, were developed using available data, and are accepted in this EA as providing adequate protection to wildlife. TBNG standards and guidelines that affect noise perceived by wildlife are summarized in Table 3.12-2.

Table 3.12-2 TBNG Standards and Guidelines That Affect Noise Levels Perceived by Wildlife

Wildlife Species	Noise Limitation[1]	Distance Offset	dBA equivalent to distance offset	Standard or Guideline
Mountain Plover	NA	Most development prohibited within 0.25 mile from known nests or nesting areas	28 dB decrease in perceived noise	standard
	NA	Restricted access to facilities in occupied habitat	NA	guideline
Sage Grouse	NA	Restricted construction within 0.25 mile of active display grounds	28 dB decrease in perceived noise	standard
	NA	Restricted construction within 2 miles of active display grounds March 1 – June 15	53 dB decrease in perceived noise	standard
	49 dB	Noise limitation on display grounds from March 1 – June 15		guideline
	49 dB at 800 feet	No development or operations within 2 miles if resulting noise exceeds limit, March 1 – June 15		guideline
Raptors	NA	Restricted development within LOS distances from active nests and winter roost sites, including seasonal restrictions	Varies from 22 dB to 42 dB, according to particular raptor	standard

Note 1: Noise limitations described in dBs as specified in the TBNG LRMP

Because dBs represent a logarithmic ratio, the decreases in sound pressure levels cannot be simply expressed as a percent reduction. An absolute reduction of six dBs represents a 50 percent absolute reduction of perceived noise. An absolute reduction of 20 dBs represents a 90 percent absolute reduction of perceived noise. The TBNG standards and guidelines that relate to distance represent a nearly 100 percent reduction of perceived noise (Shannon Enterprises, n.d.).

Noise measurements are typically measured using the dBA scale, which adjusts high and low frequencies to more closely approximate human hearing. To convert measurements made in the dBA scale to the dB scale, a correction factor would be added to the dBA measurements at the determined high and low frequencies. Although it is possible to convert specified frequencies from the dBA scale to dB scale, it may not be possible to represent noise measurements measured in dBs as representative of the sound pressure levels experienced by a particular animal species. Just as the dB scale was adjusted for human hearing, the dB scale may not

accurately represent perceived sound levels by any particular animal or avian species. TBNG standards and guidelines that address noise levels are written in terms of both dBs and dBAs, further confusing the issue. The analysis of noise impacts contained in the PRB O&G FEIS refers to noise impacts to wildlife in terms of dBAs. For this reason, the discussion of noise impacts to wildlife is described in terms of dBAs, for which noise measurements are commonly available.

3.12.2 Environmental Consequences

Concerns identified in the scoping process that relate to noise associated with implementation of the Project Area include:

- The effects of CBNG-related noise on sage grouse, passerine, and raptor reproduction.
- The effects of noise on habitat effectiveness.

The purpose of the noise analysis in this EA is to estimate and characterize construction and operational impacts resulting from the alternatives. Detailed predictive noise modeling to precisely define future noise levels was not performed.

3.12.2.1 Alternative A - No Action Alternative

The noise impacts associated with the wind, existing industrial activities, and transportation corridors would remain. Noise impacts associated with coal mining operations and roads, highways, and trains in the Project Area may increase as mining activities encroach.

3.12.2.2 Alternative B - The Proposed Action

Construction Noise. Noise impacts would result from site and facility construction operations, drilling rig operation, and additional traffic associated with construction. The level of noise that can be generated by earthwork and construction activities is considered to be very loud and would be perceived as over three times as loud as normal speech. Construction and drilling noise could be quite noticeable in this otherwise rural area. Construction operations are expected to require three to six months for the entire project. Construction activities at each drill site would occur for only one to three days. Increased traffic associated with construction activities would increase noise levels along Highways 59 and 450 and secondary roads within the TBNG during that three to six month period. Noise from construction of well pads, roads, pipeline installation, drilling operations, and traffic would occur during daylight hours, would be temporary, and would be limited to the times when construction actually occurs. Compliance with OSHA requirements for noise exposure is a site mandate, so anticipated impacts on Lance CBNG construction and operations personnel would be minimized and mitigated.

