



**U.S. Department of the Interior
Bureau of Land Management
Wyoming State Office**

Rawlins Field Office

November 2003

**ENVIRONMENTAL ASSESSMENT for the
Atlantic Rim Interim Drilling Project,
Red Rim POD, Carbon County, Wyoming**

It is the mission of the Bureau of Land Management to sustain the health, diversity, and productivity of the public lands for the use and enjoyment of present and future generations.

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United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Rawlins Field Office
P.O. Box 2407 (1300 North Third Street)
Rawlins, Wyoming 82301-2407

In Reply Refer To:
1790

December 23, 2003

Re: Environmental Assessment for the
Atlantic Rim Interim Drilling
Project, Red Rim Pod

Dear Reader:

Enclosed for your review and comment is the Environmental Assessment (EA) for Warren E & P, Inc. (Warren), and Anadarko E&P Company (AEPC), Red Rim Exploration Project. The project is located in one of nine areas proposed for exploration drilling for the purpose of providing information for use in the preparation of the Environmental Impact Statement for the Atlantic Rim Natural Gas Project. In order to satisfy the requirements of the National Environmental Policy Act, this EA was prepared to analyze impacts associated with the exploration of natural gas resources northeast of Baggs, in Carbon County, Wyoming.

Analysis of the environmental consequences has led to the determination that this proposed project, with the appropriate mitigating measures, will not have a significant effect on the human environment. Therefore, an environmental impact statement will not be required. Pending the results of a public review of this document, the Bureau of Land Management (BLM) will prepare a formal Decision Record.

Your comments should be as specific as possible. We will accept comments on the alternatives presented and on the adequacy of the impact analysis until January 26, 2004.

Comments may be submitted via regular mail to:

Larry Jackson, Project Manager
Bureau of Land Management
Rawlins Field Office
P.O. Box 2407
Rawlins, Wyoming 82301

Or they may be submitted electronically at the address shown below:

e-mail: rawlins_wymail@blm.gov

Please refer to the Red Rim Pod when submitting comments.

Please note that comments, including names, e-mail addresses, and street addresses of respondents, will be available for public review and disclosure at the above address during regular business hours (7:45 a.m. to 4:30 p.m.), Monday through Friday, except holidays. Individual respondents may request confidentiality. If you wish to withhold your name, e-mail address, or street address from public review or from disclosure under the Freedom of Information Act, you must state this plainly at the beginning of your written comment. Such requirements will be honored to the extent allowed by law. All submissions from organizations or businesses, and from individuals identifying themselves as representatives or officials of organizations or businesses, will be made available for public inspection in their entirety.

Please retain this EA for future reference. A copy of the EA has been sent to affected government agencies and to those who responded to scoping or otherwise indicated that they wished to receive a copy of the EA. The EA may also be reviewed at the following locations:

Bureau of Land Management
Wyoming State Office
5353 Yellowstone Road
Cheyenne, Wyoming 82009

Bureau of Land Management
Rawlins Field Office
1300 N. Third Street
Rawlins, Wyoming 82301

If you require additional information regarding this project, please contact Larry Jackson, Project Manager, at the address shown above or phone (307) 328-4231.

Sincerely,



Field Manager

Enclosure

1.0 PURPOSE AND NEED

1.1 INTRODUCTION

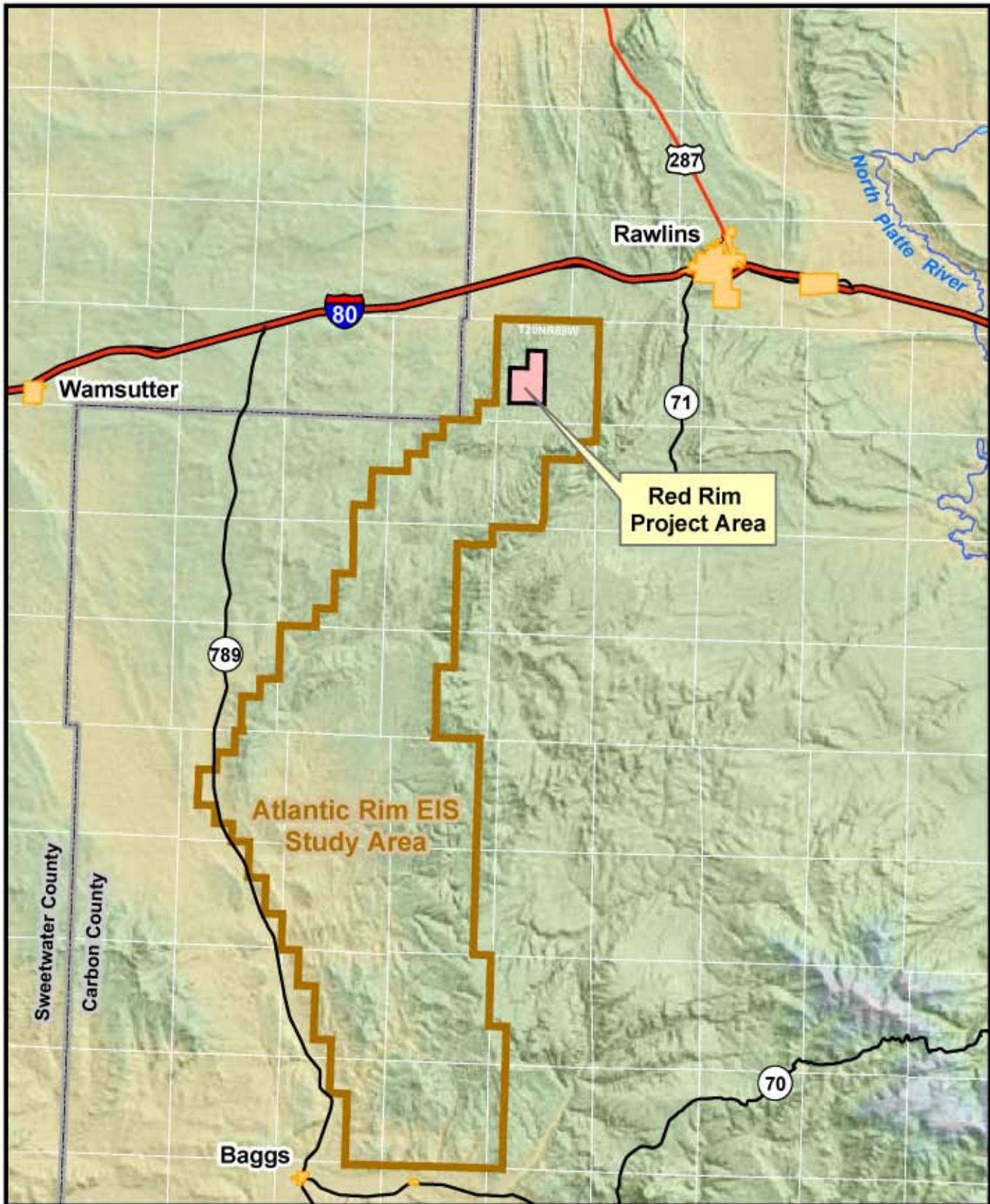
1.1.1. Description and Location

Anadarko E&P Company (AEPC) and Warren E & P, Inc. (Warren), collectively referred to as the Companies, have notified the Bureau of Land Management (BLM), Rawlins Field Office (RFO) that they propose to explore for and potentially develop coal bed natural gas (CBNG) wells in the Red Rim area (Project Area). The Project Area lies within the Atlantic Rim Environmental Impact Statement (EIS) study area in south-central Wyoming ([Figure 1-1](#)). The Project Area is located within the administrative boundary of the RFO in T20N R89W in Carbon County, Wyoming, and is one of nine areas or well pods where BLM may allow interim drilling activity while an EIS is being prepared for the Atlantic Rim Natural Gas Project.

The Red Rim interim development proposal consists of constructing, drilling, completing, testing, and producing eight exploratory gas wells and up to two injection wells; testing and operating eight existing exploratory wells; and constructing and operating two water conditioning facilities, three surface discharge outfalls, and a compressor station. Related access roads, utilities, flowlines, a market access line, self-contained tanks that allow beneficial use of produced water by livestock, and production facilities also are included in the proposed project. The life of the project is estimated to be 10 to 20 years.

Of the eight proposed well locations, five would be located on surface ownership lands administered by the BLM RFO and would develop federal minerals. One proposed well would be located on surface ownership lands administered by the RFO and would develop minerals owned by the State of Wyoming. The remaining proposed wells (two) would be located on fee lands and would develop fee minerals. The proposed water injection wells, zeolite water conditioning facilities, surface discharge outfalls, and compressor station all would be located on fee lands. In addition, eight existing or authorized wells also will be tied into the project.

The Project Area, which encompasses approximately 3,200 acres, is located about 8 miles southwest of Rawlins, Wyoming, along Carbon County Road 605 (Twentymile Road), which intersects Interstate 80 (I-80) near Rawlins. The Project Area is within the Great Divide Basin, a closed basin.



Legend

-  Red Rim POD Boundary
-  Atlantic Rim EIS Study Area
-  County Boundary
-  Interstate
-  U.S. Highway
-  State Highway



 ANADARKO PETROLEUM CORPORATION	
FIGURE 1-1 ATLANTIC RIM EIS STUDY AREA AND RED RIM PROJECT AREA	
ANALYSIS AREA: CARBON COUNTY, WY	
Date: 07/08/09	Screen File: 1:11172_1xides_map.pdf.mxd
	Prepared by: MSH

1.2 PURPOSE OF AND NEED FOR ACTION

1.2.1. Purpose and Need for the Proposed Project

The purpose of the Companies' proposal is to search for and test certain geologic formations for the presence of commercial quantities of natural gas. The proposed project would allow the Companies to evaluate through exploration and production whether the larger-scale development is feasible. The primary objective of the exploration project is to evaluate the following in support of the larger Atlantic Rim Natural Gas Project EIS (Atlantic Rim EIS):

- Ø Productivity of and reserves within the coals;
- Ø Economics of drilling and completion techniques;
- Ø Feasibility of dewatering the coals; and
- Ø Depths or pressure windows that may be preferred as the target for economic gas production.

Exploration and development of federal oil and gas leases by private industry is an integral part of the BLM's oil and gas leasing program. Statutory authority for BLM's oil and gas program is derived from the Mineral Leasing Act of 1920, as amended; the Mining and Minerals Policy Act of 1970; the Federal Land Policy and Management Act of 1976; the National Materials and Minerals Policy, Research and Development Act of 1980; and the Federal Onshore Oil and Gas Leasing Reform Act of 1987.

The proposed development would exercise the leaseholders' existing rights within the Project Area to drill for, extract, remove, and market gas products. National mineral leasing policies recognize the statutory right of leaseholders to develop federal mineral resources to meet continuing national needs and economic demands so long as natural resource values and uses are sustained. Also included is the right of the leaseholders within the Project Area to build and maintain necessary improvements for drilling, producing, and marketing the natural gas, in accordance with the appropriate authority.

Natural gas is an integral part of the U.S. energy future because of its availability, the presence of an existing infrastructure for market delivery, and the environmental advantages of clean-burning natural gas as compared with other fuels. In addition, development of abundant domestic reserves of natural gas would reduce the country's dependence on foreign sources of energy and maintain an adequate and stable supply of fuel for economic well being, industrial production, power generation, and national security. The environmental advantages of natural gas combustion versus other conventional fuels are emphasized in the Clean Air Act Amendments of 1990.

1.2.2. Environmental Analysis Process

This environmental assessment (EA) documents the environmental analysis process BLM uses to make decisions in accordance with the National Environmental Policy Act (NEPA). This document provides the decision-makers with information needed to make a decision that is fully informed and that is based on factors relevant to the proposal. The decisions to be made by BLM include which alternative to adopt, and whether the action adopted would be significant under NEPA. This EA also documents the analysis conducted on the proposal and alternatives and identifies environmental effects and mitigation measures. Finally, this document provides a vehicle for public review and comment on the proposal, the environmental analysis, and conclusions about the relevant issues.

This EA has been prepared to evaluate and disclose the potential environmental impacts associated with this project. The proposed exploration project would affect BLM lands managed by the RFO.

Factors considered during the environmental analysis for the exploratory project include the following:

- A determination of whether the proposal and alternatives conform to BLM policies, regulations, and the direction approved in the Resource Management Plan (RMP).

- A determination of whether the proposal and alternatives conform to policies and regulations of other agencies that are likely to be associated with the project.

- A determination of well pad locations, access roads, pipelines, and production facilities that best meet other resource management objectives and minimize impacts to surface resources while honoring the lease rights within the Project Area.

- A determination of impacts on the human environment that could result from the project and alternatives, and development of mitigation measures necessary to avoid or minimize these impacts.

1.3 RELATIONSHIP TO POLICIES, PLANS, AND PROGRAMS

The EA is prepared in accordance with NEPA and complies with all applicable regulations and laws passed subsequent to the act. This EA assesses the environmental impacts of the project and alternatives, including the no action alternative, and guides the decision-making process.

1.3.1. Conformance with Great Divide Resource Area RMP

In accordance with Title 43 Code of Federal Regulations (CFR) Part 1610.5, the proposed project has been reviewed and conforms to the Great Divide RMP, approved on November 8, 1990.

The BLM's Great Divide RMP and Record of Decision (ROD) (BLM 1987, 1988a, 1990) direct management of BLM-administered lands within the Project Area. Management of oil and gas resources, as stated in the RMP, provides for leasing, exploration, and development of oil and gas while protecting other resource values. According to the RMP, all public lands in the resource area are suitable for oil and gas leasing and development, subject to certain stipulations on leases and site-specific conditions of approval (COAs) attached to applications for permits to drill (APDs).

The project is located outside areas where surface-disturbing activities would be restricted and intensively managed to maintain important resource values, such as the Baggs Elk Crucial Winter Range or any areas of critical environmental concern (ACECs). All proposed roads, flowlines, and the delivery pipeline are located outside avoidance areas for utility and transportation systems.

1.3.2. Conformance with Interim Drilling Guidelines

Proposed drilling and development on public land will be consistent with the guidelines provided in the Interim Drilling Policy – “Development Authorized Concurrent with EIS Preparation for the Atlantic Rim Coalbed Methane Project” ([Appendix A](#)).

1.3.3. Relationship to Other Plans and Documents

The proposed project conforms with the State of Wyoming Land Use Plan (Wyoming State Land Use Commission 1979) and the Carbon County Land Use Plan (Pederson Planning Consultants 1997, 1998) and would comply with all relevant federal, state, and local laws and regulations. Development of this project would not affect attainment of the Wyoming Standards for Healthy Rangelands, originally produced in August 1977, and updated in May 2003 (BLM 2003a), or the July 1998 Fire Management Implementation Plan for Wyoming.

The BLM is required to consult with the Wyoming State Historic Preservation Office (SHPO) and others, as necessary, regarding potential impacts of the proposed undertaking upon historic properties. This consultation is required as part of the process under Section 106 of the National Historic Preservation Act of 1966, as amended. The project lies within the general area that contains the historic Rawlins-Baggs Stage Road that is eligible for inclusion in the National Register of Historic Places (NRHP), and prehistoric camps are evident (Hatcher 2003).

1.4 ISSUES AND CONCERNS

Environmental and social issues and management concerns associated with the proposed project are identified as follows:

Surface Water and Groundwater Resources

1. The proposed project could affect the quality of surface water in the Project Area and surrounding areas.
2. The proposed project could affect groundwater resources in the Project Area and surrounding areas.

Management of Produced Water

1. If discharges were confined to one tributary of Hadsell Draw, the impacts to the area would be localized.
2. Reservoirs associated with surface discharge should be designed and maintained to handle the volumes of water that would be anticipated during wet years.
3. An in-channel reservoir that is located just below an outfall could serve as a check on erosion. This reservoir could be enlarged so that releases into the channel below would simulate natural conditions.
4. Water should not be stored in the reservoir during winter unless riprap is placed on the face of the dam to prevent erosion from freeze-thaw movements or wave action.
5. Additional water sources should be developed to supply water after the project ends to facilities that are developed to use produced water from the project.
6. The locations and sizes of culverts should be determined in consultation with BLM and other affected stakeholders. The channel crossing to the federal wells on the west side of the drainage in Section 29 may require a culvert larger than 18 inches in diameter.
7. The calculated flood flows in the water management plan may be high and should be verified. For example, the average flow for Hadsell Draw is 0.81 cubic feet per second (cfs), but the 2-year channel maintenance flow is 176 cfs, which seems high.
8. According to the water management plan, discharge of produced water would add 1.14 cfs, which on an average day would more than double the flow. This estimate should not be compared with the peak flow, since the effects of flood flows on drainages are different from the effects of constant flows.

9. Successful strategies for livestock management, soil conservation, and protection of riparian areas encourage the use of water sources in the uplands, instead of sources in streamside riparian areas. The use of potholes near drainages as water sources because of enhanced flows could damage riparian areas or increase erosion of soils.

Rangelands and Livestock Grazing

1. Surface flows caused by discharge of produced water into Hadsell Draw and associated tributaries likely would affect distribution of livestock, grazing use, and rangeland vegetation.
2. Surface discharge could lead to unrestricted, concentrated use by livestock during periods of high stress for plants and throughout the year.
3. Watering facilities that are well planned could be used to improve distribution and timing of use by livestock, which would lead to better conditions in upland and riparian areas.
4. An estimated 6 miles along Hadsell Draw and 3 miles along feeder draws likely would be affected by surface discharge of produced water. Construction and use of extensive pasture fencing would be an effective way to manage livestock use in this area. This issue would probably be addressed most appropriately through a cooperative agreement among the Companies, Blake Sheep Company, and the BLM that would be analyzed in an allotment-wide management plan.
5. The area north and west of Atlantic Rim is currently used for grazing primarily during late fall, winter, and early spring; the addition of an open source of water would attract livestock throughout the year.
6. A controlled pipeline and trough system that could be unavailable to cattle during late spring, summer, and fall would mitigate the effects of surface discharge on rangelands and grazing.
7. Limits on the areal extent of drainages that would be affected by surface discharge or eliminating a surface discharge site (outfall) would mitigate the effects of surface discharge on rangelands and grazing. The outfall in Section 29 of T20N R89W could be eliminated, curbing surface flows to the channel below the outfall in Section 21.
8. New water developments should remain viable long after gas production ends; the livestock operator should be responsible for repairing and maintaining the developments.
9. Livestock watering facilities should be contained and shut off when not in use.

10. Reservoirs that would contain produced water should be fenced in a manner that could control when livestock have access to the water.
11. Far more produced water would be available for livestock management than could reasonably be used beneficially. Injecting produced water from the proposed federal wells would decrease the need for surface disposal of 36 percent of the water.

Wildlife Resources

1. Wildlife habitats and populations within the Project Area and adjacent lands, primarily nesting areas for greater sage grouse and crucial winter range for big game, may be affected by surface-disturbing activities, human presence, noise from the compressor station, traffic, or management of produced water.
2. Livestock fencing associated with additional water development may alter migration of wildlife to and from winter range.
3. Development of water in crucial winter range for wildlife may increase animal grazing and reduce forage that would be available during severe winters when it may be needed.
4. New watering locations may change the distribution of animals or their use of areas.
5. Bioaccumulation of inorganic constituents in water discharged to the surface may be detrimental to waterfowl over time.
6. The Red Rim-Daley Wildlife Habitat Management Area, located just west of the Project Area, could be affected by the proposed project.

Soil Resources

Soil resources in the Project Area and surrounding areas could be affected by the proposed project.

1. Erosion of surface drainages can be reduced by minimizing the distance that produced water must flow from outfalls through channels or diversions to reservoirs.
2. Disturbed areas associated with construction activities should be reclaimed.

Other Resources and Uses

1. The corridor for the Continental Divide National Recreation Trail could be affected near Rawlins by the proposed market access pipeline.
2. The proposed project could affect the historic Rawlins-Baggs stage road or historic and cultural values.
3. The proposed project (especially generators and compression facilities) could affect air quality or noise levels in the Project Area or surrounding areas.
4. Vegetation resources in the Project Area and surrounding areas could be affected by surface-disturbing activities. Invasive species or noxious weeds could increase in the Project Area.
5. The cumulative effects on all resources and uses should be addressed.

Monitoring

1. The Companies should monitor the immediate, primary effects of surface discharge. Secondary effects on rangeland resources should continue to be monitored by the BLM and livestock operator.
2. Surface drainages that receive produced water should be monitored to mitigate development of headcuts. Permanent cross sections should be established in Hadsell Draw (three sites) and in each affected tributary (one site in the draw of each tributary). One site would contain a stream gage. The locations of these sites would be selected in consultation with the BLM and affected stakeholders.
3. The measurements needed and methodology for monitoring surveys should be established in consultation with BLM and other affected stakeholders.
4. Monitoring requirements that would measure effects on groundwater resources should be established.

2.0 PROPOSED ACTION AND ALTERNATIVES

2.1 ALTERNATIVE 1 – PROPOSED ACTION

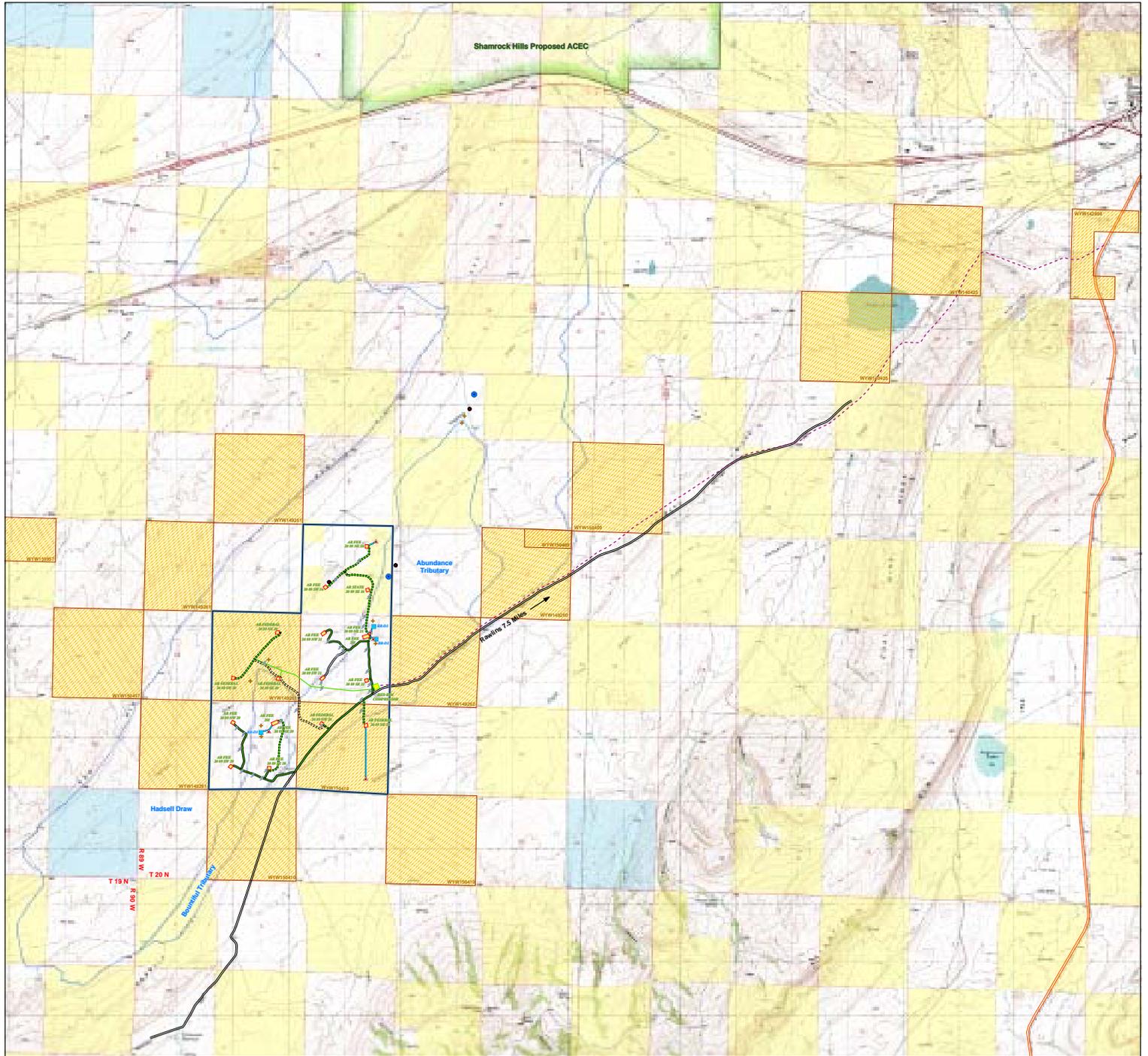
The proposed project (Alternative 1 – Proposed Action) submitted jointly by Anadarko E&P Company (AEPC) and Warren E & P, Inc. (Warren), collectively referred to as “the Companies,” consists of exploration and interim development of coal bed natural gas (CBNG) resources on existing federal, state, and fee leases in the Red Rim area (Project Area). The proposed project location is shown in [Figure 2-1](#). The proposed project will provide geologic and resource information needed by BLM for use in the Atlantic Rim Natural Gas Project EIS (Atlantic Rim EIS). Also, it will provide information to the Companies for use in evaluating the feasibility of economically developing CBNG resources in the Atlantic Rim area.

The Project Area lies within the Great Divide Basin, a sub-basin of the Greater Green River Basin. The Continental Divide splits around the Great Divide Basin, and isolates it as a closed, interior drainage basin. Therefore, any water entering the basin is contained within it.

The Proposed Action consists of constructing, drilling, completing, testing, and operating nine exploratory gas wells and up to two water injection wells; testing and operating seven existing exploratory wells; and constructing and operating two water conditioning facilities, three surface discharge outfalls, and a compressor station. The Proposed Action also would include related access roads, gathering lines for water and gas, buried electrical utilities, a market access line for gas, production facilities, and self-contained tanks that allow beneficial use of small quantities of produced water by livestock and wildlife without discharging to surface drainages. **Table 2-1** summarizes the wells and facilities that would be included in the project. A groundwater monitoring well also would be established in the Project Area, at a location specified by BLM.

The water produced from the exploratory wells would be conditioned using a proprietary, natural-mineral based process that will result in reduced levels of specific conductance and sodium adsorption ratio (SAR). The conditioned water would be discharged into ephemeral tributaries of Hadsell Draw on fee lands, provided it meets the applicable water quality standards for irrigation. Surface discharge of produced water would comply with all terms, conditions, and monitoring requirements of a National Pollutant Discharge Elimination System (NPDES) permit issued by the Wyoming Department of Environmental Quality (WDEQ).

The proposed project would be located 8 miles southwest of Rawlins, Wyoming, along Carbon County Road 605 (Twentymile Road), which intersects Interstate 80 (I-80) near Rawlins. The project is one of nine areas or well pods that make up the Atlantic Rim Interim Drilling Project. Of the nine proposed well locations, five wells would be located on surface ownership lands administered by the Bureau of Land Management (BLM) Rawlins Field Office (RFO) and would develop federal minerals. One proposed well would be located on surface ownership lands administered by



Legend		Surface Ownership		<p>Project Location</p>	<p>Transverse Mercator Projection 1927 North American Datum Zone 13</p>
<ul style="list-style-type: none"> POD Boundary ▲ Stock Tank ■ Discharge Point + Proposed Soil Sample Location ● Reservoir / Culvert ● Proposed Channel Monitoring Cross-section 	<ul style="list-style-type: none"> Red Rim Compressor Station Well Pad Lease Boundary Proposed Red Rim Lateral Pipeline Proposed Water, Gas and Electric Corridors Existing Road, Proposed Road Within POD Boundary Proposed Water Corridor Continental Divide Scenic Trail Watershed Boundary 	<ul style="list-style-type: none"> Bureau of Land Management State 			

	ANADARKO PETROLEUM CORPORATION
	FIGURE 2-1 RED RIM POD PROPOSED ACTION
ANALYSIS AREA - CARBON COUNTY, WY	
Date: 12/9/01	Author: PLS 611772_well_plat.mxd
Prepared by: A001	

TABLE 2-1 RED RIM PROJECT

Proposed Gas Wells			
Lease Number	Well Name	Well Number	Location
WYW-149261	AR Federal ¹	2089 NE20	T20N R89W Section 20 NENE
	AR Federal ¹	2089 SE20	T20N R89W Section 20 SESE
	AR Federal ¹	2089 SW20	T20N R89W Section 20 SWSW
WYW-150410	AR Federal ¹	2089 NW28	T20N R89W Section 28 SENW
	AR Federal ¹	2089 NE28	T20N R89W Section 28 NENE
FEE/STATE LEASES	AR Fee	2089 NE16	T20N R89W Section 16 SWNE
	AR Fee	2089 SW16	T20N R89W Section 16 NESW
	AR State ¹	2089 SE16	T20N R89W Section 16 NWSE
Existing or Authorized Gas Wells²			
Lease Information	Well Name	Well Number	Location
FEE LEASES	AR Fee	2089 NE21	T20N R89W Section 21 NENE
	AR Fee	2089 NW 21	T20N R89W Section 21 NENW
	AR Fee	2089 SW21	T20N R89W Section 21 NESW
	AR Fee	2089 SE21	T20N R89W Section 21 NESE
	AR Fee	2089 NW29	T20N R89W Section 29 SENW
	AR Fee	2089 SW29	T20N R89W Section 29 SWSW
	AR Fee	2089 SE29	T20N R89W Section 29 SESE
	AR Fee	2089 NE29	T20N R89W Section 29 NENE
Existing or Authorized Injection Well			
FEE LEASE	AR Fee	21I	T20N R89W Section 21 NENE
FEE LEASE	AR Fee	29I	T20N R89W Section 29 NENE
Proposed Facilities			
FEE LEASE	Conditioning Facility	Bountiful	T20N R89W Section 29 NENE
FEE LEASE	Outfall	Bountiful 001 (RR-D1)	T20N R89W Section 29 SWNE
Existing or Authorized Facilities²			
Lease Information	Site Type	Name	Location
FEE LEASE	Conditioning Facility	Abundance	T20N R89W Section 21 NENE
FEE LEASE	Outfall	Abundance 002 (RR-D2)	T20N R89W Section 21 NENE
FEE LEASE	Outfall	Abundance 003 (RR-D3)	T20N R89W Section 21 NENE
FEE LEASE	Compressor Station	Red Rim	T20N R89W Section 21 SESE

Note: ¹ BLM surface ownership lands

² Wells and facilities requiring no authorization from BLM prior to construction; development of these wells and facilities in accordance with the Red Rim POD is currently completed, underway, or planned for 2003.

the RFO and would develop minerals owned by the State of Wyoming. The remaining proposed wells (three) would be located on fee lands and would develop fee minerals. The proposed water injection wells, zeolite water conditioning facilities, surface discharge outfalls, and compressor station all would be located on fee lands.

The Proposed Action is a part of the interim drilling associated with the Atlantic Rim EIS in Carbon County, Wyoming. The Proposed Action complies with the cooperative plan established by BLM in the Interim Drilling Policy – “Development Authorized Concurrent with EIS Preparation for the Atlantic Rim Coalbed Methane Project” ([Appendix A](#)). The primary objective of interim drilling is to evaluate the following aspects of development in the Atlantic Rim area:

- Ø Productivity of and reserves within the coals;
- Ø Economics of drilling and completion techniques;
- Ø Feasibility of dewatering the coals; and
- Ø Depths or pressure windows that may be preferred as the target for economic gas production.

The BLM is preparing an EIS for the Atlantic Rim area. The RFO will allow up to 200 exploratory wells to be drilled during preparation of the EIS, provided that this activity complies with criteria described in the Interim Drilling Policy ([Appendix A](#)). In addition, the RFO must determine through a NEPA analysis that no significant or adverse impacts would occur. The RFO would monitor drilling on public lands to ensure that it does not significantly affect the environment or prejudice the decisions to be made as a result of the analysis conducted in the Atlantic Rim EIS.

The Wyoming Oil and Gas Conservation Commission (WOGCC) has established a 160-acre well spacing pattern for the wells included in the Proposed Action under Chapter 3, Section 2 of WOGCC rules that establish a 160-acre spacing for gas wells located in certain townships, including T20N R89W. This order applies to all of Sections 16, 20, 21, and 29, and all except the southeast quarter of Section 28. An 80-acre spacing pattern for wells completed in the Mesaverde Group has been established for the southeast quarter of Section 28 under Cause No. 1, Order No. 1, Docket No. 154-2001.

Interim drilling within the Red Rim area would develop over a 6- to 12-month period. Wells would be tested when completed; however, an estimated 6 to 12 months of continuous producing status in the Red Rim area would be needed to fully evaluate the economics of any additional development. The life of the project is estimated at between 10 and 20 years. The productive life of a shallow gas well completed in coals in the Mesaverde Group is estimated to be 15 years.

Specific components of the project are shown in the Red Rim Plan of Development (POD), which consists of a Master Surface Use Program (MSUP) ([Appendix B](#)), Master Drilling Plan (MDP) ([Appendix C](#)), Water Management Plan (WMP) ([Appendix D](#)), and the project map ([Figure 2-1](#)). Project plans are summarized below in the section titled “Plan of Development.” Although the entire project is described in the POD, the proposed federal action is limited to the anticipated activities that would require a decision or authorization from BLM to proceed.

2.1.1. Plan of Development

The Companies would follow the procedures outlined below to gain approval for the activities proposed on BLM-administered lands or minerals within the Project Area. Development also would be approved, as required, by other agencies.

2.1.2. Preconstruction Planning and Site Layout

Before construction begins, the Companies would submit federal Application for Permit to Drill (APD) and Right-of-way (ROW) applications along with a preliminary MSUP, MDP, WMP, and a project map to the RFO that shows the specific location of the proposed activity (such as individual drill sites, pipeline corridors, access roads, or other facilities). The application would include site-specific plans that describe the proposed development (drilling plans with casing/cementing program; surface use plans with construction details for roads and drill pads; a water management plan; and site-specific reclamation plans). Approval of all planned operations would be obtained in accordance with the applicable regulations and Onshore Oil and Gas Order No. 1 (Approval of Operations on Onshore Federal and Indian Oil and Gas Leases). Stormwater discharges during construction would be managed in accordance with a stormwater permit issued by WDEQ.

The proposed facilities would be staked by the Companies and inspected by an interdisciplinary team or an official from the BLM to verify consistency with the RMP, the Interim Drilling Policy ([Appendix A](#)), and stipulations contained in the oil and gas leases.

The Companies would submit detailed descriptions of the proposed activity or construction plans to the BLM, when required, for the proposed development. The plans would address concerns related to construction standards, required mitigation, and other issues. Negotiation of these plans between the Companies and the BLM, if necessary to resolve differences, would be based on findings of the field inspection and would take place either during or after the BLM onsite inspection.

The Companies or their contractors would revise the MSUP, MDP, or WMP, as necessary, based on changes agreed to with BLM. The BLM would complete a project-specific environmental analysis that incorporates standards for construction and mitigation. The BLM would then approve the specific proposal and attach the Conditions of Approval to the permit. The Companies must then commence the approved activity within 1 year.

A general discussion of proposed construction techniques to be used by the Companies follows. More detailed plans can be reviewed in [Appendix B](#). These construction techniques would apply to drill sites, pipelines, and access roads within the Project Area, and may vary among well sites.

2.1.3. Construction Phase

2.1.3.1.1. Construction of Access Roads

The primary access road to the Project Area would be Carbon County Road 605. Access is provided by the feeder road of I-80, which intersects Carbon County Road 605 just south and west of Rawlins. Carbon County Road 605 is an existing one-lane road that is graded and partially graveled. Access to drill locations from the existing network of roads would be provided by new and upgraded crowned, ditched, and surfaced roads. The access road would be upgraded from the point where it crosses into Section 22 of T20N R89W to the southern edge of the Project Area in Section 29 of T20N R89W.

The Companies propose to construct new access roads across public lands in accordance with the standards in BLM Manual 9113 and applicable regulations. Roads would be located to minimize disturbances and maximize transportation efficiency. The Companies would close and reclaim roads when they are no longer required for production operations, unless otherwise directed by the BLM or the affected surface owner.

Drainage crossings on the access routes within the Project Area would either be low-water crossings or crossings that use “fish-friendly” culverts where applicable. Low-water crossings would be used in shallow channel crossings. Crossings of larger channels within the Project Area would be accomplished by excavating an area approximately 4 feet deep under the travelway and filling it with rock and gravel to the level of the drainage bottom. Channel banks on either side of these deeper crossings would be cut down to reduce grade where necessary. Culverts would be installed on smaller, steeper channel crossings. Topsoil would be conserved before construction of the channel crossing occurs. In addition, the total area to be disturbed would be flagged on the ground before construction begins.

2.1.3.1.2. Well Pad Design and Construction

Six of the proposed wells would be drilled on surface lands administered by the BLM. A graded well pad would be constructed at each drill location using cut and fill construction techniques. [Appendix B](#) contains a schematic drawing of the layout for a typical drill site. The dimensions of each well pad would be about 200 feet by 200 feet. Each well site would disturb an estimated 1.0 acres, including cut and fill slopes.

A temporary reserve pit about 40 feet wide by 40 feet long by 20 feet deep would be excavated at each drill location and would be reclaimed after well completion operations end. Topsoil would be removed and stockpiled as required by the BLM before the pit is excavated. The Companies estimate that the reserve pit would be open for 2 to 8 weeks to allow fluids to evaporate. During this time, the pit would be fenced on all sides to prevent wildlife or livestock from falling in.

In the event that drilling is non-productive at any site, all associated disturbed areas would be reclaimed to the approximate landform that existed before construction.

Reclamation would encompass the drill location and new access road. Reclamation and site stabilization techniques would be applied as specified in the MSUP.

If drilling is productive, all access roads to the well site would remain in place for well servicing (such as maintenance and improvements). Portions of the drill location outside the well pad that are no longer needed would be reclaimed. Any portions of the access road ROW that are no longer needed also would be reclaimed. The outside ditch cuts also would be seeded and reclaimed.

2.1.4. Drilling and Completion Operations

A conventional drilling rig would be used to drill the gas wells and injection wells. Additional equipment and materials needed for drilling operations would be trucked to the drill location. The well control system would be designed to meet the conditions likely to be encountered in the hole and would conform to BLM and State of Wyoming requirements. Drilling plans and a completed well bore are included in [Appendix C](#).

Water for use in drilling the wells would be obtained from existing gas wells completed in the coal seams of the Mesaverde Group. Approximately 700 barrels (almost 30,000 gallons) of water would be needed to drill each well. The actual volume of water used in drilling operations would depend on the depth of the well and any losses that might occur during drilling. The proposed project also would require almost 70,000 gallons of water per well for preparation of cement or stimulation of the well (55,440 gallons), and control of dust (14,000 gallons). In all, nearly 100,000 gallons (about 0.3 acre-feet) of water per well would be used. Dust abatement would comply with all applicable WOGCC requirements. Only water suitable for livestock use would be used for dust abatement.

No oil or other oil-based drilling additives, chromium- or metals-based muds, or saline muds will be used during drilling of these wells. Only fresh water, biodegradable polymer soap, bentonite clay, and non-toxic additives will be used in the mud system.

Depending on the location of the coal seam, each producing well would be drilled to a depth of 4,050 feet to 5,850 feet or deeper. The drilling and completion operation for a shallow gas well normally requires approximately 10 to 15 workers at a time, including personnel for logging and cementing. Each well would be drilled within a period of 7 to 10 days.

A mobile completion rig similar to the drill rig may be transported to the well site and used to complete each well. Completion operations are expected to average 2 to 5 days per well. When the applicable permits are received, natural gas may be vented or flared. Formation water may be temporarily contained in the reserve pit during drilling and well completion activities. All fracturing fluids will be contained in closed tanks on location. During the testing period, produced water from the Mesaverde aquifer will be contained in closed tanks on location or trucked to an authorized disposal well, pending the completion of flowlines for produced water. All closed tanks on location will be encompassed by a 3.5 foot berm that will contain the entire contents of the largest tank in use, plus 10 percent, with one foot of freeboard, as authorized by BLM.

The injection wells would be drilled with the same equipment and personnel used for the gas wells. Depth of the injection wells, which would be completed in the Cherokee or Deep Creek sands, is expected to be between 5,965 and 6,335 feet. Drilling and completing each injection well would require approximately 7 to 14 days; installing surface equipment, holding tanks, and pumping equipment may require an additional 14 days. A schematic of a typical injection well is shown in [Appendix B](#).

2.1.5. Production Operations

Roads, culverts, cattle guards, pipelines, stock watering facilities, or other structures could be left in place at the end of the project for any beneficial use, as designated by the affected surface owners and the BLM. Water wells and produced water would be available to the surface owners and BLM, provided appropriations, diversion, and storage rights are properly filed with the Wyoming State Engineer's Office (WSEO). BLM surface ownership lands that contain disturbed areas or facilities that are no longer needed would be reclaimed in accordance with applicable regulations. Non-federal lands would be reclaimed in accordance with the requirements of the surface owner.

2.1.5.1.1. Well Production Facilities

Wells determined to be productive would be shut in until pipelines and other production facilities are constructed. Natural gas in the coal seam would then be produced through perforations in the casing.

Wellhead facilities would be installed if the wells are productive. A weatherproof covering would be installed over the wellhead facilities. A downhole pump would be used to produce water from the cased and perforated pay intervals. If productive, natural gas and produced water would be collected and transported from the wellhead via buried pipelines. Gas and water would be measured as specified in the MSUP. Additionally, a vertical separator at some well sites would separate gas from the water stream.

The long-term surface disturbance at the location of each productive well would encompass approximately 0.25 acre, including cut and fill slopes. Typically, only the production facilities at the well site would be fenced or otherwise removed from existing uses. A loop road or a small, graveled pad area would provide a safe turnaround area for vehicles. The perimeter of the pad area would be fenced if adjacent cut and fill slopes represent a safety hazard for vehicles. A typical gas production well site is shown in [Appendix B](#).

2.1.5.1.2. Power Generation

Electricity would be used to power pumps to initiate and maintain production. Engines fired either by natural gas or propane would be used to run generators temporarily at individual wells until electric distribution lines can be analyzed in the Atlantic Rim EIS and then constructed. The Companies may choose to use centrally located generation equipment at the Red Rim compressor station and an underground distribution system to provide power to well sites. Utility lines would be installed in the same trench as the gas gathering and water gathering lines to minimize surface disturbance. Electrical motors or

natural gas-fired reciprocating or microturbine engines would power booster or blower units if they are required on the gas wells. Future compressors are anticipated to be powered by natural gas engines or electric motors. All utility lines would be buried in accordance with the Interim Drilling Policy.

2.1.5.1.3. Summary of Pipelines and Related Facilities

Construction and installation of gathering lines for gas and water would occur at the same time as access roads are constructed or immediately after drilling has been completed. Construction and installation of the gas delivery pipeline would occur after the producibility of the wells has been confirmed. All produced water used to test the integrity of the gas delivery pipeline (500 bbls or 21,000 gallons) would be injected. ROWs located in the same corridor will overlap each other to the maximum extent possible, while maintaining sound construction and installation practices. Where ROW corridors are located along a road, working space for installation of facilities will be along the road. Pipeline corridors would be reclaimed as soon as practical after construction of the pipeline is complete. Three types of pipelines would be constructed as part of the proposed project:

1. A gas-gathering pipeline system (low pressure) would be constructed from the wellheads to the central compressor station. This system would use high-density polyethylene (HDPE) pipe, starting with 4-inch diameter pipe at the wellhead, and graduating up to 12-inch diameter pipe at the inlet to the compressor.
2. Produced water-gathering pipeline systems (low pressure) would be constructed from the wellheads to the centralized conditioning facilities and from the centralized conditioning facilities to the surface discharge outfalls and tire tanks used for stock watering. Water lines also would be constructed from the centralized conditioning facilities to the injection facilities for wastewater. This network of water lines would use 4-inch through 12-inch diameter pipe made of HDPE.
3. A gas-delivery pipeline (high pressure) would be constructed from the compressor station to an existing transmission pipeline. This pipeline would be constructed of 8-inch diameter steel pipe.

Related facilities would include the Red Rim compressor station and water management facilities. Water management would include two water conditioning sites that are collocated with injection wells, three surface discharge outfalls, and stock tanks.

Gathering Systems, Utilities, and Facilities for Conditioning and Injection

The ROWs for the gathering systems would typically follow access roads, except in a limited number of cases where topography dictates otherwise or as required by the BLM. Trenches would be excavated to install the flowlines and electrical lines, and then backfilled. Gas-gathering and produced water-gathering pipelines would be laid together in the same trench when practical. Trenches excavated for well gathering lines and electrical lines are expected to temporarily disturb 30-foot wide corridors, which would

be reclaimed as soon as practical after construction is completed. An additional area, estimated to be 10 feet wide, would be used to transport machinery, personnel, and equipment along the corridor to install flowlines and electrical lines, wherever the gathering system would not follow an access road. This corridor is used to allow working room for the machinery, personnel, and equipment during the installation process. Corridors for the system of gathering lines in the Project Area would be about 9.3 miles long. About 3.9 miles of corridors for gathering lines would be located on BLM surface ownership lands.

Separate gathering lines that are buried would transport natural gas from the wellheads to the compressor station and produced water to the water conditioning facilities. Produced water would be routed to one of two centralized water conditioning sites. A typical facility for water conditioning is shown in [Appendix B](#).

After it has been conditioned, produced water would be piped from the centralized conditioning facilities to the surface discharge outfalls and tire tanks used for stock watering. A small portion of the water produced from gas wells (about 5 gallons per minute at each location identified on Figure 2-1) would be dispensed for use by livestock. Water would be piped into self-contained tire tanks that would not discharge produced water into drainages. A separate gathering line would be used to transport wastewater between the conditioning facilities in the event that only one injection well would be used. Corridors from the conditioning facilities to the outfalls and stock tanks would not contain gas-gathering lines. All other corridors would contain both gas-gathering and produced water-gathering lines. The alignments of the gathering lines are shown on [Figure 2-1](#).

The central water conditioning sites also would serve as locations for central injection facilities and disposal wells ([Figure 2-1](#)). The centralized water conditioning facilities would be located in Sections 21 and 29 of T20N R89W. The centralized conditioning facilities would be approved, as required, and each would be collocated with an injection well. A typical water disposal facility is shown in [Appendix B](#). The injection wells also would be approved, as required.

A typical injection facility would consist of a pad of approximately 200 feet by 200 feet that would disturb an estimated 1.0 acre, including cut and fill slopes. Each facility would contain four 400-bbl water tanks, pump house, piping, and well house. An approximate 3.5-foot berm would be constructed around the perimeter of the water tanks, excluding the pump shed, at each injection facility to contain any potential spills on the pad. The pump shed would be excluded from the berm area to minimize the potential for electrical or safety hazards that could occur if water entered the pump shed and caused electrical shorts. The berm would be constructed to contain the water from the largest tank, plus 10 percent, and maintain a freeboard (extra capacity) of 1 foot.

The approximate minimum injection capacity of the AR Fee 2089 21I injection well would be 5,000 barrels per day (bbls/day), and the maximum injection capacity would be 12,000 bbls/day. The approximate minimum injection capacity of the AR Fee 2089 29I injection well would be 5,000 bbls/day, and the maximum injection capacity will be 12,000 bbls/day. The injection capacity would be determined by the permeability of the

receiving reservoirs and limits on the injection pressure to preclude fracturing the formation, and would be established in the permit for each well.

Water transfer pumping stations may be used during production operations to transfer produced water from the gas wells to the water handling facilities. The transfer pumping stations are needed in areas where differences in elevation require supplemental pumping to transfer the produced water. If transfer pumping stations are required, they will be identified in the MSUP. Each pumping station would contain up to two 400-barrel water tanks, an inlet separation vessel, and a small centrifugal water pump. A small pump shed would be constructed to enclose the pump. Each pumping station would consist of a pad of approximately 125 feet by 125 feet that would disturb an estimated 0.4 acre, including cut and fill slopes. An approximate 3.5-foot berm would be constructed around the perimeter of the water tanks, excluding the pump shed, at each pumping station to contain any potential spills on the pad. The pump shed would be excluded from the berm area in order to minimize the potential for electrical or safety hazards that could occur if water entered the pump shed and caused electrical shorts. The berm would be constructed to contain the water from the largest tank, plus 10 percent, and maintain a freeboard (extra capacity) of one foot. A berm that is about 40 feet by 25 feet, with a water height of 2.5 feet could contain 2,500 cubic feet of water, equivalent to the 2,250 cubic feet of water contained in a 400 bbl tank, with additional capacity (10 percent). A typical water transfer facility is shown in [Appendix B](#).

Gas-Delivery Pipelines and Compression

Produced natural gas under wellhead pressure would move through the low-pressure gas-gathering system to the compressor station. Typical pressure in the lines for a gathering system of the type proposed for this project is less than 100 pounds per square inch (psi). Gas arriving at the compressor station would be compressed from the pressure in the gathering line to facilitate delivery and introduction of the gas into an existing transmission pipeline located in Section 30, T21N R87W. Compression of the gas at a field compressor station would increase the pressure to an estimated 700 to 1,450 psi.

The compressor station will be sited to allow for the installation of one compressor initially, with the addition of up to two more compressors later in the life of the field. Each compressor would be sized to handle 5 MMCFD from 15 psi suction pressure to 1,200 psi discharge pressure. Each compressor would be driven by a natural gas engine that would be designed to meet all specifications established by the Wyoming Department of Environmental Quality, Air Quality Division (WDEQ-AQD). Generally, all engines used to drive compressors would have emissions of less than 1.5 g/bhp-hr, or less than 16.7 tons per year of nitrogen oxides (NO_x), and 0.5 hg/bhp-hr, or less than 5.6 tons per year of carbon monoxide (CO). Additional equipment at each compressor station would include a tri-ethylene glycol (TEG) dehydration system, which would dry the gas to meet all pipeline-quality specifications of the market pipeline.

The pad at the compressor station would be 300 feet by 300 feet and would result in approximately 2.2 acres of disturbance, including cut and fill slopes. All compressor engines would be housed within structures designed in accordance with applicable regulations. A typical compressor station is shown in [Appendix B](#).

Should encouraging quantities of natural gas be discovered, a delivery pipeline would be required to move the gas to an existing system located in Section 30 of T21N R87W. The alignment of the delivery line from the compressor station to the existing transmission pipeline is shown on [Figure 2-1](#). The Companies are applying for a ROW for the 8-inch diameter steel pipeline that would be buried 6 feet deep on a 50-foot wide ROW. This pipeline would be anchored at the compressor station and would proceed northeast to the existing pipeline in Section 30 of T21N R87W. This gas delivery pipeline would be 10.2 miles long, of which about 4.6 miles would be located on BLM surface ownership lands.

Construction and installation of this delivery pipeline would temporarily disturb a 50-foot wide corridor, which would be reclaimed as soon as practical after construction is completed. An additional area, estimated to be 25 feet wide, would be used to transport machinery, personnel, and equipment along the corridor to install the pipeline, wherever the delivery pipeline would not follow an access road. This corridor would allow working room for the machinery, personnel, and equipment during the installation process.

The delivery pipeline will be constructed using open cut construction methods for upland areas, and dry ditch construction methods for water body crossings. The disturbed area will be kept to a minimum. In order to minimize surface disturbance, the operator will use wheel trenchers (ditchers) or ditch witches, where possible, to construct all pipeline trenches associated with this project. Trenches that are open for the installation of pipelines will have plugs placed no more than 1,000 feet apart to allow livestock and wildlife to cross the trench or walk out of it, if needed. Placement of plugs will be determined in consultation with BLM and any affected landowner.

The Companies would complete the pipeline during periods when key habitats are not occupied to limit human presence in and disturbance of key wildlife habitats during critical periods of use. The availability of adequate working space would accelerate construction. Surface disturbance would be reclaimed when the pipeline is complete.

2.1.6. Ancillary Facilities

The Companies would operate all wells, pipelines, and associated ancillary production facilities in a safe manner, as set forth in standard industry operating guidelines and procedures. Routine maintenance of producing wells would be necessary to maximize performance and detect potential difficulties with production operations. Each well location would be visited approximately every other day to ensure that operations are proceeding in an efficient and safe manner. The visits would include checking separators, gauges, valves, fittings, tanks, generators, and pumps. The equipment onsite also would be routinely maintained, as necessary. Additionally, all roads and well locations would be regularly inspected and maintained to minimize erosion and assure safe operating conditions.

2.1.7. Estimates of Traffic and Work Force

Estimated traffic requirements for drilling, completion, and field development are shown on **Table 2-2**. The “Trip Type” column lists the various service and supply vehicles that would travel to and from the well sites and production facilities. The “Round-Trip Frequency” column lists the number of trips, both external (to and from the Red Rim Project Area) and internal (within the Red Rim Project Area). The figures provided on **Table 2-2** should be considered general estimates, based on an active drilling program. The level of drilling and production activity may vary over time in response to weather and other factors.

TABLE 2-2 TRAFFIC ESTIMATES

Trip Type	Round-Trip Frequency	
	External (to/from Project Area)	Internal (within Project Area)
Drilling (2 rigs, 2 crews/rig)		
Rig supervisor	4/day	Same
Rig crews	4/day	Same
Engineers ^a	2/week	1/day/rig
Mechanics	4/week	Same
Supply delivery ^b	1/week	2-4/day
Water truck ^c	1/month	2 round trips/day
Fuel trucks	2 round trips/well	Same
Mud trucks ^d	1/week	2/day
Rig move ^e	8 trucks/well	8 trucks/well
Drill bit/tool delivery	1 every 2 weeks	Same
Completion and Operations (2 rigs, 2 crews/rig)	External (to/from Project Area)	Internal (within Project Area)
Small rig/crew	1/day	Same
Cement crew	2 trips/well	Same
Consultant	1/day	Same
Well loggers	3 trips/well	Same
Gathering systems	2/day	Same
Power systems	2/day	Same
Compressor station	2/day	Same
Other field development	2/day	Same
Testing and operations	2/day	Same

Notes:

- ^a Engineers travel to Project Area weekly and stay in a mobile home at the Project Area during the week.
- ^b Current plans are to establish a central supply area within the Project Area and deliver supplies weekly.
- ^c Water trucks would deliver water to rigs from a location within the Project Area and provide dust abatement for roads in the Project Area.
- ^d Current plans are to establish a central mud location within the Project Area and deliver mud weekly.
- ^e Four trucks would be required to move each rig to the Project Area. When drilling is complete in a Project Area, each rig would move to the next Project Area.

2.1.8. Site Restoration and Abandonment

The Companies would completely reclaim all disturbed areas that are not needed for production. Reclamation would generally include: (1) complete cleanup of the disturbed areas (drill sites and access roads, for example), (2) restoring the disturbed areas to the approximate ground contour that existed before construction, (3) replacing topsoil over all disturbed areas, (4) ripping disturbed areas to a depth of 12 to 18 inches, and (5) seeding recontoured areas with a BLM-approved, certified weed-free seed mixture.

2.1.9. Summary of Estimated Disturbances

Table 2-3 summarizes the estimated disturbances that would result from implementation of the project.

TABLE 2-3 ESTIMATES OF DISTURBED AREA – RED RIM PROJECT AREA

Facility	Construction Phase				Operations
	Length (feet)	Width (feet)	Area, ea. (acres)	Temporary Acres	Life of Project Acres
New Roads	12,300	40	N/A	11.3	11.3
Existing Well Access Road ^a	32,300	40	N/A	29.7	29.7
Existing Road to be Upgraded ^b	17,400	40	N/A	16.0	16.0
Corridors for New Gathering Lines and Utilities	49,600	30	N/A	34.2	0
Corridor for New Market Access Line	52,800	50	N/A	60.6	0
New Drill Locations (9)	N/A	N/A	1.0	9.0	2.3
Injection Well (2)	N/A	N/A	1.0	2.0	2.0
Existing Well Location (7)	N/A	N/A	1.0	7.0	1.8
Compressor Station (1)	N/A	N/A	2.2	2.2	2.2
Water Conditioning Facility (2)	N/A	N/A	2.6	5.2	5.2
Monitoring Well (1)	N/A	N/A	1.0	1.0	0.2
Total New Disturbance				141.5	39.2
Total Disturbance				178.2	70.7

Notes:

a Carbon County Road 605 not included in existing well access road

b Existing two-track that would be upgraded, and the portion of Carbon County Road 605 within the Project Area that would be used during the project

2.1.10. Project-Wide Mitigation Measures and Procedures

For this project, the Companies have voluntarily agreed to use and comply with the following measures and procedures to avoid or mitigate potential impacts to resources or other land uses, after consultation with BLM regarding agency requirements. These

measures and procedures will be referred to as Best Management Practices (BMPs) throughout this document. These mitigation measures and procedures would be applied on privately owned surface unless the private surface owners involved specifically require alternative actions. An exception to a mitigation measure or design feature may be approved on public land on a case-by-case basis when deemed appropriate by the BLM. An exception would be approved only after a thorough, site-specific analysis had concluded that the resource or land use that the measure was intended to mitigate is not present or would not be significantly affected in the absence of the mitigating measures.

2.1.10.1.1. Preconstruction Planning, Design, and Compliance Measures

1. The Companies would designate a qualified representative to serve as compliance coordinator. This person will be responsible for ensuring that all requirements of the APD and Plan of Development (MSUP, MDP, WMP, and Conditions of Approval) are followed.
2. The Companies and the BLM would make onsite inspections of each proposed and staked facility site (such as drill locations and other facilities), new access road, access road upgrades, and pipeline alignment projects to develop site-specific recommendations and mitigation measures.
3. New roads would be constructed and existing roads maintained in the Project Area in accordance with standards in BLM Manual 9113 and applicable regulations for resource roads and construction details outlined in the MSUP and Conditions of Approval. These standards would be followed on BLM surface ownership lands.
4. Prior to construction, the Companies would submit an APD package to BLM. This package would contain individual APDs for each drill site, as well as the MDP, MSUP, WMP, schematics of facilities, and ROW applications for pipelines, utilities, and access roads. APDs submitted by the Companies would show the layout of the drill pad over the existing topography, the dimensions of the pad, cross sections of the cuts and fills (when required), the location and dimensions of reserve pits, and locations of access roads.
5. The Companies would design and engineer construction when required by the BLM (for example, in steep or unstable slopes) and receive approval from the BLM before construction begins.
6. BLM would require roads to be crowned with a 0.3- to 0.5-foot crown, and ditched. The topsoil would be graded over the cut slope so no berm is left at the top of the cut slope.
7. BLM would require that culverts be covered with a minimum of 12 inches of fill or one-half the diameter of the pipe, whichever is greater. The inlet and outlet will be set flush with existing ground and lined up in the center of the draw. Before the area is backfilled, the bottom of the pipe will be bedded on stable ground that does not contain expansive or clay soils, protruding rocks that would damage the pipe, or unevenly sized material that would not form a good seat for the pipe. The site

would be backfilled with unfrozen material and rocks no larger than 2 inches in diameter. Care would be exercised to thoroughly compact the backfill under the haunches of the conduit. The backfill would be brought up evenly in 6-inch layers on both sides of the conduit.

8. Additional culverts would be installed in the existing access road as needed or as directed by BLM.
9. The access roads would be surfaced with an appropriate grade of aggregate or gravel to a depth of 4 inches before the drilling equipment or rig is moved onto the pad.
10. BLM would require that access roads be maintained in a safe and usable condition. A regular maintenance program would include, but is not limited to, blading, ditching, installing or cleaning culverts, and surfacing.
11. The written approval of the authorized officer will be obtained before snow removal outside the new and existing roadways is undertaken. If approval is given, equipment used for snow removal operations outside the road ditches will be equipped with shoes to keep the blade off the ground surface. Special precautions will be taken where the surface of the ground is uneven to ensure that equipment blades do not destroy the vegetation.
12. BLM would require that wing ditches be constructed, as necessary, to divert water from road ditches.
13. Trenches that are open for the installation of pipelines should have plugs placed no more than 1,000 feet apart to allow livestock and wildlife to cross the trench or walk out of it, if needed. Placement of plugs would be determined in consultation with BLM and any affected landowner.
14. Procedures would be implemented to prevent livestock or wildlife from falling into open excavations. Procedures could include temporary covers, fencing, or other means acceptable to BLM and any affected landowner.

2.1.10.1.2. Resource-Specific Requirements

The Companies propose to implement the following resource-specific mitigation measures, procedures, and BLM management requirements on public lands.

Geology, Minerals, and Paleontology

Mitigation measures presented in the sections of this EA on Soils and Water Resources would avoid or minimize many of the potential impacts to surface mineral resources. BLM and WOGCC policies on casing and cementing would protect subsurface mineral resources from adverse impacts.

Scientifically significant paleontological resources that may occur within the Lance Formation, the only geologic formation of concern exposed at the surface in the Project Area, would be protected through the following mitigation measures:

1. If recommended by BLM, each proposed facility located in areas of known and potential vertebrate paleontological resources would be surveyed by a BLM-approved paleontologist before any surface disturbance is allowed (BLM 1987 and 1990).
2. Discovery. Project personnel would make contingency plans for the accidental discovery of significant fossils. If construction personnel discover fossils during implementation of the project, the BLM would be notified immediately. If the fossils could be adversely affected, construction would be redirected or halted until a qualified paleontologist had assessed the importance of the uncovered fossils, the extent of the fossiliferous deposits, and had made or implemented recommendations for further mitigation.
3. Field Survey. No specific data currently exist on deposits of high or undetermined paleontologic potential in Project Area. For that reason, field survey for paleontologic resources would be conducted on a case-by-case basis, as directed by the BLM. These resources would be surveyed in areas where surface exposures of the Browns Park, Green River, or Wasatch Formations occur. A field survey may result in the identification of additional mitigation measures needed to reduce adverse impacts to fossil resources. This mitigation may include collection of additional data or representative samples of fossil material, monitoring excavation, or avoidance. In some cases, no action beyond the measures taken during the field survey may be necessary.

A report would be submitted to the BLM after each field survey is complete. The report will describe in detail the results of the survey, with a list of fossils collected, if any, and may recommend additional mitigation measures. If scientifically significant fossils are collected, the report must document the curation of specimens into the collection of an acceptable museum repository and must contain appropriate geologic records for the specimens.

Air Quality

1. All activities conducted or authorized by BLM must comply with local, state, tribal, and federal air quality regulations and standards. The Companies would adhere to all applicable ambient air quality standards, permit requirements (including preconstruction, testing and operating permits), standards for motorized equipment, and other regulations, as required by the WDEQ-AQD.
2. Before any wells are vented or flared, WDEQ-AQD would be notified as required by Wyoming Air Quality Standards and Regulations, Chapter 1, Section 5 *Reporting Guidelines for Well Flaring and Venting*. Test periods longer than 15 days would require authorization by WOGCC, in accordance with Chapter 3, Section 40 *Authorization for Flaring and Venting of Gas*.

3. On federal land, the Companies would immediately abate fugitive dust (by application of water, chemical dust suppressants, or other measures) when air quality is impaired, soil is lost, or safety concerns are noticed by the Companies or identified by the BLM or the WDEQ-AQD. These concerns include, but are not limited to, actions that exceed applicable air quality standards. BLM would approve the control measure, location, and application rates. If watering is the approved control measure, the operator must obtain the water from state-approved sources in accordance with any applicable regulations.
4. The Companies would not allow garbage or refuse to be burned at well locations or other facilities.

Soils

1. The Companies would reduce the area of disturbance to the absolute minimum necessary for construction and production operations while providing for the safety of the operation.
2. Where feasible, the Companies would locate pipelines immediately adjacent to roads to avoid creating separate areas of disturbance and to reduce the total area of disturbance.
3. The Companies would avoid using frozen or saturated soils as construction material.
4. The Companies would minimize construction in areas of steep slopes.
5. Cut slopes would be designed in a manner that would retain topsoil, and facilitate use of surface treatment such as mulch and subsequent revegetation.
6. The Companies would selectively strip and salvage topsoil or the best suitable medium for plant growth from all disturbed areas. Topsoil would be removed and conserved to a minimum depth of 6 inches and a maximum of 12 inches from all drill locations, unless otherwise agreed by the BLM and the operator.
7. Where possible, disturbance to vegetated cuts and fills would be minimized on existing improved roads.
8. The Companies would install runoff and erosion control measures such as water bars, berms, and interceptor ditches if needed.
9. The Companies would install culverts for ephemeral and intermittent drainage crossings. In addition, drainage crossing structures would be designed to carry the 25-year discharge event, or as otherwise directed by the BLM.
10. Layout of the access roads may require minor variations in routing to avoid steep slopes adjacent to ephemeral or intermittent drainage channels. Where possible, the

Companies would maintain a 100-foot wide buffer of natural vegetation (not including wetland vegetation) between construction and ephemeral and intermittent channels.

11. The Companies would include adequate drainage control devices and measures in the design of roads (for example, berms and drainage ditches, diversion ditches, cross drains, culverts, out-sloping, and energy dissipaters). These devices and measures would be located at sufficient intervals and intensities to adequately control and direct surface runoff above, below, and within the road to avoid erosive, concentrated flows. In conjunction with surface runoff or drainage control measures, the Companies would use erosion control devices and measures such as temporary barriers, ditch blocks, erosion stops, mattes, mulches, and vegetative covers. In addition, the Companies would implement a revegetation program as soon as possible to reestablish the soil protection afforded by vegetation.
12. When the use of an area that is not specifically required for production operations is complete, the Companies would restore topography to near pre-existing contours at the well sites, along access roads and pipelines, and other facilities sites. The Companies also would replace up to 6 inches of topsoil or suitable plant growth material over all disturbed surfaces; apply fertilizer as required; seed; and mulch.

Water Resources

Other mitigation measures listed in the sections of this EA on Soils, and Vegetation and Wetlands would apply to Water Resources.

1. Applications would be submitted for all necessary NPDES permits as required by the Water Quality Division (WQD) of WDEQ for discharge of produced water into ephemeral drainages. Plans for surface discharge are described in the WMP (**Appendix D**).
2. The Companies would limit construction of all drainage crossings to no-flow or low-flow periods.
3. The area of disturbance would be minimized within perennial, ephemeral, and intermittent drainage channels.
4. BLM would prohibit construction of well sites and other non-linear features within 500 feet of surface water and riparian areas. BLM would grant possible exceptions for linear features based on a site-specific environmental analysis and site-specific mitigation plans.
5. The Companies would design channel crossings to minimize changes in channel geometry and subsequent alterations in flow hydraulics.
6. Layouts of the access roads may require minor variations in routing to avoid steep slopes adjacent to ephemeral or intermittent drainage channels. Where possible, a

100-foot wide buffer of natural vegetation (not including wetland vegetation) would be maintained between construction and ephemeral and intermittent channels.

7. Interceptor ditches, sediment traps, water bars, silt fences, and other revegetation and soil stabilization measures would be designed and constructed, as needed.
8. The Companies would construct channel crossings by pipelines such that the pipe is buried a minimum of 4 to 6 feet below the channel bottom, as specified by BLM.
9. Disturbed channel beds would be regraded to the original geometric configuration and would contain the same or similar bed material.
10. Wells must be cased during drilling, and all wells cased and cemented in accordance with Onshore Order No. 2 to protect all high-quality aquifers. High-quality aquifers exhibit known water quality of 10,000 milligrams per liter total dissolved solids (TDS) or less. Well casing and welding must be of adequate integrity to contain all fluids under high pressure during drilling and well completion. Furthermore, wells would adhere to the appropriate BLM cementing policy.
11. The reserve pits would be constructed in cut rather than fill materials. Fill material must be compacted and stabilized, as needed. The subsoil material of the pit to be constructed should be inspected to assess stability and permeability and to evaluate whether reinforcement or lining is required. If lining is required, the reserve pit must be lined with a reinforced synthetic liner at least 12 mils thick and with a bursting strength of 175 by 175 pounds per inch (American Society for Testing and Materials [ASTM] Standard D 75179). Use of closed or semi-closed drilling systems should be considered in situations where a liner may be required.
12. Two feet of freeboard must be maintained on all reserve pits to ensure they are not in danger of overflowing. Drilling operations must be shut down if leakage is found outside the pit until the problem is corrected.
13. Hydrostatic test water used in conjunction with pipeline testing, and all water used during construction or dust abatement must be extracted from sources that contain sufficient quantities and with appropriation permits approved by the State of Wyoming.
14. Hydrostatic test water would be injected into an authorized deep injection well, in compliance with all applicable requirements.
15. All concentrated water flows must be discharged within the ROW for an access road onto or through an energy dissipater structure (such as riprapped aprons and discharge points) and into undisturbed vegetation.
16. If required by the applicable regulations, the Companies would develop and implement a pollution prevention plan (PPP) for storm water runoff at drill sites as

required per WDEQ permit requirements under NPDES. All required WDEQ permits will be in place before water is discharged.

17. The Companies would exercise stringent precautions against pipeline breaks and other potential accidental discharges of oil or hazardous chemicals into adjacent streams. If liquid petroleum products are stored on site in sufficient quantities (per the criteria contained in Title 40 CFR Part 112), a Spill Prevention Control and Countermeasures (SPCC) plan would be developed in accordance with 40 CFR Part 112.
18. The Companies would coordinate all crossings or encroachments of waters of the U.S. with the U.S. Army Corps of Engineers (COE).
19. BLM must approve in writing any changes in the method or location for disposal of produced water.

Vegetation, Wetlands, and Noxious Weeds

Other mitigation measures under the section on Soils and Water Resources of this EA would also apply to vegetation and wetlands.

1. Noxious weed monitoring forms must be filed with the BLM, and the Companies must implement, if necessary, a weed control and eradication program.
2. The Companies would evaluate all project facility sites for occurrence and distribution of waters of the U.S., special aquatic sites, and jurisdictional wetlands. All project facilities would be located out of these sensitive areas. If complete avoidance is not possible, the Companies would minimize impacts through modification and minor relocations. The Companies will comply with applicable regulations for any activities that involve dredge or fill of wetlands.
3. An approved Pesticide Use Proposal would be obtained before herbicides or other pesticides are applied on BLM surface ownership lands to control noxious weeds.
4. Disturbed areas would be seeded and stabilized in accordance with BLM-approved reclamation guidelines.

Range Resources and Other Land Uses

Mitigation requirements listed under sections of this analysis on Soils, Vegetation, Wetlands, Noxious Weeds, and Wildlife also apply to Range Resources and Other Land Uses.

1. The Companies would coordinate with the affected livestock operators to ensure that livestock control structures remain functional (as directed by the livestock operator) during drilling and production operations, and to coordinate timing of activities planned.

2. When necessary, traffic control and speed limits would be used to limit potential conflicts.

Wildlife

1. During reclamation, the Companies would establish a variety of forage species that would return the land to a condition that approximates or is equal to its state before disturbance.
2. The Companies would prohibit unnecessary off-site activities of operational personnel near the drill sites. The Companies also would inform all project employees of applicable wildlife laws and the potential penalties associated with unlawful take and harassment.
3. The Companies would limit construction within crucial winter range for big game from November 15 to April 30, unless authorized by BLM.
4. A raptor survey would be completed before construction begins to ensure that well sites are located away from potential conflict areas.
5. The Companies would survey and clear well sites within 1 mile of raptor nests identified in the raptor survey before construction or drilling can begin during the raptor nesting period (February 1 through July 31).
6. When an “active” raptor nest is located 0.75 to 1 mile from a proposed well site (depending on species and line of sight), the Companies must restrict construction during the critical nesting season for the species. The distance would be increased to within 1 mile of a proposed well site for listed and BLM sensitive species (Chapter 3).
7. Raptor nests must be inventoried annually to evaluate potential nesting activity in areas where work may be occurring during the raptor nesting period from February 1 to July 31. BLM conducts inventories annually.
8. The Companies must protect leks for greater sage-grouse during the breeding, egg-laying, and incubation period (March 1 through June 30) by restricting construction within a 2-mile radius of active leks for greater sage-grouse. Exceptions may be granted if the activity would occur in unsuitable nesting habitat.
9. Construction, drilling, or other activities that could disrupt nesting areas are prohibited during the period from February 1 to July 31 (raptors) and from March 1 to June 30 (greater sage-grouse and sharp tailed grouse) for the protection of nesting areas for these species. An exception would be approved only after a thorough, site-specific analysis concluded that a negative impact would not occur.
10. Surface occupancy, Construction, or use of Public land within 0.25 mile of a greater sage-grouse strutting or dancing ground will be restricted or prohibited unless the

operator and surface managing agency arrive at an acceptable plan for mitigation of anticipated impacts.

11. All pits and open cellars must be fenced for the protection of wildlife and livestock. Fencing must be in accordance with BLM specifications. Netting must be placed over all production pits to eliminate any hazard to migratory birds or other wildlife. Netting is also required over reserve pits that have been identified as containing oil or hazardous substances as these terms are defined in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 101 (14), as determined by visual observation or testing. The mesh diameter shall be no larger than 1 inch.

Fisheries

1. No mitigation for fisheries is needed beyond the measures indicated under Water Resources and Special Status Species.

Special Status Species

Special Status Plants

1. The Companies would employ site-specific recommendations developed by the BLM interdisciplinary team (IDT) for staked facilities.
2. The occurrence and distribution of two T&E plants (Ute ladies'-tresses orchid and western prairie fringed orchid) and seven BLM sensitive plants (Laramie columbine, Nelson's milkvetch, Cedar Rim thistle, Weber's scarlet gilia, Gibben's beardtongue, persistent sepal yellowcress, and Laramie false sagebrush) will require specific consideration during the APD process.
3. Impacts caused by clearing and soil handling must be minimized.
4. Clearance surveys must be performed for plant species of concern.

Recreation

Measures under the section of the EA on Wildlife, Transportation, Soils, Health and Safety, and Water Resources apply to Recreation.

1. The Companies must minimize conflicts between project vehicles and equipment and recreation traffic by posting warning signs, implementing operator safety training, and requiring project vehicles to adhere to low speed limits.

Visual Resources

1. Roads, pipeline corridors, drill rigs, wellheads, and production facilities must be screened from view to the extent possible, when specified by BLM.

2. The Companies must paint structures at wells and central facilities with flat colors (such as Carlsbad Canyon) that blend with the adjacent undisturbed terrain. This measure does not apply to structures that require safety coloration in accordance with the requirements of the Occupational Safety and Health Administration (OSHA).

Cultural Resources

1. A Class III inventory for cultural resources has been done, but if the area of potential effect were to change, additional inventory would be required.
2. Avoidance is the preferred method for mitigating adverse effects to a property that is considered eligible for, or is already on, the NRHP.
3. Adverse effects to cultural or historical properties that cannot be avoided would be mitigated by preparing and implementing a cultural resources mitigation plan. Mitigation plans would be developed as needed for eligible sites that would be impacted.
4. If cultural resources are discovered at any time during construction, all construction would halt and BLM would be immediately notified. Work would not resume until BLM issues a Notice to Proceed.

Socioeconomics

1. Project activities must be coordinated with ranching operations to minimize conflicts that involve movement of livestock or other ranch operations. Coordination would include scheduling project activities to minimize potential disturbance of large-scale livestock movements. The Companies would establish effective and frequent communication with affected ranchers to monitor and correct problems and coordinate scheduling.

Transportation

1. Existing roads would be used as collectors and local roads whenever possible. Standards for road design would be consistent with BLM Road Standards Manual Section 9113. The proposed access road would be constructed to the BLM standard for a local road.
2. Roads that are not required for routine operation and maintenance of producing wells and ancillary facilities or field production would be permanently blocked, reclaimed, and revegetated.
3. Areas with important resource values, steep slopes, and fragile soils would be avoided where possible in planning for new roads.
4. Permits are required from Carbon County for any access to or across a county road or for any pipeline that crosses a county road. These permits would be acquired

before additional roads are built. All roads on public lands that are not required for operation and maintenance of field production would be permanently blocked, re-contoured, and seeded. Roads on private lands would be treated in a like manner, depending on the desires of the landowner.

5. The Companies would be responsible for preventive and corrective maintenance of roads in the Project Area throughout the duration of the project. Maintenance may include blading, surfacing, cleaning ditches and drainage facilities, abating dust, controlling noxious weeds, or other requirements as directed by the BLM or the Carbon County Road and Bridge Department.
6. Except in emergencies, access would be limited to drier conditions to prevent severe rutting of the road surface. No construction or routine maintenance activities would be performed during periods when the soil is too wet to adequately support construction equipment. If such equipment creates ruts in excess of 4 inches deep, the soil would be considered too wet to adequately support construction equipment. Culverts would be installed where needed to allow drainage in all draws and areas of natural drainage. Low water crossings would be used where applicable. Onsite reviews would be conducted with BLM personnel for approval of proposed access before any construction begins.

Health and Safety

Measures listed under the section of the EA on Air Quality and Water Quality also apply to Health and Safety.

1. Sanitation facilities installed on the drill sites and any resident camps would be approved by the WDEQ.
2. To minimize undue exposure to hazardous situations, the Companies would comply with all applicable rules and regulations (such as Onshore Orders and OSHA requirements) that would prevent the public from entering hazardous areas and would post warning signs to alert the public of truck traffic.
3. The Companies would haul all garbage from the drill site to a state-approved sanitary landfill for disposal. In addition, the Companies would collect and store any garbage or refuse on location in containers approved by the BLM until it can be transported.
4. During construction and when production operations begin, the Companies would maintain an inventory of chemicals or hazardous substances for all items that may be at the site. The Companies would institute a Hazard Communication Program for employees and would require subcontractors to establish programs in accordance with OSHA regulations at 29 CFR 1910.1200. These programs are designed to educate and protect employees and subcontractors with respect to any chemicals or hazardous substances that may be present in the work place. In addition, Material Safety Data Sheets (MSDS) would accompany every chemical or hazardous material that is brought on location and would become part of the file

maintained at the Red Rim field office, as required by 29 CFR 1910.1200. All employees would receive proper training in storage, handling, and disposal of hazardous substances.

5. SPCC Plans would be written and implemented as necessary, in accordance with 40 CFR Part 112, to prevent discharge into navigable waters of the United States.
6. If quantities that exceed 10,000 pounds or the threshold planning quantity (TPQ) as designated by the RFO are to be produced or stored in association with the project, chemical and hazardous materials would be inventoried and reported in accordance with the toxic release inventory (TRI) requirements set forth in Title III of the Superfund Amendments and Reauthorization Act (SARA) and codified at 40 CFR Part 335. The required Section 311 and 312 forms would be submitted at the specified times to the state and county emergency management coordinators and the local fire departments.
7. Any hazardous wastes, as defined by the Resource Conservation and Recovery Act (RCRA), would be transported and disposed of in accordance with all applicable federal, state, and local regulations.
8. All storage tanks and compressor facilities that are designed to contain oil, glycol, produced water, or other fluid that may constitute a hazard to public health or safety, must be surrounded by a secondary means of containment for the entire contents of the largest single tank in use, plus 1 foot of freeboard. The Companies would use 3.5-foot berms around affected storage tanks and facilities. The containment or diversionary structure must be impervious to any oil, glycol, produced water, or other hazardous fluid for 72 hours. In addition, it would be constructed so that any discharge from a primary containment system would not drain, infiltrate, or otherwise escape to groundwater, surface water, or navigable waters before cleanup is completed.

Noise

1. The Companies would muffle and maintain all motorized equipment according to Best Management Practices.
2. In any area of operations (such as a drill site or compressor station) where noise levels may exceed safe limits specified by OSHA, the Companies would provide and require that employees use proper personal protective equipment.
3. In addition to other restrictions on activities near leks, the BLM will require that noise levels be limited to no more than 10 decibels on the A-weighted scale (dBA) above background levels at leks for greater sage-grouse that are located on public lands. This scale simulates human hearing by placing less emphasis on lower frequency noise. The BLM will require that compressor engines located on public lands be enclosed in a building and located at least 600 feet away from sensitive receptors or sensitive resource areas to comply with these limits on noise levels.

2.2 ALTERNATIVE 2 – INJECTION OF PRODUCED WATER FROM FEDERAL WELLS WITH LIMITED BENEFICIAL USE

Alternative 2 was developed specifically to respond to issues that address the effects of the surface discharge of produced water on surface resources and uses. BLM altered the Proposed Action for federal wells under the agency's authority by providing for the disposal of produced water by injection instead of surface discharge. Other than the differences described below, Alternative 2 is the same as the Proposed Action. Under Alternative 2, almost all the produced water from the proposed federal wells in Sections 20 and 28 within the Project Area would be injected. Gathering lines would carry produced water from federal wells to the nearest injection well. A small portion of the water produced from gas wells (about 5 gallons per minute at each location identified on **Figure 2-1**) would be dispensed for use by livestock. Water would be piped into self-contained tire tanks that would not discharge produced water into drainages. A water management plan that would apply to Alternative 2 is included as [Appendix D](#).

Produced water from non-federal gas wells in Sections 16, 21, and 29 would be discharged to ephemeral draws on fee lands in compliance with an NPDES permit approved by WDEQ. Gathering lines would carry produced water from non-federal wells to a water conditioning facility and two outfalls located on fee lands in the NE1/4 of Section 21. Two outfalls would be used in order to dissipate the energy of flows and reduce potential erosion of the channel by spreading out the volume of water entering the drainage over two locations.

An outfall on fee lands in the NE1/4 of Section 29 is included in the Companies' NPDES permit. However, this outfall likely would not be needed under Alternative 2, considering the reduced volumes of produced water that would be conditioned and discharged, compared with Alternative 1. Injection of produced water from federal wells under Alternative 2 also would make it unlikely that a second conditioning facility, in Section 29, would be needed. Therefore, under Alternative 2, the conditioning facility and outfall that would have been located on fee lands in Section 29 under the Proposed Action, would not be constructed unless unforeseen circumstances develop that cannot be addressed without constructing these facilities. Examples of circumstances that could affect requirements for facilities would include a much greater volume of produced water than anticipated that cannot be handled by one conditioning facility, or injection formations not accepting the anticipated volumes of water.

Injection wells would be located in Sections 21 and 29 (AR Fee 21I in the NE1/4 of Section 21, and AR Fee 29I in the NE1/4 of Section 29) to dispose of the waste stream from the conditioning facility and to inject produced water from the federal wells. The injection wells also would be available to dispose of produced water from non-federal wells when the water conditioning facility is being maintained.

2.3 ALTERNATIVE 3 – NO ACTION ALTERNATIVE

Section 1502.14(d) of NEPA requires that the alternative analysis include the alternative of no action. Under the No Action alternative, ongoing natural gas production activities would be allowed to continue but the coordinated exploration and interim development described in the Red Rim Plan of Development (proposed project) would not be authorized by BLM. Section 1502.14(d) of NEPA requires that the alternative analysis include the alternative of no action. Under the No Action alternative, ongoing natural gas production activities, if any exist, would be allowed to continue but the coordinated exploration and interim development described in the Red Rim Plan of Development (proposed project) would not be authorized by BLM. The Project Area has been disturbed by existing CBNG exploration (**Table 2-1** and **Table 2-3**). BLM would consider additional APDs and ROW actions for federal lands on a piecemeal or case-by-case basis outside the scope of this EA, consistent with the scope of existing environmental analysis. Transport of natural gas products would be allowed from existing wells within the Project Area. Additional gas development could occur on state and private lands within the Project Area under APDs approved by the WOGCC.

Exploration in Sections 21 and 29, as described below, is included in the No Action alternative because these activities would not require approval from BLM. The Companies would gain access to the fee leases in Sections 21 and 29 from Carbon County Road 605. If gas cannot be transported across federal surface ownership lands because BLM would not approve a ROW until the Atlantic Rim EIS is complete, then gas would be vented during testing in accordance with State of Wyoming requirements.

The produced water from fee wells located in Sections 21 and 29 would be discharged to ephemeral draws in compliance with an NPDES permit approved by WDEQ. Gathering lines would carry produced water from the fee wells in Sections 21 and 29 to a water conditioning facility located in Section 21 near the Abundance outfalls in the E1/2NE1/4, where it would be conditioned and discharged. Produced water from four fee wells located in Section 29 also would be transported to the same water conditioning facility, where it would be conditioned and discharged. A water management plan that would apply to Alternative 3 – No Action is included as **Appendix D**.

An injection well, AR Fee 21I in the NE1/4 of Section 21, would inject the waste stream from the conditioning facility and provide an alternative method for handling water. Injection would be available to dispose of produced water when the water conditioning facility is being maintained.

A small portion of the water produced from fee wells in Sections 21 and 29 (about 5 gallons per minute at each location identified on **Figure 2-1**) would be dispensed for use by livestock. Water would be piped into self-contained tire tanks that would not discharge water into drainages.

2.4 ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL

The proposed project has a limited scope and purpose, to obtain resource information in support of the Atlantic Rim EIS that is currently being prepared. A reasonable range of alternatives under NEPA would include actions under BLM's authority that could be implemented before the Atlantic Rim EIS is completed. Under the Interim Drilling Policy, the proposed project must not significantly affect the environment or prejudice the decisions that would be made as a result of the analysis conducted for the Atlantic Rim EIS. Therefore, construction of new linear features such as access roads or pipelines should occur parallel to existing roads to minimize disturbance. In addition, the integrity of important wildlife habitats and sensitive areas, such as areas of critical environmental concern (ACECs), should not be compromised.

The Proposed Action, Alternative 2, and No Action alternative are consistent with the guidance found in the Interim Drilling Policy – “Development Authorized Concurrent with EIS Preparation for the Atlantic Rim Coalbed Methane Project” ([Appendix A](#)). They address a reasonable range of alternatives for the limited scope and purpose of the proposed project.

Only one route for the market access pipeline (Proposed Action) could be implemented, based on the considerations described below, and was analyzed in detail. Alternatives for federal actions also must be based on the activities under the control of the BLM. For example, BLM would have no authority over activities that would occur on a fee lease. As a result, only one alternative to the project for water management (Alternative 2), other than the No Action alternative, was considered.

The Companies have entered into a sales agreement with a pipeline company that will purchase gas from the Project Area. Alternative routes for the market access pipeline that would transport gas to this pipeline company were considered in this analysis. Furthermore, the Companies' market access pipeline must enter the interstate pipeline at a block valve. Only two block valves exist near the Project Area (Section 34 in T21N R90W and Section 30 in T21N R87W). These two locations were the only end points for the market access line that were considered. The end point in Section 30 was considered in the Proposed Action.

A pipeline route that would move gas from the compressor station to an existing system located in Section 34 of T21N R90W also was considered. This pipeline route would have been 1.4 miles shorter and would have resulted in about 9 acres less disturbance during construction of the pipeline. This northwestern pipeline route would have cost almost \$250,000 less to construct than the northeastern route the Companies included in the Proposed Action. The northwestern route was not analyzed in detail based, in part, on concerns that included crossing undisturbed lands, natural features such as Red Rim and Separation Creek, and crucial winter range for pronghorn antelope. The northwestern route also would have crossed the Red Rim-Daley Wildlife Habitat Management Area. Under the Interim Drilling Policy, pipelines would follow the ROW for the road where possible. BLM and the Companies determined that it was possible to follow the ROW

for the road with the northeastern pipeline route included in the Proposed Action. Therefore, the northwestern pipeline route was dropped from further consideration, in accordance with the Interim Drilling Policy.

Alternate pipeline routes that would have ended at pipelines where the Companies have no sales agreement were not considered alternatives that could be implemented for an interim, exploratory project. An alternative that consists of a market access pipeline to a different interstate pipeline than the one already contracted by the Companies also would represent uneconomic conditions.

Uneconomic routes would not be implemented, and were not analyzed in detail. A person or company of ordinary prudence would consider as uneconomic any pipeline that would cost more to construct, operate, and maintain than the value of the gas, or that would not provide a reasonable rate of return on the Companies' investments in the infrastructure.

3.0 AFFECTED ENVIRONMENT

3.1 INTRODUCTION

The Affected Environment for the proposed Red Rim project discusses environmental, social, and economic factors currently existing within the Red Rim Project Area (Project Area). The Project Area includes the Red Rim Plan of Development (POD), and the pipeline corridor, which extends northeast from the proposed well locations toward Rawlins. The material presented here has been guided by management issues identified by the RFO, by public scoping, and by interdisciplinary field analysis of the area.

The critical elements, as listed in BLM’s NEPA Handbook H-1790-1 (BLM 1988b), and other resource elements of the human environment have been considered. The elements of the human environment, including critical elements, their status in the Project Area, and their potential to be affected by the proposed project, are listed in **Table 3-1**. Those items listed as “none present” would not be affected by the project or the No Action alternative and are not addressed further in this document.

TABLE 3-1 ELEMENTS OF THE HUMAN ENVIRONMENT, RED RIM PROJECT ATLANTIC RIM INTERIM DRILLING PROGRAM CARBON COUNTY, WYOMING – 2003

Element	Project Area Status	Addressed in Text
Geology/Minerals/Paleontology	Potentially affected	Yes
Climate and Air Quality	Potentially affected	Yes
Soils	Potentially affected	Yes
Water Resources (including surface and ground-water quality)	Potentially affected	Yes
Vegetation, Wetlands, and Noxious Weeds (including riparian zones, invasive species, threatened, and endangered, and special status species)	Potentially affected	Yes
Range Resources and Other Land Uses	Potentially affected	Yes
Wildlife/Fisheries (including threatened and endangered species, and special status species)	Potentially affected	Yes
Recreation	Potentially affected	Yes
Visual Resources	Potentially affected	Yes
Cultural Resources	Potentially affected	Yes
Socioeconomics	Potentially affected	Yes
Environmental Justice	Potentially affected	Yes
Transportation	Potentially affected	Yes
Health and Safety	Potentially affected	Yes
Noise	Potentially affected	Yes
Areas of Critical Environmental Concern	None present	No
Prime or Unique Farmlands	None present	No
Floodplains	None present	No
Native American Religious Concerns	Potentially affected	Yes
Hazardous or Solid Wastes	Potentially affected	Yes
Wild and Scenic Rivers	None present	No
Wilderness	None present	No

3.2 GEOLOGY, MINERALS, AND PALEONTOLOGY

3.2.1. Physiography, Topography, and Landforms

The Project Area occupies the southeastern portion of the Greater Green River Basin, a large intermontane structural and topographic basin that is part of the Wyoming Basin Physiographic Province. The Project Area is located in an area of northwest/southeast trending ridges that have been greatly dissected by several small drainages of Hadsell Draw. Landforms consist of ridges, finger ridges, knolls, hills, and gentle to moderate slopes. Elevations range from 6,200 feet to 7,630 feet (Hatcher 2003). Carbon County Road 605 (Twentymile Road) connects the Project Area with Rawlins, which is located 8 miles to the northeast.

3.2.2. Geology

The Greater Green River Basin began developing about 70 million years ago and filled with sediments eroded from surrounding highlands and mountains during the late Cretaceous and early Tertiary. The Project Area lies within the southeastern part of the Great Divide Basin, a sub-basin of the Greater Green River Basin, and is near the Continental Divide, which forms the eastern limit of the Greater Green River Basin. The Continental Divide splits around the Great Divide Basin, and isolates it as a closed, interior drainage basin. Therefore, any water entering the basin is contained within it.

Sub-basins within the Greater Green River Basin are separated by uplifts caused by the deformation of basement rock, which consists of a complex of Precambrian metamorphics and intrusives. At the surface, structural features define the margins of the basin. These structural features include the Wind River Range and the Green Mountains to the north, the Rawlins Uplift to the east, and the Rock Springs Uplift to the west. The Washakie Basin is south of the Great Divide Basin, and is separated from it by the Wamsutter Arch. The east-west trending Cherokee Ridge along the border between Wyoming and Colorado forms the southern limit of the Washakie Basin and separates the southeastern portion of the Greater Green River Basin of Wyoming from the Sand Wash Basin of Colorado. (GHEP 2003)

Late Cretaceous rocks exposed at the surface and underlying the Project Area consist of a complex sequence of sedimentary units, including sandstone, shale, coal, and carbonaceous shale. The Upper Cretaceous Lance Formation, which consists of interbedded gray sandstone and mudstone, carbonaceous shale and coal of alluvial origin (GHEP 2003), is exposed at the surface in the Project Area. The Lance Formation is underlain by the nonresistant Lewis Shale of late Cretaceous age.