Construction noise could affect recreational users of the TBNG. It is possible that wildlife may temporarily re-locate while construction activities occur. If so, opportunities to view wildlife would be removed from the construction activity. Similarly, hunters would follow the game away from the construction activity. Overall noise in the TBNG could increase during hunting season when hunters use secondary roads for access; however, the gain in additional road miles as a result of project implementation would be slightly over one mile and not expected to generate more traffic from hunters in the area. The impacts to temporary or transient receptors

such as hunters would be dependent on their distance from the construction and drilling operations. In most cases, hunters and other recreational users probably avoid areas with activity and would not be within a half a mile from construction and drilling operations and would not be exposed to levels above 55 dBA. The impacts from construction noise would be short-lived, temporary, and transient. No developed recreation areas are located near the Project Area. Therefore, no significant impacts are expected to recreational users of the TBNG.

Noise is a factor in the displacement of raptors from areas of otherwise suitable habitat. Elevated noise levels associated with increased human activities and facility operations have been shown to be factors in raptor displacement. Possible effects depend upon the patterns of occurrence and the intensity of the noise. Responses of individual raptors may vary from tolerance to avoidance of affected habitats (BLM, 2003, p. 4-219). Timing limitations and distance offsets would restrict construction activities during nesting season thereby reducing adverse noise impacts to raptors. Following TBNG standards and guidelines would reduce perceived noise to raptors from 90 to 100 percent.

Construction and road use noise may result in adverse effects to sage grouse, particularly during the breeding season. Enforcement of TBNG standards and guidelines as well as the lease conditions would substantially reduce noise disturbance to sites and nests. Following TBNG standards and guidelines would reduce perceived noise to sage grouse from 90 to 100 percent. However, the potential remains for impacts and decreasing sage grouse populations to occur as a result of the proposed project (BLM, 2003, p. 4-269).

Regular noise from stationary sources can disrupt bird behavior, including passerines. While individual birds may avoid nesting in areas of regular noise, construction noise would be regular or sustained. The impacts from construction noise would be short-lived, temporary, and transient. The overall effect of noise generated by the project on populations of passerines would be minor (BLM, 2003, p. 4-232).

Additional discussion relating the impacts of noise to wildlife and land use can be found in Sections 3.6.2.2, 3.7.2.2, and 3.8.2.2.

Noise from Routine Operations. Noise associated with production operations would consist primarily of traffic noise. Under the Proposed Action, truck traffic may increase slightly to support CBNG maintenance activities; however, traffic would be limited by the use of telemetry equipment. Truck traffic would be infrequent, short in duration, and thus, noise impacts are expected to be minimal. Recreational ATV, OHV, and dirt bike use in the Project Area is not expected to change with the net addition of approximately one mile of two-track road associated with the Proposed Action.

As Lance would use a previously permitted compressor on adjacent lands, no new noise impacts associated with compressor engines would occur as a result of the Proposed Action. Previously installed compressors on federal lands would have been subject to an appropriate level of environmental review by the TBNG and the WDEQ prior to installation.

The TBNG LRMP limits noise levels from oil and gas production facilities within 0.25 mile of developed recreation sites in the TBNG. This standard does not apply to drilling operations or

other temporary noises. There are no developed recreation sites near the Project Area; therefore, noise from routine operations would not impact recreational users of the TBNG.

Routine traffic noise can affect sage grouse lek activity and reduce survival. Sage grouse do not appear to avoid roads but shift their habitat use when nesting near roads to areas with greater vegetative cover, creating the potential for some adverse impacts (BLM, 2003 p. 4-269).

3.12.2.3 Alternative C: Modified Development Alternative

Impacts resulting from the implementation of Alternative C would be nearly identical to those described for Alternative B. Implementation of Alternative C would result in construction activity nearly equivalent to that of the Proposed Action; however, the potential impacts to sage grouse would be reduced. Alternative C was developed in response an issue identified during the scoping process. Alternative C was developed to eliminate proposed wells and the roads that could possibly adversely impact sage grouse leks and ferruginous hawk nests.

3.12.3 Cumulative Effects

3.12.3.1 Alternative B - The Proposed Action

The short-term noise impacts due to construction and drilling activities would not add substantially to the ambient noise level within or near the Project Area, nor would they incrementally add to the noise level of the TBNG. Implementation of the TBNG standards and guidelines would essentially protect wildlife species in the TBNG and ensure their viability and long term survival. Long-term noise effects from the operation of the 32 proposed wells would be insignificant in terms of CBNG operation throughout the entire TBNG or the Powder River Basin.