The Lewis Shale is exposed at the surface along Hogback Ridge, just south of the Project Area (Colorado School of Mines 1999). This formation consists of a thick sequence of shale, siltstone, and sandstone that accumulated in deltaic, interdeltaic, and marginal marine environments within a shallow epicontinental sea that extended northward from the Gulf of Mexico to the Arctic Ocean in the Maestrichtian (Winn et al. 1985a, 1985b, 1985c). These

sediments were derived from thrust belts to the west. The Lewis Shale is underlain by 12,000 feet of sedimentary rock, which in turn lies on basement rock.

The Cretaceous seaway retreated eastward, and the marine deposits of the Lewis Shale were replaced progressively upward by beach, estuarine, and continental deposits that spread westward in response to the Sevier and Laramide orogenies. The Laramide orogeny resulted locally in the uplift of the Sierra Madre Mountains and the subsidence of the Great Divide Basin. The basin was subsequently filled with Paleocene deposits of the Fort Union Formation, and later, with Eocene deposits of the Wasatch Formation.

In places atop modern terraces and buttes, these consolidated sedimentary rocks are overlain by a thin veneer of much younger, unconsolidated sediments of Quaternary age. These sediments include alluvium, colluvium, stream terrace gravels, and wind-blown sands that are late Pleistocene to Holocene in age.

Underlying the Lewis Shale at depth in the Project Area is the Mesaverde Group, which contains massive beach and shelf sandstones with abundant carbonaceous shale and coal. Resistant sandstone beds of the Mesaverde Group form the Atlantic Rim escarpment located immediately east of the Project Area.

The Mesaverde Group includes the Almond Formation, the Pine Ridge Sandstone, and the Allen Ridge Formation, which contain numerous thin coal seams (GHEP 2003, Roehler 1990). The coal beds within these formations are targeted as exhibiting the greatest potential for natural gas production in the Atlantic Rim area. The lateral continuity of the coal seams is variable (Hamilton 1993). Geophysical logs from test wells within the Atlantic Rim EIS study area indicate that the coal beds are somewhat discontinuous laterally; however, data to correlate the coal seams are limited.

3.2.3. Mineral and Energy Resources

The three primary mineral commodities that occur in Carbon County are coal, natural gas, and oil (Hoffman and Nunley 2000). Mineral development in the Project Area has been limited to natural gas and oil. Additional mineral resources near the Project Area include coal, uranium, construction aggregate, and geothermal resources.

The Great Divide Basin has been explored and developed for oil and gas resources for many years. Production has been proven in a number of formations; however, Cretaceous-age formations have been the most productive. The coal beds of the Mesaverde Group, underlying the Lewis Shale, are the objective for the proposed exploratory gas wells. Existing and authorized gas wells and facilities in the Project Area are listed in Table 2-1. One abandoned well, the Mesa Federal 1, is located within the Project Area. This conventional oil well was plugged and abandoned in 1975.

Coal reserves in the Greater Green River Basin have been estimated at nearly 1,300 trillion tons (Scott et al. 1995). Coal occurs primarily in the Allen Ridge, Pine Ridge, and Almond Formations within the upper part of the Mesaverde Group. The coal is sub-bituminous to

high-volatile C bituminous in rank (Tyler et al. 1995). Significant quantities of natural gas also are associated with coal seams in other formations of the Mesaverde Group and the Fort Union Formation. Scott (et al. 1994) estimated total reserves of natural gas in the Greater Green River Basin at 300 trillion cubic feet. Two nearby gas fields have been explored for coal bed natural gas (CBNG) resources: the Dixon Field (T12N R90W), and the Cow Creek Field (T16N R92W); both target coal seams in the Mesaverde Group.

3.2.4. Geologic Hazards

Potential geologic hazards include landslides, subsidence, and known or suspected active faults. No known active faults with evidence of Quaternary movement or earthquake epicenters occur within the Project Area (GHEP 2003). Landslide potential is greatest in areas where steep slopes occur, particularly where rock layers dip parallel to the slope, or where erosional undercutting may occur. Landslides occur east of the Project Area in steeper regions of the Sierra Madre Mountains, but none have been mapped in the Project Area (Case et al. 1991). Slope gradients in the Project Area are gentle to moderate. Unstable soils in steep areas may be susceptible to slumping, sliding, and creeping.

An earthquake that measured 4.3 on the Richter scale occurred on April 4, 1999, southwest of the Project Area, with its epicenter near Baldy Butte in T17N R92W (41.45°N, 107.74°W). No other earthquake epicenters have been recorded in or immediately adjacent to the Project Area in the past 100 years.

No subsidence hazards or features with potential for subsidence are known to exist within the Project Area.

3.2.5. Paleontology

Paleontological resources include the remains or traces of any prehistoric organism that have been preserved in the earth's crust by natural processes (BLM Information Bulletin WY-93-371). Within sedimentary deposits in the Project Area, paleontological resources serve as a record of the history of animal and plant life in Wyoming during the Late Cretaceous Period. The Lewis Shale represents this period and is known to yield scientifically significant vertebrate fossils in several areas of Wyoming. However, no specific localities have been reported within the Project Area.

Fossils of scientific interest may occur within or in association with energy minerals such as coal, oil shale, lignite, bitumen, asphalt, and tar sands. They may also occur with industrial minerals such as phosphate, limestone, diatomaceous earth, and coquina. Fossils of scientific interest include those of interest to professional paleontologists and educators, or any vertebrate fossil. If other types of fossils are discovered in the Project Area, the BLM state director and field managers, in consultation with BLM staff paleontologists or other source of expertise, may consider them of scientific interest.

Fossils known from the Lewis Shale represent a large and varied marine invertebrate fauna, including many genera of bivalves, baculites, scaphites, and ammonites and isurid shark teeth (Breithaupt 1985; Gill et al. 1970). Significant fossils are known from the Lewis Shale from some areas of Wyoming. Still, the potential for discovery of scientifically significant fossils in the Project Area is considered moderate to low when compared with other Late Cretaceous age formations in Wyoming.

3.3 CLIMATE AND AIR QUALITY

3.3.1. Climate

The Project Area is located in a semiarid, upland climate regime of the Northern Great Plains that is typified by dry, windy conditions with limited rainfall, and long, cold winters. The nearest meteorological measurements were collected at Rawlins, Wyoming (1951 to present), 14 miles northeast of the Project Area, at an elevation of 6,736 feet (WRCC 2003).

The average annual precipitation at Rawlins is 9.21 inches, ranging from 4.90 inches (1954) to 12.63 inches (1998). An average of 51.9 inches of snow falls during the year (the annual high was 89.7 inches in 1980), with January and March being the snowiest months. In the Project Area, average annual precipitation is about 13 inches, as recorded near U.S. Geological Survey (USGS) gaging station 09216527. Approximately half the annual precipitation occurs during the growing season, from April through June.

Temperatures are generally cooler, frost-free periods are shorter, and both precipitation and snowfall are greater at higher elevations. The region is typically cool, with average daily temperatures ranging between 5 °F (low) and 33 °F (high) in mid-winter and between 48 °F (low) and 86 °F (high) in mid-summer. Extreme temperatures have ranged from -50 °F to 100 °F (both occurring in 1984). The frost-free period (at 32 °F) generally occurs from mid-May to mid-September.

Mean annual evaporation ranges from 38 inches (lake) to 55 inches (pan) and potential annual evapotranspiration is 18 inches (U.S. Department of Commerce 1979). Compared with the average annual precipitation of 13 inches, this mean annual evaporation yields an average annual deficit of 6 inches. These characteristics of the Project Area combine to produce a predominantly dry climate where evaporation exceeds precipitation.

The Project Area is subject to strong and gusty winds, reflecting channeling and mountain valley flows caused by the complex terrain. During the winter, strong winds are often accompanied by snow, producing blizzard conditions and drifting snow. The closest comprehensive wind measurements are collected at the airport in Rawlins, Wyoming, about 14 miles northeast of the Project Area. However, hourly wind measurements for December 1994 through November 1995 were collected near Baggs, Wyoming, during the Mount Zirkel Wilderness Area Visibility Study. Based on the data collected at Baggs, winds originate from the south to southwest nearly 37 percent of the time, and the annual mean wind speed is nearly 10 mph.

3.3.2. Air Quality

The National Ambient Air Quality Standards (NAAQS) and the Wyoming Ambient Air Quality Standards (WAAQS) set the upper limits for concentrations of specific air pollutants. Incremental increases in the ambient concentration of criteria pollutants are regulated under the Prevention of Significant Deterioration (PSD) program. The program is designed to limit the incremental increase in concentrations of specific air pollutants above a legally defined baseline level, depending on the classification of a location. The Project Area and adjacent areas are identified as PSD Class II where incremental increases are not as restrictive compared with the incremental increases allowed in PSD Class I areas.

Emissions are limited within the Project Area, with only a few industrial facilities and residential sources in the relatively small communities and isolated ranches. In addition, the good atmospheric dispersion conditions in the Project Area are expected to result in low concentrations of criteria air pollutants. Although criteria air pollutants have not been monitored in the Project Area, background values measured in the region are well below the NAAQS, WAAQS and the Colorado Ambient Air Quality Standards (CAAQS). Standards have been established for six criteria air pollutants, including carbon monoxide (CO), nitrogen dioxide (NO₂), ozone (O₃), particulate matter less than 10 microns in effective diameter (PM₁₀), sulfur dioxide (SO₂), and lead (Pb).

The Wyoming Department of Environmental Quality, Air Quality Division (WDEQ AQD 1997) and Colorado Department of Public Health and Environment, Air Pollution Control Division (CDPHE APCD 1996) provided data on the background concentration of air pollutants, with the exception of lead. Inferred background concentrations of air pollutants, applicable WAAQS and NAAQS, and Class I and II increments (measured in micrograms per cubic meter, or µg/m³) are provided in **Table 3-2**. Values included in **Table 3-2** reflect the most recently available air quality monitoring data collected near the Project Area. An estimate of background concentrations is needed to combine with modeled, project-related impacts to air quality and to compare the total predicted impacts with applicable air quality standards. It is important that the background concentration of each pollutant, model predictions, and air quality standards are all based on the same averaging times.

TABLE 3-2 AIR POLLUTANT BACKGROUND CONCENTRATIONS, STATE AND FEDERAL AMBIENT AIR QUALITY STANDARDS, AND PSD INCREMENTS ($\mu\text{g}/\text{m}^3$)

Pollutant/Averaging Time	Measured Background Concentration	State and National Ambient Air Quality Standards	Incremental Increase Above Legal Baseline PSD Class I	Incremental Increase Above Legal Baseline PSD Class II
Carbon Monoxide (CO)				
1-hour	2,299 ^a	40,000	n/a	n/a
8-hour	1,148 ^a	10,000	n/a	n/a
Nitrogen Dioxide (NO ₂)				
Annual	10 ^b	100	2.5	25
Ozone (O ₃)				
1-hour	117 ^c	235	n/a	n/a
Particulate Matter (PM ₁₀)				
24-hour	20 ^c	150	8	30
Annual	12 ^c	50	4	17
Sulfur Dioxide (SO ₂)				
3-hour (National)	29 ^d	1,300	25	512
24-hour (National)	18 ^d	365	5	91
24-hour (Wyoming)	18 ^d	260	n/a	n/a
Annual (National)	5 ^d	80	2	20
Annual (Wyoming)	5 ^d	60	n/a	n/a

Notes:

- Data for measured background concentration of ozone are the top tenth percentile maximum 1-hour value during July; other short-term background concentrations are second-maximum values measured.
 - n/a - not applicable
 - Wyoming Ambient Standards from: Wyoming Air Quality Standards and Regulations, Chapter 2 – Ambient Standards
 - National Ambient Standards from: Title 40 Code of Federal Regulations (CFR) Part 50
 - PSD Increments from: 40 CFR Parts 51 and 52 Prevention of Significant Deterioration for Particulate Matter, EPA Final Rule. Federal Register Vol. 58, No. 105, Thursday, June 3, 1993.
 - Background Air Quality Data Sources:
- a Data collected at Rifle and Mack, Colorado, in conjunction with proposed oil shale development during early 1980s (CDPHE-APCD 1996).
- b To supplement monitored NO₂ data, a separate NO₂ modeling analysis was performed, including many oxides of nitrogen (NO_x) emission sources (BLM 1996).
- c Data collected at UCG Project, 9 miles west of Rawlins, Wyoming, June 1994 – November 1994 (WDEQ-AQD 1997).
- d Data collected at Craig Power Plant site and at Colorado oil shale areas (CDPHE-APCD 1996).

$\mu\text{A}/\text{m}^3$ = micrograms per cubic meter.

Concern has been expressed in recent years regarding the potential impacts of oil, gas, and other activities on air quality and Air Quality Related Values (AQRV) in the Class I and sensitive Class II airsheds in the region. The closest federally mandated Class I areas located potentially downwind (northeast or southeast) of the Project Area are the Mount Zirkel Wilderness, 60 miles southeast, and the Rawah Wilderness, 92 miles southeast, in northern

Colorado. The USFS manages both of these areas. **Table 3-3** shows Distant Class I and Class II wilderness areas or monuments located within 100 miles of the Project Area.

TABLE 3-3 CLASS I AND II WILDERNESS AREAS AND NATIONAL MONUMENT WITHIN 100 MILES OF THE PROJECT AREA

Area	State	Federal classification	Distance ^a (miles)	Managed by
Huston Park	Wyoming	II	42	USFS
Encampment River	Wyoming	II	50	USFS
Mount Zirkel	Colorado	I	60	USFS
Savage Run	Wyoming	II ^b	62	USFS
Platte River	Wyoming and Colorado	II	65	USFS
Rawah	Colorado	I	92	USFS

Notes:

a Distances are south and east of the Project Area.

b The State of Wyoming manages the Savage Run Wilderness as a Class I air quality area.

USFS = U.S. Forest Service.

Continuous data for the visibility-related optical background were collected at the Class I Bridger Wilderness Area in Wyoming and the Class I Rocky Mountain National Park (just south of the Class I Rawah Wilderness Area) in Colorado, as part of the Interagency Monitoring of Protected Visual Environments (IMPROVE) program. Visibility in the Central Rocky Mountains is very good (averaging more than 70 miles Standard Visual Range), with impacts from fine particles accounting for nearly half of the average degradation (Sisler 1996). In addition, impacts from background atmospheric deposition (acid rain) were monitored at the National Acid Deposition Program/National Trends Network sampling station near Pinedale, Wyoming. In addition, site-specific background data on lake chemistry (pH, acid neutralizing capacity, elemental concentrations, and other factors) have been collected by the USGS Water Quality Division in several high mountain lakes in the nearby wilderness area.

The frequency and strength of the winds greatly affect dispersion and transport of air pollutants. Because of the strong winds in the Project Area, the potential for atmospheric dispersion is relatively high. It is possible that nighttime cooling, which stabilizes air, could inhibit mixing and transport of air pollutants. Dispersion will be the greatest to the north and along the ridge and mountaintops.

The WDEQ AQD is the primary regulatory agency responsible for evaluating potential impacts when detailed development plans are finalized. These plans for natural gas development are subject to applicable air quality laws, regulations, standards, control measures, and management practices. Therefore, the State of Wyoming has responsibility, with U.S. Environmental Protection Agency (EPA) consultation, for reviewing and permitting proposed emission sources before the Companies begin operations in the Project Area. The WDEQ AQD pre-construction air quality permitting would be based on site-specific, detailed engineering values that would be included in the Companies' permit application.

3.4 SOILS

The description of the soils resource forms the basis by which to assess the intensity, duration and magnitude of soil impacts associated with the construction of access roads, well pads, and facilities and to develop effective mitigation measures to prevent, reduce or eliminate impacts to the soils resource. Productivity of soils can be affected by removal of vegetative cover, invasion by undesirable weed species, soil compaction and an increased potential for wind and water erosion. Wind and water erosion potential is, in part, dependent on grain size distribution. For example, clayey soils are sensitive to reduction in permeability through the reduction in the amount and distribution of pore spaces. Reduced permeability can increase runoff of precipitation, thereby increasing concentrated overland flow. Reduction in the amount and distribution of porosity can also exacerbate potential for upward migration of soluble salts. In addition, clay in lower horizons of a soil retards permeability and may cause salt to build up in the soil, reducing productivity. In addition to these physical limitations of the soils, in many areas chemical limitations exist primarily in terms of sodium.

The soils in the Project Area have been formally mapped and described at different levels of detail. Munn and Arneson (1999) described the soils within the Project Area using a broad perspective of soils within a large area, at an Order IV or V level of detail. Texas Resource Consultants (1981) and Wells et al. (1981) describe the dominant soils in the Project Area at an Order III level of detail. As the survey order number decreases, the level of survey detail or specificity increases. For example, the components of an Order IV map unit are typically phases above the series level, whereas the components of an Order III map unit are typically phases at or below the series level. The Order III soil surveys of the Project Area complement the survey conducted by Munn and Arneson. The results of these surveys are described in this section.

Munn and Arneson (1999) describe the soils within the Project Area at an Order IV or V level of intensity. Order IV soil surveys typically include a map scaled at 1:63,360 to 1:250,000 that contains soil map units of approximately 40 to 623 acres. Based on this survey, the Project Area is located within Soil Zone 9, which is characterized as intermontane basin, frigid, and ustic. There are two soil types in the Project Area: Ustic Haplargids (in a small area south of Rawlins) and Ustic Torrifluvents. Ustic Haplargids and Ustic Torrifluvents are fine-loamy, sandy or sandy-skeletal soils that occur on alluvium and slopes. Torrifluvents occur on active floodplains. Haplargids occur on more stable terrain along the Hogback Ridge. Most have ustic moisture regimes and frigid temperature regimes. Climates are usually dry and cold where these soil types occur. According to established range site descriptions for the associated soil series descriptions, 10 to 14 inches of rainfall fall during the year, with an average air temperature of 35 to -40 °F. The climax plant community is characterized by species with high tolerance to salt that are capable of withstanding drought.

More detailed soils information is also available for the Project Area. An Order III soil survey was prepared by Texas Resource Consultants (1981) and Wells et al. (1981) for the BLM, in cooperation with the Natural Resources Conservation Service (then Soil Conservation Service). Order III soil surveys typically include a map scaled at 1:20,000 to 1:63,360

that contains soil map units approximately of 4 to 40 acres in size that delineate soil associations and complexes. The soil associations and complexes that are mapped represent various soil series. To augment existing soils data, Greystone Environmental Consultants (Greystone) conducted a field reconnaissance on September 19, 2003, to verify the distribution and properties of soils in the Project Area.

Characteristics of the soil map units delineated within the Project Area according to the Order III survey, are presented in **Table 3-4**. Soils in the Project Area formed in residuum and alluvium derived from Cretaceous and Tertiary shales, siltstones and sandstones. An ustic moisture regime with a frigid temperature regime prevails. Soils typically are dry for more than 90 days, but less than 180 days within a year. The mean annual soil temperature is between 0°C to 8°C (32°F to 47°F).

Textures in surface soil are typically fine sandy loam to loam. The textures in the B-horizon (if present) are sandy clay loams. The textures in the C-horizon and regolith are typically fine sandy loam to clay loam. These soils are classified as well drained. In general, permeability is moderate. Runoff potentials are slow to rapid.

The water and wind erosion hazard classification for disturbed soils is generally moderate to severe. The soil erodibility factor (Revised Universal Soil Loss Equation - K-factor) for these soils varies from 0.32 to 0.43 and the tolerable soil loss is between 1 and 2 tons/acre/year. The soil erodibility factor is a measure of the susceptibility of a soil to erosion based on empirically derived relationships between soil texture, organic matter, structure and permeability. It ranges from 0.1 to 0.64 where higher values denote a higher susceptibility to erosion. The wind erodibility grouping is 4L. Wind erodibility groupings are explained in **Table 3-4**.

Soil salinity is generally low and ranges from 2-4 mmhos/cm. The soil horizon pH may range above 8.5 in all or parts of each map unit. Typically, this condition indicates sodic soils.

The average annual aboveground biomass productivity (based on range site classifications) of these soils ranges from 200 to 1,200 lbs/acre (dry weight).

TABLE 3-4 RED RIM SOIL CHARACTERISTICS

Map Unit #	Map Unit Name	Series (% of map unit)	Taxonomic Classification	Landscape Position	Slope	Soil Parent Material	Horizon	Depth (inches)	Texture	Shrink/Swell	Erosion Factor		Runoff	Drainage Class	Permeability	Erosion Hazard			
											K	T (tons/ acre/yr)				Water	Blowing		
202	Rentsac - Shinbara Complex	Rentsac - 40%	Loamy-skeletal, mixed (calcareous), frigid, Lithic, Ustic Torriorthents	Gentle sloping to moderately steep uplands on residuum	6%-30%	Hard sandstone	A	0-3	loam, fine sandy loam, sandy loam	NA	18	NA	NA	Medium - Rapid	Well Drained	Moderately Rapid	Moderate	NA	
							C	3-15	loam, sandy loam	NA	NA	NA							
		Shinbara - 40%	Loamy, mixed (calcareous), frigid, shallow Ustic Torriorthents			6%-30%	Shale and siltstone	A	0-2	loam	Low	0.32	1	Well Drained	Moderate	Moderate - Severe	Moderate	Moderate	
								C	2-9	channery loam	Low	0.32							
213	Seaverson - Blazon Complex	Seaverson - 40%	Loamy, mixed (calcareous), frigid, shallow Ustic Torriorthents	Undulating to rolling, dissected uplands on residuum	3%-15%	Shale	A	0-3	clay loam	Moderate	0.43	2	Well Drained	Medium - Rapid	Well Drained	Moderately Slow	Moderate - Severe	Moderate	
							C	3-16	clay loam	Low	0.43								
		Blazon - 30%	Loamy, mixed (calcareous), frigid, shallow Ustic Torriorthents			3%-15%	Shale, siltstone, or loamstone	A	0-15	loam	Low	0.32	1	Well Drained	Medium - Rapid	Well Drained	Moderate	Moderate - Severe	Moderate
								Shinbara - 10%	Loamy, mixed (calcareous), frigid, shallow Ustic Torriorthents										
235	Blazon - Shinbara Complex	Blazon - 45%	Loamy, mixed (calcareous), frigid, shallow Ustic Torriorthents	Ridgecrest, sideslopes, and foot-slopes on residuum. Slopes irregular with	6%-20%	Shale	A	0-10	loam	Low	0.32	1	Well Drained	Rapid	Moderate	Severe	Moderate		
							Shinbara - 30%	Loamy, mixed (calcareous),											
		Abston, Railrod, Delphill, Diamondville, and Rock outcrop - 20%							A	0-2	loam	Low	0.32	1	Well Drained	Rapid	Moderate	Severe	Moderate
									C	2-10	loam	Low	0.32						

TABLE 3-4 RED RIM SOIL CHARACTERISTICS

Map Unit #	Map Unit Name	Series (% of map unit)	Taxonomic Classification	Landscape Position	Slope	Soil Parent Material	Horizon	Depth	Texture	Shrink/Swell	Depth to Bedrock	Erosion Factor	Wind Erodibility Group	Runoff	Drainage Class	Permeability	Erosion Hazard	
258	Rock River-Satanka Association	Rock Outcrop, Seaverson, Cushool and Diamondville - 25%	frigid, shallow Ustic Torrorthents	some highly dissected areas			C	2-9	channery loam	Low		0.32						
		Rock River - 45%	Fine-loamy, mixed Borfic Hapregids	Level to sloping alluvial fans and adjacent uplands	0%-12%	NA	A B C	0-3 3-37 37-60	sandy loam sandy clay loam sandy loam	NA	>60	NA NA NA NA	NA	NA	Medium	Well Drained	Moderate	Moderate
258	Satanka Association	Satanka - 35%	NA		0%-12%	NA	NA	NA	NA	NA	NA	NA	NA	Medium	Well Drained	Moderate	Moderate	
		Blazon, Black-hill, and Rock Outcrop - 20%																
1301	Sandbranch-Tresano Loams	Sandbranch - 60%	Fine-loamy, mixed, frigid Typic Natragids		0%-8%	Sandstone and shale	A B C	0-1 1-12 12-60	fine sandy loam sandy clay loam silt loam	NA NA NA	>60	NA NA NA	NA	NA	Medium	Well Drained	Moderate Slow	Moderate
		Tresano - 25%	Fine-loamy, mixed, frigid Typic Haplagids	Gentle to steep upland ridges on residuum	0%-8%	Sandstone and shale	A B C	0-7 7-27 27-60	fine sandy loam sandy clay loam fine sandy loam	NA NA NA	>60	NA NA NA	NA	NA	Slow	Well Drained	Moderate	Slight
		Westvaco and Sagecreek and soils similar to Tresano, but with less clay in the subsoil - 15%																
1																		
230																		

TABLE 3-4 RED RIM SOIL CHARACTERISTICS

Map Unit #	Map Unit Name	Series (% of map unit)	Taxonomic Classification	Landscape Position	Slope	Soil Parent Material	Horizon	Depth	Texture	Shrink/Swell	Depth to Bedrock	Erosion Factor	Wind Erodibility Group ¹	Runoff	Drainage Class	Permeability	Erosion Hazard	
401		no data available																
1405		no data available																

NA - data Not Available

*Source - Soil Inventory of the Overland Area, Wyoming, Volume 1 - Soil and Land Use Technologies, Inc.

- 1 **Wind erodibility** groups are made up of soils that have similar properties affecting their susceptibility to wind erosion in cultivated areas. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible. The groups are as follows:
 - 1 Coarse sands, sands, fine sands, and very fine sands.
 - 2 Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, ash material, and sapric soil material.
 - 3 Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams.
 - 4L Calcareous loams, silt loams, clay loams, and silty clay loams.
 - 4 Silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay.
 - 5 Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material.
 - 6 Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay.
 - 7 Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material.
 - 8 Soils that are not subject to wind erosion because of coarse fragments on the surface or because of surface wetness.

¹ *Source - Soil Inventory of the Overland Area, Wyoming, Volume 1 - Soil and Land Use Technologies, Inc.

3.5 WATER RESOURCES

3.5.1. Groundwater

Groundwater resources include deep and shallow, confined and unconfined aquifers. Site-specific groundwater data for the Project Area and vicinity are limited, however. Existing information comes primarily from WOGCC oil and gas well records, water well records from the Wyoming State Engineers Office (WSEO), and the USGS (Weigel 1987). Regional aquifer systems pertinent to the Project Area are discussed by Heath (1984), Freethey (1987), and Driver et al. (1984). Basin-wide evaluations of hydrogeology specific to the Project Area have been investigated by Collentine et al. (1981). The most relevant hydrogeologic study specific to the Project Area is by Welder and McGreevy (1966). The Project Area is located in the Colorado Plateau and Wyoming Basin groundwater regions described by Heath (1984); the Upper Colorado River Basin groundwater region described by Freethey (1987); and the Great Divide and Washakie Basins described by Collentine et al. (1981) and Welder and McGreevy (1966).

3.5.1.1. Location and Quantity

Groundwater in the Great Divide and Washakie Basins is generally found in artesian aquifers, although it is also present in unconfined alluvial valleys and in isolated, saturated outcrops (Welder and McGreevy, 1966). **Table 3-5** summarizes the water-bearing characteristics of the geologic formations present in the Project Area and vicinity. Of the geologic units listed in Table 3-4, Welder and McGreevy (1966) suggest that the units capable of producing the largest quantity of water include the following: Quaternary alluvium; Tertiary deposits in the Browns Park, Wasatch, and Fort Union Formations; Cretaceous formations, including the Mesaverde Group, Frontier and Cloverly Formations; the Sundance-Nugget Sandstone of Jurassic age; and the Tensleep and Madison Formations of Paleozoic age.

Quaternary aquifers in the Great Divide and Washakie Basins are made up of alluvial deposits along major floodplains and isolated windblown and lake sediments elsewhere. Ephemeral and intermittent drainages often contain groundwater in the associated unconsolidated valley fills. Flow of groundwater within the sandy Quaternary aquifers is typically downward, toward permeable underlying formations (Collentine et al. 1981).

Tertiary aquifers in and near the Project Area occur in the Browns Park Formation along the Little Snake River floodplain and adjacent to the Sierra Madre Uplift, the Fort Union Formation near the Muddy Creek floodplain to the west, and isolated outcrops of the Wasatch Formation to the southwest. Groundwater generally flows west-southwest from the higher elevations along the Sierra Madre Uplift toward the low-lying centers of the Great Divide and Washakie Basins and the major streams (Collentine et al. 1981).

TABLE 3-5 WATER-BEARING CHARACTERISTICS OF GEOLOGIC FORMATIONS IN THE GREAT DIVIDE AND WASHAKIE BASINS^A

Era	Period	Geologic Unit	Thickness (feet)	Hydrologic Properties			
				Well Yield (gpm)	Transmissivity (gpd/ft)	Permeability (gpd/ft ^b)	
Cenozoic	Quaternary		0-70	<30	168-560	21-62	
	Tertiary	Browns Park Formation	0-1,200	3-30	100-10,000	NM	
		Wasatch Formation	0-4,000+	30-50	150-10,000	0.04-18.2	
		Fort Union Formation	0-2,700+	3-300	<2,500	<1	
Mesozoic	Upper Cretaceous	Lance Formation	0-4,500+	<25	<20	0.007-8.2	
		Fox Hill Sandstone	0-400	NM	10-20	0.9	
		Lewis Shale	0-2,700+	2-252	0.03-50	0.002-0.9	
		Almond Formation ^c	0-600	NM	2,000-8,000	100-800	
		Mesaverde Group (incl. Almond Formation)	300-2,800	<100	<3,000	NM	
		Baxter Shale (incl. Steele Shale and Niobrara Formation)	2,000-5,000+	Major regional aquitard between Mesaverde and Frontier aquifers. Hydrologic data unavailable.			
	Lower Cretaceous	Frontier Formation	190-1,900+	1-100+	<100-6,500	NM	
		Mowry Shale	150-525	Regional aquitard. Hydrologic data unavailable.			
		Thermopolis Shale (incl. Muddy Sandstone)	20-235	Considered a leaking confining unit. Hydrologic data unavailable.			
	Upper Jurassic	Cloverly Formation	45-240	25-120	340-1,700	1-177	
		Morrison Formation	170-450+	Confining unit between Cloverly and Sundance-Nugget aquifers. Hydrologic data unavailable.			
	Lower Jurassic-Upper Triassic	Sundance Formation	130-450+	27-35	12-3,500	NM	
		Nugget Sandstone	0-650+	35-200	<2,166	NM	
		Triassic	Chugwater Formation	900-1,500+	Confining unit between Sundance-Nugget and Paleozoic aquifers. Hydrologic data unavailable.		
Mesozoic-Paleozoic	Lower Triassic Permian	Phosphoria Formation (incl. Goose Egg Formation)	170-460	Probable poor water-bearing capabilities because of low permeability. Hydrologic data unavailable.			
Paleozoic	Permian-Pennsylvanian	Tensleep Formation	0-840+	24-400	1-374	NM	
	Lower and Middle Pennsylvanian	Amsden Formation	2-260+	Probably poor water-bearing capabilities because of predominance of fine-grained sediments.			
	Mississippian	Madison Limestone	5-325+	<400	Variable	NM	
	Cambrian	Indef. Rocks	0-800+	4-250	NM	NM	
Precambrian	N/A	Igneous and metamorphic rocks	Unknown	10-20	<1,000	Generally high in upper 200 ft of unit	

Notes:

a Adapted from Table V-1 in Collentine et al. (1981). Formations that are not encountered in the Atlantic Rim Project Area have been omitted.

b From well completion records on file with WSEO.

c From Atlantic Rim gas well test data.

gpm = gallons per minute.

gpd/ft = gallons per day per foot.

Cretaceous aquifers in and near the Project Area occur in three major geologic formations. From youngest to oldest, they are the Almond Formation of the Mesaverde Group, the Frontier Formation, and the Cloverly Formation. The Mesaverde Group is exposed along the eastern slopes of the Project Area, although a mantle of Tertiary deposits unconformably

overlies large areas of Late Cretaceous strata. No outcrops of the Frontier or Cloverly Formations are present within the Project Area.

The Cretaceous aquifers are composed of interbedded sandstone, shale, and coal and have demonstrated considerable yields in existing wells (Collentine et al. 1981). Recharge to these water-bearing strata is principally from infiltration of precipitation and movement of groundwater from the overlying Tertiary sediments at their outcrops and subcrops along the elevated eastern margin of the Washakie Basin. The direction of regional groundwater flow is toward the west in response to the structural dip and surface topography.

Separated from the Cretaceous aquifers by the impermeable Morrison Formation is the Sundance-Nugget Aquifer of the Jurassic Age. The Sundance-Nugget aquifer is composed of permeable sandstone with minor quantities of shale, siltstone, and limestone (Collentine et al. 1981). The flow characteristics of the Sundance-Nugget aquifer are not well defined.

The remaining two major aquifers occur in Paleozoic Era rocks. The Tensleep Formation from the Pennsylvania Age consists of fine- to medium-grained sandstone between confining layers of the Chugwater Formation (Triassic) and the Amsden Formation (Pennsylvanian) (Collentine et al. 1981). The Madison aquifer is composed of limestone and dolomite bordered on the top by the fine-grained Amsden sediments and on the bottom by Cambrian rocks. Wells completed in both of these Paleozoic aquifers have demonstrated yields up to 400 gallons per minute (gpm). Groundwater flow is to the south-southeast in the Project Area.

Recharge to the aquifers is generally by precipitation and surface water seepage percolating through permeable overlying materials (Welder and McGreevy 1966). Driver et al. (1984) suggest that the Browns Park Formation would be the best candidate for large-scale groundwater development.

3.5.1.2. Quality

Groundwater quality is related to the depth of the aquifers, flow between aquifers, and the rock type. Groundwater quality is variable in the Project Area. Total dissolved solids (TDS), an indicator of salinity, is generally less than 2,000 mg/L (slightly saline to saline) in the Project Area, with local concentrations of less than 500 mg/L (considered fresh and meeting EPA National Secondary Drinking Water Regulations).

As the proposed wells of the Project Area occur in aquifers in the Mesaverde Group, a detailed analysis of groundwater from this unit has been included. **Table 3-6** lists the major cation and anion composition of groundwater from the Mesaverde Group in the area of the project. Sodium and bicarbonate dominate as the major ionic species. Collentine et al. (1981) offer three possible explanations for this dominance: (1) exchange of dissolved calcium for sodium; (2) sulfate reduction, resulting in generation of bicarbonate; and (3) intermixing of sodium-rich, saline water from low-permeability zones within the Mesaverde or adjacent aquifers.

**TABLE 3-6 MAJOR ION COMPOSITION OF MESAVERDE
GROUNDWATER**

Cation	Concentration (mg/L)	Anion	Concentration (MG/L)
Sodium	513	Bicarbonate ^a	1,284
Calcium	7	Carbonate ^b	9
Magnesium	3	Chloride	56
Potassium ^b	5	Sulfate	11

Notes:

^a Bicarbonate was not measured; value shown was calculated from ion balance.

^b Concentrations of potassium and carbonate were not measured in well samples; values represent composite of USGS data for Mesaverde wells in the vicinity of the project (USGS 1980).

mg/L = milligrams per liter.

Table 3-7 presents a comparison of the quality of groundwater from the Mesaverde Group with WDEQ standards for groundwater suitability. The composite results of samples from three gas wells analyzed indicate water that is generally suitable for livestock use, but is unsuitable for domestic supply or irrigation without treatment or dilution. Parameters measured at concentrations that exceed Wyoming drinking water standards include iron, manganese, and TDS. Calculated values for SAR (47.3) and residual sodium carbonate (41 milliequivalents per liter [meq/L]) exceed the agriculture suitability limits of 8 for SAR and 1.25 for residual sodium carbonate. Unless the water were mixed with an existing water source of lower sodium and bicarbonate and lower total salinity, irrigation with this water would reduce infiltration in the affected soil and potentially decrease crop production.

Confining beds slow the vertical movement of water, and hence, movement of potential contaminants between aquifers. Although there is some downward movement of water from the surface units, most of the groundwater movement, if any, is upward from the deeper aquifers to the shallower aquifers. Concerns have been raised for several gas field projects in southwest Wyoming over degradation of groundwater quality caused when confining layers are pierced and allow vertical and horizontal migration and mixing of water of variable qualities. Data that would suggest this degradation is a current problem in the Project Area are not available. Improperly completed injection wells could be a source of contamination, however.

There are no permitted water wells within 1 mile of the Project Area, based on information obtained from the WSEO ([Appendix B](#)).

TABLE 3-7 GROUNDWATER QUALITY FOR MESAVERDE WELLS IN VICINITY OF PROJECT AREA

Parameter	Concentration ^a	Unit	Groundwater Suitability Standards ^b		
			Domestic	Agriculture	Livestock
Aluminum	0.045	mg/L	---	5	5
Ammonia	0.9	mg/L	0.5	---	---
Arsenic	0.0006	mg/L	0.05	0.1	0.2
Barium	0.36	mg/L	1	---	---
Beryllium	<0.002	mg/L	---	0.1	---
Boron	0.25	mg/L	0.75	0.75	5
Cadmium	<0.0002	mg/L	0.01	0.01	0.05
Chloride	56	mg/L	250	100	2000
Chromium	0.002	mg/L	0.05	0.1	0.05
Cobalt	NM	mg/L	---	0.05	1
Copper	0.03	mg/L	1	0.2	0.5
Cyanide	<5	mg/L	0.2	---	---
Fluoride	1.0	mg/L	1.4 - 2.4	---	---
Hydrogen Sulfide	NM	mg/L	0.05	---	---
Iron	3.06	mg/L	0.3	5	---
Lead	0.004	mg/L	0.05	5	0.1
Lithium	NM	mg/L	---	2.5	---
Manganese	0.102	mg/L	0.05	0.2	---
Mercury	<0.0004	mg/L	0.002	---	0.00005
Nickel	0.041	mg/L	---	0.2	---
Nitrate	<0.03	mg/L	10	---	---
Nitrite	<0.03	mg/L	1	---	10
Oil & Grease ^c	<1	mg/L	Virtually Free	10	10
Phenol	65	mg/L	0.001	---	---
Selenium	<0.005	mg/L	0.01	0.02	0.05
Silver	<0.003	mg/L	0.05	---	---
Sulfate	11	mg/L	250	200	3000
TDS	1,322	mg/L	500	2000	5000
Uranium	NM	mg/L	5	5	5
Vanadium	NM	mg/L	---	0.1	0.1
Zinc	0.3	mg/L	5	2	25
pH	8.2	s.u.	6.5 - 9.0	4.5 - 9.0	6.5 - 8.5
SAR	47.3	<none>	---	8	---
RSC ^d	41	meq/L	---	1.25	---
Radium 226 + Radium 228	0.9	pCi/L	5	5	5
Strontium 90	NM	pCi/L	8	8	8
Gross alpha	NM	pCi/L	15	15	15

a Concentrations ammonia, fluoride, and nitrate/nitrite from 11 Mesaverde groundwater wells (USGS 1980); remaining concentrations from three Mesaverde gas wells in Atlantic Rim Project Area.

b From WDEQ Water Quality Rules and Regulations, Chapter VIII.

c Reported as total petroleum hydrocarbons.

d Residual sodium carbonate calculated from measured calcium and magnesium concentrations and calculated bicarbonate concentration.

Notes:

meq/L = Milliequivalents per liter

mg/L = Milligrams per liter

NM = not measured

pCi/L = Picocuries per liter

s.u. = Standard units

TDS = Total dissolved solids

3.5.2. Surface Water

The Project Area is located within the Great Divide Closed Basin, Hydrologic Unit Code (HUC) 14040200. Surface waters near the Project Area include the intermittent to perennial

Separation Creek, ephemeral tributaries including Hadsell Draw, and several unnamed ephemeral channels and constructed ponds. Surface drainages carry water most of the year to the confluence of Hadsell Draw with Separation Creek, which then flows into Separation Lake, a topographically closed lake located north of I-80. The proposed pipeline corridor is within the Upper North Platte Basin (HUC 10180002). The two basins are separated by the Continental Divide.

3.5.2.1. Quantity

Statistics on flow have been compiled for the USGS gaging station (09216527) located on Separation Creek. There are no stream gaging stations in the Project Area since all drainages are ephemeral. These statistics provide a perspective of perennial streamflow in the vicinity of the Project Area. This information is summarized in **Table 3-8**.

TABLE 3-8 HISTORICAL STREAMFLOW AT SELECTED USGS GAGING STATIONS

Station Name	Station Number	Drainage Area (mi ²)	Period of Record	Mean Annual Flow (cfs)	Mean Annual Flow (ac-ft/yr)	Maximum Peak Flow (cfs)	Annual Runoff (ac-ft/yr)
Separation Creek near Riner, WY	09216527	53.3	10/1/75 – 9/30/81	2.1	1,520	141 (4/20/1980)	1,300

Source: USGS 2003.
mi² = square mile.
cfs = cubic feet per second.
ac-ft/yr = acre-feet per year

Annual peak flows for all streams in the Project Area and vicinity generally occur in late May through early June in response to snowmelt. Baseflows are reached in the fall and continue through March, until low-elevation snowmelt initiates the rising limb of the hydrograph. Hadsell Draw, Abundance Tributary, and Bountiful Tributary are intermittent to ephemeral drainages in the Project Area that flow mostly in response to precipitation and snowmelt. These streams are supplemented by discharge from bedrock but do not maintain a quantifiable baseflow.

Peak flows for Hadsell Draw, Abundance Tributary, and Bountiful Tributary were calculated using regression equations developed by H.W. Lowham (1988). These equations provide an analysis tool for estimating mean annual flow and peak flow where gaging data are not available. Calculated values for the 2-year, 5-year, 10-year, 25-year, 50-year, and 100-year 24-hour storm events, as well as mean annual flow for Hadsell Draw, Abundance Tributary, and Bountiful Tributary, were tabulated and are summarized in **Table 3-9**.

TABLE 3-9 ANALYSIS OF PEAK FLOW

Drainage	Recurrence Interval (years)	Peak Discharge (cfs)
Hadsell Draw	2	176
Mean Annual Flow = 0.81 cfs	5	461
= 585.39 ac-ft/yr	10	726
	25	1,192
	50	1,742
	100	2,273
Abundance Tributary to Hadsell	2	67
Mean Annual Flow = 0.14 cfs	5	173
= 98.32 ac-ft/yr	10	275
	25	448
	50	660
	100	859
Bountiful Tributary to Hadsell Draw	2	31
Mean Annual Flow = 0.04 cfs	5	84
= 30.18 ac-ft/yr	10	139
	25	232
	50	354
	100	464

cfs = cubic feet per second.
ac-ft/yr = acre feet per year.

3.5.2.2. Reservoirs

There are two existing reservoirs in the Project Area; however, neither of these reservoirs has been permitted by the WSEO. The Abundance Reservoir, located in the NENE quarter-quarter of Section 16 in T20N R89W, is less than 5 acre-feet in capacity and is in poor structural condition. Mean annual discharge from this reservoir to Hadsell Draw was estimated at about 55 acre-feet; however, this estimate did not consider releases from upstream reservoirs located outside the Project Area. The Espy Reservoir, located in the NESE quarter-quarter of Section 3 in T20N R89W, is 5 to 10 acre-feet in capacity and is in poor structural condition. Mean annual discharge from this reservoir could not be estimated, as there is no outlet structure or spillway.

3.5.2.3. Quality

Average data on water quality collected at the USGS monitoring station on Separation Creek are shown in **Table 3-10**. The data suggest that surface water in the Project Area is of neutral to slightly alkaline pH and contains moderate quantities of TDS.

TABLE 3-10 SURFACE WATER QUALITY IN THE VICINITY OF THE PROJECT AREA^a

Station Name	Separation Creek near Riner, WY
Station Number	09216527
Period of Record	1975-1981
Number of Samples ^b	39
pH, standard units	8.20
Total Dissolved Solids (TDS) ^c	774
Total Suspended Solids (TSS)	363
Turbidity (JTUs) ^d	131
Hardness as CaCO ₃	467
Dissolved Oxygen	9.01
Sodium	80.4
Calcium	74.4
Magnesium	68.6
Potassium	5.5
Bicarbonate	276
Carbonate	0.2
Sulfate	385
Chloride	13
Nitrate	0.14
Sodium Adsorption Ratio (SAR), unitless	1.6

Source: USGS 2003

- a Values are representative of means.
- b Total number of grab samples analyzed; not every parameter was analyzed in every sample.
- c All units are milligrams per liter (mg/L) except as noted.
- d Jackson Turbidity Units.

WDEQ classifies Wyoming streams according to quality and degree of protection. WDEQ identifies all surface waters within the Great Divide Closed Basin as Class 4 waters, which support agricultural uses and wildlife watering (WDEQ 2000).

3.5.2.4. Waters of the United States

Surface waters in the Great Divide Closed Basin drain toward the inner areas of the basin, with no connection to external drainages or to navigable waterways leaving the state. Therefore, surface water features in the Project Area do not qualify as waters of the United States. Surface water features in the Upper North Platte watershed, where the proposed pipeline corridor for the project is located, qualify as waters of the U.S. These areas are regulated by the EPA and U.S. Army Corps of Engineers (COE). Any activity that would involve excavation or discharge of dredge or fill material in a manner that affects waters of the U.S. is subject to regulation by the COE pursuant to Section 404 of the Clean Water Act (CWA). Activities that modify the morphology of stream channels are also subject to regulation by the WSEO.

3.5.2.5. Water Use

The total surface water withdrawals for the Great Divide Closed Basin that encompasses the Project Area equaled 103.2 million gallons per day (MGD) in 1995 (USGS 1995). Consump-

tion of surface water is predominantly associated with irrigation, which represents about 99 percent of surface water withdrawals in the basin (102.7 MGD) (USGS 1995).

3.5.2.6. Water Rights

Surface water rights in the Project Area on file with WSEO are summarized in Appendix D. All of the water rights identified support irrigation use, with some additional stock watering. The water right does not necessarily mean that all of the water is available every year for the intended use, but instead reflects legal claims on the water.