The noise impacts associated with the wind, existing industrial activities, and transportation corridors would remain. Noise impacts associated with coal mining operations, roads, highways, and trains may increase as mining activities encroach. The use of compressors required for the pipeline transport of CBNG to market would add to the ambient noise levels near where they are installed.

3.12.3.2 Alternative C - Modified Development Alternative

The short-term noise impacts due to construction and drilling activities would not add substantially to the ambient noise level within or near the Project Area, nor would they incrementally add to the noise level of the TBNG. Implementation of the TBNG standards and guidelines would essentially protect wildlife species in the TBNG and ensure their viability and long term survival. Long-term noise effects from the operation of the 28 Alternative C wells would be insignificant in terms of CBNG operation throughout the entire TBNG or the Powder River Basin.

3.13 ENVIRONMENTAL JUSTICE

Executive Order 12898, February 11, 1994, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, addresses the potential for impacts from federal actions which may disproportionately affect minority or low-income populations. A specific consideration of equity and fairness in resource decision making is encompassed in the issue of environmental justice. All federal actions are required to consider potentially disproportionate effects on minority or low income communities. Where possible, measures should be taken to avoid impact to these communities or to mitigate any adverse effects.

The Project Area lies in southern Campbell County, within approximately 10 miles of the Converse County line. Origins of populations within Campbell and Converse counties are 96 percent and 95 percent European American, respectively (USCB, 2004a and 2004b). Within the Project Area, there are no communities with significant low-income or minority populations, so specific actions to address environmental justice concerns were not implemented for the Project.

No Indian reservation is located in the vicinity of the Project Area. The appropriate Native American tribes were contacted during scoping for the proposed project. No known Native American cultural sites, sacred sites, or burials are within the proposed areas of potential direct effect.

CHAPTER 4
CONSULTATION AND COORDINATION

The Forest Service consulted the following individuals, federal, state and local agencies, tribes, and non-Forest Service personnel during the development of this EA:

4.1 Forest Service and BLM Buffalo Field Office ID Team Members

Alice Allen, ID Team Leader, USFS TEAMS Enterprise
Barbara Beasley, Paleontologist, Nebraska National Forest
Dave Gloss, Hydrologist, Brush Creek/Hayden Ranger District
Paula Guenther-Gloss, Fisheries biologist, Brush Creek/Hayden Ranger District
Thomas John, Soils Scientist, Steamboat Springs Headquarters
Ron Luehring, Geotechnical Engineer, R2 Regional Office
Clarke McClung, Rangeland Management Specialist, Douglas Ranger District
Troy Palmer, Engineer Technician, Douglas Ranger District
John Proctor, Botanist, Parks Ranger District
Brian Pruiett, Mineral Specialist, Buffalo Field Office, Bureau of Land Management
Joe Reddick, Mineral Specialist, Douglas Ranger District
Ian Rithchie, Archeologist, Douglas Ranger District
Ann-Marie Verde, Transportation Planner, Medicine Bow-Routt Supervisors Office

4.2 Federal, State and Local Agencies

U.S.D.I Bureau of Land Management - Buffalo Field Office
U.S. Fish & Wildlife Service – Ecological Services Office
U.S. Environmental Protection Agency
State of Wyoming, Office of Federal Land Policy
State of Wyoming, Office of State Lands and Investments
State of Wyoming, Department of State Parks & Cultural Resources – SHPO
State of Wyoming, Wyoming Game & Fish Department
State of Wyoming, State Engineer's Office
State of Wyoming, Department of Agriculture

4.3 Lance Oil & Gas Company, Inc.

Mary Mondragon, (Denver) Permitting Coordinator
Jon Bartow, (Gillette) PRB Development Coordinator

4.4 O&G Environmental Consulting

Richard Bell, Project Manager, Soil Resources, Cultural Resources, Visual Resources
Bonnie Carson, NEPA Specialist, Geological Resources, Water Resources, Air Quality, Socioeconomics, Noise, Visual Resources
Priscilla Neus, Geology, Soils
Tom Jaap, Water Resources
Joe Fetzer, Water Resources, Air Quality
Ethan Jahnke, Water Resources
Chris Gayer, Biological Resources
Bea VanHorn, Document Coordination
Joanne Bacalman, Document Coordination

CHAPTER 5
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