3.6 VEGETATION, WETLANDS AND NOXIOUS WEEDS

3.6.1. Vegetation and Cover Types

Vegetation within the Project Area represents the semi-arid Wyoming Great Divide Basin floristic region, where precipitation and parent material for soils are the primary variables that control composition, cover, and annual production of the plant species. The Project Area is located in the sagebrush steppe plant community that is typical of the high intermountain desert of south-central Wyoming. The primary vegetation cover types, as identified by the Wyoming Gap Analysis Program, are Wyoming big sagebrush, desert shrub, and shrub-dominated riparian.

A biological survey of the Project Area was conducted in 2000 and 2001 by Hayden Wing Associates (HWA 2003). To enhance the general vegetation information provided above, a field reconnaissance of the Project Area was conducted on September 18, 2003, as part of this analysis. Existing vegetation within the proposed disturbance areas was observed and recorded.

Wyoming big sagebrush cover type typically consists of a mixture of greasewood, Wyoming big sagebrush, rabbitbrush, and saltbush. These tall shrubs provide excellent cover for many species of wildlife and protection from adverse weather and detection by predators. Understory grasses and forbs include western wheatgrass, little bluegrass, Indian ricegrass, bottlebrush squirreltail, needle and thread, phlox, buckwheat, penstemon, and prickly-pear cactus.

Common species in shrub-dominated riparian areas include sagebrush, greasewood, and willow, as well as the grass and forbs that are common to Wyoming big sagebrush community type. The principal riparian habitat within the Project Area consists of a narrow band of vegetation along Hadsell Draw and its tributaries. Key species in riparian areas include spikesedge, redbud, tufted hairgrass, Kentucky bluegrass, and saltgrass.

The vegetation community type in the proposed disturbed area is generally sagebrush/grassland. Typically, two integrading varieties of sagebrush occur in the Project Area and tend to occupy distinct habitats. Wyoming sagebrush typically is found in the more xeric uplands, while big sagebrush is found in the more mesic narrow valley bottoms. Wyoming sagebrush is distinguished from big sagebrush by its shorter growth form and spherical canopy. In some locations along parallel ridges, the shrub canopy is absent and a grass

grass canopy predominates. The dominant grass is prairie junegrass with species of wheatgrass and wild rye, and Indian ricegrass occurring less frequently.

Within the sagebrush/grassland community type, rubber rabbitbrush, broom snakeweed, gray horsebrush, and Gardner's saltbush are common. In a few small locations the density of rubber rabbitbrush and Gardner's saltbush equals or exceeds that of sagebrush. Black greasewood is generally uncommon but is often a dominant component of the shrub canopy in valley terraces and toe-slopes where shale and saline soils are prevalent. Antelope bitterbrush occurs rarely to infrequently. Common herbaceous forbs included species of buckwheat flower and lupine, and to a lesser degree, species of phlox.

3.6.2. Threatened and Endangered Species

Three federally listed plant species, blowout penstemon (*Penstemon haydenii*), Ute ladies' tresses orchid (*Spiranthes diluvialis*), and Western prairie fringed orchid (*Platanthera praeclara*), have the potential to occur within the Atlantic Rim EIS study area; however, none have the potential to occur within the Project Area for the Red Rim POD.

3.6.3. Species of Concern

Seven species of plants of special concern may occur within or near the Project Area (HWA 2003). Four of the species (Laramie columbine, Weber's scarlet-gilia, persistent sepal yellowcress, and Laramie false sagebrush) are unlikely to occur in or near the Project Area because their preferred habitat types are not present. Two special-concern species (Nelson's milkvetch and Cedar Rim thistle) have low to moderate potential to occur in or near the Project Area. Gibben's beardtongue has a high probability of occurrence in the eastern portion of the Project Area. The occurrence and distribution of any of these species will require specific consideration in planning the proposed project. **Appendix E** provides information on the names and sensitivity status, notes on their overall range and distribution within Wyoming, probability of occurrence in the Project Area, and descriptions of habitat types where these special concern plants are found.

3.6.4. Wetlands

No special aquatic sites or wetlands have been identified in or near the Project Area, including the lateral sales pipeline route; therefore, these resources were not analyzed further.

3.6.5. Noxious Weeds and Invasive Species

The Project Area is vulnerable to invasion of noxious weeds species such as Canada thistle, spotted and Russian knapweed, and whitetop, and invasive species such as black greasewood, musk thistle, black henbane, halogeton, and cheatgrass. Based on field reconnaissance conducted on September 18, 2003, noxious weeds and invasive species are a relatively minor component of the vegetation community within the Project Area.

One noxious weed species on the Wyoming Designated Noxious Weed List, spotted or Russian knapweed (*Centaurea maculosa or repens*), was observed rarely to infrequently in the vicinity of proposed production facilities in the southwest quarter of Section 16 and the northwest quarter of Section 29, in T20N R89W. Other noxious weed species that were not apparent during the site reconnaissance may exist within the Project Area.

Halogeton, an invasive species, was observed on the recently completed drill pad for the AR Fee 2089 NW 21 well.

3.7 RANGE RESOURCES AND OTHER LAND USES

3.7.1. Range Resources

The Project Area is within the Sixteen Mile Allotment (#10616). The allotment includes 81,509 acres, of which 37,513 acres are public land, 42,716 acres are private land, and the remaining 1,280 acres are state land. The allotment is permitted for 7,257 Animal Unit Months (AUMs), which includes 4,325 AUMs for cattle, 2,674 AUMs for sheep, and 258 AUMs for horses. The average stocking rate is 11 acres per AUM. The season of use extends from March 1 to November 10. The Sixteen Mile Allotment will be included in a watershed assessment that will evaluate rangeland health.

3.7.2. Other Land Uses

The Project Area contains an estimated 1,840 acres of federal surface ownership lands in Sections 16, 20, and 28, T20N R89W. These public lands are open for public use and are administered by the RFO in accordance with the Great Divide RMP. Within the Project Area, privately owned lands are located in Sections 6, 21, and 9, T20N R89W. Public lands within and adjacent to the Project Area are interspersed with private lands in a checkerboard pattern. There are no State of Wyoming lands within the Project Area.

Other land uses within and adjacent to the Project Area include wildlife habitat; oil and gas exploration, development, and transmission; and dispersed outdoor recreation (primarily hunting in the fall).

3.8 WILDLIFE AND FISHERIES

3.8.1. Wildlife

The Project Area includes sagebrush steppe and greasewood wildlife habitats. Many common species of birds, mammals, amphibians, and reptiles may be found within the Project Area. The proposed development is not expected to significantly affect the common species found in the Project Area; therefore, they are not discussed further in this analysis. Species considered for threatened or endangered status, big game species, raptors, and greater sage-grouse are considered in this analysis. The area of analysis for wildlife concerns consists of

the Project Area plus a 2-mile buffer for greater sage-grouse leks and a 1-mile buffer for raptor nests. Wildlife surveys discussed and summarized were conducted as part of larger-scale surveys performed in preparing the Atlantic Rim EIS (HWA 2003); the following discussion focuses only on the Project Area for the Red Rim POD.

Information on the occurrence of big game species, raptors, and greater sage-grouse near the Project Area was obtained from several sources. Locations of greater sage-grouse leks, seasonal big game range designations, and raptor nest locations were obtained from the Wyoming Game and Fish Department's (WGFD) Wildlife Observation System (WOS). WGFD annual reports on big game herd units were used for statistics on the population of the herd units. The existing information on wildlife for the Project Area was supplemented through survey data collected by in 2000 and 2001 (HWA 2003). Data were collected through a series of aerial and ground surveys to: (1) determine the occurrence, location, size, and burrow density of white-tailed prairie dog colonies; (2) determine the location and activity status of raptor nests; (3) search for previously undocumented greater sage-grouse leks and determine the activity status of all leks in the area; and (4) locate winter greater sage-grouse concentration areas

3.8.1.1. Big Game

Three big game species — pronghorn antelope, mule deer, and elk — occur within the Project Area during all or parts of the year. Winter ranges are used by substantial numbers of animals only during the winter (December through April). Winter/year-long ranges are occupied throughout the year, but during winter these ranges are used by additional animals that migrate from other seasonal ranges. Crucial big game range (crucial winter or year-long range) describes any seasonal range or habitat component that has been documented as a determining factor in the ability of a population to maintain itself at a specified level over the long term. Crucial winter ranges are typically used eight out of 10 winters.

3.8.1.1.1. Pronghorn Antelope

The Project Area is within the 1,394-square-mile Baggs Herd Unit. The Project Area contains seasonal ranges for pronghorn designated as winter, spring/summer/fall, and crucial winter/year-long. Crucial winter/year-long range exists in the extreme northwestern corner of Sections 16 and 20 (less than 11 acres). Pronghorn likely migrate across the southern portion of the Project Area onto the crucial winter/year-long range (HWA 2003). Pronghorn congregate on the crucial winter range during years with higher snowfall across the winter range, resulting in heavy browse use and only light use of the transition area in the fall and spring. The pronghorn are not forced to spend as much time on the crucial winter range in years with low amounts of snow. Use of important shrub species is then more evenly distributed across this transition area, with lighter consumption of the plants in the crucial winter range. The 2001 post-hunt season population estimate of 6,800 animals is 9 percent higher than the 1996-2000 estimated population average of 6,240 (HWA 2003). The population objective was increased 25 percent in 1994, from 7,200 to 9,000 animals. The current population estimate is 24 percent below the WGFD management objective. The Baggs antelope herd had experienced low fawn production, resulting in slow growth, but production has improved during recent years and the population appears to be rebounding (HWA 2003).

The Project Area is located within Hunt Area 55, where the hunter success rate in 2001 was 77.8 percent.

3.8.1.1.2. Mule Deer

The Project Area is within the Baggs Herd Unit. The Baggs Herd Unit is large (3,440 square miles) and contains habitats that range from subalpine and montane coniferous forests to desert shrub. The Project Area is within the portion of the unit designated as winter/year-long mule deer range. No migration routes for mule deer pass through the Project Area. The 2001 post-hunt population estimate for the Baggs Herd Unit was 18,000 animals. This estimate is slightly below the WGFD's management objective of 18,700 animals (HWA 2003). The Project Area is within Hunt Area 84; of the three hunt areas within the Baggs Herd Unit, only 3 percent of hunters used this area.

3.8.1.1.3. Elk

The Project Area is located within the Sierra Madre Herd Unit (2,425 square miles). Most elk in the herd unit use spring/summer/fall ranges in the Sierra Madre Mountains, although some groups use habitats on Atlantic Rim and around McCarty Canyon. During winter, the elk migrate to winter range habitats at lower elevation on the western side of the Sierra Madre Mountains and into the Atlantic Rim/Sand Hills areas. Some animals may migrate as far west as the Powder Rim (about 40 miles west of Baggs; Porter 1999). However, no major migration routes for elk pass through the Project Area (HWA 2003). The majority of the pod is classified as elk non-use and the remaining southern portion of the pod is classified as elk winter range. The 2001 post-hunt season population estimate for the Sierra Madre Herd Unit of 5,500 animals is 31 percent above the WGFD management objective of 4,200. The Project Area is located within Hunt Area 108, where the hunter success rate for 2001 was 67.7 percent.

3.8.1.2. Upland Game Birds

3.8.1.2.1. Greater Sage-Grouse

The Project Area is located within the extensive sagebrush/grassland habitat of south-central Wyoming, where greater sage-grouse are common. Strutting grounds (leks), nesting, brood-rearing, and wintering habitats are all important components required by greater sage-grouse. This habitat can occur as contiguous or in a patchy, disconnected pattern (HWA 2003). Preferred nesting habitat is usually located within 2 miles of leks (HWA 2003; HWA et al. 1986). The greater sage-grouse is listed as a BLM sensitive species and receives special consideration because its population is declining over much of its range.

The Project Area is within the Sierra Madre upland game management unit area (Area 25). According to the Annual Report of Upland Game and Furbearer Harvest for 2001, 761 greater sage-grouse were harvested in Area 25, providing 724 hunter recreation days (HWA 2003). The Sierra Madre Upland Game Management Area accounted for about 6 percent (761 birds out of 12,742) of the statewide harvest of greater sage-grouse in 2001.

The Project Area is covered by habitats dominated by sagebrush. Because greater sage-grouse use sagebrush habitats all year, the area provides excellent year-round range. Aerial surveys were conducted during the winter of 2001 to identify and define greater sage-grouse winter concentration areas. The Atlantic Rim EIS study area, including the Project Area, was surveyed on February 17 to 18, 2001. Snow cover during the winter of 2000 and 2001 was much deeper than normal. Deep snow cover forced greater sage-grouse to seek out habitat with tall sagebrush. During the spring and summer of 2001, each location where greater sage-grouse were observed during the winter aerial survey was visited on the ground, and habitat used by the greater sage-grouse was mapped. Habitat patches located from the air were refined by walking the perimeter and recording Universal Transverse Mercator (UTM) coordinates with a handheld global positioning system (GPS). Sagebrush in the greater sage-grouse winter use areas was usually located in long linear patches in drainage bottoms and was between 2 and 4 feet tall. These habitat areas are referred to as crucial or severe winter relief habitat (HWA 2003). This single season survey in the winter of 2000/2001 found no crucial greater sage-grouse winter habitat was located in the Project Area (HWA 2003).

Aerial surveys were also conducted by HWA biologists in late March and early April 2001 to check the status of known sage-grouse leks and document new leks. Two active greater sage-grouse leks were documented south of the Project Area (**Figure 3-1**). Additionally, one active lek was located south of the delivery pipeline and access road (**Figure 3-1**). A 2-mile buffer around these three leks includes approximately 1,539 acres of the Project Area. Neither lek is within $\frac{1}{4}$ mile of the pod, however. The proposed Red Rim Lateral Pipeline would intersect 4.4 miles of potential nesting habitats within 2-mile buffers of these two known lek sites.

In addition the greater sage-grouse surveys in 2001, the Wyoming Game and Fish Department maintains an on-going database of lek locations and activity. The two leks identified by HWA were the Scotty's Peak and Ram Canyon leks. Wyoming Game and Fish records identify several other leks in the area, including one on private land inside the pod boundary and two just outside the pod boundary on the north end. In all 6 pods have two mile seasonal restriction areas within the pod boundary. No portion of the project area is outside of the two mile timing stipulation.

Leks are monitored annually for greater sage-grouse use in the spring. Not every lek is visited every year, and absence of strutting birds in a single year does not result in its classification as a historic lek. "Historic" leks do not receive protection however "inactive" leks do. This lek is classified as "undetermined." "Undetermined" leks are those leks that have not been documented as being active in the last ten years, but do not have sufficient documentation to be designated as historical. The lek found inside the pod boundary on private land is Hogback lek. As shown on Table 3-11 the last record of greater sage-grouse activity is 1978. It is located next to an existing road and within less than $\frac{1}{4}$ mile of an existing well site on private land. This lek is classified as "inactive" under the Wyoming BLM definitions for greater sage-grouse leks.

**Table 3-11
Wyoming Game & Fish Recorded Leks and Location**

Lek Name	Legal Location				Last Year	
	TXXN	RXXW	Section	Location	Active	Surveyed
Red Rim Basin	20	89	17	SE NE	1990	2001
Red Rim	20	89	19	C E2	2001	2001
Hogback	20	89	29	SE	1978	2003
Scottys Peak	20	89	34	SW N	2001	2001
Ram Canyon	19	89	4	S2 N	2001	2003
Midnight Valley	19	89	5	SW NE	2003	2003

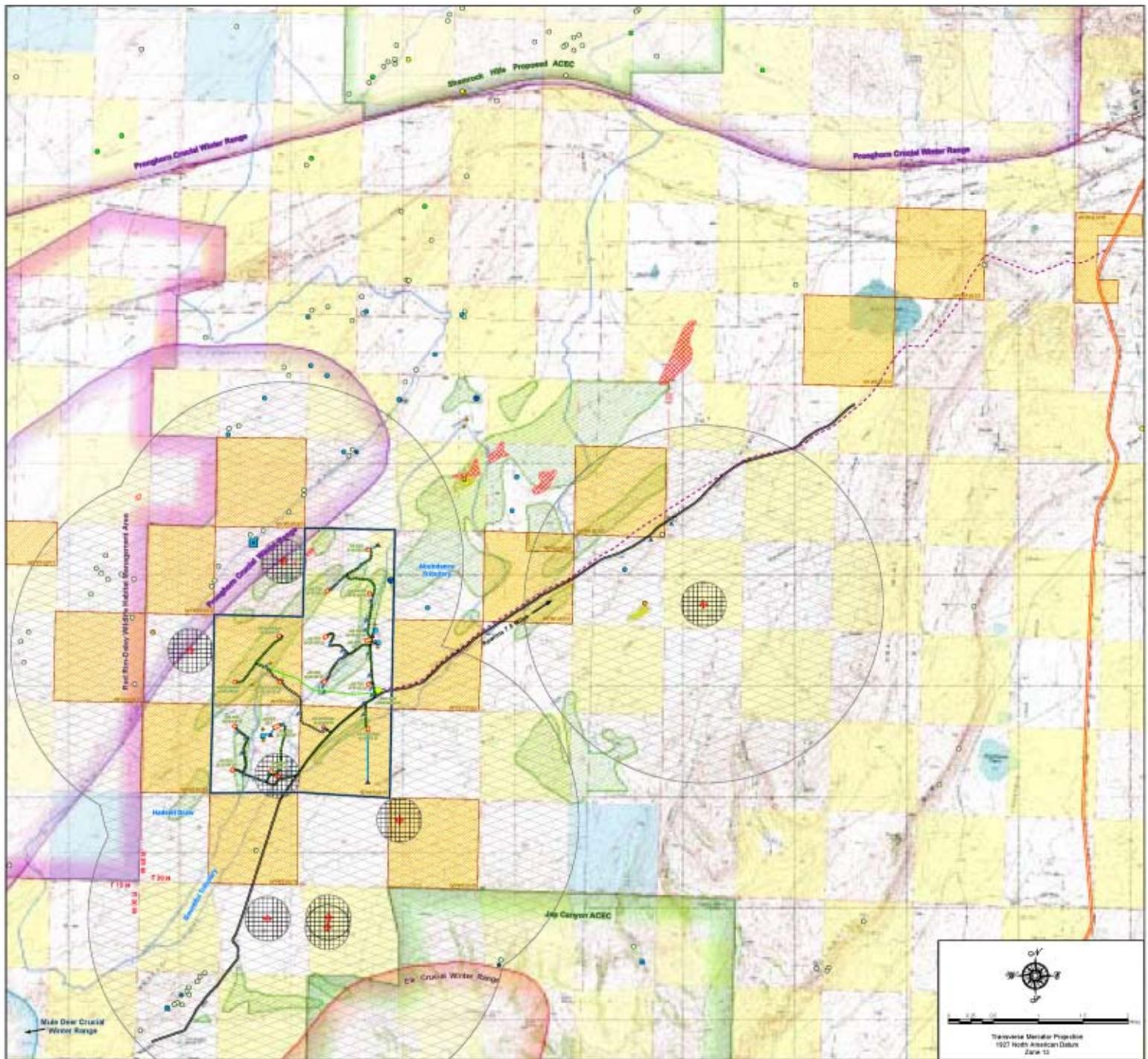
3.8.1.3. Raptors

Several species of raptors occur or potentially occur within the Project Area. They include the golden eagle, northern harrier, sharp-shinned hawk, Cooper’s hawk, northern goshawk, red-tailed hawk, Swainson’s hawk, rough-legged hawk, ferruginous hawk, American kestrel, merlin, prairie falcon, peregrine falcon, short-eared owl, long-eared owl, great-horned owl, and burrowing owl.

Helicopter surveys in and around the Project Area were conducted during late May 2001 to locate raptor nests (HWA 2003). One inactive raptor nest is located within the Project Area. Observations during the helicopter survey within the 1-mile buffer of the Project Area included an active golden eagle nest, 0.6 miles west of the Project Area; two inactive ferruginous hawk nests; one inactive red-tailed hawk nest; and an inactive nest of an unknown raptor. One inactive ferruginous hawk nest and two inactive golden eagle nests are located within 0.5 miles of the proposed pipeline route in Sections 7 and 13 of T20N R88W (**Figure 3-1**). Approximately 5 miles of the proposed pipeline route were not included in the May 2001 survey, as the area is located outside the area flown for the Atlantic Rim EIS study area. The Companies will consult with the BLM RFO to identify any additional raptor surveys that are needed before construction of the pipeline begins.

3.8.2. SPECIAL STATUS SPECIES – Wildlife and Fish

U.S. Fish and Wildlife Service (FWS) surveys for federally listed threatened, endangered, candidate, and species of concern discussed and summarized here were conducted as part of larger-scale surveys performed in preparing the Atlantic Rim EIS in 2000 and 2001 (HWA 2003). The area of interest for threatened, endangered, candidate and species of concern includes the Project Area and a 1-mile buffer for raptor nests. In addition, the Red Rim pipeline corridor, which extends northeast from the well locations toward Rawlins, is also considered. Locations for threatened and endangered species were obtained from the WGFD WOS.



Legend

- Red Rim POD Building
- Proposed Well Pad
- Stock Tank
- Proposed Discharge Point
- Lease Boundary
- Alternative Red Rim Lateral Pipeline
- Proposed Water, Gas and Electric Corridors
- Reservoirs
- Existing Road, Proposed Road
- Proposed Water Corridor
- Continental Divide Scenic Trail
- Culvert

BLM Wildlife Data

- Active Raptor Nest
- Historical Raptor Nest
- Wildlife Observation Site
- Burrowing Owl
- Winter Greater Sage-Grouse Site
- Bureau of Land Management
- State

Hayden-Wing Assoc. Wildlife Data

- Greater Sage-Grouse Lek
- Lek Quarter-Mile Buffer
- Lek 2-Mile Buffer
- Greater Sage-Grouse Severe Winter Relief Habitat
- Prairie Dog Colonies
- Potential Mountain Plover Habitat

- Ferruginous Hawk
- Golden Eagle
- Red-tailed Hawk
- Active Golden Eagle Nest
- Unknown Raptor
- One-Mile Buffer Around Active Raptor Nest 2001

ANADARKO PETROLEUM CORPORATION

**FIGURE 3-1
RED RIM POD PROPOSED ACTION
WILDLIFE AND SENSITIVE AREAS**

DATE: 11/11/11
SCALE: AS SHOWN
PROJECT NO. 11000000000000000000
REVISION NO. 11000000000000000000
PROJECT BY: [Name]
DATE: 11/11/11

Data were collected through a series of aerial and ground surveys to: (1) determine occurrence of threatened, endangered, proposed, or candidate species for listing in the Project Area; and (2) determine the occurrence, location, and size of mountain plover habitat and conduct a preliminary presence/absence survey for the species.

3.8.2.1. Threatened and Endangered Species – Wildlife and Fish

3.8.2.1.1. Wildlife Species

Black-footed Ferret and Associated White-tailed Prairie Dog Colonies

In Wyoming, large colonies of white-tailed prairie dog (*Cynomys leucurus*) provide habitat for black-footed ferrets. Aerial surveys for prairie dog colonies were conducted over the Project Area in late March and early April 2001. One prairie dog colony of approximately 3 acres occurs in the Project Area (**Figure 3-1**). The colony is part of a larger prairie dog complex that stretches north, south, and west of the Project Area. During a July 2001 survey, four colonies in this complex were found to exceed 200 acres in size and to exhibit burrow densities of eight burrows per acre. Therefore, these colonies are considered potentially suitable habitat for black-footed ferrets (HWA 2003). A nocturnal survey for black-footed ferrets was conducted in August 2001 over the entire prairie dog town, and no ferrets or their sign were found (HWA 2001). The black-footed ferret is not likely to occur within the Project Area.

Canada Lynx

Records of lynx in Wyoming indicate that most lynx or lynx sign between 1973 and 1986 were in lodgepole pine (18 percent) and spruce-fir (41 percent) communities. There is a lack of high-elevation lodgepole pine/spruce-fir habitat types preferred by this species within the Project Area, the area does not support a population of snowshoe hares (preferred prey), there are no recorded lynx sightings near the Project Area (HWA 2003), and the closest potentially suitable habitats are located more than 10 miles away in the Sierra Madre Mountains (HWA 2001). The nearest records of lynx to the Project Area were from the Medicine Bow River in 1856. Therefore, it is unlikely that Canada lynx occur within or near the Project Area.

Bald Eagle

Primary wintering areas for the bald eagle are typically associated with concentrations of food sources along major rivers that remain unfrozen where fish and waterfowl are available, and near winter ranges for ungulates that provide carrion (HWA 2003). Wintering bald eagles are also known to roost in forests with large, open conifers and snags protected from winds by ridges, often near concentrations of domestic sheep and big game (HWA 2003). Incidental sightings of bald eagles have been recorded near the Project Area (HWA 2003). Most observations were documented between November and March, indicating that the area is commonly hunted by bald eagles during the winter. However, the occurrence of communal winter roosts in or near the Project Area has not been documented. Inspection of BLM and WGFD records on raptor nests and the results of aerial and ground surveys for raptor

nests conducted suggest that bald eagle nests do not occur within 2 miles of the Project Area. The closest known nest occurs more than 21 miles southwest of the Project Area. This nest has been active each of the last 5 years.

3.8.2.1.2. Fish Species

No federally listed fish species have the potential to occur within the Project Area.

3.8.3. Species of Concern - Wildlife and Fish

3.8.3.1. Wildlife Species

Twenty-five species of special concern wildlife occur or potentially occur in the Project Area. They include seven mammal species, 16 bird species, and three amphibian species (HWA 2003). These species and their sensitivity status and rank are listed in **Appendix E**.

3.8.3.1.1. Mammals

Seven sensitive mammal species may be found in the Project Area. These species include the dwarf shrew, Wyoming pocket gopher, white-tailed prairie dog, swift fox, fringed myotis, long-eared myotis, and Townsend's big-eared bat. Only one of these species, the white-tailed prairie dog, is known to occur within the Project Area; one small town (3.04 acres) exists in the northwestern quarter of Section 16. The dwarf shrew, Wyoming pocket gopher, and swift fox are likely to occur in the Project Area. The remaining species (fringed myotis, long-eared myotis, and Townsend's big-eared bat) have a slight potential to occur on the Project Area.

3.8.3.1.2. Birds

Sixteen sensitive bird species may be found in the Project Area. These species include Baird's sparrow, sage sparrow, Brewer's sparrow, long-billed curlew, sage thrasher, western burrowing owl, yellow-billed cuckoo, loggerhead shrike, Columbian sharp-tailed grouse, greater sage-grouse, white-faced ibis, trumpeter swan, peregrine falcon, ferruginous hawk, northern goshawk, and mountain plover. The western subspecies of yellow-billed cuckoo is considered an FWS candidate for listing as endangered. Eight of these species are known to be present in the Project Area and include sage sparrow, Brewer's sparrow, sage thrasher, western burrowing owl, loggerhead shrike, greater sage-grouse(see Section 1.2.3), ferruginous hawk, and northern goshawk (not likely to nest in the Project Area, however). Five species (Baird's sparrow, long-billed curlew, yellow-billed cuckoo, white-faced ibis, and trumpeter swan) are unlikely to occur. The Columbian sharp-tailed grouse and peregrine falcon have a slight potential to occur in the Project Area.

Mountain Plover

The mountain plover nests over much of Wyoming, but preferred habitat is limited throughout its range (HWA 2003). This ground-nesting species is typically found in areas of short (less than 4 inches) vegetation on slopes of less than 5 percent. Any short grass, short shrub,

or cushion plant community could be considered plover nesting habitat (HWA 2003); however, mountain plovers prefer shortgrass prairie with open, level or slightly rolling areas dominated by blue grama and buffalograss (HWA 2003). Loss of wintering and breeding habitats and declines in the prey base from pesticide use are thought to be factors that contribute to the decline of mountain plovers on the North American Continent (HWA 2003).

The Project Area was surveyed for mountain plover habitat in May 2001 (HWA 2003). Five habitat patches, totaling 699.9 acres, of potential mountain plover habitat were located within the boundary of the Project Area (Figure 3-1). Potential plover habitats defined during 2001 were again surveyed for plovers in April 2002 and 2003. No plovers were sighted during any of the three years' surveys of the Atlantic Rim EIS study area. One opportunistic sighting of a mountain plover was recorded approximately 2 miles east of the Project Area on June 20, 2001. Potential effects to mountain plover habitat will be determined during the APD phase of development.

3.8.3.1.3. Amphibians

Three sensitive amphibian species may be found in the Project Area. These species include the boreal toad, Great Basin spadefoot toad, and northern leopard frog. The Great Basin spadefoot toad has a slight potential to occur, and the boreal toad and northern leopard frog are unlikely to occur in the Project Area.

3.8.3.2. Fish Species

Fish species, the roundtail chub, bluehead sucker, flannelmouth sucker, and Colorado River cutthroat trout, are classified as candidate species and are included on the BLM (2002) Sensitive Species List. These species are not listed as endangered or threatened by the FWS, but have been identified for possible listing in the future. The four BLM sensitive fish species do not occur in the Great Divide Basin or the Platte River system (BLM 2002); therefore, no BLM sensitive fish would occur in or downstream of the Project Area.

3.9 RECREATION

Hunting, camping, and off-road vehicle (ORV) use are the most popular recreational activities in or near the Project Area, although no developed recreational sites, facilities, or special recreational management areas exist within or adjacent to the Project Area. An OHV/motocross recreation area is proposed for Hogback Lake in Section 34, T21N R88W, about 5 miles to the northeast. The majority of recreation use is associated with the fall hunting seasons, specifically during September and October for the greater sage-grouse. Pronghorn hunting also occurs in September, and other hunting use occurs during the mule deer season in mid- to late October. Rabbits and some predators are hunted during the fall and winter. Outside the hunting seasons, the area attracts small numbers of visitors who engage

in rock collecting, camping and hiking, observing wildlife, outdoor photography, and picnicking. Although data on recreational visitation are not available, overall use levels are generally low (BLM 2000). Low visitation to the Project Area is a result of the small number of local residents, the long drives from major population centers, lack of publicized natural attractions, and road conditions or land ownership patterns that limit access by vehicles into many areas.

The Continental Divide National Scenic Trail is located along State Highway 71 through Rawlins. The proposed delivery pipeline route ends near this portion of the trail corridor. This portion of the trail along the highway provides a link between designated segments of the trail, which are entirely on public land. Land ownership near Rawlins, including the Project Area, is a checkerboard of public and private land. No other developed recreational sites, facilities, or special recreational management areas exist within or adjacent to the Project Area.

3.10 VISUAL RESOURCES

The Project Area is typical of the more rugged sections of Wyoming Red Desert region: lands in the Project Area are moderately undulating. Numerous small drainages dissect the landscape, providing topographic diversity. The visual resource management (VRM) class of the Project Area is Class III, which includes areas where changes in the basic elements (form, line, color, or texture) caused by management activities may be evident in the characteristic landscape. The objective of this class is to provide for management activities that may modify the existing character of the landscape. However, changes should remain subordinate to the visual strength of the existing character.

Larger views that encompass several viewsheds are available from high points. The expansive panorama dominated by the horizon between sky and land is a significant aspect of all distant views. The predominant vegetation types, typical of cold desert steppe, are alkali and low sagebrush, mixed desert scrub, and grasses and forbs, with scattered patches of big sage/rabbit brush on flatter north- and east-facing slopes, along drainage ways, and in large depressions. Small, established stands of juniper also grow within the Project Area. The combination of plant communities creates a subtle mosaic of textures and colors. Predominant vegetation colors in early spring are green and gray green, changing to gray/green and buff/ochre as grasses and forbs cure in the summer and fall. Reddish brown and buff colors of the badland formations add contrast and dominate in areas of steep topography.

Evidence of cultural modification in the Project Area includes unimproved roads and some oil and gas production facilities. Motorists traveling I-80 and WY 71 would not have visual access to the Project Area because of the viewing distance (5 to 8 miles) and intervening elevated topography. However, facilities and activities located on ridgelines or buttes are visible over longer viewing distances. The quality of the visual resource is an important part of the recreational experience for many of these users. Other nonrecreational users of the area, including grazing permit holders and employees working in the oil and gas industry, would also be affected by changes to the visual landscape.

The pipeline corridor is within the foreground views of motorists on State Highway 71 and is within an existing pipeline corridor. The visual resource management class of the Project Area is Class III. Class III includes areas where changes in the basic elements (form, line, color, or texture) caused by a management activity may be evident in the characteristic landscape. The objective of this class is to provide for management activities that may require modification of the existing character of the landscape. However, changes should remain subordinate to the visual strength of the existing character.

3.11 CULTURAL RESOURCES

3.11.1. Culture History

The earliest known period of culture history in southwestern Wyoming is that of Paleoindian beginning about 12,000 years before present (B.P.), which has come to signify hunting and gathering adaptations of late Pleistocene and early Holocene age. The hunting and butchering of megafaunal animals such as mammoths and bison characterize this period. At these sites large, lanceolate projectile points are often found in association with the skeletal remains of the now extinct megafauna.

Following the Paleoindian period is the Archaic. The Archaic period dates from about 8,500 to 2,000 years B.P. During this time, groups adopted a more varied hunting and gathering subsistence pattern. In southwestern Wyoming, recent investigations reveal a subsistence system with an emphasis on plant processing and small game. The Early Archaic period is also marked by a change in projectile point technology from lanceolate types to side-notched dart points. The Archaic period in Washakie Basin is divided into the Early and the Late periods. The Early period is subdivided into the Great Divide and Opal phases. The Middle Archaic period is represented in other areas of the southwest Wyoming and is known as the McKean complex. The subsistence economy remained much as it had been during the Early Archaic period with both hunting and gathering activities in evidence. By 3,000 years before present, new cultural manifestations replaced the McKean complex. The first of these is Pelican Lake, known for its corner-notched projectile points. In the Wyoming Basin, Elko series points are also relatively common during this time. In the Waskakie Basin, the chronology goes from the Early Archaic to a Late Archaic. The Late Archaic is subdivided into the Pine Spring and Deadman Wash phases. The subsistence economy remained much as it had been during the Early Archaic period.

The Late Prehistoric period 2,000 B.P. is subdivided into the Uinta and the Firehole phases in the Washakie Basin and is marked by the introduction of bow and arrow and pottery. Small side- and corner-notched projectile points including the Desert side-notched and Rose Springs types appear at this time. With the exception of the bow and arrow and ceramics, there was little change in the material culture or in life ways over the preceding Archaic periods. The Protohistoric period is marked by the introduction of the horse and European trade goods. The horse and gun allowed some tribes to concentrate intensely on bison hunting. The influx of European technology also changed patterns of trade and migration among groups. In some instances, the social and economic organization shifted from small family bands to larger, more permanent groups of several families.

Southwestern Wyoming in the Historic period has predominantly been used for cattle and sheep ranching. Fur trapping and trading was not an important occurrence in the Project Area due to lack of perennial streams. Settlement has been limited due to scarce water sources and rugged terrain. There are historic trails and transportation routes such as the Overland Trail, Cherokee Trail, Outlaw Trail, Rawlins to Baggs Stage Road, and Baggs to Wamsutter Road that are important corridors that occur in and near the Project Area. The Rawlins to Baggs Stage Road (48CR3648) is within the Project Area. This stage road was a route used for freight, mail, and passengers between Rawlins and Baggs, Wyoming. The route was first used in 1881 and was known as the Rawlins to White River, the Rawlins, and the Snake River Road (GHEP 2003). The route was later labeled the Baggs to Rawlins Road (1916). The road is depicted on Holt’s Map of Wyoming (1883). Stage stations were established along the route with service to ranching communities in the Little Snake River Valley. There is a strong association between the road and the history of the Ute White River Agency and the Ute Massacre.

The Rawlins to Baggs Stage Road and the Baggs to Wamsutter Road (48CR5739) follow the same route for about 10 miles north of Baggs; generally the same route as Wyoming Highway 789. At this point, they diverge with the Rawlins to Baggs Stage Road trending north and east toward Rawlins, crossing Muddy and Dry Cow Creeks. This route has been maintained as a transportation corridor with blading and widening of the route in the 1960s as needed to meet changing needs of vehicles used. Portions of the original route have been abandoned with the construction of Twentymile Road.

The accepted cultural chronology of the Washakie Basin is based on a model for the Wyoming Basin by Metcalf (1987) and revised by Thompson and Pastor (1995). The Wyoming Basin prehistoric and historic chronology is documented in **Tables 3-12** and **3-13**.

TABLE 3-12 PREHISTORIC CHRONOLOGY OF THE WYOMING BASIN

Period	Phase	Age (B.P.)
	Paleoindian	12,000 – 8,500
Early Archaic	Great Divide	8,500 – 6,500
	Opal	6,500 – 4,300
Late Archaic	Pine Spring	4,300 – 2,800
	Deadman Wash	2,800–2,000/1,800
Late Prehistoric	Uinta	2,000/1,800 – 650
	Firehole	650 – 300/250
	Protohistoric	300/250 – 150

Source: Metcalf (1987), as modified by Thompson and Pastor (1995)
 B.P. = Before present

TABLE 3-13 HISTORIC CHRONOLOGY OF THE WASHAKIE BASIN

Phase	Age A.D.
Pre-Territorial	1842 – 1868
Territorial	1868 – 1890
Expansion	1890 – 1920
Depression	1920 – 1939
Modern	1939 – Present

Source: Massey 1989

3.11.2. Cultural Environment

The Red Rim Project Area is located on Hogback Ridge with local topography dominated by northeast-southwest trending ridges. These ridges have been cut by Sixteenmile Draw, Hadsell Draw, and small intermittent drainages. Landforms consist of ridges, finger ridges, knolls, and hills. Stabilized, intermittent sand dunes occur in hilly upland areas. Eolian sands from western sources add an additional component to localized soils. In southwest Wyoming, sand deposits (dunes, shadows, and sheets) are recognized as highly likely to contain cultural material.

Prehistoric use of the Washakie Basin reflects a hunter-gatherer lifestyle. Research into the subsistence and settlement patterns during the Archaic period indicates summer occupations in the mountains, winter occupations in the foothills, and spring and fall movements that made use of all available zones (Creasman and Thompson 1997). Subsistence patterns in the Archaic and the Late Prehistoric periods are similar in that they are based on seasonal movement throughout the basins and foothills in response to the availability of floral and faunal resources (Creasman and Thompson 1988). The topographic setting is conducive to prehistoric occupation. A high potential for prehistoric sites occurs near reliable water such as Sixteenmile Draw and Hadsell Draw. As distance increases from these water sources, site density drops.

Historical use of the Washakie Basin area was affected by the formidable topographic relief. Steep canyons, hogback ridges, and escarpments make the area more difficult for settlement. The area was primarily used for cattle and sheep ranching. Limited ranching is identified by the presence of historic debris scatters and the historical record. A portion of the Rawlins to Baggs Stage Road is in the southern boundary of the Project Area. Stage stops, road ranches, and historic trash can be found along historic transportation corridors such as the Rawlins to Baggs Stage Road.

3.11.3. Summary of Cultural Resources

Previous fieldwork was identified during the Class I file searches requested from the Wyoming Cultural Records Office for the surveys (Hatcher 2003). A limited amount of field work has occurred near the Project Area, resulting in the documentation of only a few cultural resources through survey, examination of ethnographic records, and research of historic records. No sites have been extensively tested or excavated in the Project Area. However,

several sites have been excavated in the surrounding area, contributing data about the prehistory and history of the area.

3.11.3.1. Previous Surveys

One previous survey has been conducted in the Project Area. The Class III linear survey resulted in the recording of two sites and no isolated finds. One other site has been previously recorded in the Project Area but it is not associated with a project. Only the linear survey covered any portion of the Project Area.

The previously recorded sites include two prehistoric and one historic resource. Site 48CR928 and Site 48CR3648 were re-located and re-recorded. These two sites are discussed below in the section on Recent Cultural Resource Investigations. The third site is 48CR7618, a prehistoric lithic scatter. This site is recommended as not eligible for the NRHP and is outside the current Project Area boundaries, although it is within ¼ mile of the boundary.

3.11.3.2. Potential Site Types

Based on the results of the files searches, the expected cultural resources for this area include prehistoric and historic resources. The prehistoric and historic site types that could be expected are:

- ∅ Prehistoric open camps that contain evidence of a broad range of activities, including subsistence-related activities. Cultural remains include features, lithic debris, chipped stone tools, and depending on the temporal period of use, evidence of milling and vegetable processing, including ground stone and pottery.
- ∅ Prehistoric lithic scatters consist of lithic debris such as debitage or chipped stone tools.
- ∅ Prehistoric or historic cairns that are low piles of local stone. Historic cairns are often constructed by shepherders.
- ∅ Historic artifact scatters that are collections of historic debris often left by shepherders and consist of artifacts such as glass, ceramic, and cans. Small artifact scatters may also be found along historic transportation routes such as the Rawlins to Baggs Stage Road.

Other site types that could occur but that have not been recorded in the Project Area include:

- ∅ Prehistoric quarries that are areas where lithic raw material was obtained and initially processed.

- Ø Human burials, rock art (both pictographs and petroglyphs), and rock alignment could occur and may be identified as sensitive or sacred to Native Americans. Few of these types of sites have been located in southwestern Wyoming.
- Ø Historic sheepherder's camps that would consist of features and historic debris.

Historic ranch complexes that are complex sites with historic debris and features and structures such as corrals, barns, dugouts, foundations, or standing elevation walls.

3.11.3.3. Cultural Resource Inventory for the Project

The Project Area was intensively surveyed in 2003 (Hatcher 2003). This investigation resulted in the recording of seven new sites, re-recording two previously recorded sites, and recording of seven new isolated finds. There are three prehistoric sites, six historic sites, and seven prehistoric isolated artifacts. Three prehistoric sites are recommended eligible to the NRHP and one historic site is eligible to the NRHP.

Site 48CR928 is a prehistoric site that was previously recorded and updated with the current investigation. The site consists of lithic debitage and features. The site has the potential for buried in situ cultural deposits and could contribute information regarding the prehistory of the area. The site is recommended eligible to the NRHP.

Site 48CR3648 is the Rawlins to Baggs Stage Road and consists of intact two-track ruts, swales and vegetative changes which can be followed with a reasonable degree of certainty. This segment is recommended as a contributing element to this eligible resource.

Site 48CR7927 is a prehistoric lithic scatter consisting of lithic debitage. The site is recommended as not eligible to the NRHP.

Site 48CR7928 is a historic stock watering structure and scatter of historic artifacts. The structure and artifacts are not unique or associated with events or persons important in the history of the area. The site is recommended as not eligible to the NRHP.

Site 48CR7929 is a prehistoric open camp with three features, one chipped stone tool, a scatter of possible groundstone, fire altered rock, and lithic debitage. This site has potential of buried in situ cultural deposits. The site is recommended as eligible to the NRHP.

Site 48CR7930 is a large cairn constructed of hundreds of tabular sandstone slabs. This cairn is located on a section line and is likely historic. The site is recommended as not eligible to the NRHP.

Site 48CR7931 is a prehistoric open camp consisting of lithic debitage, one core, and fire altered rock. The site has potential for buried in situ cultural deposits and is recommended as eligible to the NRHP.

Site 48CR7932 is a cairn constructed of tabular sandstone slabs. The cairn is next to the Section marker and is likely historic. The site is recommended as not eligible to the NRHP.

Site 48CR7933 is a historic artifact scatter consisting of scatter milled lumber, wooden wheel, tin cup, metal shovel, wooden hame, metal lid, oven, and glass jar. The site is recommended as not eligible to the NRHP.

3.11.4. Conclusion

The recent cultural inventory of the Red Rim Project Area identified three previously recorded sites, three newly recorded prehistoric sites, four newly recorded historic sites, and seven isolated finds. One site is within ¼ mile of but outside the Project Area. There are three eligible prehistoric sites and one eligible historic site. The eligible historic site is the Rawlins to Baggs Stage Road and the segment recorded in the Project Area is recommended as a contributing element to this eligible resource.

In southwest Wyoming, sand deposits (dunes, shadows, and sheets) are recognized as highly likely to contain cultural material. Certain topographic settings have greater archaeological sensitivity including eolian deposits (sand dunes, sand shadows, and sand sheets), and to a limited degree, colluvial deposits along lower slopes of ridges. The Project Area includes these deposits. The eligible prehistoric sites contain these deposits and have the potential for buried in situ cultural remains. Proximity to reliable water sources such as Sixteenmile Draw and Hadsell Draw is an important factor in predicting the occurrence of prehistoric resources and usually results in a high potential for prehistoric sites. If the proposed action is modified, an additional cultural resources inventory for the new area of proposed disturbance would be required.

3.12 SOCIOECONOMICS

The geographic area of analysis for potential socioeconomic effects is Carbon County, Wyoming, and the nearest communities of Baggs, Dixon, and Rawlins. The availability of temporary housing is also described for the communities of Craig in Moffat County, Colorado, and Wamsutter in Sweetwater County, Wyoming, the closest and most likely sources of the available workforce. Socioeconomic conditions in Carbon County that were characterized for the assessment include economic and population conditions, temporary housing re-sources, law enforcement and emergency management services, certain local and state government revenues, and local attitudes and opinions.

3.12.1. Economic Conditions

The economy of Carbon County is based on natural resources. Basic economic sectors that bring revenues into the county include oil and gas production and processing, coal mining, electric power generation, agriculture (primarily ranching and logging), some manufacturing, and transportation (primarily the Union Pacific railroad). Those portions of the retail and service sectors that serve travelers and tourism and recreation visitors are also basic.

Employment and earnings are two common measures of economic activity. The mining sector, which includes oil and gas employment, would be the primary sector affected by exploration or development of CBNG resources.

Employment, like the overall economy, has followed a boom and bust cycle. In 2000, employment in Carbon County totaled 12,392 full- and part-time jobs, which was about 25 percent higher than the 1990 level (WDAI 2000a, 2003) and about 9 percent lower than the 1980 level of 13,560 jobs. Employment in the mining sector, which includes jobs in the oil and gas industry, decreased 76 percent from 1990 to 2000, from 934 to 223 jobs. The 2000 level was 94 percent lower than the 1980 level of 3,563 jobs mining jobs (UW 1997). The losses in the mining sector and the volatility in total employment are attributed to the shutdown of the Rosebud and Seminoe # 2 mines (BLM 1999a) and more recently the RAG Shoshone mine near Hanna (Rawlins Daily Times 2000). Other reductions in the mine workforce and the delay in opening an anticipated mine have further affected employment in the mining sector throughout the county; however, increased natural gas drilling has resulted in growth in employment in the oil and gas industry in recent years (Schnal 2000).

In Carbon County, 10-year unemployment rates ranged from a low of 4 percent (2000) to a high of 6.1 percent (1993). In 2000, the total labor force in Carbon County was 8,357, which included 337 unemployed persons, resulting in an unemployment rate of 4 percent (Wyoming Department of Employment 2003).

Carbon County earnings increased from \$202 million to \$211 million between 1990 and 1998, a 5 percent increase. However, when adjusted for inflation, earnings in Carbon County decreased by 21 percent from their 1990 level during the 8-year period.

3.12.1.1. Oil and Gas Activities

Production of natural gas in Carbon County increased from 76 million cubic feet (MCF) in 1995 to about 97 MCF during 2000. In addition, production of oil in Carbon County in 2000 was within 1.6 percent of the 1995 level of 1.3 million barrels. During 2000, there were 1,032 producing oil and gas wells in Carbon County (WOGCC 1995-2000).

One indicator of future production, approved Applications for Permits to Drill, increased steadily in Carbon County in recent years, from 50 in 1995 to 162 in 2000 to 225 to date in 2003. Increased drilling may result in increased production in the county if drilling efforts are successful and commodity prices rise or stabilize at economic levels.

3.12.1.2. Economic Activities

Other economic activities occurring in and near the Project Area include oil and gas exploration (Vosika Neuman 2000), cattle grazing (Warren 2000), and outdoor recreation such as hunting (pronghorn antelope, mule deer, elk and upland birds), hiking, off-road vehicle use, camping, and sightseeing. Many commercial hunting outfitters hold permits for the hunt areas where the Project Area is located, although the Project Area makes up only a small portion of these hunt areas (Clair 2000).

3.12.1.3. Population

The growth and decline in the population of Carbon County parallel the employment boom and bust cycle outlined at the beginning of this section. For example, the 2000 population of Carbon County (15,639) was 29 percent lower than its 1980 level of 21,896 (WDAI 2001). Between 1990 and 2000, the City of Rawlins, the largest community in Carbon County, lost an estimated 842 persons to end the period at 8,538, although the city is growing because a new state prison opened. The Town of Baggs gained 76 residents or 28 percent of its 1990 population. Likewise, the Town of Dixon, several miles east of Baggs, gained 12 persons to end the period with an estimated population of 79.

3.12.2. Temporary Housing Resources

Natural gas development typically involves relatively short-duration tasks carried out primarily by contractors. The nature of these activities results in demand for temporary housing resources such as motel rooms and mobile home and recreational vehicle (RV) spaces in the Project Area and vicinity.

The most convenient access to the Project Area would be from communities located along I-80 in Carbon and Sweetwater Counties. Rawlins is the county seat of Carbon County and the community nearest to the Red Rim Project Area. Temporary housing includes 20 hotels and four RV parks. Hotels and RV parks routinely accommodate oil and gas industry workers as well as tourists, travelers, and hunters. Longer-term rental housing in the Rawlins area consists of 10 apartment complexes and numerous rental houses. According to the 2000 Census, 17.3 percent, or 667 housing units, of the total 3,860 housing units were rental vacancies.

Temporary housing resources are available in the Town of Wamsutter, located 28 miles west of the Project Area on I-80, including several mobile home parks and three motels (Carnes 2000; Carbon County Chamber of Commerce 2003). The town is the center of a 200-well per year British Petroleum (BP) drilling and field development program. Wamsutter officials recently stated that no housing was available in the town to accommodate workers and their families associated with the current drilling and field development (Rock Springs Rocket Miner 2001).

3.12.3. Local Government and State Government Revenues

The fiscal condition of local and state governments most likely to be affected by interim drilling includes county, school, and special district ad valorem property tax revenues; state, county, and municipal sales and use tax revenues; state severance taxes; and federal and state mineral royalty distributions. Some county, municipal, and special district service expenditures may also be minimally affected.

3.12.3.1. Ad Valorem Property Tax

The assessed valuation in Carbon County for fiscal year (FY) 2001 totaled about \$554 million, which yielded total property tax revenues of \$34.9 million. Mineral production is assessed at 100 percent of value. The countrywide mill levy in 2001 was 12.76. Assessed valuation in FY 2001 from 2000 natural gas production totaled \$363 million, or about 66 percent of total assessed valuation. Assessed valuation from oil production totaled \$31.1 million, or about 6 percent of total valuation (WTA 2001).

3.12.3.2. Sales and Use Tax

FY 2000 sales and use tax collections in Carbon County totaled about \$21 million. These collections include a 4 percent statewide sales and use tax, a 1 percent general purpose local option sales and use tax, and a 1 percent specific-purpose local option sales and use tax, which expired in the summer of 2001 (WDAI 2000b).

3.12.3.3. Severance Taxes

In Wyoming, severance taxes are levied against certain minerals produced in the state, including a 6 percent severance tax on natural gas. In FY 2000, distributions from the severance tax totaled \$275 million (WDAI 2000c). Of the total, 44 percent was attributable to severance taxes on natural gas.

3.12.3.4. Federal Mineral Royalties

The federal government collects a 12.5 percent royalty on oil and natural gas extracted from federal lands. After certain costs are deducted, half of those royalties are returned to the state where production occurred. In Wyoming, the state's share is distributed to a variety of accounts, including the university, school foundation fund, highway fund, Legislative Royalty Impact Account, and cities, towns, and counties. During FY 2000, \$309 million in federal mineral royalty funds were distributed to entities in Wyoming (WDAI 2000d).

3.12.3.5. State Mineral Royalties

The State of Wyoming collects a 16.7 percent royalty on the fair market value of gas produced from state leases, less production, and transportation costs. During FY 2000, income from state leasing was \$35 million (PRCBMIC 2001).

3.12.4. Attitudes and Opinions

A 1996 survey conducted in conjunction with preparation of the Carbon County Land Use Plan provides some insight into the attitudes and opinions of residents regarding land use, oil and gas development, natural resource conservation, and use and other topics. Slightly more than 300 residents completed the survey, yielding an estimated statistical reliability of about

95 percent (Pederson Planning Consultants 1998). Water resource conservation and concern for government regulation of land use were the most frequently listed important land use issues. This issue was followed closely by the availability of water to support future land uses; the economic viability of ranching, timber, and oil and gas industries; and the need to conserve wildlife habitat.

Approximately 55 percent of countywide survey respondents (based on a weighted average; some respondents indicated more than one response) indicated that conservation of land, water, and wildlife resources was more important than increased oil and gas production, while 36.9 percent indicated that increased oil and gas production was more important. However, 54 percent of the respondents from Baggs indicated that increased oil and gas production was more important than conservation of land, water, and wildlife resources, while 36 percent indicated that resource conservation was more important. The land use plan attributes this difference to the greater economic dependence in Baggs on future employment in the oil and gas industry.

Concerning management of federal lands, the largest number of respondents (69.5 percent) indicated that more federal lands within the county should be designated for conserving fish and wildlife habitat and surface water and groundwater resources. In addition, 60.8 percent of respondents indicated that more land should be designated for public recreation, 48.8 percent indicated that more land should be leased for oil and gas industry exploration and production, 48.7 percent indicated that more land should be leased for commercial mining, and 44.5 percent indicated that more land should be made available to local timber companies for commercial timber harvest.

3.12.5. Environmental Justice

Executive Order (EO) 12898, “Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations,” was published in the *Federal Register* (59 FR 7629) on February 11, 1994. EO 12898 requires federal agencies to identify and address disproportionately high and adverse effects on human health or the environment of their programs, policies, and activities on minority and low-income populations (defined as living below the poverty level). The EO makes clear that its provisions apply fully to American Indian populations and Indian tribes, and specifically to effects on tribal lands, treaty rights, trust responsibilities, and the health and environment of Indian communities.

Communities within Carbon County and entities or individuals with interests in the area may have concerns about the presence of natural gas development within the Project Area. Communities potentially affected by the presence or absence of the proposed development have been identified in the previous sections. Environmental justice concerns are usually directly associated with impacts on the natural and physical environment, but these impacts are likely to be interrelated with social and economic impacts as well. Environmental justice concerns focus on promoting the protection of human health and the environment, encouraging public participation, and disseminating relevant information to educate potentially affected communities.

Native American access to cultural and religious sites may fall under the umbrella of environmental justice concerns if the sites are on tribal lands or access to a specific location has been granted by treaty right. With regard to environmental justice issues affecting Native American tribes or groups, the Project Area contains no tribal lands or Indian communities, and no treaty rights or Indian trust resources are known to exist for this area.

3.13 TRANSPORTATION

The regional transportation system that serves the Project Area includes an established network of interstate and state highways and county roads. Improved and unimproved BLM roads serve local traffic on federal land.

Federal and state highways that provide access to the Project Area include U.S. Interstate Highway 80 (I-80) Wyoming State Highway (WY) 789, WY 71, and WY 70. The Wyoming Department of Transportation (WYDOT) measures annual average daily traffic (AADT) and collects accident statistics on federal and state highways. AADT and accident statistics for highways providing access to the Project Area are shown in **Table 3-14**.

WYDOT assigns levels of service to highways in the state system. Levels of service (A through F) are assigned based on qualitative measures (speed, travel time, freedom to maneuver, traffic interruptions, and comfort and convenience) that characterize operational conditions within traffic streams and the perceptions of those conditions by motorists. “A” represents the best travel conditions, and “F” represents the worst. Levels of service for highways that provide access to the Project Area are shown in **Table 3-14**.

The Project Area would be accessed from Carbon County Road (CCR) 605 (Twentymile Road), which connects with I-80 at the west side of Rawlins. Limited access is also available from unimproved BLM roads that connect with State Highway 71. CCR 605 is a one-lane road that is graded and partially graveled. It is located adjacent to most of the pipeline corridor and intersects the southeastern portion of the Project Area. The road currently provides access to hunting on public lands, grazing operations on public and private lands, and other oil and gas operations in the area.

**TABLE 3-14 HIGHWAY ACCESS, ANNUAL AVERAGE DAILY TRAFFIC,
AND ACCIDENT STATISTICS**

Highway	2000 AADT	Projected 2012 AADT	Level of Service/Annual Average Accidents 1996 -2000
I-80 from Rawlins west to Creston Junction	10,900	15,000	A/123.4
I-80 from Rock Springs east to Creston Junction	10,900	15,000	A/246.6
WY 789 from Creston Junction south to Baggs	760	800	B/18.8
WY 70 from Savery west to Baggs	530	550	B/14.8
WY 71 I-80 south	160	160	B/3.2

Sources: GHEP 2003

3.14 HEALTH AND SAFETY

Existing health and safety concerns in and adjacent to the Project Area include occupational hazards associated with natural gas exploration and operations; risks associated with vehicular travel on improved and unimproved county and BLM roads; firearms accidents associated with hunting or casual use of firearms; and low-probability events such as landslides, flash floods, and range fires.

3.14.1 Occupational Hazards

Two types of workers would be employed by the project: oil and gas workers who in 1998 had an annual accident rate of 4.0 per 100 workers, and special trade contractors, who had a non-fatal accident rate of 8.9 per 100 workers (U.S. Department of Labor, Bureau of Labor Statistics 1998). These rates compare with an overall private industry average for all occupations of 6.2 per 100 workers.

There has been recent concern among drillers that worker safety standards and training used for conventional oil and gas may not be appropriate for the CBNG industry (Rock Springs Rocket Miner 2001). During 2000, five workers died and six others were seriously injured in CBNG-related accidents in Campbell County, Wyoming. The Wyoming Occupational Safety and Health Administration (OSHA), Worker's Safety Division, is working with company officials to consider changes in worker safety standards and revised training requirements.

3.14.2. Pipeline Hazards

Accident rates for gas transmission pipelines are historically low. Nationwide, injuries associated with gas transmission pipelines averaged 12 per year from 1990 through 2001, fatalities averaged one per year, and incidents such as ruptures averaged 79 per year (U.S. Department of Transportation 2002).

3.14.3. Other Risks and Hazards

Hazards would exist from sanitation and materials used during oil and gas development. Federal regulations establish standards for safety procedures during drilling, including blow-out prevention equipment to control abnormally high pressures if encountered during drilling operations, and procedures to be employed for the control and removal of wastes, spill prevention, fire prevention, and suppression. The existing risks associated with wildfire in the Project Area have not been characterized or quantified for either natural or human-caused ignitions. The handling, storage, transportation, and disposal of hazardous materials, if any are used, also are regulated. A spill prevention control and countermeasures plan is required.

The types of materials used in the development of CBNG are materials that are often found in a garage at a residence, including ammonia, gasoline, diesel fuel, motor oil, greases and lubricants, solvents to clean equipment, antifreeze-type heat transfer fluids (glycols), paint, sand, fertilizers, and herbicides (weed killers). Additional materials that are typically used are solutions that are used to regulate acidity and alkalinity, such as those that could be used for spa maintenance, including sodium hydroxide, and acids. Surfactants (soap-like materials), inert gases that are not toxic, flammable, or explosive, and welding or cutting materials also are used.

3.15 NOISE

The Project Area is located in a sparsely populated rural setting with modest sound disturbances. The principal source of sound within the Project Area is the wind. Vehicle traffic on I-80 and WY 71; jet aircraft overflights at high altitudes; localized vehicular traffic on county and BLM roads and two-tracks in the Project Area; nearby drilling; a compressor station, and generation also cause sound disturbances within the Project Area. The EPA has established an average 24-hour noise level of 55 A-weighted decibel (dBA) as the maximum level that does not adversely affect public health and welfare. The State of Wyoming has not established regulations for quantitative noise levels. Definitive data have not been established concerning noise levels that may affect animals.

4.0 ENVIRONMENTAL CONSEQUENCES

4.1 INTRODUCTION

This chapter analyzes the potential environmental consequences that would result from implementation of Alternative 1 – Proposed Action, Alternative 2, or Alternative 3 – No Action alternative. The Proposed Action is found in Chapter 2.

This analysis of environmental consequences addresses the direct and indirect impacts associated with exploration and interim development of the Red Rim Project Area. It also addresses cumulative impacts that would result from past, present, and reasonably foreseeable future actions (RFFAs) within a cumulative impact assessment area relevant to the resource analyzed. The description of environmental consequences includes the following subsections, where applicable:

4.1.1. Direct and Indirect Effects

This subsection analyzes the level and duration of direct and indirect effects that would occur because of the Proposed Action, Alternative 2, or the No Action alternative. The impact evaluation assumes that the applicant-committed and BLM-required practices described in Chapter 2 would be implemented.

4.1.2. Cumulative Impacts

This section describes impacts that are likely to occur as a result of this project. These impacts are described in combination with other ongoing and recently approved activities, recently constructed projects and other past projects, and projects that are likely to be implemented in the near future (RFFAs).

This environmental analysis addresses cumulative impacts associated with exploration and interim development of 200 interim coal bed natural gas (CBNG) wells and other activities, ongoing or proposed, within the Atlantic Rim EIS study area. The proposed project (Red Rim POD) is included in the 200 wells. The Atlantic Rim area is located generally in Townships 13 through 20 North and Ranges 89 through 92 West in Carbon County, Wyoming. Cumulative impacts associated with exploration and development of the Project Area (Red Rim area) are described later in this chapter.

4.2 GEOLOGY, MINERALS, AND PALEONTOLOGY

4.2.1. Alternative 1 - Proposed Action

Use of cut and fill construction techniques to develop well locations, access roads, and facilities would alter existing topography. An estimated 141,5 acres would be affected by surface-disturbing activities. Use of proper construction techniques, described in Chapter 2, would reduce the effects associated with topographic alteration.

In addition, as discussed in Chapter 3, no major landslides have been mapped within the Project Area. By following prescribed procedures, construction would not be likely to activate landslides, mudslides, debris flows, or slumps. Seismic activity is low in the area, so the potential for an earthquake to damage project facilities is minimal.

Drilling the wells may result in discovery of CBNG resources. An economic discovery in the Project Area, in conjunction with other economic discoveries under the Interim Drilling Policy, could lead to full-scale development, which is currently being analyzed in the Atlantic Rim EIS (in preparation). If no natural gas is discovered, however, additional exploratory wells may or may not be drilled, depending on the information obtained in drilling the proposed wells. In addition, the Atlantic Rim EIS may not be required or may be modified. No other major mineral resources would be affected by the project.

As discussed in Chapter 2, mitigation measures presented in the sections on Water Resources or Soils would avoid or reduce potential effects to the surface geologic environment. Implementation of these measures and adherence to federal and state rules and regulations regarding drilling, testing, and completion procedures would prevent potential effects on the subsurface geologic environment.

It is not anticipated that development of the project would affect any sensitive resource area, such as a high-density paleontological site or stabilized sand dunes. Although the surface-disturbing activities associated with the project could disturb paleontological resources, the potential for recovery of important vertebrate fossils in the Project Area is considered low to moderate. Excavation associated with development of access roads, well pads, gas and water pipelines, and related gas production and water disposal facilities could directly expose, damage, or destroy scientifically significant fossil resources. For example, fossils may be damaged or destroyed by erosion that is accelerated by disturbance from construction. In addition, improved access and increased visibility as a result of construction and ongoing production may damage or destroy fossils through unauthorized collection or vandalism. However, no occurrences of paleontological resources are documented in the Project Area. Mitigation measures discussed in Chapter 2 would protect potential paleontological resources that may be inadvertently uncovered during excavation.

4.2.2. Alternative 2 - Injection of Produced Water from Federal Wells with Limited Beneficial Use

Effects on geology, minerals, and paleontological resources likely would be similar to the impacts that would occur from implementation of the Proposed Action.

4.2.3. Alternative 3 - No Action Alternative

The No Action alternative would involve denial of the Red Rim Pod on public lands in the Project Area. Under the No Action alternative, ongoing natural gas production activities would be allowed to continue but the coordinated exploration and interim development described in the Red Rim Plan of Development (proposed project) would

not be authorized by BLM. Development on public would not be considered again until the EIS for the Atlantic Rim Natural Gas Project is completed. The federal CBNG resources in the Project Area would not be depleted if the proposed wells are not drilled. Furthermore, additional information on natural gas accumulation under federal lands in this area of the Great Divide Basin may not be obtained, and the collective knowledge base may not increase.

4.3 AIR QUALITY

4.3.1. Alternative 1 - Proposed Action

The small number of exploratory wells and facilities included in the project would generate only a small amount of air pollutants. Some temporary effects on air quality would likely occur in the immediate vicinity of the project, caused by particulate matter and exhausts from vehicles and equipment. These effects would be local and would be dispersed by prevailing winds. The effects on air quality would be minimized through dust abatement practices.

No noticeable deterioration in visibility would occur at Class I or sensitive Class II wilderness areas that are located within 100 miles of the project (Mount Zirkel, Rawah, Savage Run, Platte River, Huston Park, or Encampment River). Dispersion by the wind of the small quantity of air pollutants generated by the project would likely eliminate formation of regional haze or acid deposition.

If these wells were deemed economical to produce, the Companies would be required to file an application with WDEQ for an air quality permit for oil and gas production facilities under Section 21 of the Wyoming Air Quality Standards and Regulations.

No violations of applicable state or federal air quality regulations or standards are expected to occur as a result of direct or indirect emissions of air pollutants from natural gas development (including both construction and operation) in the Project Area.

Air emissions would occur from construction and production of gas wells within the Project Area. Emissions from construction would include PM₁₀, SO₂, NO_x, CO, and volatile organic compounds (VOCs) from ground clearing, use of heavy equipment, drilling, and well completion, as well as from construction of access roads. Emissions from construction are temporary and would occur in isolation, without significantly interacting with emissions from adjacent wells.

Production emissions of NO_x, CO, VOCs, and hazardous air pollutants (HAPs) (specifically formaldehyde) would result primarily from operation of compressor engines. Estimated impacts to air quality assumed that the average potential emission rate of NO_x for the compressor engines would be approximately 2 grams per horsepower-hour (g/hp-hr) of operation. This rate reflects emission control levels that have already been required in similar applications and is conservative when compared with the emissions projected in Chapter 2, (less than 1.5 g/hp-hr). WDEQ-AQD operating permit records also have shown existing facility emissions to be substantially less than 2.0 g/hp-hr. The

emissions generated from operation of the compressors would contain negligible amounts of SO₂ and particulate matter because of the composition of natural gas from coal seams in the Mesaverde Group. Production emissions from the compressor engines would occur over the life of the project. Emissions from production wells would be negligible because the produced gas is nearly 100 percent methane and would require no ancillary production facilities at the well site.

Pollutant emissions from construction and operation of natural gas fields near the Project Area have been analyzed in recent air quality studies completed by BLM under NEPA. Studies conducted for the Continental Divide/Wamsutter II and South Baggs Natural Gas Development Projects (BLM 1999a, 2000) indicated potential near field increases in concentrations of CO, NO₂, PM₁₀, and SO₂; however, the predicted maximum concentrations would be well below applicable WAAQS, CAAQS, and NAAQS. Similarly, predicted concentrations of HAPs (specifically formaldehyde) would be below various 8-hour maximum Acceptable Ambient Concentration Levels, and the related incremental cancer risks to residents would also be below applicable significance levels.

The emissions that would result from implementation of this project would be much the same as those projected for other oil and gas projects, such as Continental Divide, but on a smaller scale. The exploratory project described in this EA is within the limit of the 3,000-well air quality analysis prepared for the Continental Divide EIS, considering that only 2,130 wells were authorized for that project. The analysis for the Continental Divide EIS project included impacts to Class I areas from oil and gas development in southern Wyoming. Based on the relative size of this project, including the associated lateral sales pipeline, when compared with the magnitude of these previous projects, no ambient air quality standards would be violated and no adverse air quality conditions would result from the proposed project.

4.3.2. Alternative 2 - Injection of Produced Water from Federal Wells with Limited Beneficial Use

Effects on air quality likely would be similar to the effects that would occur under the Proposed Action.

4.3.3. Alternative 3 - No Action Alternative

Under the No Action alternative, the coordinated plan of development described under the Proposed Action would not be approved. No additional effects on air quality would be expected to occur beyond the current pollutant concentrations if the proposed wells are not drilled. Future mineral development in the Project Area would occur under the guidelines of the RMP, by development of individual wells with no coordinated planning for the cumulative impacts.

4.4 SOILS

4.4.1. Alternative 1 - Proposed Action

The proposed construction and operation of wells and facilities could affect the productivity of soils in the Project Area by:

- Ø Removing existing vegetation cover;
- Ø Redistributing or removing all or part of the soil profile;
- Ø Compacting soils;
- Ø Exposing soil to accelerated wind and water erosion;
- Ø Potentially covering adjacent soils and drainages with sediments;
- Ø Exposing the soil to noxious and invasive weed infestation;
- Ø Potentially increasing soil salinity and sodicity (only the tributaries to Hadsell Draw that would receive discharge of conditioned water); and

These activities would reduce soil productivity within and immediately adjacent to the proposed areas of disturbance. The effects of these activities on soil productivity have been evaluated based on their duration, magnitude, and intensity and are described below. The measures that would be used to prevent, reduce or mitigate the effects of these activities on soil productivity are identified below. The residual impacts (if any) to the soils productivity and their significance are identified.

Both long-term and short-term effects on soil productivity would occur under the Proposed Action. An estimated 141.5 acres of surface disturbance would occur as a result of well drilling and testing, and construction of facilities. If exploratory wells are productive, an estimated 39.2 acres of land would remain disturbed after initial reclamation for the production of natural gas. Therefore, approximately 102.3 acres would be affected in the short term only (i.e., no more than 2 to 4 years) and 39.2 acres would be affected in the long term (i.e., for as long as 15 to 20 years). The land area potentially affected by the discharge of conditioned water is difficult to estimate with a high degree of certainty. However, for the purposes of this analysis, it is assumed that a 20-foot corridor would be affected along approximately 2.75 miles of tributaries to Hadsell Draw, or 6.6 acres.

Vegetation and soil would be removed from a total of 141.5 acres of land, and subsoil would be redistributed to create well and compressor pads. Discharge facilities, roads, and other facilities including trenches for burying water delivery pipelines would also result in soil and vegetation removal.

Removed and redistributed soils would be:

- Ø Compacted in localized areas due to equipment traffic;
- Ø Susceptible to accelerated wind and water erosion and deposition due to an increase in the amount of exposed and unprotected soil surfaces; and

- Ø Susceptible to noxious and invasive weed infestation due to the removal of desirable perennial vegetation.

As a result, the productivity of soils would decline due to:

- Ø Reduced soil microbial activity and soil fertility;
- Ø Interruption of nutrient and organic matter addition to soil from vegetation;
- Ø Impaired water infiltration from soil compaction.
- Ø Mixing of soil horizons and soils of differing chemistry/composition.
- Ø Top soil loss; and
- Ø Introduction of weed seeds and propagules.

The intensity of these effects would vary according to the type and location of disturbance, development and production activities, and the period of disturbance prior to reclamation.

Soil and vegetation productivity would potentially decline due to the discharge of conditioned water into tributaries of Hadsell Draw. Soil may potentially decline due to:

- Ø Reduced soil permeability to water and air caused by:
 1. Disruption of soil aggregation resulting from the excess sodium loading to the soil.
 2. Deterioration of soil structure due to the swelling and dispersion of clays resulting from excess sodium loading to the soil.
 3. Cementation of soil and the obstruction of soil pores due to the precipitation of CaCO_3 (lime) and CaSO_4 (gypsum).
- Ø Disruption of plant osmotic regulation due to elevated soil salinity, which reduces or limits water uptake by plant roots due to excessive concentration of salt ions regardless of the type of ion or ionic species.
- Ø Toxicity or deficiency of particular ionic species such as sodium or bicarbonate and calcium.
- Ø Anoxic soil conditions induced by frequent, extensive, and prolonged inundation.

In addition, water erosion could increase in drainages downstream from development caused by runoff from the release of produced water. A more detailed description of erosive effects to drainages is contained in the discussion of surface drainages in the section on Surface Water.

To address these soil productivity issues, the Companies have committed to using the BMPs described in the Master Surface Use Program (MSUP) ([Appendix B](#)) and Chapter 2 during construction, operation, and reclamation that, combined with existing regulatory requirements, would reduce the effect on soil productivity through:

- Ø Removal and storage of soils prior to drilling and testing;
- Ø Scarification of disturbed areas prior to soils redistribution;
- Ø Management of noxious weeds and invasive species;
- Ø Timely and effective erosion control and revegetation in disturbed areas; and,

- Ø Treating of soils with amendment (if necessary) and seeding with salt tolerant species within the tributaries of Hadsell Draw that would receive conditioned water.

Following the drilling and testing activities and the construction of facilities, the disturbed areas not required for production of natural gas, or an estimated 108.5 acres, would be reclaimed as described in the MSUP ([Appendix B](#)) and Chapter 2. Facility areas and roads would be regraded to blend the disturbed area into the surrounding topography. Regraded areas and redistributed soil would be scarified to alleviate compaction, seeded, and protected from wind and water erosion. Measures to control erosion, runoff and sedimentation during operations and reclamation also are described in the MSUP ([Appendix B](#)) and Chapter 2.

However, native plant species may be excluded if noxious and invasive weed species invasion progresses to the point that the density of desirable plant species and plant diversity is reduced. Therefore, the procedures and measures that would be used to identify and eradicate undesirable plant species on soil stockpiles, disturbed areas, and areas that are undergoing reclamation are described in the MSUP and Chapter 2.

The anticipated reduction in soil productivity would require many years to fully recover due to low annual precipitation and soil fertility and the short growing season. However, the majority of the sagebrush/grassland community that would be disturbed by the Proposed Action is decadent with little herbaceous and grass cover and diversity. Therefore, the reclamation of disturbed areas would initially lead to greater diversity and production of herbaceous and grass species. In addition, the structural diversity of the sagebrush/grassland vegetation community would increase due to the reclamation of disturbed areas. Eventually recolonization of the reclaimed area by surrounding native shrub species would reduce production of herbaceous and grass species. Species numbers and structural diversity also would be reduced. Reclamation would reduce erosion within the disturbed area and would more than compensate for the loss in soil productivity due to gas development.

For the 41.1 acres that would be affected in the long term, the impacts to soil productivity described above would be slightly more intense and prolonged. However, the intensity of the reduction in microbial activity and organic matter addition and its effect on inherent soil fertility will be substantially greater than for soils that would be disturbed in the short term. To minimize this long-term effect on soil productivity, the BMPs described in Chapter 2 would be implemented.

Conditioning of produced water prior to release into the tributaries of Hadsell Draw would reduce the deleterious effect of water-soluble salts and SAR on productivity of the soil. Produced water would be routed to two centralized conditioning facilities, which would treat the water before it is discharged to surface drainages. The water would be conditioned using a proprietary, natural mineral-based process that would result in reduced levels of specific conductance and SAR.

Based on monitoring of soils and vegetation in the tributaries of Hadsell Draw that would receive conditioned water, the BMPs described in Chapter 2 would be implemented to reduce the potential detrimental effects of produced water on soil productivity.

Impacts to soil resources in the Project Area are anticipated to be minimal based on the following:

- Ø Small area of disturbance;
- Ø Small amount of disturbance to the soil map units when compared with the area covered by these map units in Carbon County;
- Ø Use of proper construction and reclamation techniques; and,
- Ø Implementation of the measures described in Chapter 2.

Depending on the rate of infiltration, storage or discharge within soils of produced water could alter the physical and chemical properties of soils. Water erosion would increase in drainages downstream from development caused by runoff from the release of produced water. A more detailed description of erosive effects to drainages is contained in the discussion of surface drainages in the section on Surface Water.

4.4.2. Alternative 2 - Injection of Produced Water from Federal Wells with Limited Beneficial Use

Effects on soils likely would be similar to the effects that would occur from implementation of the Proposed Action. Surface disturbance for Alternatives 1 and 2 would be the same because these alternatives include the same number of wells and related facilities. Under Alternative 2, injection wells would be used to dispose of produced water from federal wells, which would reduce disturbance of soils and soil loss.

4.4.3. Alternative 3 - No Action Alternative

This alternative would also most likely limit the effects of produced water discharge to Abundance tributary, Hadsel Draw, and all of Bountiful Draw from potential salt load effects.

Under the No Action alternative, the coordinated plan of development described under the Proposed Action would not be approved. No additional effects on soils would be expected to occur if the proposed wells are not drilled. Future mineral development in the Project Area would occur under the guidelines of the RMP, by development of individual wells with no coordinated planning for the cumulative impacts.

4.5 WATER RESOURCES

4.5.1. Alternative 1 - Proposed Action

Minimal effects on aquifers and groundwater quality would be anticipated as a result of the project with proper construction techniques, drilling practices, and BMPs described in the MSUP and Chapter 2. Groundwater would be removed from the coal seam aquifers

within the Allen Ridge, Pine Ridge, and Almond Formations, members of the Upper Cretaceous Mesaverde Group. Well testing is intended to lower the hydraulic head in the affected coal seam aquifer. (The reduction of hydraulic head in an aquifer also is referred to as drawdown.) Relative to the available drawdown within the aquifer, the effect on the coal aquifer during the interim drilling project is expected to be minimal.

These targeted coal seams are classified as confined to semi-confined aquifers because they are bounded by confining layers that consist of impervious to semi-pervious layers of shale and siltstone. Hydraulic connection between the coal seams and any aquifer stratigraphically above or below the coal seams is limited. The hydrostatic head of the water measured in test wells completed in coal seams near the Project Area can be considerably higher than the elevation of the ground level at a specific well location. Confined, or artesian, aquifer conditions of this type indicate an effective seal above and below the aquifer. However, lowering the hydraulic head in the coal seam aquifers by removing water may induce a slight leakage through the semi-pervious shale layers into the pumped aquifer. Because of the extremely low hydraulic conductivity of the confining layers and the limited number of gas wells proposed, enhanced leakage from any aquifer stratigraphically above or below the affected coal seams would be minimal.

The water level in existing water wells completed in the Mesaverde aquifer also may be lowered or drawn down. As a result, the potential yield from nearby water wells may be affected by removal of groundwater under the project. However, no water wells permitted by the WSEO are known to occur within a mile of the Project Area; therefore, effects to nearby water wells are not expected to occur.

Under this alternative, the water produced from the exploratory wells would be conditioned using a proprietary, natural mineral-based process and discharged to ephemeral tributaries of Hadsell Draw within the Great Divide Basin. Injection wells would be used to dispose of the waste stream from the conditioning facilities. The proposed injection targets for each injection well are the Hatfield, Cherokee, and Deep Creek Sandstones, located 5,965 to 6,335 feet below the surface. These injection wells are stratigraphically below the coal zones explored. Injection of the wastewater is not expected to result in any deterioration in quality of useable groundwater within the injection horizon. These sandstones are isolated above and below by competent shale barriers that would prevent initiation and propagation of fractures through overlying strata to any zones of fresh water. The Cherokee or Deep Creek Sandstone would be tested to evaluate its suitability for disposal before any water is injected. Maximum pressure requirements to prevent initiation and propagation of fractures through overlying strata to any zones of fresh water would be determined and would be regulated by the State of Wyoming and the BLM. The only effect on the injection horizons would consist of an increase in the hydraulic head emanating from the injection well, which would dissipate with distance away from the wellbore. The minimum capacity of the two proposed injection wells is estimated at 5,000 barrels per day (BPD) for each well. The water conditioning facilities would generate about 300 BPD of wastewater. Additional capacity for injection would be available, if needed, for produced water should the water conditioning facilities be shut down for maintenance, or the water reaches the in-channel reservoir on Hadsell Draw. The effect of the Proposed Action on the injection horizon would be minimal in terms of groundwater quantity and quality.

Shallow sources of groundwater (stratigraphically above the Mesaverde coal zones) are not likely to be affected by the project. Ponds associated with the water conditioning facilities would be lined to minimize impacts to shallow groundwater.

Water used for drilling the gas wells would be obtained from existing wells completed in the coal seams of the Mesaverde Group. This use would be relatively small and would not adversely affect existing sources for or rights to groundwater.

Potential impacts that could occur to surface water resources as a result of the project include increased surface water runoff and off-site sedimentation caused by surface disturbance, increased streamflows, impairment to surface water quality, and changes in morphology of the stream channel caused by construction of road and pipeline crossings. Effects on surface water resources would depend on:

- Ø The proximity of the disturbance to a drainage channel,
- Ø The aspect and gradient of the slope,
- Ø The areal extent of soil disturbance,
- Ø Characteristics of the soil,
- Ø Duration of construction, and
- Ø Timely implementation and success or failure of mitigation measures.

Surface disturbance associated with drilling would increase the potential for erosion or increased sediment load to ephemeral drainages within the Project Area. These disturbances include removing vegetation and stockpiling topsoil, road construction, or shallow excavations for drill pads or facilities. Implementation of the mitigation measures described in Chapter 2 would control wind and water erosion at disturbed sites so that ephemeral drainages are not affected by interim drilling. The Companies have committed to the practices described in Chapter 2 that include design of surface-disturbing activities in a manner that diverts and controls runoff, as needed, and provides for re-establishment of vegetation on disturbed areas at the earliest opportunity. These measures, collectively, would represent BMPs for erosion control. The application of these BMPs would result in minimal impacts on water and soil resources.

Construction would occur over a relatively short period. Impacts from construction would likely be greatest shortly after the project starts and would decrease in time as a result of stabilization, reclamation, and revegetation. The construction disturbance would not be uniformly distributed across the Project Area; instead, construction would be concentrated near the proposed wells.

During production, water produced from exploratory wells would be discharged to ephemeral tributaries of Hadsell Draw. Surface discharge would create a mean annual flow in the Abundance and Bountiful Tributaries by 0.71 cubic feet per second (cfs) in Abundance and 0.43 cfs in Bountiful, provided the NPDES permit is approved by the WDEQ and effluent limitations specified in the permit are achieved. Although this scenario is the most likely for discharge, all the wells at one time could discharge to a single outfall, resulting in a maximum discharge of 1.14 cfs at a specific outfall, if approved by the WDEQ. This analysis assumes an initial maximum flow rate of 32

gallons per minute (gpm) from each well. Maximum discharge would be expected to occur after several months of production and then to decline over the life of the producing wells. Because of the piping arrangement of the wells to the outfalls, flow rates for Hadsell Draw and its tributaries may vary at different times of the year.

Continuous discharge of produced water to previously ephemeral drainages would cause native vegetation to undergo changes that could affect the stability of existing spillways and natural channels. As these changes occur, native dryland grass communities would be replaced with wetland species that are more tolerant to and characteristic of perennial flows. Growth of wetland/riparian species would contribute to channel stabilization and erosion control during high precipitation events. Surface drainages in the Project Area may also be affected by increased flows from discharges of produced water where channels are not stable, armored, or large enough to accommodate the anticipated flows. BMPs described in the WMP ([Appendix D](#)), such as locating the outfalls in well-developed, low-gradient channels and lining the channels with crushed rock, would dissipate energy and minimize erosion of the receiving drainages.

Surface water quality is not expected to be affected by the discharge of produced water. The water the Companies plan to produce generally meets WDEQ water quality standards for livestock and wildlife watering. Conditioning the water to meet criteria for irrigation water quality could provide beneficial use in the form of enhanced natural infiltration, growth of possible riparian and grazing species near flowing channels, and irrigation for local ranchers. Flows of produced water would not be expected to reach Separation Creek and ultimately Separation Lake, a Class 3 water that is 43 miles from the discharge outfalls. If water reaches the in-channel reservoir on Hadsell Draw (<1 miles) additional water will be injected. Monthly water balances indicate that in-channel infiltration would accommodate all of the produced water flow within Hadsell Draw. Thus, the probability that produced water would reach Separation Lake, where water quality standards for aquatic life would apply, would be extremely low.

A small portion of the water produced from the gas wells would be dispensed for use by livestock. This water would be piped into self-contained tire tanks and would not discharge into surface drainages. About 5 gpm per well (8.1 acre-feet/year) would be available for beneficial use. The upgrade of an existing reservoir in the Project Area would provide additional beneficial use for livestock watering operations.. Abundance Reservoir would be designed as a flow-through structure and would be properly permitted through the WSEO. This reservoir would be downstream of the tributary outfalls to Abundance Tributary and would provide erosion control during high flow in the drainage. The reservoir would increase the seepage loss in the basin, but would not remove a significant amount of water from the system because evaporation would be minimal based on reservoir size.

The Companies have committed to the mitigation and monitoring plan described in the proposed Water Management Plan ([Appendix D](#)) to ensure that surface discharge of produced water from the Red Rim POD wells under the Proposed Action would not affect designated uses of the surface waters in the Project Area or change the physical or biological components of Hadsell Draw and its tributaries.

4.5.2. Alternative 2 - Injection of Produced Water from Federal Wells with Limited Beneficial Use

Under Alternative 2, the effects on water resources would be similar to the Proposed Action, with the exceptions described below.

Under this alternative, almost all the produced water from the proposed federal wells would be injected, which would decrease the volume for surface disposal. Produced water from non-federal wells would be discharged to ephemeral tributaries of Hadsell Draw. Surface discharge would increase the mean annual flow in the Abundance Tributary by 0.50 cfs and in the Bountiful Tributary by 0.28 cfs, provided the NPDES permit is approved by the WDEQ and effluent limitations specified in the permit are achieved. Although this scenario is the most likely for discharge, all the wells at one time could discharge to a single outfall, resulting in a maximum discharge of 0.78 cfs at a specific outfall, if approved by the WDEQ. Therefore, under this alternative, injection of the water produced from the federal wells would decrease the volume of water for surface disposal by about 32 percent. This reduced volume would limit the effects on the ephemeral channels from increased flows in the Project Area.

The mitigation and monitoring plan described in the proposed Water Management Plan ([Appendix D](#)) would ensure that surface discharge of produced water from wells in the Project Area under Alternative 2 would not affect designated uses of the surface waters in the Project Area or change the physical or biological components of Hadsell Draw and its tributaries.

4.5.3. Alternative 3 - No Action Alternative

Under the No Action alternative, the coordinated plan of development described under the Proposed Action would not be approved. No additional effects on water resources would be expected to occur if the proposed wells are not drilled. Future mineral development in the Project Area would occur under the guidelines of the RMP, by development of individual wells with no coordinated planning for the cumulative impacts.

The mitigation and monitoring plan described in the proposed Water Management Plan ([Appendix D](#)) would ensure that surface discharge of produced water from the Red Rim POD wells under the No Action alternative would not affect designated uses of the surface waters in the Project Area or change the physical or biological components of Hadsell Draw and its tributaries.

4.6 VEGETATION, WETLANDS, AND NOXIOUS WEEDS

4.6.1. Alternative 1 - Proposed Action

4.6.1.1. Vegetation

Implementation of the project would result in loss of natural vegetation in terms of cover and species composition in areas where well sites, facilities, and access roads would be constructed. Use of BMPs described in the MSUP ([Appendix B](#)) and Chapter 2 during construction, operation, and reclamation would minimize effects on vegetation resources. An estimated 149.6 acres would be affected by surface-disturbing activities during drilling, testing, and pipeline construction. Topsoil would be stockpiled, and reclaimed areas would be seeded with site-specific mixes approved by the BLM or the landowner, as appropriate, to avoid permanent loss of species diversity and vegetative cover.

Should the exploratory wells be productive, the surface areas required for production facilities would not be reclaimed until production ends, which could be up to 20 years. An estimated 41.1 acres could be affected by production facilities over the long term. Reclamation efforts would initially lead to greater species and structure diversity within these communities. Herbaceous species composition and production would be increased, once established, until big sagebrush or other shrubs reoccupy disturbed areas.

In general, the duration of effects on vegetation in the Project Area would depend on the time required for reclamation and natural succession to return disturbed areas to pre-disturbance conditions of diversity (both species and structural). Reestablishment of pre-disturbance conditions would be influenced by factors that are both climatic (growing season, temperature, and precipitation patterns) and edaphic (physical, chemical, and biological conditions in soil). Edaphic factors would include the amount and quality of topsoil salvaged, stockpiled, and spread over disturbed areas.

Surface disturbance could affect vegetation directly and indirectly by destroying existing vegetation. The Wyoming sagebrush, big sagebrush, greasewood, and saltbush vegetation that would be disturbed due to the proposed action are common in southwestern Wyoming. In addition, topsoil would be stockpiled, and reclaimed areas would be seeded with site-specific seed mixtures to avoid permanent loss of species diversity and vegetative cover. Therefore, short-term or long-term loss in acreage described above would not alter the overall abundance and quality of the vegetation community.

Surface disturbance also could affect vegetation indirectly by introducing noxious and invasive weeds. Weedy species often thrive on disturbed sites such as road ROWs and out-compete more desirable plant species. Increased invasion by weeds may render a site less productive as a source of forage for wildlife and livestock. However, if the mitigation measures summarized in Chapter 2 are applied, invasion of noxious and invasive weed species is not expected.

Surface discharge of produced water from gas wells has the potential to alter vegetation patterns in areas downstream of discharge points. The increased availability of water along normally dry stream channels would increase the extent of riparian and wetland vegetation and cause a corresponding decrease in the upland vegetation that formerly occupied these areas. This shift in vegetation types would create another type of disturbance that could be exploited by weed species. The extent of these changes depends on the locations chosen for discharge points and on the existing vegetation downstream.

An indirect impact on vegetation resources in the Project Area would be increased water levels and rates of flow through stream corridors. Vegetation communities at particular risk of alteration as a result of rising stream levels are shrublands along the upland border of riparian areas. Wyoming big sagebrush is intolerant to root-zone inundation. The vigor of big sagebrush is reduced in response to short periods of surface flooding, and flooding for a period of 21 to 28 days can result in complete mortality of big sagebrush (GHEP 2003). Greasewood showed more tolerance to flooding, enduring 40 to 42 days of flooding before any visible effects were detected and 60 days of continuous flooding before any wilting appeared. Shrubs would likely die off along the edges of riparian areas long before riparian species are able to migrate laterally and take advantage of the open space with abundant water available. Instead, an area vulnerable to invasion of weeds would develop. Areas where species mortality occurs would be seeded as described in Chapter 2 with desirable species before weeds invade.

Changes in water salinity and soil permeability to water and air pose another indirect effect to vegetation resources within the Project Area. Vegetation communities develop in association with certain environmental conditions such as available water and soil properties. Increases in salinity and reductions in soil permeability may also favor establishment of weeds. However, produced water would be routed to a centralized conditioning site, where it would be conditioned using a proprietary, natural mineral-based process that would reduce levels of SAR. The conditioned water would be discharged into ephemeral tributaries of Hadsell Draw provided it meets the applicable water quality standards for irrigation. There would be no harmful effects to vegetation from increased SAR levels in the conditioned water if the BMPs described in Chapter 2 are implemented.

4.6.1.2. Wetlands

No riparian areas or wetlands have been identified in or near the Project Area, including the pipeline route. Therefore, the Proposed Action would not affect existing wetlands.

4.6.1.3. Threatened and Endangered Species

No threatened or endangered plant species or their habitat are known to occur in the Project Area. Development of the project would not be expected to directly or indirectly affect federally listed species.

4.6.1.4. Species of Concern

The distribution of plant species of concern is limited in the Project Area because of a lack of suitable habitat. Given the low likelihood that the sensitive plant species occur in the Project Area ([Appendix E](#)), implementation of the proposed BMPs and mitigation measures, and the small amount of disturbance associated with the project, no direct or indirect effects to plant species of concern would be expected.

4.6.2. Alternative 2 - Injection of Produced Water from Federal Wells with Limited Beneficial Use

Effects on vegetation and weeds likely would be similar to the impacts that would occur from implementation of the Proposed Action, but would be lessened because water produced from the federal wells would not be discharged on the surface. The facilities proposed for Alternative 2 are similar to the Proposed Action and would result in similar short- and long-term disturbances. The principle difference between the Proposed Action and Alternative 2 is the different method for disposal of produced water from federal wells. Injection wells would be used to dispose of the produced water from the federal wells, which would mitigate possible effects of surface discharge on vegetation. Produced water from fee wells would be conditioned and discharged into ephemeral drainages on fee lands. Implementation of Alternative 2 would result in lower potential for effects on vegetation within the Project Area than Alternative 1 because of the reduced volume of surface water discharges.

4.6.3. Alternative 3 - No Action Alternative

Under the No Action alternative, the coordinated plan of development described under the Proposed Action would not be approved. No additional effects on vegetation or wetland and riparian habitats would be expected to occur if the proposed wells are not drilled. Future mineral development in the Project Area would occur under the guidelines of the RMP, by development of individual wells with no coordinated planning for the cumulative impacts.

4.7 RANGE RESOURCES AND OTHER LAND USES

4.7.1. Alternative 1 - Proposed Action

Anticipated effects on range resources associated with the project are limited to increased availability of water for livestock, a minimal loss of forage, an increased potential for collisions between livestock and vehicles, and an increased potential for the spread of noxious and invasive weeds (previously discussed above under the section on Vegetation, Wetlands, and Noxious Weeds). The project itself (well pads, access roads, pipeline routes, etc.) would not have noticeable effects on range resources; Water discharge from the project would, however effect range resources. Primary effects center around changes in grazing patterns due to available water, secondary effects to upland and riparian vegetation from changes to grazing patterns. In 2 to 3 years, reclaimed areas

would have higher forage production that would more than compensate for the short-term loss of forage due to development if livestock and wildlife foraging is controlled. Failure to control foraging could have adverse effects on re-generated forage.

Livestock grazing would continue during the drilling and interim development. Forage in the Project Area would be reduced slightly during drilling and field development and would be restored as soon as practical. Areas used for roads, production equipment, and ancillary facilities would remain disturbed throughout the productive life of the field. Temporary, self-contained water troughs or stock tanks that can be established for livestock use would benefit livestock season-of-use and distribution, particularly in the years with below normal levels of precipitation. Additional water sources would have to be controlled to avoid year round useage by livestock. This area is currently used as a late fall/winter/early spring pasture concentrating cattle use on plants during the dormant season. Unrestricted use during the growing season will put stress on forage plants during their grow period possibly reducing vigor and abundance of desireable plant species, and corresponding reduction of range conditions.

The project would result in an estimated 149.6 acres of short-term disturbance during drilling, interim development, and construction of the delivery pipeline. An estimated 41.1 acres of long-term disturbance would remain after the initial reclamation measures described in Chapter 2 are completed. The short-term disturbance from portions of drill pads that are not needed for production facilities would be reclaimed as soon as practical after drilling ends, as would all areas disturbed for gas and produced water pipelines. All remaining disturbed areas would be reclaimed at the end of field operations, except any that BLM may identify as desirable for another use.

The average stocking rate for the Sixteen Mile Allotment is 11 acres per AUM. The project would result in a short-term loss of forage associated with about four AUMs. This loss would correspond to a small short-term reduction in available forage within the Sixteen Mile Allotment that would amount to substantially less than 1 percent of the total grazing capacity in the allotment. Also, disturbances would be interspersed throughout the Project Area, and should not affect grazing in the Sixteen Mile Allotment. Although disturbance from the actual project should not effect grazing in the allotment, the water discharge from the project has the potential to affect grazing and the rangeland resource.

There is potential for conflict between activities under the project and range operations. Conversely, the activities under the project also could benefit range operations. Reclamation may increase forage production and availability, since shrubs would be removed in disturbance areas and shrub species would be slow to recover.

The increased availability of water for livestock at locations shown on [Figure 2-1](#) could encourage concentration of livestock in these areas. Concentration of livestock near new supplies of water could result in overuse of some areas, unless the movements of livestock are controlled. Control of livestock movements by the addition of fencing also would affect the movements of wildlife in the same area. A condition of approval for the proposed project that would require the Companies to initiate development of a cooperative plan for fencing among affected interests would provide a reasonable approach for addressing this concern. Without some means of controlling livestock

access to the produced water, the season, duration and/or intensity of use in this area will change, most likely adversely affecting range land vegetation.

4.7.2. Alternative 2 - Injection of Produced Water from Federal Wells with Limited Beneficial Use

Effects on range resources likely would be similar to the effects that would occur from implementation of the Proposed Action. The facilities proposed under Alternative 2 are identical to the Proposed Action and would result in the same short- and long-term disturbances. The principal difference between the Proposed Action and Alternative 2 is the different method for disposal of produced water from federal wells. Injection wells would dispose of the produced water from the federal wells, which would mitigate possible effects of surface discharge to vegetation. Produced water from fee wells would be conditioned and discharged onto fee lands.

4.7.3. Alternative 3 - No Action Alternative

Under the No Action alternative, the coordinated plan of development described under the Proposed Action would not be approved. No additional effects on range resources would be expected to occur if the proposed wells are not drilled. Future mineral development in the Project Area would occur under the guidelines of the RMP, by development of individual wells with no coordinated planning for the cumulative impacts.

4.8 WILDLIFE AND FISHERIES

4.8.1. Alternative 1 - Proposed Action

The effects on wildlife would be associated with construction and operation and would include displacement of some individuals of some wildlife species, loss of wildlife habitats, and an increase in the potential for collisions between wildlife and motor vehicles. Other potential effects include a rise in the potential for illegal kill, harassment, and disturbance of wildlife because of increased human presence and improved vehicle access. The increased availability of water in the Project Area could affect the movements of wildlife in the area. Any additional fencing constructed to control the movements of livestock also could affect the movements of wildlife. The effects of the increased availability of water are described under Range Resources and Other Land Uses. The magnitude of impacts to wildlife resources would depend on a number of factors, including the type and duration of disturbance, the species of wildlife present, the time of year, and successful implementation of avoidance and mitigation measures.

The capacity of the Project Area to support various wildlife populations should remain essentially unchanged from current conditions. Only a small proportion of the available wildlife habitat in the Project Area would be affected. Construction, operation, and maintenance of the proposed wells and associated facilities are expected to have minimal short-term effects on wildlife in the Project Area. Some wildlife species may be temporarily displaced during construction on pipeline routes, well sites, and access road

locations, but should return once construction is complete. Furthermore, extensive suitable habitats for many species exist on lands adjacent to the Project Area and would support any individuals that may be temporarily displaced. Long-term effects on wildlife are expected to be minimal, as most species would become accustomed to routine operation and maintenance.

The duration of impacts to vegetation would depend, in part, on the success of mitigation and reclamation efforts and the time needed for natural succession to return revegetated areas to pre-disturbance conditions. The unused portion of well sites and pipelines would be reclaimed during the production phase. After production operations end (the life of the project is estimated at 10 to 20 years), the well fields and ancillary facilities would be reclaimed and abandoned. Well pads would be removed; the areas would be revegetated with seed mixes approved by the BLM, and of these mixes, some are specifically designed to enhance use by wildlife. Grasses and forbs would be expected to become established within the first several years after reclamation; however, much more time would be required to re-establish shrub communities. Consequently, disturbance of shrub communities would result in a longer-term loss of the habitats.

In addition to the direct loss of habitat caused by construction of well pads and associated roads and pipelines, disturbances from human activity and traffic would reduce use of habitat immediately adjacent to these areas. Species that are sensitive to indirect human disturbance (both noise and visual) would be most affected. The effectiveness of habitat in these areas would be lowest during the construction phase, when human activities are more extensive and localized. Disturbance would be reduced during the production phase of operations, however, and many animals could become accustomed to equipment and facilities in the gas field and may return to habitats adjacent to disturbance areas.

4.8.1.1. Small Mammals and Birds

The direct disturbance of wildlife habitat in the Project Area likely would reduce the availability and effectiveness of habitat for a variety of common small mammals, birds, and their predators. The initial phases of surface disturbance and increased noise that are likely would result in some direct mortality to small mammals and would displace songbirds from construction sites. In addition, a slight increase in mortality from increased vehicle use of roads in the Project Area would be expected. Quantification of these losses is not possible; however, the loss is likely to be low over the short term. Increased noise from compressor engines and other production activities would displace some animals and would affect the production potential of some species during the operations phase of the project. Based on the relatively high production potential of these species and the relatively small amount of habitat disturbed, however, populations of small mammals and songbirds would quickly rebound to pre-disturbance levels. This rebound would be expected after pipelines, unused portions of roads, well pads, and wells that are no longer productive have been reclaimed. No long-term effects on populations of small mammals and songbirds would be expected.

4.8.1.2. Big Game

In general, effects on big game would include direct loss of habitat and forage and increased disturbance and noise from drilling, construction, operation, and maintenance operations. Disturbance of big game during the parturition period and on winter range can increase stress and may influence species distribution (Hayden-Wing 1980; HWA 2003). There may also be a potential for an increase in poaching and harassment of big game, particularly during winter. According to management directives in the RMP (BLM 1990), crucial winter ranges for big game will be closed to construction and development from November 15 through April 30. This partial closure of crucial winter ranges would reduce disturbance to wintering big game. This partial closure would also limit the potential for poaching and harassment of big game species wintering in the area. Recreational use of the area and production would not, however, be affected by the partial closure.

Effects on big game are expected to be minimal, as the Project Area represents less than one-tenth of a percent of the winter or year-long range for any species (HWA 2003) (Figure 3-1). No long-term loss of habitat is expected once construction is complete, and big game species are expected to return to the area.

Less than 11 acres of the Project Area has been designated as crucial winter range for pronghorn antelope. Furthermore, no project-related disturbance is scheduled within the crucial winter range. Activities associated with the construction phase of the project would likely temporarily displace antelope; however, once construction is complete, antelope would likely habituate and return to pre-disturbance activity patterns. Reeve (1984) found that pronghorn acclimated to increased traffic and machinery as long as they moved in a predictable manner (HWA 2003). Overall, no noticeable effects on the antelope population that inhabits the Project Area are expected, provided mitigation measures contained in this document, the RMP, and the Interim Drilling Policy are implemented.

4.8.1.3. Upland Game Birds

No noticeable effect on the population of greater sage-grouse is expected, provided all applicant-committed and BLM-required mitigation measures described in Chapter 2 are followed. Production facilities at well sites often act as raptor perches, increasing predation on greater sage-grouse and other wildlife. Use of low-profile structures and anti-perching devices will mitigate these potential effects.

The four leks where recent greater sage-grouse activity has been noted are within the two mile nesting and brood rearing habitat buffers for the project area. These seasonal timing stipulations will prevent operations (March 01 to June 30) in the proposal area unless exceptions are requested and obtained. None of the leks on federal ground are within ¼ mile of well sites. One lek on private surface adjacent to an existing road and within ¼ mile of an existing well pad may be adversely affected by this project. This is Hogback lek which has no record of recent activity, but is maintained as active on the Wyoming Game & Fish database.

Recent surveys found two active leks south of the pod, and one is located south of the Red Rim Lateral Pipeline and access road in the Project Area. Wyoming Game and Fish records show all portions of the proposal area are within two miles of a recorded lek. Suitable habitat for the greater sage-grouse is abundant. Under the Proposed Action, 132.7 acres of the Wyoming big sagebrush vegetation cover type would be disturbed during construction and 41.1 acres would be disturbed in the long term. This amount of habitat disturbed would be minimal, considering the quantity available in the Project Area. However, greater sage-grouse can be affected by other activities associated with natural gas development, including increased human activity and traffic disturbance and noises from pumping or compressor engines. Increased noise that occurs in sensitive resource areas could affect the ability of greater sage-grouse to mate. Careful siting of noise sources, addressed in applicant-committed and BLM-required mitigation measures in Chapter 2 and in the MSUP, would result in minimal effects on greater sage-grouse.

The proposed market access pipeline would pass through 4.4 miles of potential nesting habitats (within the 2-mile buffers) of two active greater sage-grouse leks. These leks are south of the Project Area and located south of the pipeline and access road. Controlled Surface Use (CSU) stipulations to restrict disturbance of greater sage-grouse leks apply within a ¼-mile buffer around active leks on public lands. There is a greater sage-grouse lek within ¼ mile of an existing well pad on private surface. No areas of CSU associated with greater sage-grouse leks are located in the Project Area on public lands. The entire Project Area is included within the 2-mile buffer of an active greater sage-grouse lek. Activity in such areas is limited by timing stipulations between March 1 and June 30 for the protection of nesting greater sage-grouse. As a result, mitigation measures must be followed to protect this area, especially during periods when greater sage-grouse mating could be affected by noise associated with the project.

The potential effects of the project on avian species would be nest abandonment and reproductive failure caused by project-related disturbance and increased noise. Other potential effects involve increased public access and subsequent human disturbance that could result from new construction or production, and small, temporary reductions in populations of prey for raptors. An active golden eagle nest was found 0.6 miles west of the pod. Approximately 5 miles of the proposed pipeline route were not included in a May 2001 survey for raptors, as the area is located outside the area flown for the Atlantic Rim EIS study area. In addition, inactive raptor nests were found within 1 mile of the Project Area (Chapter 3). These nests should be monitored each spring for subsequent use by raptors. If these nests do become active, avoidance and mitigation measures must be followed to protect this area. The Companies will consult with RFO to identify any additional raptor surveys that are needed before construction of the pipeline begins. If an exception is requested during the raptor stipulation period, BLM will conduct an inventory of the particular nest to determine the status of the nest (active vs. inactive). Aboveground power lines are not included in the project and are therefore not considered here.

4.8.1.4. Raptors

No effects on breeding raptors would be expected, provided avoidance and mitigation measures are followed. Mitigating measures for oil and gas projects contained in the RMP state that no activity or surface disturbance would be allowed near nesting habitat for raptors from February 1 through July 31. The size of the restrictive radius and the timing on the restriction may be modified, however, depending on species of raptor and whether the nest would be within the line of sight of construction. No effects on breeding raptors would be expected, provided that avoidance and mitigation measures in this document, the RMP, and the Interim Drilling Policy are followed.

4.8.1.5. Fish

There would be no potential effects to fish downstream because the Great Divide Basin is a closed basin, and no water would enter the Colorado or North Platte River Systems.

4.8.1.6. Threatened and Endangered Species - Wildlife and Fish

4.8.1.6.1. Wildlife Species

Black-footed Ferret. Implementation of this project is not expected to affect black-footed ferrets.

Canada Lynx. The Canada lynx is not expected to occur within the Project Area because of the lack of potentially suitable habitats. Thus, implementation of the project is not expected to affect Canada lynx.

4.8.1.7. Species of Concern - Wildlife and Fish

4.8.1.7.1. Wildlife

Effects on BLM wildlife species of concern could occur as a result of loss of habitat or displacement caused by increased noise. No noticeable effects would be expected based on the relatively small size of the Project Area, the inherent mobility of the species of concern, and the abundance of nearby potentially suitable habitats. However, the lack of effects assumes that the avoidance and mitigation measures described in Chapter 2, the RMP, and the Interim Drilling Policy would be followed.

Mountain Plover

Potential habitat for mountain plovers (HWA 2003) was found in the Project Area, but surveys did not detect the presence of mountain plovers. Implementation of the project is not expected to affect mountain plovers; however, surveys should be completed in areas of potential habitat before construction begins. Timing restrictions may apply in areas of suitable mountain plover habitat ([Figure 3-1](#)).

4.8.1.7.2. Fish

There are no BLM sensitive fish species in the Great Divide Basin or the Platte River system.

4.8.2. Alternative 2 - Injection of Produced Water from Federal Wells with Limited Beneficial Use

Effects on wildlife and fisheries or threatened, endangered, or sensitive species likely would be similar to the effects that would occur from implementation of the Proposed Action. The facilities proposed for Alternative 2 are identical to the Proposed Action and would result in the same short- and long-term disturbances to wildlife habitat.

4.8.3. Alternative 3 - No Action Alternative

Under the No Action alternative, the coordinated plan of development described under the Proposed Action would not be approved. No additional effects on wildlife or fisheries or threatened, endangered, or sensitive species would be expected to occur if the proposed wells are not drilled. Future mineral development in the Project Area would occur under the guidelines of the RMP, by development of individual wells with no coordinated planning for the cumulative impacts.

4.9 RECREATION

4.9.1. Alternative 1 - Proposed Action

Recreational access to the checkerboard land pattern in this area is at the discretion of the private land owner. Impact to the recreational use of the Project Area would involve a temporary displacement of some hunters, particularly during construction and drilling. Some hunters perceive these activities as displacing game species and creating an environment that detracts from the hunting experience. Displacement would be highest during the general deer and elk season, when the most hunters are in the area. The proposed drilling schedule would limit displacement to one season. Hunters would relocate to other areas near the project if landowners allow access.

Undisturbed landscapes, isolation, and solitude are important to some recreationists. Project-related disturbances that impair the characteristic landscape could also contribute to a decline in the quality of the recreational experience for these users. The recreational experience could be less satisfying than under the pre-disturbance conditions described in Chapter 3. The effects would diminish substantially after drilling and construction are completed. Some long-term displacement of hunters and other recreationists likely would occur under the project. Human access and activities would increase under the project with the improved and new access roads. Overall, effects on the recreation resource would be minimal because of the short-term nature of drilling and construction and the concentrated locations of these activities.

Proposed OHV uses at Hogback Lake would not be affected by interim development activities because it is unlikely that the surface discharge of produced water would reach Hogback Lake. The proposed delivery pipeline would be constructed near Hogback Lake, but would not conflict with or reduce OHV use.

Recreationists on the Continental Divide National Scenic Trail adjacent to WY 71 would experience temporary disturbance from the sight and noise of construction of the market access pipeline for the project. The visual intrusion of construction and construction-related noise could reduce the quality of the recreational experience in general. However, effects would be short-term and generally would be restricted to the immediate vicinity of the work. There would be no interference with recreation once construction is completed and the construction ROW is reclaimed. The appearance of the reclaimed ROW would be similar to the existing pipeline ROW, as assessed in the section on Visual Resources.

The proposed pipeline is adjacent to Carbon County Road 605 along most of the 10.2-mile length. The pipeline would cross the road at the north end of Coal Mine Ridge, nearly 2 miles southwest of Rawlins. Construction at the road crossing would inconvenience recreationists who use the roads to gain access to recreational opportunities in the area. However, any road closures would be temporary, occurring for a brief period. Road access would be restored to existing uses after construction is completed.

4.9.2. Alternative 2 - Injection of Produced Water from Federal Wells with Limited Beneficial Use

Effects on recreational opportunities in the Project Area likely would be similar to the effects that would occur under the Proposed Action. The facilities proposed for Alternative 2 are identical to the Proposed Action and would result in the same short- and long-term disturbances to public access and the Continental Divide National Scenic Trail.

4.9.3. Alternative 3 - No Action Alternative

Under the No Action alternative, the coordinated plan of development described under the Proposed Action would not be approved. No additional effects on recreation resources or use would be expected to occur if the proposed wells are not drilled. Future mineral development in the Project Area would occur under the guidelines of the RMP, by development of individual wells with no coordinated planning for the cumulative impacts. The market access pipeline would not be approved under the No Action alternative, so there would be no effect on recreationists in the Project Area or on the Continental Divide National Scenic Trail from construction of the pipeline.

4.10 VISUAL RESOURCES

4.10.1. Alternative 1 - Proposed Action

As noted in Chapter 3, Affected Environment, the Project Area is not pristine. ORV tracks are evident throughout the area and are used by ranchers, recreationists, and traffic

related to mineral development. The Proposed Action would be consistent with the existing VRM Class III objectives in the Project Area.

Short-term impacts to the visual resource associated with construction and drilling in the Project Area would include contrasts in line, form, color, and texture. These contrasts would be associated with drilling rigs, construction equipment, service trailers, and the general industrial character of drilling. Additional impacts may occur from fugitive dust produced by construction.

The Project Area would not be visible from I-80 or WY 71. Potential viewers of the contrasts described would be few and would include hunters and other recreationists, ranchers, and oil and gas field workers.

Construction of the Red Rim lateral pipeline would be visible to motorists on WY 71. A segment of the Continental Divide National Scenic Trail is located along the highway. This segment provides a link to segments of the trail that are accessible to recreationists on public lands. Short-term construction on the pipeline would be within an existing ROW in foreground views that would be visible to motorists and recreationists on the trail route.

The severity of impact with the BLM VRM rating system is related to the scenic quality, sensitivity level, and distance zone of the affected environment. In general, short-term impacts would be most severe where the level of contrast is high and is highly visible to potentially large numbers of viewers.

The short-term impacts would be considered acceptable in a Class III area. The contrasts during construction would be seen by relatively few viewers and would be visible only for a short time.

Permanent production facilities, as described in Chapter 2, would remain after well drilling is completed. The presence of permanent production facilities would create continued impacts over the long term.

These facilities would create contrasts in line, form, color, texture, and overall pattern in the landscape that would remain for the duration of the project. However, as noted for short-term impacts, these contrasts would not be visible to many viewers. The level of contrast would not exceed Class III standards if the mitigating measures described in Chapter 2 are implemented. Levels of contrast would, however, detract from the recreation experience of visitors to the Project Area.

Additional facilities, such as access roads, would be required to service production facilities. Roads would create additional contrasts in line, color, and texture. The level of contrast would not exceed Class III standards with appropriate mitigation measures, as described in Chapter 2. However, contrasts could diminish the experience of motorists and recreationists.

There would be no long-term impacts to the visual quality of the viewshed from the Red Rim delivery pipeline as seen from the Continental Divide National Scenic Trail. Once

the pipeline is installed and the construction ROW is reclaimed, the appearance of the ROW would be similar to the existing ROW that is currently within the viewshed of the highway and the trail.

4.10.2. Alternative 2 - Injection of Produced Water from Federal Wells with Limited Beneficial Use

Effects on the visual quality of the Project Area likely would be similar to the effects that would occur under the Proposed Action. The facilities proposed for Alternative 2 are identical to the Proposed Action and would result in the same short- and long-term disturbances to visual resources.

4.10.3. Alternative 3 - No Action Alternative

Under the No Action alternative, the coordinated plan of development described under the Proposed Action would not be approved. No additional effects on visual quality or visual resources would be expected to occur if the proposed wells are not drilled. Future mineral development in the Project Area would occur under the guidelines of the RMP, by development of individual wells with no coordinated planning for the cumulative impacts. The market access pipeline would not be approved under the No Action alternative, so there would be no impacts to the visual quality of the Project Area from pipeline construction or to recreationists on the Continental Divide National Scenic Trail.

4.11 CULTURAL RESOURCES

4.11.1. Alternative 1 - Proposed Action

Reduction of direct and indirect adverse effects to historic properties through avoidance or mitigative measures (data recovery or recordation) can be accomplished on a case-by-case basis. No identified sites are located within potential disturbance areas. Site 48CR3648 represents the route of the Rawlins-Baggs Stage Road and is considered eligible for inclusion in the National Register of Historic Places. The portion of the Rawlins-Baggs Stage Road that passes through the project area is considered a contributing segment to the eligible site (Darlington 2003).

Direct impacts would result primarily from construction-related activities. Activities that could affect cultural resources would include grading well pads and associated facilities and construction of roads and pipelines. Sites located outside the Project Area would not be directly affected by construction

Based upon the current Great Divide Resource Area Record of Decision and Approved Resource Management Plan, surface disturbance mitigation guideline, surface disturbance will be prohibited within either one-quarter mile or the visual horizon (whichever is closer) of historic trails. A viewshed analysis of the project area reveals section 28, T.20N. R.89W. is the only portion of the project area that falls within the quarter mile viewshed of the Rawlins-Baggs Stage Road.

Direct visual impacts to the trail would result from the construction of roads, pipeline corridors, and well locations. A lasting visual impact from the placement of tank covers over wells would adversely impact the visual integrity of the trail. Currently, the only visual intrusions to the Rawlins-Baggs stage road are bladed roads which have significantly re-vegetated. Any construction within the view shed of the Rawlins-Baggs Stage Road would be an adverse direct impact to the contributing segment.

Block surveys have been completed in the Project Area, as required by the Interim Drilling Policy. Identification and avoidance or mitigation of eligible sites before disturbance would minimize impacts to these cultural resources. Previously unidentified buried sites could be impacted during construction activities. Implementation of measures described in Chapter 2 would reduce impacts and minimize the loss of cultural resource information.

Mitigation measures could include avoidance or monitoring of the historic properties. The proposed impact at the sites would be moved to prevent disturbance during construction or a qualified archaeologist would monitor construction of the proposed impact location. All recommendations are subject to approval and alteration by the BLM RFO archaeologist. In the event that buried cultural materials are discovered during construction, those activities would be halted until a qualified archaeologist visits the site and evaluates the find. If the proposed action is modified, an additional cultural resources inventory for the new area of proposed disturbance may be required.

4.11.2. Alternative 2 - Injection of Produced Water from Federal Wells with Limited Beneficial Use

Effects on cultural resources in the Project Area likely would be similar to the effects that would occur from implementation of the Proposed Action. The locations of facilities proposed for Alternative 2 are identical to the Proposed Action and would result in the same potential disturbances to cultural resources that have been identified.

4.11.3. Alternative 3 - No Action Alternative

Under the No Action alternative, the coordinated plan of development described under the Proposed Action would not be approved. No additional effects on cultural resources would be expected to occur if the proposed wells are not drilled. Future mineral development in the Project Area would occur under the guidelines of the RMP, by development of individual wells with no coordinated planning for the cumulative impacts.

4.12 SOCIOECONOMICS

4.12.1. Alternative 1 - Proposed Action

Socioeconomic impacts of the project would be largely positive. The project would enhance regional economic conditions and generate revenues from local, state, and federal government taxes and royalties. The relatively small, short-term drilling and field

development workforce would not create noticeable effects on population or increase in demand for temporary housing or local government services.

The project would involve capital investment in gas wells, injection wells for produced water, gathering systems, compression stations, and other field infrastructure. The project would require between 16 and 36 workers for drilling and field development over a 30- to 45-day period and one operations worker for as much as a 20-year period (Table 2-2).

Development and operation of the project would require goods and services from a variety of local and regional contractors and vendors, from the oil and gas service industry, and from other industries. Expenditures by the Companies for these goods and services, coupled with employee and contractor spending, would generate economic effects in Carbon County, southwest Wyoming, and the nation as a whole. The project may create up to three new indirect jobs (defined as jobs that become available in support industries as a result of the project).

4.12.1.1. Oil and Gas Activity in Carbon County

Successful completion of the project would increase production of natural gas in Carbon County, especially during the first several years of the project. To date in 2003, 225 APDs have been issued for Carbon County. The 14 wells associated with the project would be about 6 percent of the APDs received in 2003 for the county. However, the relatively short drilling time and low requirements for infrastructure and labor associated with gas development would not result in a substantial increase in drilling or employment in the county.

Economic effects on grazing would include small losses of forage caused by temporary and long-term disturbance until revegetation is successful. Temporary disturbance could result in a small reduction in grazing. If grazing does not increase accordingly in nearby areas, the associated economic activity in Carbon County could be lost, although the economic impact of the loss of four AUMs would be small. A recent University of Wyoming study estimated that each AUM of cattle grazing was worth \$65.07 in total economic impact in the region (UW 2000). Using this estimate, the proposed development could result in a loss of \$260 annually for the life of the project.

4.12.1.2. Population Effects

Population effects of the project would not be noticeable. Some of the skills and services required for the project are available in the local labor pool, although the recent increase in oil and gas drilling in southwest Wyoming has absorbed much of the available workforce. Of the short-term demand for 16 to 36 drilling and field development workers, some would likely be contractors from other areas of Wyoming (such as Rock Springs, Gillette, and Casper) and from northern Colorado. The remainder would be hired from the local workforce. Given the short duration of the drilling phase (less than 2 months), most nonlocal workers who would relocate to Carbon County would be single.

Nonlocal workers would attempt to obtain temporary housing as close to the work site as possible, most likely in Rawlins. Workers who are not able to secure temporary housing in Rawlins might locate in Sinclair, Hanna, Saratoga, or other communities further away. Given the current level of drilling and field development in Wamsutter, it is unlikely that drilling and field development workers for the project would find temporary housing in that community.

Based on the relatively small workforce and short-term nature of the drilling and field development phase of the project, area businesses could accommodate the increase in economic activity with existing employees.

4.12.1.3. Temporary Demand for Housing

Existing resources could accommodate the relatively small demand for temporary housing during drilling and field development under the project. Demand may be accommodated in nearby Rawlins, which provides the largest pool of temporary housing in Carbon County. Additional temporary housing is available in Wamsutter, Baggs, Rock Springs, and Craig, depending on seasonal considerations and other activity in the oil and gas industry.

4.12.1.4. Law Enforcement and Emergency Response

The relatively small level of field development and operations would be accommodated by existing law enforcement and emergency management resources.

4.12.1.5. Fiscal Effects

If the productive life of each successful well in the project is 15 years and produces on average nearly 100 MMCF per year of methane, which is sold for \$2.50 per MCF, the sales value of each well would be about \$3.5 million over the life of the project. If five federal wells within the Project Area were productive, the federal royalties would exceed \$2 million. One well is on federal land, but the mineral is owned by the State of Wyoming. Royalties to the State of Wyoming have been estimated using 16.67 percent of the estimated sales volume for each well. The project is therefore expected to generate more than \$600,000 in state royalties over the life of the well. State royalties are deposited in the permanent fund and are used for schools and public institutions. The severance tax collected by the State of Wyoming on 14 producing wells would exceed \$3 million. The sales and use taxes collected by the state and by Carbon County also would exceed \$3 million. Ad valorem taxes would contribute more than \$600,000 to Carbon County. These values are approximate, are based on assumptions, and are intended to indicate the order of magnitude of possible fiscal effects.

4.12.1.6. Environmental Justice

The project would not directly affect the social, cultural, or economic well being and health of Native American, minority or low-income populations. The Project Area is relatively isolated from population centers, so no populations would be affected by physical or socioeconomic impacts from the project.

4.12.2. Alternative 2 - Injection of Produced Water from Federal Wells with Limited Beneficial Use

The production value of gas wells under Alternative 2 would be the same as for the Proposed Action; therefore, the beneficial economic impacts at the county, state, and federal levels likely would be similar to the impacts that would occur from implementation of the Proposed Action. Effects on other socioeconomic factors, including employment, wages, housing, and environmental justice, in Carbon County would also be similar to the effects under the Proposed Action.

4.12.3. Alternative 3 - No Action Alternative

Under the No Action alternative, the coordinated plan of development described under the Proposed Action would not be approved. No federal mineral royalties would be gathered and no additional socioeconomic effects would be expected to occur if the proposed wells are not drilled. Future mineral development in the Project Area would occur under the guidelines of the RMP, by development of individual wells with no coordinated planning for the cumulative impacts.

4.13 TRANSPORTATION

4.13.1. Alternative 1 - Proposed Action

4.13.1.1. Federal and State Highways

The project would increase the volume of traffic on highways that provide access to the Project Area and on county and operator-maintained roads within the Project Area. These increases would result from movement of project-related workers, equipment, and materials to and from the Project Area for drilling, field development, well service, field operations, and reclamation.

Based on these assumptions and estimates, the incremental increase in area traffic associated with the project would not result in a significant deterioration of level of service for I-80 (Rounds 2000). Based on the relatively small increase in traffic and short duration of traffic caused by the project during the drilling and field development phase, it is unlikely that the project would result in a measurable increase in accident rates on federal and state highways. During the operations phase, the probability of an increase in accident rates that could be attributable to the project is negligible.

4.13.1.2. County Roads

The project would increase traffic on Carbon County Road 605 (Twentymile Road), which provides the primary access into the Project Area from I-80. The relatively small, short-term increases in traffic are unlikely to result in significant deterioration of the road or substantial increases in accidents. The primary effects of traffic related to the Proposed Action on county and BLM roads would be to accelerate requirements for maintenance on the segments that are not maintained by the Companies. The revenues related to the Proposed Action generated for county government, which are described under the section

on Socioeconomics, may offset the cost associated with accelerated road maintenance on county roads.

Increased traffic may raise the potential for accidents that involve vehicles and stock animals, although the slower speeds required by the condition of county roads tend to minimize their frequency (Warren 2000). Coordination with livestock operators during sensitive periods (such as cattle movements and calving season) could further reduce the potential for accidents that involve vehicles and stock animals.

4.13.1.3. Internal Roads

The Companies would be responsible for constructing and maintaining new and improved roads within the Project Area; therefore, no fiscal impacts are anticipated for the BLM or Carbon County.

4.13.2. Alternative 2 - Injection of Produced Water from Federal Wells with Limited Beneficial Use

Effects on transportation likely would be similar to the impacts that would occur from implementation of the Proposed Action. Access into the Project Area from I-80 and Carbon County Road 605 would be the same as the Proposed Action. Internal roads constructed within the Project Area also would be the same as under the Proposed Action.

4.13.3. Alternative 3 - No Action Alternative

Under the No Action alternative, the coordinated plan of development described under the Proposed Action would not be approved. No additional effects on transportation would be expected to occur if the proposed wells are not drilled. Future mineral development in the Project Area would occur under the guidelines of the RMP, by development of individual wells with no coordinated planning for the cumulative impacts.

4.14 HEALTH AND SAFETY

4.14.1. Alternative 1 - Proposed Action

Health and safety impacts would include a relatively low risk to project workers from industrial accidents, firearms, and natural disasters. There would be a slight increase in risk of traffic accidents and range fires for the public during drilling and field development and a negligible increase during field operations.

4.14.1.1. Occupational Hazards

The statistical probability of injuries is low during the drilling and field development phase of the project, when a peak of 36 workers may be employed. The annual statistical

probability of injuries is minimal during field development because only one worker would be employed.

The BLM, OSHA, USDOT, WOGCC, and WDEQ each regulate certain safety aspects of oil and gas development. Adherence to relevant safety regulations by the Companies and enforcement by the agencies would reduce the probability of accidents. Additionally, in light of the remote nature of the Project Area and the relatively low use of these lands by others (primarily grazing permittees and hunters), occupational hazards associated with the project would mainly be limited to employees and contractors rather than the public.

4.14.1.2. Pipeline Hazards

The risk of pipeline failure would increase with increasing length of the gathering system or market access pipeline. The relatively small amount of new pipeline associated with the project, coupled with the low probability of failure and the remote nature of the Project Area, would result in minimal risk to public health and safety. Pipeline markers posted on the rights of way for the pipelines would reduce the likelihood that pipeline ruptures would be caused by excavation equipment, especially near road crossings or areas likely to be disturbed by road maintenance.

4.14.1.3. Other Risks and Hazards

Risks to public health and safety are not expected to increase under the project. Impacts to highway safety are discussed under the section on Transportation of this document. Impacts associated with sanitation or the materials used in CBNG development would be prevented or reduced by the mitigation measures described in Chapter 2.

The risk of fire in the Project Area could increase under the project but would remain low. Fire is a potential impact associated with construction, industrial development, and the presence of fuels, storage tanks, natural gas pipelines, and gas production equipment. This small risk would be reduced further because facilities would be situated on pads and in locations that are graded and devoid of vegetation. In the event of a fire, property damage most likely would be limited to construction- or production-related equipment and range resources. Fire suppression equipment, a no-smoking policy, shutdown devices, and other safety measures typically incorporated into gas drilling and production procedures also would minimize the risk of fire. Risk of wildfire would be heightened where construction places welding and other equipment near native vegetation. However, the risk to the public would be minimal because of limited public use and presence in the Project Area. A small increase in risk to area fire suppression personnel would be associated with the project.

4.14.2. Alternative 2 - Injection of Produced Water from Federal Wells with Limited Beneficial Use

Effects on health and safety in the Project Area likely would be similar to the effects that would occur from implementation of the Proposed Action. The locations of facilities proposed for Alternative 2 would be the same as under the Proposed Action and would

result in the same level of hazard to health and safety that would occur under the Proposed Action.

4.14.3. Alternative 3 - No Action Alternative

Under the No Action alternative, the coordinated plan of development described under the Proposed Action would not be approved. No additional effects on public health or safety would be expected to occur if the proposed wells are not drilled. Future mineral development in the Project Area would occur under the guidelines of the RMP, by development of individual wells with no coordinated planning for the cumulative impacts.

4.15 NOISE

4.15.1. Alternative 1 - Proposed Action

Noise associated with construction and natural gas production operations can create a disturbance that affects human safety (at extreme levels) or comfort and can modify animal behavior. Identifying the activities that may exceed the maximum standards is not a simple issue. Perception of sound varies with intensity and pitch of the source, air density, humidity, wind direction, screening or focusing by topography or vegetation, and distance from the observer. Noise levels that exceed the 55-dBA maximum standards can occur at construction and production operations. Noise levels around a compressor engine contained in an enclosed building would be below 55 dBA at an estimated 600 feet from the compressor site (BLM 1999b). Construction-related impacts would be short term, lasting only as long as construction was under way at well sites, access roads, pipelines, and other ancillary facilities such as compressor sites. Noise would be created over a longer term at the individual well sites as a result of production facilities.

The density of the human population is low in the Project Area; therefore, construction and development operations under the project would be sufficiently distant from residences that none would be affected by construction or development operations. Overall, noise produced by construction and support equipment during periods of peak activity would be moderate because of the dispersed and short-term nature of these activities.

4.15.2. Alternative 2 - Injection of Produced Water from Federal Wells with Limited Beneficial Use

Effects on noise from activities proposed for Alternative 2 likely would be the same as the effects that would occur from implementation of the Proposed Action. The facilities proposed for Alternative 2 are the same as the Proposed Action and would result in the same level of noise.

4.15.3. Alternative 3 - No Action Alternative

Under the No Action alternative, the coordinated plan of development described under the Proposed Action would not be approved. No additional noise effects would be expected to occur if the proposed wells are not drilled. Future mineral development in the Project Area would occur under the guidelines of the RMP, by development of individual wells with no coordinated planning for the cumulative impacts.

4.16 CUMULATIVE IMPACTS

4.16.1. Alternative 1 - Proposed Action

Cumulative impacts would result from the incremental impacts of the project (Red Rim POD) when added to non-project impacts that result from past, present, and reasonably foreseeable future actions (RFFAs). Reasonably foreseeable development is any development likely to occur within the Project Area (Red Rim POD), or cumulative impact assessment (CIA) area, within the next 5 years. CIA areas vary between resources and are generally based on relevant landscapes, resources, projects, or jurisdictional boundaries.

The only major resource development currently proposed near the Project Area (Red Rim POD) is the other exploration planned under the Interim Drilling Policy for the Atlantic Rim EIS study area ([Appendix A](#)). Thus, the effects of the Red Rim POD (described in this chapter) would not overlap cumulatively with the effects of current or reasonably foreseeable projects or activities other than interim drilling, grazing, and existing or planned prescribed burns within the Atlantic Rim EIS study area.

The Interim Drilling Policy allows a maximum of 200 wells within the Atlantic Rim EIS study area for research and exploration during the interim period while the Atlantic Rim EIS is prepared. Wells would be allowed only in the nine pods identified by the Companies. In addition, a maximum of only 24 wells will be allowed within any pod, even if multiple zones are to be evaluated. Total distance between pods at the north and south ends of the Atlantic Rim EIS study area is about 40 miles. The distances between the individual pods vary, from 1.5 miles to more than 6 miles. The Red Rim POD is part of the 200-well interim drilling project.

Existing natural gas development under the Interim Drilling Policy in the Atlantic Rim EIS study area includes wells and related facilities that have been developed in the Sun Dog, Cow Creek, Blue Sky, and Red Rim areas. There have been 44 natural gas wells drilled in these areas, along with related facilities that include injection wells, roads, corridors for gathering lines and utilities, compressor stations, pumping stations, and water handling facilities. The cumulative long-term disturbance associated with existing gas wells and related facilities in the Atlantic Rim EIS study area is projected to be 74 acres.

Reasonably foreseeable development in the Atlantic Rim EIS study area includes development of the Red Rim area and the remaining well pods referenced in the Interim Drilling Policy. Considering the wells that already exist (44), the proposed wells in the Red Rim area (9), the reasonably foreseeable wells in the Doty Mountain area (24), and the 200-well limit imposed by BLM under the Interim Drilling Policy, the remaining RFFAs associated with interim drilling would include 123 gas wells that would be located in the remaining pods within the Atlantic Rim EIS study area.

Surface-disturbing activities for the wells mentioned in the Interim Drilling Policy may affect an estimated 650 acres (short- and long-term disturbance), including an estimated 60 miles of new access roads. (New roads associated with interim drilling will likely be in the form of spurs from the existing network of roads.). In addition, an estimated 100 miles of water and gas flowlines could be required.

The long-term disturbance from gas wells and facilities associated with the 200 wells mentioned in the Interim Drilling Policy during the life of the proposed wells, after short-term disturbance is reclaimed, would include existing wells and facilities (74 acres), proposed wells and facilities in the Red Rim area (25 acres), RFFAs in the Doty Mountain area (29 acres), and RFFAs in the remaining well pods (220 acres). The cumulative long-term disturbance associated with the 200 wells mentioned in the Interim Drilling Policy would likely affect an estimated 348 acres. These 348 acres would be reclaimed after the wells have been found not to produce or when they cease to produce at some time in the future.

Other past or existing actions in or near the Project Area (Red Rim POD) that continue today and have influence include the road network, oil and gas wells that are not part of the Red Rim POD, ranching and livestock facilities (including fences, stock watering facilities, ranch houses, power lines, and pipelines), and prescribed burns.

To date, 59 oil and gas wells that are not part of the 200 wells mentioned in the Interim Drilling Policy have been plugged and abandoned or are in various stages of reclamation; 37 wells that are not part of the 200 wells mentioned in the Interim Drilling Policy are in various stages of completion. An estimated 337 acres of cumulative, long-term disturbance from wells and facilities that are not part of the 200 wells mentioned in the Interim Drilling Policy are associated with development of oil and gas resources in the Atlantic Rim EIS study area.

The total cumulative long-term disturbance anticipated in the Atlantic Rim EIS study area from oil and gas development, including the 200 wells mentioned in the Interim Drilling Policy and other wells in the Atlantic Rim EIS study area that are not part of the 200 wells mentioned in the Interim Drilling Policy, is about 700 acres. This disturbance would be associated with 296 wells and related facilities.

4.16.1.1. Geology, Minerals, and Paleontology

Existing, proposed, and reasonably foreseeable actions would not affect landslide deposits and would be unlikely to trigger geologic hazards such as landslides, mudslides, debris flows, or slumps. Therefore, no incremental increase in cumulative impacts

associated with geologic hazards would occur. The cumulative impacts to the surface geologic environment would be minimized if the terms of the Interim Drilling Policy are followed and proper techniques for well pad and facility siting, construction, and reclamation are used. Proposed actions and RFFAs would require restoration of disturbed lands and would minimize alterations to topography. Standard stipulations and project- and site-specific construction and reclamation procedures would be required for additional development on federal lands. These measures would further minimize cumulative impacts on the surface geologic environment.

With the exception of natural gas, no major surface mineral resources would be affected by the RFFAs. Subsurface mineral resources are protected by the BLM and WDEQ policies on casing and well bore cementing.

4.16.1.2. Air Quality

Cumulative impacts from emissions that would result from past oil and gas activity and the proposed wells mentioned in the Interim Drilling Policy would be much the same as were found on similar projects such as the Continental Divide. Emissions from oil and gas facilities approved before 1999 were included in the 3,000-well air quality analysis prepared for the Continental Divide EIS, although only 2,130 wells were approved. The emissions from the wells mentioned in the Interim Drilling Policy have been incorporated under the air quality model completed for the Continental Divide project.

RFFAs, including the relatively small number of exploratory wells and facilities mentioned in the Interim Drilling Policy, would generate only a small amount of air pollutants. Some temporary effects on air quality would likely occur in the immediate vicinity of interim drilling, created by particulate matter and exhausts from vehicles and equipment. These effects would be local and would be dispersed by the prevailing winds from the west. The effects on air quality would be minimized through dust abatement practices. The cumulative effects of other RFFAs in the Atlantic Rim EIS study area, such as prescribed burns that are planned, projected grazing of livestock, and vehicle emissions from recreation traffic, were not modeled, but would generate only a small amount of air pollutants.

No noticeable deterioration in visibility would occur at Class I or sensitive Class II wilderness areas located within 100 miles of interim drilling (Mount Zirkel, Rawah, Savage Run, Platte River, Huston Park, or Encampment River). Furthermore, no noticeable deterioration in visibility would occur at the Dinosaur National Monument in Colorado. Wind dispersion of the small quantity of air pollutants generated by RFFAs would likely eliminate formation of regional haze or acid deposition.

4.16.1.3. Soils

The CIA area for soils includes the 219,500-acre portion of the Muddy Creek Watershed that overlaps the Atlantic Rim EIS study area. Cumulative impacts include effects on soil from ongoing exploration and development, recently constructed projects, and RFFAs. Cumulative long-term disturbance consists of about 700 acres, or 0.3 percent of the

Muddy Creek CIA area. Cumulative impacts on the soil resources would be minimal if all mitigation and avoidance measures were implemented.

Minimal effects on soils would be anticipated from the wells mentioned in the Interim Drilling Policy, with proper construction techniques, drilling practices, and the BMPs described earlier in this chapter in the section on Soils and Water Resources. Surface disturbance associated with drilling would increase the potential for erosion and sedimentation. This surface disturbance could include removing vegetation and stockpiling topsoil, road construction, or shallow excavations for drill pads or facilities. Implementation of BMPs during construction, operation, and reclamation to control erosion would minimize effects on soil resources. The cumulative effects of other RFFAs in the Atlantic Rim EIS study area, such as prescribed burns that are planned, projected grazing of livestock, recreation use, and oil and gas development, would have a minimal effect on soil resources, provided BMPs for the management of these activities are implemented.

4.16.1.4. Water Resources

Water wells completed in water-bearing strata above or below the Almond Formation coal seams are not likely to be affected because of the thick confining layers. Water wells completed in the coal seams of the Almond Formation in close proximity (less than 1 mile) to the Project Area could be affected, but wells of this type do not exist. As described in Chapter 2, tests are under way to evaluate whether water from the coal seams in the Almond Formation contributes to the surface water system in the Colorado River Basin. It is highly unlikely that the Almond Formation is contributing to the Colorado River Basin, considering that the overpressured condition of the Almond Formation indicates it is isolated and has no communication with upper horizons.

Cumulative impacts to the groundwater resources within the Mesaverde Group would be limited to a decline in hydrostatic head within the coal aquifers that would result from development of gas wells during drilling. Existing impacts to groundwater resources within the Mesaverde Group that have resulted from prior development are so limited as to be nonexistent.

Minimal effects on groundwater aquifers or groundwater quality would be anticipated during interim drilling. These effects would be minimized with proper construction techniques, drilling practices, and BMPs similar to the applicant-committed and BLM-required mitigating measures that are described in Chapter 2. Current and future oil and gas exploration and development in the Project Area (Red Rim POD) must comply with federal and state environmental regulations. Specifically, wells would be completed in accordance with Onshore Order No. 2 and the recent BLM guidelines that reduce the potential for groundwater contamination.

Surface disturbance would increase the potential for erosion and sedimentation. This disturbance would be associated with related activities, such as removing vegetation and stockpiling topsoil, road construction, or shallow excavations for drill pads or facilities and existing burned areas within the CIA. Burns, prescribed and otherwise, would

increase the potential for erosion and sedimentation for the first 2 years after they occur, because of their effects on erosion of areas without vegetative cover.

Cumulative impacts to surface water resources would be maximized shortly after construction begins and would decrease over time in response to reclamation efforts. These impacts would then stabilize during the production and operation period, when routine maintenance of wells and ancillary facilities takes place. The cumulative effects of other RFFAs in the Atlantic Rim EIS study area, such as prescribed burns that are planned, projected grazing of livestock, recreation use, and oil and gas development, would have a minimal effect on water resources, provided BMPs for the management of these activities are implemented. Additionally, all roads, well locations, and facility infrastructure would be regularly inspected and maintained to minimize erosion, sedimentation, and impairment of surface water quality.

Under the interim drilling policy, maximum development would increase surface flows in the Red Rim portion of the CIA area, provided NPDES permits for surface discharge are approved by the WDEQ and effluent limitations specified in the permits are achieved. Under the interim drilling policy, eight additional gas wells could be drilled in the Project Area (Red Rim POD). Surface discharge of the water produced from these wells would increase the mean annual flow in Hadsell Draw by 1.71 cfs, if approved by the WDEQ. Cumulatively, this discharge would not affect surface flows in the Muddy Creek portion of the CIA area, since there is no hydrological connection between surface waters within the Great Divide Basin, which is a closed basin, and external watersheds.

4.16.1.5. Vegetation, Wetlands, and Noxious Weeds

Cumulative impacts include impacts on vegetation and wetlands from ongoing exploration and development, recently constructed projects, prescribed burns where the sagebrush cover type has been converted to grass and bare ground, and RFFAs. The cumulative effects of other RFFAs in the Atlantic Rim EIS study area, such as prescribed burns that are planned, projected grazing of livestock, recreation uses such as hunting and ORV use, and oil and gas development, would have a minimal effect on vegetation resources, provided BMPs for management of these activities are implemented.

An estimated 20,000 acres have been burned as a result of prescribed fires and 4,000 acres have been affected by wildfire over the past 15 years within a 500,000-acre area that includes the CIA. The objective in prescribed burns is not to burn all vegetation, but to leave mosaics of burned and unburned areas. These burned areas are in various stages of vegetative succession.

The distribution of plant species of concern is likely limited within the Atlantic Rim EIS study area by the lack of suitable habitat. The required application of existing FWS and BLM monitoring and mitigation measures would be expected to adequately protect threatened, endangered, and special status plant species. Thus, impacts to special status species would not be expected to occur.

4.16.1.6. Range Resources and Other Land Uses

RFFAs located within the Sixteen Mile Allotment include the proposed Red Rim. Based on the anticipated disturbance associated with these RFFAs, the cumulative disturbance would be 41 acres in the Sixteen Mile Allotment. The estimated 41 acres of cumulative long-term disturbance equates to a small reduction in available forage within the Allotment.

4.16.1.7. Wildlife and Fisheries

4.16.1.7.1. Wildlife

RFFAs, including the wells mentioned in the Interim Drilling Policy, are expected to have minimal cumulative effects on wildlife. Some wildlife species may be temporarily displaced by construction at well sites, access roads, and pipeline routes, but should return once construction is complete. Extensive suitable habitats for many species exist on adjacent lands and would support individual animals that may be temporarily displaced during RFFAs. Cumulative long-term effects on wildlife also are expected to be minimal, as most species would become accustomed to routine operation and maintenance. Only a small portion of available wildlife habitats within the Atlantic Rim EIS study area would be affected. As a result, the capacity of the area to support various wildlife populations should remain essentially unchanged from current conditions. No cumulative effects on wildlife, including threatened or endangered species or species of concern, are expected during interim drilling. This lack of effects is predicted provided avoidance and mitigation measures, lease stipulations, and provisions in the RMP are followed. The cumulative effects of other RFFAs in the Atlantic Rim EIS study area, such as prescribed burns that are planned, projected grazing of livestock, recreation uses, and oil and gas development, would have a minimal effect on wildlife and fisheries resources, provided BMPs are implemented.

The CIA area varies with species, as indicated in the analysis. Disturbance of wildlife habitat that results from RFFAs, including the wells mentioned in the Interim Drilling Policy, would reduce the availability and effectiveness of habitat for a variety of common mammals, birds, and their predators. Initial phases of surface disturbance would result in some direct mortality to small mammals, would displace songbirds, and would cause a slight increase in mortality from increased use of vehicles. However, populations of small mammals and songbirds would quickly rebound to pre-disturbance levels after reclamation is complete because of the relatively high production potential of these species and the relatively small amount of habitat disturbed (0.006 percent of the Atlantic Rim EIS study area). Therefore, no long-term impacts to these populations are expected.

RFFAs, including activities associated with the construction phase of each of the pods mentioned in the Interim Drilling Policy, would likely temporarily displace antelope, mule deer, and elk; however, once construction is completed, they would likely return to pre-disturbance activity patterns. Elk winter range occurs in the Atlantic Rim EIS study area, but should not be affected by interim drilling. A small area of crucial winter range for pronghorn occurs in the Project Area (Red Rim POD), but would not be affected by development. The proportion of crucial winter range for the pronghorn within the Baggs

Herd Unit that would be affected over the short term would be 0.03 percent and 0.008 percent in the long term. Furthermore, construction on crucial winter range would be limited to May 1 through November 14. Prescribed burns are not expected to affect big game, as the burns would not alter the dominant forage. Provided that mitigation measures described in Chapter 2 and the Interim Drilling Policy are implemented, cumulative impacts to big game populations within the herd units are expected to be minimal.

Greater sage-grouse occupy the area where interim drilling is proposed year round and make seasonal use of the habitats. No exact figures are available on the amount of greater sage-grouse habitat that is available within the Atlantic Rim EIS study area, but the RMP identifies the area as included in the Baggs Habitat Management Plan. In this larger area, 160,500 acres of greater sage-grouse habitat was identified.

4.16.1.7.2. Fisheries

There are no fisheries resources present within the Great Divide Basin.

4.16.1.8. Recreation

BLM has not obtained statistics on historical use of the interim drilling area by recreation groups that could be used to identify trends in cumulative impacts on recreation use and displacement that could result from past or current activities and RFFAs. Cumulatively, overall impacts to the recreation resource are expected to be minimal, with some temporary displacement of hunters and recreationists during the short-term construction and drilling periods. Some long-term displacement of hunters and nonconsumptive users may occur, and levels of satisfaction may be reduced for any who might continue to use the area. The cumulative effects of other RFFAs in the Atlantic Rim EIS study area, such as prescribed burns that are planned, projected grazing of livestock, and oil and gas development, would have a minimal effect on recreation resources, provided BMPs for management of these activities are implemented.

4.16.1.9. Visual Resources

Existing visual qualities in the interim drilling area and adjacent lands have already been affected by ongoing natural gas development, including road building and pipeline construction. Existing, proposed, or reasonably foreseeable development would add to the level of impact to visual resources in the immediate area. The composite experience of people traveling through the area, particularly on back roads, is a modified landscape. Contrasts in line, form, color, and texture from development begin to dominate the viewer's experience. These conditions would increase the likelihood that viewers, particularly backcountry recreationists, would be dissatisfied with the visual component of the recreation experience. However, the cumulative impact of the wells mentioned in the Interim Drilling Policy and other RFFAs, such as grazing, recreation use, prescribed burns, and oil and gas development, on visual resources would still be consistent with the current VRM Class III designation, provided BMPs for these activities that are similar to the techniques described in Chapter 2 would be implemented.

4.16.1.10. Cultural Resources

Federal law and regulations protect cultural resources on public lands, including archaeological sites and historic properties. Cultural resources in the interim drilling area and adjacent lands already may have been affected by surface-disturbing activities, including ongoing natural gas development, road building, and construction of pipelines. Existing, proposed, or reasonably foreseeable development could add to the level of impact on cultural resources in the immediate area, unless inventories and protective or mitigation measures specified by BLM are followed. BLM has required cultural resource inventories before surface-disturbing activities can begin. These inventories have been used to identify sites potentially eligible for inclusion on the NRHP and to identify sites where BLM has required past exploration and development to avoid.

The potential for increased impacts on cultural artifacts would be minimized because Class III cultural resource inventories would be completed. Cultural resource inventories would have a beneficial, cumulative impact on the level of cultural information available about the interim drilling area.

It should be possible to eliminate direct and indirect adverse effects to historic properties from wells mentioned in the Interim Drilling Policy through avoidance or mitigation measures (data recovery or recordation) on a case-by-case basis. The potential for incremental increases in cumulative impacts would be circumvented by avoiding known cultural and historical sites in laying out drill sites, access roads, and pipeline corridors. Some unintentional damage to subsurface resources could occur during grading or excavation. However, implementation of resource protection and mitigation measures similar to the techniques described in Chapter 2 would protect these resources when they are discovered.

4.16.1.11. Socioeconomics

Southwest Wyoming is currently experiencing an increase in the pace and level of natural gas development. Drilling and field development are occurring near the interim drilling area (Atlantic Rim EIS study area), including Continental Divide/Wamsutter II, South Baggs, Mulligan Draw, Creston/Blue Gap, Hay Reservoir and, potentially, Desolation Flats. Although this surge in development will result in increased employment, income, and tax revenues in the region, it will also raise the demand for housing and for local and state government facilities and services. Rawlins is also experiencing some growth associated with the opening of a new prison facility.

Communities such as Rawlins and Rock Springs are still below the peak population levels of the early 1980s and have infrastructure and housing in place to accommodate some growth in population. Smaller communities near the Project Area (Red Rim POD), such as Wamsutter or Baggs, are struggling to accommodate the growth in population associated with development of the currently approved natural gas fields identified above. Neither the relatively small, short-term drilling and field development workforce nor the minimal operations employment and activity associated with the existing, proposed, or reasonably foreseeable development would add appreciably to cumulative demand for housing and local government services in the area. Drilling and field development

associated with these activities would be completed some time before interim drilling ends and the proposed Atlantic Rim Natural Gas Project begins.

4.16.1.12. Transportation

Oil and gas development in western Carbon County and eastern Sweetwater County would result in increased traffic on affected segments of I-80, WY 70, and WY 789. The condition of these highways is adequate to accommodate existing levels of traffic and some increases (Rounds 2000).

Currently known cumulative impacts on Carbon County Roads 605 and 608 would be limited to grazing and recreation and occasional traffic associated with oil and gas exploration. The increased traffic associated with drilling and field development for the 200 wells mentioned in the Interim Drilling Policy would accelerate maintenance requirements; however, revenues generated, which are described under the section of this chapter on Socioeconomics, may offset associated costs.

4.16.1.13. Health and Safety

Cumulative impacts to health and safety would be limited to effects associated with the 200 wells mentioned in the Interim Drilling Policy and to existing grazing and recreation. Cumulative impacts to health and safety are anticipated to be similar to the effects described for the project (Red Rim POD). Occasional traffic and activity associated with oil and gas exploration would slightly increase risks to workers and the public.

4.16.1.14. Noise

Cumulative noise impacts would be limited to the 200 wells mentioned in the Interim Drilling Policy and to existing grazing and recreation. Cumulative noise impacts are similar to the effects described for the project (Red Rim POD). Noise would result from ongoing construction, drilling, and production operations, including an estimated nine compressor stations, during interim drilling. Traffic would increase on existing transportation system roads within the area where interim drilling is planned, thus adding to the existing traffic noise. The additional traffic-related noise would be minimal given the current and anticipated low volumes of traffic and the dispersed nature of traffic and natural gas operations within the interim drilling pods. The locations of the interim drilling pods are dispersed, so that the noise from compressor stations would not likely be noticeable throughout the interim drilling area (Atlantic Rim EIS study area) ([Figure 1-1](#)). The distance between the pods also would minimize the overall impact of noise on visitors to the area; however, the cumulative additional noise from all RFFAs would combine to create an environment with an overall increase in sound disturbances. Applicant-committed and BLM-required mitigation measures for interim drilling, similar to the techniques described in Chapter 2 for the Red Rim POD, would result in minimal noise impacts.

4.16.2. Alternative 2 - Injection of Produced Water from Federal Wells with Limited Beneficial Use

Cumulative impacts under Alternative 2 likely would be similar to the effects that would occur under the Proposed Action. The facilities proposed for Alternative 2 are the same as the Proposed Action. The planned exploration and interim development under Alternative 2 would result in similar short- and long-term disturbances and similar cumulative effects on all affected resources. The principal difference between the Proposed Action and Alternative 2 is the different method of disposal for produced water from federal wells in the Red Rim POD. Levels of cumulative impacts would be similar under Alternative 2 for interim drilling associated with all pods, including the Red Rim POD, as for the Proposed Action.

4.16.3. Alternative 3 - No Action Alternative

Under the No Action alternative, without a coordinated plan of development for the Project Area (Red Rim POD), mineral development associated with interim drilling likely still would occur within the Project Area (Red Rim POD) and other pods within the Atlantic Rim EIS study area. However, reasonably foreseeable mineral development would occur under the guidelines of the RMP, by development of individual wells with no coordinated planning for the cumulative impacts.

The cumulative impacts could be similar to the effects of the wells mentioned in the Interim Drilling Policy described above under the Proposed Action, provided the consideration of drilling proposals individually, instead of in a coordinated plan, would not result in additional cumulative impacts. However, considering the difficulty of siting routes for pipelines in the coordinated plan for Red Rim so that impacts to important wildlife habitat were prevented, impacts almost certainly would be greater without a coordinated plan.

Cumulative effects of RFFAs other than the wells mentioned in the Interim Drilling Policy would be similar to the Proposed Action. Grazing, hunting, ORV use, other recreational activities, prescribed burns, and oil and gas development still would occur. These RFFAs would affect soil and water resources, vegetation, and socioeconomics of the Atlantic Rim EIS study area even if RFFAs associated with interim drilling did not occur, or did not occur under a coordinated plan. If no coordinated plan were developed, the potential benefits might be reduced or eliminated to grazing, soil and water resources, vegetation in riparian areas, and wildlife, that would be associated with a coordinated plan to reduce concentrated use of riparian areas by providing small quantities of produced water where it was previously not available.

5.0 CONSULTATION AND COORDINATION

5.1 CONSULTATION AND COORDINATION

An environmental analysis is prepared when a federal government agency considers approving an action within its jurisdiction that may impact the human environment. An environmental analysis aids federal decision makers by presenting information on the physical, biological, and social environment of a proposed project and its alternatives. The first step in conducting an environmental analysis that meets the requirements of NEPA is to determine the scope of the project, the range of action alternatives, and the impacts to be included in the document.

The Council on Environmental Quality (CEQ) regulations (40 CFR, Parts 1500-1508) require an early scoping process to determine the issues related to the Proposed Action and alternatives that the analysis should address. The purpose of the scoping process is to identify important issues, concerns, and potential impacts that require analysis. The results of the scoping process are used to focus the analysis on the issues and concerns identified for the proposed project, so that alternatives or mitigation considered can be responsive to the issues and concerns. Alternatives that are not technically or economically feasible or responsive to the issues and concerns are not considered further in the analysis.

The environmental assessment documenting the NEPA analysis conducted for the Red Rim POD was prepared by a third-party contractor working under the direction of and in cooperation with the lead agency for the project, BLM Rawlins Field Office in Rawlins, Wyoming.

5.2 PUBLIC PARTICIPATION

A scoping notice was prepared and submitted to the public by the BLM on June 14, 2001, requesting comments on the proposed Atlantic Rim Natural Gas Project. Scoping documents were sent out to the public listed on the BLM mailing list, as well as organizations, groups, and individuals that requested a copy of the scoping document.

As a part of the scoping process, the interim drilling programs proposed by the Companies were included in the scoping notice. The scoping period ended on July 25, 2001. During preparation of the EA, the BLM and the consultant interdisciplinary team have communicated with, and received or solicited input from various federal, state, county, and local agencies, elected representatives, environmental and citizens groups, industries, and individuals potentially concerned with issues regarding the proposed exploratory drilling activities. The contacts made are summarized in the following sections.

The following organizations and individuals either provided comment or were provided the opportunity to comment during the scoping period.

FEDERAL OFFICES

U.S. Bureau of Land Management, Wyoming State Office
U.S. Congresswoman Barbara Cubin
U.S. Senator Mike Enzi
U.S. Senator Craig Thomas
U.S. Army Corps of Engineers
U.S. Bureau of Reclamation
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service

STATE AGENCIES

Governor Dave Freudenthal
State Representatives
State Senators
State Engineer's Office
Wyoming Department of Environmental Quality
Wyoming Department of Transportation
Wyoming Game and Fish Department
Wyoming Oil and Gas Conservation Commission
Wyoming State Planning Coordinator

COUNTY GOVERNMENT

Carbon County Commissioners
Carbon County Planning Commission

MUNICIPALITIES

Mayor-Baggs
Mayor-Rawlins
Mayor-Wamsutter

NATIVE AMERICAN TRIBES

Northern Arapahoe Tribal Council
Shoshone Tribal Council
Ute Mountain Tribe
Ute Tribal Council
Shoshone-Arapahoe Joint Tribal Council
Uinta-Ouray Tribal Council

GRAZING PERMITTEES

Weber Ranch
Montgomery Livestock Company
Salisbury Livestock Company

Stratton Sheep Company
Three Forks Ranch Corporation
Sam Morgan
Mike Sheehan
Robert Orchard
H.B. Lee
Matt Weber
Espy Livestock
Jack Creek Land and Cattle Company
PH Livestock Company

LEASE AND ROW HOLDERS

Benson–Montin-Greer
KCS Mountain Resources, Inc.
Merit Energy Company
North Finn, LLC
P&M Petroleum Management
Stone & Wolf, LLC

LANDOWNERS

The scoping notice was sent to 111 landowners potentially affected by the proposal.

LOCAL MEDIA

Casper Star-Tribune
Rawlins Daily Times
Rock Springs Rocket Miner
Wyoming State Journal
Wyoming State Tribune/Eagle
Gillette News-Record
Northwest Colorado Daily News
KRAI - Craig, Colorado
KRAL - Rawlins
KRKK - Rock Springs
KSIT - Rock Springs
KTWO - Casper
KTWO TV - Casper
KUWR - University of Wyoming

OTHER AGENCIES, INDUSTRY REPRESENTATIVES, INDIVIDUALS, AND ORGANIZATIONS

Audubon Society
National Wildlife Federation
Wilderness Society
Carbon County Stockgrowers

The Nature Conservancy
 Wyoming Association of Professional Archaeologists
 Field Museum of Natural History, Department of Geology
 Independent Petroleum Association of Mountain States
 Montana Oil Journal
 Murie Audubon Society
 Petroleum Association of Wyoming
 Sierra Club
 Wyoming Farm Bureau Federation
 Wyoming Outdoor Council
 Wyoming Public Lands Council
 Wyoming Stockgrowers Association
 Wyoming Wildlife Federation
 Wyoming Woolgrowers Association
 Vern Brodsho
 Ivan Herold
 Little Snake River Conservation District

5.3 LIST OF PREPARERS

The following tables identify the core BLM IDT (**Table 5-1**) and the consultant IDT (**Table 5-2**) who were principally involved in preparing this EA.

TABLE 5-1 BLM INTERDISCIPLINARY REVIEWERS

Name	Responsibility
BLM Team	
Larry Jackson	BLM IDT Lead
Dave Simons	Atlantic Rim EIS Coordinator
Tom Williams	Natural Resource Specialist
Pam Huter	Cultural Resources
Pat Walker	Cultural Resources
Krystal Clair	Visual Resources/Recreation
Bob Lange	Water Resources
Lloyd Chism	Petroleum Engineering, Geology
Andy Warren	Vegetation/Range Issues
Gay Seay	Pipeline Construction
Susan Foley	Soils/Reclamation
Frank Blomquist	Wildlife/T & E Issues
Mike Bower	Fisheries Biologist; Riparian/Wetland
Janelle Wrigley	Realty Specialist

TABLE 5-2 CONSULTANT INTERDISCIPLINARY TEAM EA PREPARERS

Name	Affiliation	Area of Expertise and Responsibility
Principal Interdisciplinary Team		
Kathy Wilkerson	Greystone Environmental Consultants, Inc.	Interdisciplinary Team Leader, Project Manager, Mineral and Energy Resource Specialist
Sue Barker	Greystone Environmental Consultants, Inc.	Hydrologist (Water Resources)
Henry Sauer	Greystone Environmental Consultants, Inc.	Soils and Range Science
Tim Kalus	Greystone Environmental Consultants, Inc.	Water Management
Brian Heath	Greystone Environmental Consultants, Inc.	Surface Discharge of Produced Water
Bliss Lilley	Greystone Environmental Consultants, Inc.	Physical Resources
Lisa Welch	Greystone Environmental Consultants, Inc.	Environmental Scientist
Cherie Walth	Greystone Environmental Consultants, Inc.	Archaeologist
Pat Golden	Greystone Environmental Consultants, Inc.	Wildlife and Fisheries Biologist
Mike Holle	Greystone Environmental Consultants, Inc.	GIS Specialist
Dave Cameron	Greystone Environmental Consultants, Inc.	NEPA Specialist, Wildlife Biologist
Technical Support Team		
Larry Hayden-Wing	Hayden-Wing Associates	Wildlife/Fisheries/Special Status Species
Travis Olson	Hayden-Wing Associates	Wildlife Biologist
Jeffrey Winstead	Hayden-Wing Associates	Wildlife Biologist & Cartographer
Scott Mullner	Hayden-Wing Associates	Fisheries Biologist
Butch Fries	Greystone Environmental Consultants, Inc.	Editor
Julie Hatcher	Pronghorn Archaeology	Cultural Resources
Gary Holsan	Gary Holsan & Associates	Atlantic Rim Natural Gas Project EIS-ongoing environmental analysis for EIS

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7.0 ACRONYMS

ACEC	Area of Critical Environmental Concern
ADT	Average Daily Traffic
AADT	Annual Average Daily Traffic
ANC	Acid Neutralizing Capacity
APCD	Air Pollution Control Division (Colorado Department of Public Health and Environment)
APD	Application for Permit to Drill
AQD	Air Quality Division (Wyoming Department of Environmental Quality)
AQRV	Air Quality Related Value
ASTM	American Society for Testing and Materials
ATV	All-terrain Vehicle
AUM	Animal Unit Months
bb1	Barrel (42 U.S. gallons)
BLM	U.S. Bureau of Land Management
BMPs	Best Management Practices
B.P.	Before Present
CAAQS	Colorado Ambient Air Quality Standards
CBM	Coal Bed Methane
CCR	Carbon County Road
CDPHE	Colorado Department of Public Health and Environment
CFR	Code of Federal Regulations
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfs	Cubic feet per second (equivalent to 448.83 gallons per minute)
CIA	Cumulative Impact Assessment
CO	Carbon monoxide
COA	Conditions of Approval
COE	U.S. Army Corps of Engineers
CWA	Clean Water Act
CWR	Crucial Winter Range
dBA	A-weighted scale, decibels
DEIS	Draft Environmental Impact Statement
EA	Environmental Assessment
EIS	Environmental Impact Statement
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
F	Degrees in Fahrenheit
FEIS	Final Environmental Impact Statement
FR	Federal Register
FWS	U.S. Fish and Wildlife Service
FY	Fiscal Year
IDT	Interdisciplinary Team
g/hp-hr	Grams per horsepower-hour

GAP	Wyoming Gap Analysis Program
gpd/ft	Gallons per day per foot
gpd/ft ²	Gallons per day per square foot
gpm	Gallons per minute
GPS	Global Positioning System
GWD	Ground Water Division, Wyoming Department of Environmental Quality
HAP	Hazardous Air Pollutants
HDPE	High Density Polyethylene
HUC	Hydrologic Unit Code
IMPROVE	Interagency Monitoring of Protected Visual Environments
JTU	Jackson Turbidity Unit
MDF	Million Cubic Feet
MDP	Master Drilling Plan
meq/L	Milliequivalents per liter
mg/L	Milligrams per liter
mmhos/cm	Soluble salts (salinity) in a soil expressed in millihmos per centimeter.
MSDS	Material Safety Data Sheet
MSHA	Mine Safety and Health Administration
MSUP	Master Surface Use Program
NAAQS	National Ambient Air Quality Standard
NCR	Nonselective Catalytic Reduction
NEPA	National Environmental Policy Act
NO ₂	Nitrogen dioxide
NO _x	Nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resource Conservation Service
NRHP	National Register of Historic Places
NSO	No Surface Occupancy
NTU	Nephelometric Turbidity Unit
O ₃	Ozone
ORV	Off-road Vehicle
OSHA	Occupational Safety and Health Administration (federal and state)
Pb	Lead
pCi/l	Picocurie per liter, used to measure Radium 226.
PM ₁₀	Particulate matter less than 10 microns in effective diameter
PM _{2.5}	Particulate matter less than 2.5 microns in effective diameter
Pod	Grouping of CBM wells into a well pod, for example, Pod 7
POD	Plan of Development
PPP	Pollution Prevention Plan
PRCBMIC	Powder River CBM Information Council
PSD	Prevention of Significant Deterioration
psi	Pounds per square inch
RCRA	Resource Conservation and Recovery Act
RFFA	Reasonably Foreseeable Future Action
RFO	Rawlins Field Office, Bureau of Land Management
RMP	Resource Management Plan
ROD	Record of Decision
ROW	Right-of-Way

RV	Recreational Vehicle
R_W	Range number West
SAR	Sodium Adsorption Ratio
SARA	Superfund Amendments and Reauthorization Act
SCR	Selective Catalytic Reduction
SH	State Highway
SHPO	State Historic Preservation Office
SO ₂	Sulfur dioxide
SPCC	Spill Prevention Control and Countermeasures
s.u.	Standard Units
TDS	Total Dissolved Solids
TEG	Triethylene Glycol
T_N	Township number North
TPQ	Threshold Planning Quantity
TRI	Toxic Release Inventory
TSS	Total Suspended Solids
g/m ³	Micrograms per cubic meter (1 g=0.001 mg or 1 part per billion)
USDI	U.S. Department of the Interior
USDOT	U.S. Department of Transportation
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
UW	University of Wyoming, Laramie
VOC	Volatile Organic Compounds
VRM	Visual Resources Management
WAAQS	Wyoming Ambient Air Quality Standard
WDAI	Wyoming Department of Administration and Information
WDEQ	Wyoming Department of Environmental Quality
WGFD	Wyoming Game and Fish Department
WMP	Water Management Plan
WOGCC	Wyoming Oil and Gas Conservation Commission
WOS	Wildlife Observation System
WRCC	Western Regional Climate Center
WSEO	Wyoming State Engineer's Office
WTA	Wyoming Taxpayers Association
WY	Wyoming State Highway
WYDOT	Wyoming Department of Transportation
WYNDD	Wyoming Natural Diversity Database

APPENDIX A

Interim Drilling Policy - Development Authorized Concurrent with EIS Preparation for the Atlantic Rim Coalbed Methane Project

During the preparation of the Atlantic Rim Coalbed Methane EIS, the Bureau of Land Management's (BLM) authority to allow drilling on the federal mineral estate is limited. The Council on Environmental Quality (CEQ) Regulations and 40 CFR 1506.1, *limitations on actions during NEPA process* to comply with the National Environmental Policy Act (NEPA) provide the following regarding limitation on concurrent authorizations:

Section 1506.1

(a) Until an agency issues a record of decision as provided in para. 1505.2 (except as provided in paragraph (c) of this section), no action concerning the proposal shall be taken which would:

- (1) Have an adverse environmental impact; or*
- (2) Limit the choice of reasonable alternatives.*

(b) If any agency is considering an application from a non-federal entity, and is aware that the applicant is about to take an action within the agency's jurisdiction that would meet either of the criteria in paragraph (a) of this section, then the agency shall promptly notify the applicant that the agency will take appropriate action to insure that the objectives and procedures of NEPA are achieved.

(c) While work on a required program environmental impact statement is in progress and the action is not covered by an existing program statement, agencies shall not undertake in the interim any major Federal action covered by the program which may significantly affect the quality of the human environment unless such action:

- (1) Is justified independently of the program;*
- (2) Is itself accompanied by an adequate environmental impact statement; and*
- (3) Will not prejudice the ultimate decision on the program. Interim action prejudices the ultimate decision on the program when it tends to determine subsequent development or limit alternatives.*

(d) This section does not preclude development by applicants of plans or designs or performance of other work necessary to support an application for Federal, State or local permits or assistance....

The above regulations and the following criteria and conditions will be used by the BLM to determine new exploratory activities allowed on Federal surface and/or minerals during preparation of the EIS. They also establish conditions under which these activities will be approved. The intent of these criteria and conditions are to keep all activity within the scope of existing analysis and at a reasonable level, to allow limited drilling activity for acquisition of additional data necessary for completion of the EIS, and to prevent unnecessary hardship to leaseholders. These criteria may be modified by the BLM authorized officer (AO) if any of the allowed activities are viewed as having a potentially significant effect on the environment or prejudice the ultimate decision on the drilling program for the EIS as outlined in the CEQ regulations quoted above.

APPENDIX A: INTERIM DRILLING POLICY

Activities Allowed on Federal Lands and Minerals During EIS Preparation

1. A maximum of 200 coalbed methane wells will be allowed within the project area, for research and exploratory purposes, during the interim period in which the EIS is prepared. Wells will only be allowed in the nine pods the operators have proposed and a maximum of only 24 coalbed methane wells will be allowed within any pod, regardless of multiple zones to be evaluated (see map).
2. Activities within individual pods will be authorized by BLM. For any pod location which overlaps the boundary of a sensitive resource area for sage grouse, mountain plover, raptors, big game migration corridors, and sensitive plants, appropriate stipulations and mitigation will be applied to protect any sensitive resources present (see Term Definitions below). Some sensitive resources such as high density paleontological or cultural resources sites, are not mapped and will also be handled on a pod basis.
3. Existing coalbed methane wells (two wells re-completed as coalbed methane producers in the Cow Creek Unit by Double Eagle and one new well completed by Petroleum Development Corporation, to the east of this unit) will count toward the above well limits. As Federal 1691 #10-8 has been plugged and abandoned, it will not count toward the above well limit. In addition, the six coalbed methane wells originally permitted by North Finn LLC and drilled in Section 5, T17N, R90W, and the well located in Section 36, T15 N, R91W, will not count toward the allowed well number, as long as they are not included as part of any proposed pod. In addition, required injection wells and monitoring wells will not count toward the well limit.
4. Any modifications proposed to the approved pods (i.e. changing pod locations, drilling wells outside of the current pod locations, or increasing the total number of wells allowed during interim drilling), will only be approved if geologic, hydrologic, or reservoir characteristics support a change. These changes will be allowed after review by, and concurrence of, the Reservoir Management Group and authorization by the BLM, Rawlins Field Office. Additional federal drainage protection wells may be required.
5. During preparation of the EIS, coalbed methane wells and associated roads and pipelines on any private surface/private mineral where the operator has, or has obtained legal access (i.e., county roads, approved BLM ROW grant or private access road) prior to approval of the interim drilling plan, may be developed as deemed appropriate by the operator/lessee. However, these wells will count toward the total number of wells allowed to be drilled under this interim drilling policy.

Criteria and Conditions that Apply to Interim Drilling Operations

1. A detailed Plan of Development/Surface Use Plan (POD/SUP) and Master Drilling Plan for each individual pod, using guidance provided by the BLM Rawlins Field Office, will be submitted and approved prior to surface disturbing activities.
2. The operator(s) agree to supply the geologic, coal, and water data information discussed in Appendix C of this document.
3. Prior to initiating interim drilling, an environmental assessment (EA), including a detailed Water Management Plan will be prepared and approved for each individual pod. Because

APPENDIX A: INTERIM DRILLING POLICY

- of the current BLM workload, and in order to expedite the completion of the EAs, it is recommended that these documents be prepared by a third-party contractor.
4. All pod EA's will be submitted to the BLM in pdf format and each document will be placed on the BLM Wyoming web page. A 30-day public review of each document will occur from the date the document is placed on the site. BLM will be responsible for writing the Decision Record for each EA.
 5. A 1/4 mile buffer is required between surface disturbing activities and the Overland Trail.
 6. Block surveys for cultural resources will be required for each pod.
 7. No interim drilling will be allowed in the Sand Hills Area of Critical Environmental Concern as described in the Great Divide Resource Management Plan Record of Decision (RMP-1990).
 8. The Great Divide RMP states the BLM will include intensive land-use practices to mitigate salt and sediment loading caused by surface disturbing activities within the Muddy Creek watershed. The Muddy Creek Coordinated Resource Management (CRM) group was established as an advisory group to address this issue. Because this area overlaps with the Muddy Creek CRM effort, and since road use contributes the most in increasing the amount of sediment in the Muddy Creek drainage, the POD/SUP will be reviewed by the Muddy Creek CRM Road Committee and recommendations of the group will be considered by BLM. Changes to the POD/SUP will be made prior to initiating work on the pod EA.
 9. Surface discharge as a method of disposal for produced coalbed methane waters will be considered for each individual pod during interim drilling activities within the Great Divide Basin. This is subject to the approval of the Water Management Plan and upon obtaining all required federal, state and local permits.
 10. Prior to completion of the EIS, water produced from coalbed methane wells located in the Colorado River Basin will be disposed of by re-injection. The only exception to this would be waters produced from the Double Eagle's coalbed methane existing and proposed wells located in the Cow Creek POD. Double Eagle has applied to the Wyoming Department of Environmental Quality (WDEQ) for a National Pollutant Discharge Elimination System (NPDES) permit for their two existing wells and four wells permitted recently by BLM. Should Double Eagle receive their state permit, they will be allowed to surface discharge from these six wells. Prior to any additional drilling of CBM wells by Double Eagle in the Cow Creek Pod, an environmental assessment, including a Water Management Plan, will be prepared and submitted to BLM which will examine the environmental impacts from these wells. Double Eagle will be allowed to dispose of produced CBM waters to the surface only after completion of the environmental analysis and a determination is made that the additional surface discharge will cause no significant impact to the environment.
 11. No drilling activities will be allowed in prairie dog towns during interim operations. However, drilling will be allowed in each individual pod containing prairie dog towns upon the completion of black-footed ferrets survey using methods approved by the United States Fish and Wildlife Service. These surveys will clear the pod for a one year period. The operators also have the option of completing surveys in the whole EIS area which would clear the area for the life of the project.

APPENDIX A: INTERIM DRILLING POLICY

In the event a black-footed ferret or its sign is found, the BLM Authorized Officer shall stop all action on the application in hand, and/or action on any application that may directly, indirectly, or cumulatively affect the colony/complex, and initiate Section 7 review with the USFWS. No project related activities will be allowed to proceed until the USFWS issues their biological opinion. The USFWS biological opinion will specify when and under what conditions and/or prudent measures the action could proceed or whether the action will be allowed to proceed at all.

12. No drilling or disturbance will be allowed in those areas determined to be critical winter habitat for sage grouse.
13. No drilling or disturbance will be allowed in areas where any two or more big game (elk, deer, or antelope) crucial winter ranges overlap.
14. The operators will be required to submit a drilling schedule as part of the Master Drilling Plan. This schedule will be reviewed, and approved by BLM, to ensure that activities are limited within proven big game migration corridors at critical use times during the year.
15. Pipelines, power lines, waterlines, fiber optic lines will be buried and, where possible, will follow the road rights-of-way.
16. Fish passage structures will be installed for roads which cross drainages with fisheries concerns as identified by BLM.

Term/Definitions

SENSITIVE RESOURCE AREAS are defined as those areas containing stabilized sand dunes, sensitive plant areas, raptor nesting concentration areas, prairie dog towns, two-mile buffer around sage grouse leks, mountain plover aggregation areas or potential habitat, big game migration corridors and crucial big game winter ranges, and areas with high density cultural or paleontological resource sites. Field inspections by the BLM will be conducted to verify presence of these resource values and potential impacts prior to considering authorization of any proposed development activity on Federal surface and/or minerals.

WILL BE AUTHORIZED means BLM will authorize the action if, following the environmental review of the APD or ROW application, sensitive resource areas are protected with appropriate stipulations or mitigation and the criteria established under CEQ regulation 40 CFR 1506.1 have been met. An environmental assessment (EA) will be completed for each individual pod prior to authorizing the proposal. Consultation and Coordination with the Wyoming Game and Fish Department and the U.S. Fish and Wildlife Service will occur when applicable for proposed activity within sensitive resource areas. The pod EA will identify the most environmentally acceptable access route, well site, and pipeline location. Mitigation measures developed from nearby project EISs and EAs for protection of resource values may be considered in the assessment. Any action proposed must be in conformance with the Great Divide Resource Management Plan (RMP) and mineral lease terms and conditions.

A coalbed methane pod may consist of two or more production wells, injection wells, access roads, product pipelines, water pipelines, power lines and other ancillary facilities designed specifically to assess the development potential of the play.

Appendix B

MASTER SURFACE USE PROGRAM (MSUP) RED RIM PLAN OF DEVELOPMENT (POD) RIGHT-OF-WAY (ROW) APPLICATION FOR FACILITIES

OPERATORS:

Warren E & P, Inc. and Anadarko E & P Company

LANDS INVOLVED:

Sections 20 & 28 in T20N R89W, 6th PM, Carbon County, Wyoming

BLM LEASES:

WYW149261, WYW150410

Surface Use Program and Plan of Development for the subject wells listed below:

Gas Wells in T20N R89W Section 20

AR Federal 2089 NE20 (WYW149261)
AR Federal 2089 SE20 (WYW149261)
AR Federal 2089 SW20 (WYW149261)

Gas Wells in T20N R89W Section 28

AR Federal 2089 NW28 (WYW150410)
AR Federal 2089 NE28 (WYW150410)

Plan of Development for the facilities listed below:

Proposed ROW (BLM surface ownership lands): Road Access to Fee and State Gas Wells in T20N R89W (AR Fee 2089 NE16, AR Fee 2089 SW16, AR State 2089 SE16, and AR Fee 2089 NE29):

Lands Involved: T20N R89W, Sections 16 and 28

Proposed ROW (BLM surface ownership lands): Road Access to Fee Injection Well in T20N R89W (AR Fee 2089 29I):

Lands Involved: T20N R89W, Section 28

Proposed ROW (BLM surface ownership lands): Gathering System for Water and Gas and Buried Electrical Utility Lines

Lands Involved: T20N R89W, Sections 20 and 28

Proposed ROW (BLM surface ownership lands): Delivery Pipeline for Gas

Lands Involved: T20N R88W, Section 8
T20N R89W, Sections 12, 14, and 22
T21N R87W, Section 30
T21N R88W, Sections 26 and 34

PROJECT DESCRIPTION

The MSUP for the Red Rim POD is submitted by Warren E & P, Inc. (Warren) and Anadarko E & P Company (AEPC), collectively referred to as “the Companies.” The proposed project would be located 8 miles southwest of Rawlins, Wyoming, along Carbon County Road 605 (Twentymile Road). The project area lies within the Great Divide Basin, a sub-basin of the Greater Green River Basin. The Continental Divide splits around the Great Divide Basin, and isolates it as a closed, interior drainage basin. Therefore, any water entering the basin is contained within it.

The project is one of nine areas or well pods that make up the Atlantic Rim Interim Drilling Project. Of the nine proposed gas well locations, five wells would be located on surface ownership lands administered by the Bureau of Land Management (BLM) Rawlins Field Office (RFO) and would develop federal minerals. Of the remaining proposed wells, three wells would develop fee minerals on fee surface, and one well would develop state minerals on federal surface. There are currently seven gas wells in the Red Rim POD that are existing/authorized, which were previously permitted by AEPC on fee surface and minerals. A groundwater monitoring well also will be established in the project area, at a location specified by BLM.

Several additional facilities would be included as part of the Red Rim POD. All of these facilities would be located on fee surface and would require no authorization from BLM prior to construction. Development of these wells and facilities is currently completed, underway, or planned for 2003:

- ∅ Two produced water-conditioning facilities would be utilized to treat water produced by gas wells (one is existing/authorized and one is proposed, as needed),
- ∅ Two deep injection wells would be utilized for disposal of hydrostatic test water and the waste stream from the water conditioning facilities (one is existing/authorized and one is proposed, as needed),
- ∅ Three outfalls would be utilized for the discharge of produced water (two are existing/authorized and one is proposed, as needed), and
- ∅ One compressor station (existing/authorized).

The MSUP contains surface operating procedures for the Companies’ federal Applications for Permits to Drill (APDs), as required under Onshore Order No. 1. The enclosed **Project Map** shows all wells and facilities associated with the Red Rim POD. Name, number, location, and lease information for the proposed wells and information on proposed facilities are listed in **Table B-1 – Red Rim Project**. Additional information on each federal well is contained in the **BLM APD Form 3160-3** and **Well Survey Plat** already on file with BLM.

Wells are currently planned on federal leases WYW149261 and WYW150410 in T20N R89W, Sections 20 and 28. Lease stipulations that affect these sections are described below.

TABLE B-1 – RED RIM PROJECT

Proposed Gas Wells			
Lease Number	Well Name	Well Number	Location
WYW-149261	AR Federal ¹	2089 NE20	T20N R89W Section 20 NENE
	AR Federal ¹	2089 SE20	T20N R89W Section 20 SESE
	AR Federal ¹	2089 SW20	T20N R89W Section 20 SWSW
WYW-150410	AR Federal ¹	2089 NW28	T20N R89W Section 28 SENW
	AR Federal ¹	2089 NE28	T20N R89W Section 28 NWNE
FEE/STATE LEASES	AR Fee	2089 NE16	T20N R89W Section 16 SWNE
	AR Fee	2089 SW16	T20N R89W Section 16 NESW
	AR State ¹	2089 SE16	T20N R89W Section 16 NWSE
	AR Fee	2089 NE29	T20N R89W Section 29 NENE
Existing or Authorized Gas Wells²			
Lease Information	Well Name	Well Number	Location
FEE LEASES	AR Fee	2089 NE21	T20N R89W Section 21 NENE
	AR Fee	2089 NW 21	T20N R89W Section 21 NENW
	AR Fee	2089 SW21	T20N R89W Section 21 NESW
	AR Fee	2089 SE21	T20N R89W Section 21 NESE
	AR Fee	2089 NW/29	T20N R89W Section 29 SENW
	AR Fee	2089 SW29	T20N R89W Section 29 SWSW
	AR Fee	2089 SE29	T20N R89W Section 29 SESE
Proposed Injection Well			
FEE LEASE	AR Fee	29I	T20N R89W Section 29 NENE
Existing or Authorized Injection Well			
FEE LEASE	AR Fee	21I	T20N R89W Section 21 NENE
Proposed Facilities			
FEE LEASE	Conditioning	Bountiful	T20N R89W Section 29 NENE
FEE LEASE	Outfall	Bountiful 001 (RR-D1)	T20N R89W Section 29 SWNE
Existing or Authorized Facilities²			
Lease Information	Site Type	Name	Location
FEE LEASE	Conditioning Facility	Abundance	T20N R89W Section 21 NENE
FEE LEASE	Outfall	Abundance 002 (RR-D2)	T20N R89W Section 21 NENE
FEE LEASE	Outfall	Abundance 003 (RR-D3)	T20N R89W Section 21 NENE
FEE LEASE	Compressor Station	Red Rim	T20N R89W Section 21 SESE

Note: ¹ BLM surface ownership lands

² Wells and facilities requiring no authorization from BLM prior to construction; development of these wells and facilities in accordance with the Red Rim POD is currently completed, underway, or planned for 2003.

Lease WYW149261 contains a timing limitation stipulation in Section 20 to protect nesting habitat for raptors and greater sage-grouse, from February 1 through July 31 (raptors), and from March 1 through June 30 (greater sage-grouse and sharp tailed grouse). In addition, this lease

contains a controlled surface use requirement for surface occupancy within ¼ mile of greater sage-grouse and sharp-tailed grouse strutting/dancing grounds, which requires a mitigation plan where impacts may occur. Potential mountain plover habitat has been identified in Section 20, which will require mitigation of impacts from April 10 through July 10. Finally, this lease contains a timing limitation for big game crucial winter range (November 15 through April 30), however, this stipulation is applied to Section 18, which is outside the POD. No project activities are proposed in Section 18, where crucial winter range for pronghorn antelope is delineated.

Lease WYW150410 contains a timing limitation stipulation in Section 28 to protect nesting habitat for raptors and greater sage-grouse, from February 1 through July 31 (raptors), and from March 1 through June 30 (greater sage-grouse and sharp tailed grouse). In addition, this lease contains a controlled surface use requirement for surface occupancy within ¼ mile of greater sage-grouse and sharp-tailed grouse strutting/dancing grounds, which requires a mitigation plan where impacts may occur. Potential mountain plover habitat has been identified in Section 28, which will require mitigation of impacts from April 10 through July 10.

Gas wells are also planned on BLM surface ownership lands in Section 16 that are not included in a federal lease because oil and gas rights for this section are not federally owned. No project activities are proposed near the very small area in the extreme northwestern portion of Section 16 that is delineated as crucial winter range for pronghorn antelope.

This MSUP is intended to serve as the ROW pre-application for the gas lines, water lines, access roads to well locations, and electric lines in the POD. A more detailed Plan of Development will be submitted with each application. Roads will require a 30-foot right-of-way. Gas-gathering lines will require a 30-foot right-of-way, water-gathering lines a 20-foot right-of-way, and electric lines a 10-foot right-of-way. The delivery pipeline will require a 50-foot right-of-way. All ROWs located in the same corridor will overlap each other to the maximum extent possible, while maintaining sound construction and installation practices. Where ROW corridors are located along a road, working space for installation of facilities will be along the road. All flowlines and roads have been collocated where possible. The enclosed [Project Map](#) shows the location of all access routes, gathering lines, and the delivery pipeline.

The primary access road to the Project Area would be Carbon County Road 605. Access is provided by the feeder road of I-80, which intersects Carbon County Road 605 just south and west of Rawlins. Carbon County Road 605 is an existing one-lane road that is graded and partially graveled. Access to drill locations from the existing network of roads would be provided by new and upgraded crowned, ditched, and surfaced roads.

An existing two-track runs north for about 0.8 mile from its intersection with County Road 605 in Section 21, T20N R89W to a point where new access road would be constructed across BLM lands in Section 16 to serve two fee wells and one state well proposed in Section 16. New access roads would be constructed from County Road 605 to proposed federal wells in Sections 20 and 28 and fee wells in Section 29. The Companies propose to construct new access roads across public lands in accordance with the standards in BLM Manual 9113 and applicable regulations. Roads would be located to minimize disturbances and maximize transportation efficiency. The

Companies will close and reclaim roads when they are no longer required for production operations, unless otherwise directed by the BLM or the affected surface owner.

The primary targeted reservoir in the Red Rim POD is coal seams within recognized productive formations of the Mesaverde Group. All unproductive wells will be plugged and abandoned as soon as practical after the conclusion of production testing. Productive wells may be shut-in temporarily for gas pipeline connections and/or Sundry Notices under review by the BLM for production activities and facilities.

The Red Rim POD contains approximately 3,200 acres. **Table B-2** summarizes the estimated disturbances that would result from implementing the project. The following schematics, which show typical facilities, operating standards, and methodologies, are attached to this MSUP: [Drill Site Layout](#); [Well Site](#); [Water Disposal Facility](#); [Water Transfer Facility](#); [Water Conditioning Facility](#); and [Compressor Station](#). A typical discharge structure is shown in the [Water Management Plan \(WMP\)](#). Additional schematics for this POD are attached to the [Master Drilling Plan \(MDP\)](#): [B.O.P.](#); [Bottom Flange](#); [Configuration Options](#); [Completed Well](#); and [Injection Well](#).

TABLE B-2 ESTIMATES OF DISTURBED AREA – RED RIM PROJECT AREA

Facility	Construction Phase				Operations
	Length (feet)	Width (feet)	Area, ea. (acres)	Temporary Acres	Life of Project Acres
New Roads	12,300	40	N/A	11.3	11.3
Existing Well Access Road ^a	32,300	40	N/A	29.7	29.7
Existing Road to be Upgraded ^b	17,400	40	N/A	16.0	16.0
Corridors for New Gathering Lines and Utilities	49,600	30	N/A	34.2	0
Corridor for New Market Access Line	52,800	50	N/A	60.6	0
New Drill Locations (9)	N/A	N/A	1.0	9.0	2.3
Injection Well (2)	N/A	N/A	1.0	2.0	2.0
Existing Well Location (7)	N/A	N/A	1.0	7.0	1.8
Compressor Station (1)	N/A	N/A	2.2	2.2	2.2
Water Conditioning Facility (2)	N/A	N/A	2.6	5.2	5.2
Monitoring Well (1)	N/A	N/A	1.0	1.0	0.2
Total New Disturbance				141.5	39.2
Total Disturbance				178.2	70.7

Notes:

- a Carbon County Road 605 not included in existing well access road
- b Existing two-track that would be upgraded, and the portion of Carbon County Road 605 within the Project Area that would be used during the project

Natural gas is naturally adsorbed to the surfaces of the coal matrix and typically is not free to migrate in the subsurface until pressure is relieved. Hydrostatic head provides the pressure that

keeps the majority of the gas adsorbed to the coal. Gas is liberated from the coal matrix by the withdrawal of water, which in turn reduces the hydrostatic head present in the coal formation. Once a “critical” subsurface coal formation pressure is reached as water is pumped from the coal formation, gas is free to migrate. Gas will then flow or can be pumped to the surface through the wellbore.

The Companies plan to spud the wells during fall 2003. The wells will be drilled through the coal seam formations. The natural gas will be produced from the coal seams through perforations in the casing. Drilling activities are expected to occur over several months.

The wells may be tested for a period of months. Well testing involves pumping and testing water from each well and determining its capacity to produce natural gas. It is anticipated that well testing will be completed within 6 to 12 months. If unproductive, the drill holes will be plugged and abandoned in accordance with Wyoming Oil and Gas Conservation Commission (WOGCC) rules and regulations and BLM guidance as soon as practicable after the conclusion of well testing.

During well testing associated with this project, natural gas, to the extent it is produced, will be vented or flared on-location in accordance with the applicable BLM Onshore Orders, Notices To Lessees, and WOGCC regulations, and authorized by the WOGCC and the BLM in Sundry Notices until wells are connected to the gathering system. Wet gas from the productive wells will be collected and transported via buried pipelines to the compressor station. During testing, produced water will be gathered from the well sites and piped to a water conditioning facility.

The water produced from the gas wells will be conditioned using a proprietary, natural-mineral based process that will result in reduced levels of specific conductance and sodium adsorption ratio (SAR). The conditioned water will be discharged into ephemeral tributaries of Hadsell Draw on fee lands, provided it meets the applicable water quality standards for irrigation. Surface discharge of produced water will comply with all terms, conditions, and monitoring requirements of a National Pollutant Discharge Elimination System (NPDES) permit issued by the Wyoming Department of Environmental Quality (WDEQ). The waste stream from the water conditioning facility will be injected.

An allocation meter will be used to measure raw produced gas volumes for each well in the POD. A sales meter will be located downstream of the final compressor and dehydration unit, at the compressor station, and will be used to measure dry salable-quality gas. A request for variance from Onshore Order No. 5, if needed, along with a description of the measurement equipment, will be submitted in a Sundry Notice if the wells are deemed producible.

Oil and gas activities in Wyoming are managed by the WOGCC. All of the Companies’ operations, and those of its contractors, will be conducted in accordance with all BLM and WOGCC rules and regulations.

The WOGCC has established a 160-acre well spacing pattern for the wells included in the Proposed Action under Chapter 3, Section 2 of WOGCC rules that establish a 160-acre spacing for gas wells located in certain townships, including T20N R89W. This order applies to all of

Sections 16, 20, 21, and 29, and all except the southeast quarter of Section 28. An 80-acre spacing pattern for wells completed in the Mesaverde Group has been established for the southeast quarter of Section 28 under Cause No. 1, Order No. 1, Docket No. 154-2001.

1. EXISTING ROADS AND TRAVELWAYS

The project area is accessible from Rawlins, Wyoming, by traveling approximately 8 miles southwest on Carbon County Road 605. In Section 21, T20N, R89W, County Road 605 intersects an existing two-track that proceeds north toward various access roads that serve existing gas wells on fee lands. As stated previously, the Companies are applying for a ROW to construct new road access in the Red Rim project area. The remaining access roads are on private surface and will be maintained by access agreement with fee surface owners.

Local roads are shown on the enclosed map of the project area. Existing roads and gates will be used when practical. If necessary, existing roads will be improved. All existing roads shall will be brought up to minimum standards for a Resource Road as found in BLM Manual 9113.

The existing roads will be maintained in the same or better condition as existed prior to the start of operations. Maintenance of the roads used to access the well locations will continue until final abandonment and reclamation of the well locations occur. A regular maintenance program will include, but is not limited to, blading, ditching, culvert installation and cleanout, and gravel surfacing where excessive rutting or erosion may occur. Limiting or temporarily suspending vehicle access during adverse conditions will reduce excessive rutting or other resource damage that may be caused by vehicle traffic on access roads that are wet, soft, or partially frozen. If vehicles create ruts in excess of 4 inches deep, the soil will be deemed too wet to adequately support vehicles, and routine activities shall be temporarily suspended.

Culverts will be placed in the existing BLM roads as the need arises or as directed by BLM's Authorized Officer. Gates and cattle guards will be installed where appropriate (refer to Project Map).

The Companies will share maintenance costs in dollars, equipment, materials, or labor proportionate to the Companies' use with other authorized users. Upon request, the BLM's Authorized Officer shall be provided with copies of any maintenance agreement entered into.

During periods of high potential for wildfire, extreme caution will be used in accessing the drill locations. To ensure that no ignitions occur, measures such as mowing the access rights-of-way or limiting vehicles may be undertaken as necessary. The Companies are sensitive to fire issues and risks in the western United States.

2. PROPOSED ACCESS ROUTES

Well Access

New access routes will be sited to avoid sensitive resource areas, such as leks, and areas susceptible to increased resource damage from the proposed project, such as areas of steep

terrain or poor vegetative cover. Every effort will be made to minimize the amount of cut-and-fill construction needed to maintain safe, environmentally sound, year-round access to the well sites. The special conditions of approval specified for this POD by the BLM will be implemented.

Access to the individual well sites will be provided by crowned and ditched roads that are surfaced with an appropriate grade of gravel. To the extent possible, the access roads will follow existing terrain and two-tracks that would represent a sound alignment for a constructed road.

Where possible, existing two-tracks will be upgraded, as specified by BLM, to provide access to well sites. Newly constructed access routes will be crowned, ditched, and graveled, as specified by BLM. All equipment and vehicles will be confined to identified travel corridors and other areas specified in this MSUP. Gates and cattle guards will be installed where appropriate. The access roads will be surfaced with an appropriate grade of aggregate or gravel to a depth of 4 inches before the drilling equipment or rig is moved onto the pad.

Unless otherwise exempted, free and unrestricted public access will be maintained on the access road. All construction work will be accomplished as specified by the landowner and the BLM. Access roads will be maintained in a safe and usable condition. A regular maintenance program will include, but is not limited to, blading, ditching, installing or cleaning culverts, and surfacing. Maintenance work will be accomplished as specified by the BLM.

The access roads will be constructed to minimum standards for a BLM Resource Road, as outlined in BLM Manual 9113. The minimum travelway width of the road will be 14 feet with turnouts. No structure will be allowed to narrow the road top. The inside slope will be 4:1. The bottom of the ditch will be a smooth V with no vertical cut in the bottom. The outside slope will be 2:1 or shallower. Turnouts will be intervisible and/or spaced at a minimum of 1000 feet.

Wing ditches will be constructed as deemed necessary to divert water from the road ditches. Wing ditches will be constructed at a slope of ½ percent to 1 percent.

Topsoil and vegetation will be windrowed to the side of the newly constructed access roads. After the roads are crowned and ditched with a 0.03 to 0.05 foot crown, the topsoil will be pulled back onto the cut slopes of the road right-of-way so no berm is left at the top of the cut slope.

Drainage crossings on the access routes will be low water crossings or crossings using “fish friendly” culverts. Crossings of Hadsell Draw and its tributaries will be accomplished according to BLM specifications. Low water crossings would be used in shallow channel crossings and at crossings of the main channel. Crossings of the main channel would consist of excavating an area approximately 4 feet deep, or deeper if specified by BLM, under the travelway and filling it with rock and gravel to the level of the drainage bottom. Channel banks on either side of these crossings would be cut down to reduce grade where necessary. Culverts would be installed on smaller, steeper channel crossings. Rip-rap will be added at the outlet of each culvert to minimize erosion. Topsoil would be conserved before channel crossing construction occurs. Additional culverts would be placed as the need arises or as directed by the BLM’s Authorized

Officer. Also, the total area to be disturbed would be flagged on the ground for review during the onsite and before construction begins.

Where low water crossings are required, a 30-inch deep rock fill over geotextile through the drainage will be required. The rock fill will consist of 75 percent 3-inch to 10-inch diameter rough rock and 25 percent Wyoming Grading "W" Material to fill the voids. The geotextile will be overlapping at all joints and will extend beyond the rock fill. The top of the rock fill in the drainage bottom will match the elevation of the natural drainage to allow for smooth flow with no unnatural scouring or water backup. Four inches of course gravel over the rock will be used for the surface.

Culverts will be covered with a minimum of 12 inches of fill or one-half the diameter of the pipe, whichever is greater. The inlet and outlet will be set flush with existing ground and lined up in the center of the draw. Before the area is backfilled, the bottom of the pipe will be bedded on stable ground that does not contain expansive or clay soils, protruding rocks that would damage the pipe, or unevenly sized material that would not form a good seat for the pipe. The site will be backfilled with unfrozen material and rocks no larger than 2 inches in diameter. Care will be exercised to thoroughly compact the backfill under the haunches of the conduit. The backfill will be brought up evenly in 6-inch layers on both sides of the conduit and thoroughly compacted. A permanent marker will be installed at both ends of the culvert to help keep traffic from running over the ends. Culverts will be installed in a manner that minimizes erosion or head-cutting and may include rip rapping or other measures as required. Additional culverts will be placed in the access road as the need arises or as directed by BLM's Authorized Officer.

If additional structures are warranted to maintain the access routes in acceptable condition during use, the affected road segments will be identified for BLM approval. In the event that specific BLM field survey requirements are not provided or do not exist, the field survey requirements described in BLM Manual 9113 will be followed.

The access roads will be winterized by providing a well-drained travelway to minimize erosion and other damage to the roadway or the surrounding public land. Construction activity or routine maintenance will not be conducted using frozen or saturated soil material or during periods when watershed damage is likely to occur.

No construction or routine maintenance activities will be performed during periods when the soil is too wet to adequately support construction equipment. If such equipment creates ruts in excess of 4 inches deep, the soil will be deemed too wet to adequately support construction equipment, and construction and maintenance will be temporarily suspended.

The written approval of the Authorized Officer will be obtained before snow removal is undertaken outside the new and existing roadways. If approval is given, equipment used for snow removal operations outside the road ditches will be equipped with shoes to keep the blade off the ground surface. Special precautions will be taken where the surface of the ground is uneven to ensure that equipment blades do not destroy the vegetation.

Design drawings and templates will be submitted only if specifically required by the BLM. A “plans-in-hand” review will be conducted with the drilling contractor prior to construction to review the access routes to the well sites. Directional markers will be set where needed and will be removed as soon as they are no longer needed.

If drilling is productive, all access roads to the well site would remain in place for well servicing (such as maintenance and improvements). Portions of the drill location outside the well pad that are no longer needed would be reclaimed. Any portions of the ROW for the access road that are no longer needed also would be reclaimed. The outside ditch cuts also would be seeded and reclaimed.

3. LOCATION OF EXISTING WELLS

As mentioned previously, AEPC previously permitted seven gas wells that are currently existing or authorized for development on fee surface and minerals. These wells are identified in **Table B-1**. Apart from the existing or previously authorized wells that are part of the Red Rim POD, a search of the WOGCC website identified one oil well drilled in 1974 by Davis Oil Company in Section 20 (API 720214), which was subsequently abandoned in 1975. The enclosed **Project Map** shows locations of disposal, drilling, producing, injection, and abandoned oil and gas wells within 1 mile of the Red Rim POD wells.

According to the Wyoming State Engineer's Office (WSEO), there are no permitted water wells located within one mile of the project area.

Each Company would offer a water well agreement to the landowner for all wells within the circle of influence for that Company’s producible gas wells. However, no permitted water wells are located within the circle of influence of any gas wells in the Red Rim POD.

4. LOCATION OF EXISTING AND/OR PROPOSED FACILITIES, IF WELLS ARE PRODUCTIVE

On Well Pad

Wellhead facilities would be installed if the gas wells are productive. Natural gas and produced water would be collected and transported from the wellhead via buried pipelines. Gas and water would be measured as specified elsewhere in this MSUP.

The long-term surface disturbance at the location of each productive well would encompass approximately 0.25 acre, including cut and fill slopes. Typically, only the production facilities at the well site would be fenced or otherwise removed from existing uses. A loop road or a small, graveled pad area would provide a safe turnaround area for vehicles. The perimeter of the pad area would be fenced if adjacent cut and fill slopes represent a safety hazard for vehicles.

The wellhead facilities would be contained within an area covering approximately 15 feet by 15 feet. The surface equipment at each well will consist of the wellhead, a pump panel, and an insulated wellhead cover. Additionally, a vertical separator at some well sites would separate gas

from the water stream. Each productive well is expected to require installation of an electric submersible pump below ground level, which will be used to produce water necessary to lower pressure within the coal seams. A schematic of a **Typical Well Site** is enclosed with the MSUP.

The Companies will paint structures at wells and central facilities with flat colors that blend with the adjacent undisturbed terrain. The paint used will be a color which simulates “Carlsbad Canyon”, color 2.5Y 6/2 of the “Standard Environmental Colors,” unless otherwise specified by the BLM. This measure does not apply to structures that require safety coloration in accordance with the requirements of the Occupational Safety and Health administration (OSHA).

Electricity would be used to power pumps during well development and to initiate and maintain production. Engines fired by natural gas or propane would be used to run generators temporarily at individual wells until electric distribution lines are analyzed in the Atlantic Rim EIS and then constructed. If a well is productive, it will be shut-in until production facilities are constructed.

After construction of the production facilities, a temporary generator would be centrally located and used until permanent electrical services are installed. The Companies may choose to use centrally located generation equipment at the compressor station and an underground distribution system to supply power to well sites.

Where practical, utility lines on the well pad would be installed in the same trench as the gas-gathering and water-gathering lines to minimize surface disturbance. All utility lines would be buried in accordance with the Interim Drilling Policy.

Off Well Pad

Pipelines (Gathering Lines and Delivery Pipeline)/Compressor Station/ Water Handling and Disposal Facilities/Injection Wells/Tanks

The operator will submit a Sundry Notice for approval prior to construction of any new surface-disturbing activities on-lease that are not specifically addressed in the MSUP or individual APDs.

Pipelines

The ROWs for the gathering systems will typically follow access roads, except in a limited number of cases where topography dictates otherwise or as required by BLM. ROWs located in the same corridor will overlap each other to the maximum extent possible, while maintaining sound construction and installation practices. Where ROW corridors are located along a road, working space for installation of facilities will be along the road.

Trenches will be excavated to install the flowlines and electrical lines. Trenching will occur as close to the road prism as feasible. Gas-gathering and produced water-gathering pipelines (as well as utility lines) will be laid together in the same trench when practical. Trenches excavated for well gathering lines and electrical lines are expected to temporarily disturb 30-foot wide corridors, which would be reclaimed as soon as practical after trenching and backfilling are completed. An additional area, estimated to be 10 feet wide will be used to transport machinery,

personnel, and equipment along the corridor to install flowlines and electrical lines wherever the gathering system would not follow an access road. This corridor is used to allow working room for the machinery, personnel, and equipment during the installation process. Corridors for the system of gathering lines in the Project Area would be 9.3 miles long. About 3.9 miles of corridors for gathering lines would be located on BLM surface ownership lands.

Construction and installation of gathering lines for gas and water would occur at the same time as access roads are constructed or immediately after drilling has been completed. Construction and installation of the gas delivery pipeline would occur after the producibility of the wells has been confirmed. All produced water used to test the integrity of the gas delivery pipeline (500 barrels [bbls] or 21,000 gallons) would be injected. Pipeline corridors would be reclaimed as soon as practical after construction of the pipeline is complete. Three types of pipelines would be constructed as part of the proposed project:

1. A gas-gathering pipeline system (low pressure) would be constructed from the wellheads to the compressor station. This system would use high-density polyethylene (HDPE) pipe, starting with 4-inch diameter pipe at the wellhead and graduating up to 12-inch diameter pipe at the inlet to the compressor.
2. A produced water-gathering pipeline system (low pressure) would be constructed from the wellheads to a water conditioning facility. This network of water lines would use 4-inch through 12-inch diameter pipe made of HDPE.
3. Should encouraging quantities of natural gas be discovered, a gas delivery pipeline (high pressure) would be constructed. This pipeline would be constructed of 8-inch diameter steel pipe.

The alignment of the delivery line from the compressor station to the existing transmission pipeline is shown on the [Project Map](#). The Companies are applying for a ROW for the delivery pipeline that would be buried 6 feet deep on a 50-foot wide ROW. This pipeline would be anchored at the compressor station and would proceed northeast to an existing pipeline located in Section 30 of T21N R87W. This gas delivery pipeline would be 10.2 miles long, of which about 4.6 miles would be located on BLM surface ownership lands.

Construction and installation of this delivery pipeline would temporarily disturb a 50-foot wide corridor, which will be reclaimed as soon as practical after construction is completed. An area, estimated to be 25 feet wide, would be used to transport machinery, personnel, and equipment along the corridor to install the pipeline wherever the delivery pipeline would not follow an access road. This corridor would allow working room for machinery, personnel, and equipment during the installation process.

The delivery pipeline will be constructed using open cut construction methods for upland areas, and dry ditch construction methods for water body crossings. The disturbed area will be kept to a minimum. Surface soil material will be stockpiled to the side and segregated. Surface soil

material will not be mixed or covered with subsurface material. Trenches will be compacted during backfilling. Pipeline routes will be graded to conform to the adjacent terrain. Cuts and fills will be made only where necessary. After construction, cut and fill slopes will be waterbarred or regraded to conform to the adjacent terrain, as specified by the BLM. The constructed pipeline will not block, dam, or change the natural course of any drainage. Water body crossings will be completed as quickly as possible, with ditching, pipeline installation, and backfilling completed in less than 48 hours if possible. All minimum requirements contained in the pipeline safety regulations of the U.S. Department of Transportation will be met or exceeded.

The Companies would complete the pipeline during periods when key habitats are not occupied to limit human presence in and disturbance of key wildlife habitats during critical periods of use. The availability of adequate working space would accelerate construction.

In order to minimize surface disturbance, the operator will use wheel trenchers (ditchers) or ditch witches, where possible, to construct all pipeline trenches associated with this project. Track hoes or other equipment will be used where topographic or other factors require their use.

Trenches that are open for the installation of pipelines will have plugs placed no more than 1,000 feet apart to allow livestock and wildlife to cross the trench or walk out of it, if needed. Placement of plugs will be determined in consultation with BLM and any affected landowner.

Procedures will be implemented to prevent livestock or wildlife from falling into open excavations. Procedures could include temporary covers, fencing, or other means acceptable to BLM and any affected landowner.

Compressor Station

The compressor station will be sited to allow for the installation of one compressor initially, with the addition of up to two more compressors later in the life of the field. Each compressor would be sized to handle 5 million cubic feet per day (MMCFD) from 15 pounds per square inch (psi) suction pressure to 1,200 psi discharge pressure. Each compressor would be driven by a natural gas engine that would be designed to meet all specifications established by the Wyoming Department of Environmental Quality, Air Quality Division (WDEQ–AQD). Engines used to drive compressors would have emissions of less than 1.5 grams per brake horsepower per hour (g/bhp-hr), or less than 16.7 tons per year of nitrogen oxides (NO_x), and 0.5 g/bhp-hr, or less than 5.6 tons per year of carbon monoxide (CO). Additional equipment at the compressor station would include a tri-ethylene glycol (TEG) dehydration system, which would dry the gas to meet pipeline-quality specifications of the market pipeline.

The compressor station facility is expected to be constructed within a site area covering approximately 300 feet by 300 feet (see enclosed [Typical Compressor Station](#)). In addition to the facilities on the pad, the Companies will construct drainage ditches to divert stormwater away from the compressor station pad. About one-half of the compressor station site area will be affected by construction, maintenance, and operation of the facility. The compressor station facility will be of all-weather construction, having a thick layer of gravel surfacing over the pad site. Topsoil will be removed and conserved for later reclamation activities. The compressor station will consist of an insulated header building containing a separator or a separator and

allocation meters for each well. The compressor station will also have a dehydrator that will remove water from the wet gas stream. The water will be pumped from the header building to an approved injection well. If different production facilities are required, plans will be submitted in a Sundry Notice.

Water Handling and Disposal Facilities, Injection Wells, Monitoring Well

Within 90 days of initial production start-up, the operator will submit an analysis of the produced water to the BLM's Authorized Officer. The source of the water to be disposed is the coals in the Mesaverde Group. Coal bed formation water (produced water) will be collected in a buried polyethylene flowline (pipeline) for transport to the water conditioning facility. After it has been conditioned, produced water will be discharged into ephemeral draws, except as noted below. Any changes in the produced water disposal method or location must receive written approval from BLM's Authorized Officer before the changes take place.

After it has been conditioned, produced water will be piped from the conditioning facility to a surface discharge outfall located in an ephemeral draw. Plans for surface discharge are described in the WMP. In addition, a small portion of the water produced from gas wells, about 5 gallons per minute at each location identified on the [Project Map](#), would be dispensed for use by livestock in five stock watering tanks at locations specified by BLM and the surface owners. Three of these stock tanks would be located adjacent to the discharge outfalls and would be allowed to overflow into ephemeral drainages. The other two would be equipped with float valves that would prevent overflow and discharge into drainages.

Injection will be utilized for disposal of hydrostatic test water used to test the integrity of the gas delivery pipeline (500 bbls or 21,000 gallons), the waste stream from the water conditioning process, and to provide an alternative method for handling water. Injection would be available to mitigate possible effects of surface discharge or to dispose of produced water when the water conditioning facility is being maintained.

A typical water disposal facility would consist of a pad of approximately 200 feet by 200 feet that would disturb an estimated 1.0 acre, including cut and fill slopes. Each facility would contain four 400-bbl water tanks, pump house, piping, and well house (see attached schematic of [Typical Water Disposal Facility](#)). An approximate 3.5-foot berm would be constructed around the perimeter of the water tanks, excluding the pump shed, at each disposal facility to contain any potential spills on the pad. The pump shed would be excluded from the berm area to minimize the potential for electrical or safety hazards that could occur if water entered the pump shed and caused electrical shorts. The berm would be constructed to contain the water from the largest tank, plus 10 percent, and maintain a freeboard (extra capacity) of 1 foot.

The approximate minimum injection capacity of the injection wells would be 5,000 barrels per day (bbls/day), and the maximum injection capacity would be 12,000 bbls/day. Both injection wells will be located on fee land. The injection zone, in the Hatfield, Cherokee, or Deep Creek sands, is isolated above and below by competent shale barriers. Maximum pressure requirements for the injection zone would be established through injectivity tests that would identify fracture pressure limits to prevent the overlying shale from being breached by the

initiation and propagation of fractures through overlying strata to any zones of fresh water. The injection capacity would be determined by the permeability of the receiving reservoirs and limits on the injection pressure to preclude fracturing the formation, and would be established in the permit for each well. Injection horizons will not be exceeded based on injectivity tests and applicable permit limits, as regulated by the State of Wyoming and BLM. These deep sands are limited reservoirs, and it may be necessary to find deeper reservoirs if they become filled to capacity. There are a number of deeper reservoirs that could be utilized.

Each injection well will be drilled, cased, and cemented from TD to surface. The injection wells would be drilled with the same equipment and personnel used for the gas wells. Depth of the injection wells is expected to be between 5,965 and 6,335 feet. Drilling and completing each injection well would require approximately 7 to 14 days; installing surface equipment, holding tanks, and pumping equipment may require an additional 14 days.

BLM has requested that three to six groundwater monitoring wells be installed within the Atlantic Rim EIS study area during the interim drilling project. The locations of these monitoring wells have not yet been specified, however, one of them will be located in the Red Rim project area. The effects of interim drilling and development on the coal aquifer, including drawdown, will be monitored by these wells.

Transfer pumping stations, consisting of two 400-bbl water tanks with associated pump and piping, may be needed (see attached [Typical Water Transfer Facility](#)). Water transfer pumping stations may be used during production operations to transfer produced water from the gas wells to the water handling facilities. The transfer pumping stations are needed in areas where differences in elevation require supplemental pumping to transfer the produced water. Each pumping station would contain up to two 400-bbl water tanks, an inlet separation vessel, and a small centrifugal water pump. A small pump shed would be constructed to enclose the pump. Each pumping station would consist of a pad of approximately 125 feet by 125 feet that would disturb an estimated 0.4 acre, including cut and fill slopes. An approximate 3.5-foot berm would be constructed around the perimeter of the water tanks, excluding the pump shed, at each pumping station to contain any potential spills on the pad. The pump shed would be excluded from the berm area to minimize the potential for electrical or safety hazards that could occur if water entered the pump shed and caused electrical shorts. The berm would be constructed to contain the water from the largest tank, plus 10 percent, and maintain a freeboard (extra capacity) of 1 foot. These transfer stations will be located near proposed disturbance areas, outside cultural sites, and, where possible, away from any known sensitive wildlife or resource areas. Final location of the water transfer facilities will be submitted in a Sundry Notice.

Tanks

The water tanks at transfer and disposal facilities will be constructed, maintained, and operated to prevent unauthorized surface or subsurface discharges of water. The tanks will be located away from the established drainage patterns in the area and will be constructed to prevent the entrance of surface water.

The closed-top water tanks will be fenced or capped to prevent livestock or wildlife entry.

The water tanks will be kept reasonably free from surface accumulations of liquid hydrocarbons and are not to be used for disposal of water from other sources without the prior approval of the BLM. Any discharge from the tanks will be reported to the BLM as required by NTL-3A.

All storage tanks and compressor facilities designed to contain oil, glycol, produced water, or other fluid, which may constitute a hazard to public health or safety, will be surrounded by a secondary means of containment for the entire contents of the largest single tank in use, plus one foot of freeboard. The 3.5 foot berms planned for any closed produced water tanks used at well sites before flowlines are constructed, closed tanks used to hold frac-ing fluids during well completion and testing, water disposal facilities, and water transfer facilities will contain the contents of the largest tank in use at that site, plus one foot of freeboard. The containment or diversionary structure will be impervious to any oil, glycol, produced water, or other toxic fluid for 72 hours and would be constructed so that any discharge from a primary containment system would not drain, infiltrate, or otherwise escape to groundwater, surface water, or navigable waters before cleanup is completed.

5. LOCATION AND TYPE OF WATER SUPPLY FOR DRILLING

Water to drill the first well will be trucked from the AR Fee 20 89 SE21 well located in T20N R89W, Section 21.

Water produced from project wells will be transported to nearby drilling locations and used to drill subsequent wells.

Water for use in drilling the wells would be obtained from existing wells completed in the coal seams of the Mesaverde Group. Approximately 700 barrels of water (almost 30,000 gallons) would be needed to drill each well. The actual volume of water used in drilling operations would depend on the depth of the well and any losses that might occur during drilling. The proposed project also would require almost 70,000 gallons of water per well for preparation of cement and stimulation of the well (14,000 gallons) and control of dust (55,440 gallons). In all, nearly 100,000 gallons (about 0.3 acre-feet) of water per well would be used.

Any changes in the water source or method of transportation must receive written approval from BLM's Authorized Officer before the changes take place.

6. CONSTRUCTION MATERIALS

Construction materials (mineral material aggregate suitable for surfacing material) will be purchased from a nearby private source or a local supplier having a permitted source of materials in the area. No construction materials will be removed from federal and/or Indian lands without prior approval from the BLM.

7. METHODS FOR HANDLING WASTE DISPOSAL

Drill cuttings (rock fragments generated during drilling) will be produced during drilling of the borehole. Cuttings will be buried in the reserve pit upon closure of the reserve pit.

No oil or other oil-based drilling additives, chromium/metals-based muds, or saline muds will be used during drilling of these wells. Only fresh water, biodegradable polymer soap, bentonite clay, and non-toxic additives will be used in the mud system. Details regarding the mud program are incorporated within the MDP. These wells will not produce oil or salt water typical of oil production. Furthermore, other liquid hydrocarbons are not anticipated. Should unexpected liquid petroleum hydrocarbons (crude oil or condensate) be encountered during drilling or well testing, all liquid petroleum hydrocarbons will be contained in test tanks on the well site.

Dust abatement will comply with all applicable WOGCC, WDEQ, or BLM requirements. Only water suitable for livestock use would be used for dust abatement. Only disturbed areas will be sprayed. Spraying will be done in a way that will reduce runoff and channelized flow.

A portable, self-contained chemical toilet will be provided on location during drilling and completion operations. Upon completion of operations, or as required, the contents of toilet holding tanks will be disposed of at an authorized sewage treatment and disposal facility. Disposal will be in accordance with State of Wyoming, Carbon County, and BLM requirements regarding sewage treatment and disposal. The Companies will comply with all state and local laws and regulations pertaining to disposal of human and solid wastes.

No trash will be placed in the reserve pit. All refuse (trash and other solid waste including cans, paper, cable, etc.) generated during construction, drilling, and well testing activities will be contained in an enclosed receptacle, removed from the drill locations promptly, and hauled to an authorized disposal site.

Immediately after removal of the drilling rig, all debris and other waste materials not contained within trash barrels will be cleaned up and removed from the well location. No potentially adverse materials or substances will be left on the drill locations.

Hazardous Materials Management

All project-related activities involving hazardous materials will be conducted in a manner that minimizes potential environmental impacts. An on-site file will be maintained containing current Material Safety Data Sheets (MSDS) for all chemicals, compounds, or substances that are used in the course of construction, drilling, completion, production, and reclamation operations. Netting will be placed over any pits that may contain hazardous substances (Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA] Section 101(14)), as determined by visual observation or testing. The mesh diameter shall be no larger than 1 inch.

No hazardous substance, as defined by CERCLA, will be used in the construction or drilling operations associated with these wells. No Resource Conservation and Recovery Act (RCRA) hazardous wastes will be generated by well-drilling operations. The term “hazardous materials” as used here means: (1) any substance, pollutant, or containment (regardless of quantity) listed as hazardous under CERCLA of 1980, as amended 42 U.S.C. 9601 et seq., and the regulations issued under CERCLA; (2) any hazardous waste as defined in RCRA of 1976, as amended; and (3) any nuclear or nuclear byproduct as defined by the Atomic Energy Act of 1954, as amended,

42 U.D.C. 2001 et seq. The operator will be required to provide a referenced list of hazardous materials that could be used, produced, transported, disposed of, or stored on the well location including a discussion on the management of the hazardous materials.

Any spills of oil, gas, or any other potentially hazardous substance will be reported immediately to the BLM, landowner, local authorities, and other responsible parties and will be mitigated immediately, as appropriate, through cleanup or removal to an approved disposal site.

8. ANCILLARY FACILITIES

Several self-contained travel-type trailers may be used onsite during drilling operations. No facilities other than those described in this MSUP will be constructed to support the operations associated with the wells.

9. WELL SITE LAYOUT

A schematic drawing of the **Typical Drill Site Layout** used for each well is enclosed with this MSUP. Information on each federal well is contained in the **BLM APD Form 3160-3, Well Survey Plat**, and **Drill Pad Cross Section** already on file with BLM. The cross section shows the orientation of the drill pad with respect to the topographic features (cut and fill), facilities, and access to the pad.

At each drill location, surface disturbance will be kept to a minimum. The areal extent of each drill pad is approximately 200 feet by 200 feet. Each drill pad will be leveled using cut and fill construction techniques where needed. Prior to constructing the drill pad the top 6 to 8 inches of soil (more if available) and associated vegetative material will be removed and stockpiled. Drainage ditches will be constructed to divert stormwater away from each pad. All surface disturbance related to drilling will be confined to each drill site.

The Companies plan to use one reserve pit at each drilling location. A reserve pit is used during drilling to circulate the drilling mud (mostly bentonite clay and fresh water) and rock cuttings out of the borehole and for holding drilling fluids. This pit will be designed and constructed according to WOGCC and BLM requirements.

Each reserve pit will be approximately 20 feet deep (including 2 feet of freeboard), and will be 40 feet wide and 40 feet long (at the surface). Each pit will be excavated within the “cut area” of the drill site to minimize any potential for slope failure. Each pit will be designed to prevent collection of surface runoff and will be closely monitored to ensure no pit overflows occur. The reserve pit will be open for an estimated 2 to 8 weeks to allow for evaporation of pit fluids. During this time the pit will be closed off from wildlife and livestock by two strands of barbed wire above a woven wire fence.

Each reserve pit will be constructed in a manner that minimizes the accumulation of surface precipitation runoff into the pit. This will be accomplished by appropriate placement of subsoil/topsoil storage areas or construction of berms or ditches.

Netting will be placed over any pits that have been identified as containing oil, as determined by visual observation or testing. The mesh diameter will be no larger than 1 inch. For the protection of livestock and wildlife, all pits and open cellars will be fenced. Fencing shall be in accordance with BLM specifications.

A conventional drilling rig would be used to drill the gas wells. Additional equipment and materials needed for drilling operations would be trucked to the drill location. Depending on the location of the coal seam, each producing well would be drilled to a depth of 4,050 feet to 5,850 feet or deeper. Natural gas in the coal seam would be produced through perforations in the casing. The well control system will be designed to meet the conditions likely to be encountered in the hole and will conform to BLM and State of Wyoming requirements.

The drilling and completion operation for a gas well normally requires a maximum of 10 to 15 workers at a time, including personnel for logging and cementing. Each well would be drilled within 7 to 10 days. A well completion program may be initiated to stimulate production of gas and to evaluate the characteristics of gas and water production in preparation for production of gas from a drilled, cased, and cemented well. Wells determined to be productive would be shut in until pipelines and other production facilities are constructed.

A mobile completion rig similar to the drill rig may be transported to the well site and used to complete each well. Completion operations are expected to average 2 to 5 days per well. When the applicable permits are received, methane gas may be vented or flared. Formation water may be temporarily contained in the reserve pit during drilling and well completion activities. All frac-ing fluids will be contained in closed tanks on location. During the testing period, produced water from the Mesaverde aquifer will be contained in closed tanks on location or trucked to an authorized disposal well, pending the completion of flowlines for produced water. All closed tanks on location will be encompassed by a 3.5 foot berm that will contain the entire contents of the largest tank in use, plus 10 percent, with one foot of freeboard, as authorized by BLM.

10. PROGRAMS FOR RECLAMATION OF THE SURFACE

BLM surface ownership lands that contain disturbed areas or facilities that are no longer needed would be reclaimed at the earliest opportunity in accordance with applicable regulations and agency guidance. Non-federal lands would be reclaimed in accordance with the requirements of the surface owner.

Roads, culverts, cattle guards, pipelines, stock water facilities, or other structures could be left in place at the end of the project for any beneficial use, as designated by the affected surface owners and BLM. Water wells and produced water would be available to the surface owners and BLM, provided that appropriations, diversions, and storage rights are properly filed with the WSEO.

As soon as practical after the conclusion of drilling and testing operations, unproductive drill holes will be plugged and abandoned and site reclamation will commence. The BLM will be notified prior to commencement of reclamation operations. A Notice of Intent to Abandon will be filed for final recommendations regarding surface reclamation.

Upon completion of drilling, the reserve pit will be dewatered and reclaimed in accordance with BLM guidance. Typically, this procedure involves allowing the contents to dry naturally, and then backfilling, re-contouring, and reclaiming the reserve pit area to approximate pre-drilling site conditions. The reserve pit will be backfilled with a minimum cover of 5 feet of soil or subsoil material.

After abandonment of productive wells, all wellhead equipment that is no longer needed will be removed, and the well sites will be restored.

Any areas, including the drilling locations, reserve pits, or access routes, that are disturbed by earthwork will be recontoured to a natural appearance as near to the original contour as possible as soon as practical after the conclusion of operations. Any flowline trenches that may be constructed will be backfilled completely.

Recontoured areas will be graded to be outsloped, and waterbreaks will be constructed where needed to avoid concentrating surface waters and producing gullies. The land surface will be left “rough” after recontouring to ensure that the maximum surface area will be available to support the reestablishment of vegetative cover.

All topsoil conserved during earthwork will be redistributed evenly and left “rough” over these recontoured areas. BLM goals for vegetative cover will guide revegetation efforts. Common goals are erosion control, weed control, palatable and nutritious forage for livestock and wildlife, and visual aesthetics.

Revegetation efforts will comply with BLM specifications on all BLM surface ownership lands. If no specifications are provided, the following specifications will be used. Seeding is expected to occur in the fall after September, prior to ground frost, or in the spring after frost has left the ground. The seed mixture, including fertilizer and mulching requirements, seeding depth, and seed drilling specifications, will be developed in consultation with the BLM. Seed will be drilled on the contour using a seed drill equipped with a depth regulator to ensure even depths of planting. Seed will be planted between one-quarter to one-half inch deep. The anticipated seed mix to be applied and rates of application are listed below in **Table B-3**. Soil material that will be stockpiled for 10 months or longer will be seeded according to BLM specifications, to the extent practicable. Prior to seeding, the stockpile will be protected from wind and water erosion by roughening the soil surface, covering the stockpile with vegetation that has been removed, and mulching, if necessary.

TABLE B-3 SEED MIX FOR RECLAMATION

Species	Rate of Application*
Western Wheatgrass	4 lbs./Acre
Green Needlegrass	4 lbs./Acre
Indian Ricegrass	4 lbs./Acre
Sandberg Bluegrass	0.5 lbs./Acre
Gardner’s Saltbush	1 lb./Acre
Winterfat	0.5 lbs./Acre

These rates of application apply to pure live seed (PLS) that is used for drill seeding. For broadcast seeding, the rates of application will be doubled.

11. SURFACE OWNERSHIP

U.S. Bureau of Land Management
Rawlins Field Office
1300 North Third
Rawlins, Wyoming 82301-2407
(307) 328-4200

Mr. John Espy / Red Rim Company (*Sections 21 and 29*)
206 West Maple Street
Rawlins, Wyoming 82301
(307) 324-4174

A **Water Management Plan** is enclosed with this MSUP.

The Companies are the lessee or operator for the federal oil and gas leases associated with this MSUP and these APDs.

No slopes in excess of 25 percent would be affected by this proposal. No activities are planned near existing highways, railroads, pipelines, or powerlines. There are no occupied buildings or residences within one-quarter mile of the proposed drill sites.

Any road crossings of dry drainages, riparian, or other wetland areas will use appropriate Best Management Practices (BMP) to minimize impacts to these areas.

The presence, distribution, and density of noxious weeds in the project area will be monitored. The well access roads and well pads will be inspected regularly to ensure that noxious weeds do not become established in newly disturbed areas. Control methods will be based on available technology, taking into consideration the weed species present. Methods of noxious weed control may include revegetation of disturbed areas to reduce the potential for and success of weed establishment, mowing, hand-pulling, or application of appropriate herbicides. All BLM requirements associated with the control of noxious weeds will be met.

The project area encompasses public lands that contain sagebrush/grassland community types on gentle to steep upland ridges and undulating to rolling uplands, with some highly dissected areas. The existing stream channels are intermittent or ephemeral and are partially vegetated with grasses and shrubs.

Local flora consist primarily of needlegrass, western wheatgrass, prairie junegrass, blue grama grass, Indian rice grass, prickly pear cactus, and two varieties of big sagebrush intermixed with rabbitbrush and saltbush, horsebrush, and occasionally dense greasewood near drainages. Local

fauna consist primarily of mule deer, antelope, greater sage-grouse, coyotes, rabbits, raptors, and various smaller vertebrate and invertebrate species. Livestock graze on some of these lands. Oil and gas activities have occurred in the general area.

Soils have a good reclamation potential provided the hazards of wind and water erosion are mitigated through the use of surface roughening, management of grubbed vegetation, surface mulch, adequate water breaks, and drainage structures in recontoured areas. With proper management, suitable soil material is available to reestablish vegetation at the conclusion of project activities.

A cultural/historical resource inventory has been conducted on the public lands by a qualified archaeologist permitted in Wyoming by the BLM. A block survey for cultural resources was required by the BLM for the Red Rim POD. The findings have been submitted under separate cover. Any additional areas of potential effect identified subsequent to the completion of these reports will be inventoried as specified by the BLM, and a supplemental report will be prepared.

Landowner Notification

The Companies would obtain a surface use agreement with the landowner.

13. SITE-SPECIFIC CONDITIONS OF APPROVAL

Wildlife Stipulations

Wells: AR Federal 20 89 NE28 and AR Federal 20 89 NW28

Construction, drilling, and other activities potentially disruptive to strutting and nesting of greater sage-grouse or sharp tailed grouse are prohibited during the period of March 1 through June 30 for the protection of nesting areas.

Wells: AR State 20 89 SE16 (BLM Surface), AR Federal 20 89 NE20, and AR Federal 20 89 SW 20

Mitigation of impacts is required during April 10 through July 10 for the protection of potential mountain plover habitat.

Road and Well Pad Minimum Requirements

Culverts (minimum 18 inches in diameter) will be placed in drainages and draws that are shown on the enclosed [Project Map](#).

Project-Wide Mitigation Measures and Procedures

For this project, the Companies have voluntarily agreed to use and comply with the following measures and procedures to avoid or mitigate potential impacts to resources or other land uses, after consultation with BLM regarding agency requirements. These measures and procedures

will be referred to as Best Management Practices (BMPs). These mitigation measures and procedures would be applied on privately owned surface unless the private surface owners involved specifically require alternative actions. An exception to a mitigation measure or design feature may be approved on public land on a case-by-case basis when deemed appropriate by the BLM. An exception would be approved only after a thorough, site-specific analysis has been concluded that the resource or land use that the measure was intended to mitigate is not present or would not be significantly affected in the absence of the mitigating measures.

Preconstruction Planning, Design, and Compliance Measures

1. The Companies would designate a qualified representative to serve as compliance coordinator. This person will be responsible for ensuring that all requirements of the APD and Plan of Development (MSUP, MDP, WMP, and Conditions of Approval) are followed.
2. The Companies and the BLM would make onsite inspections of each proposed and staked facility site (such as drill locations and other facilities), new access road, access road upgrades, and pipeline alignment projects to develop site-specific recommendations and mitigation measures.
3. New roads would be constructed and existing roads maintained in the Project Area in accordance with standards in BLM Manual 9113 and applicable regulations for resource roads and construction details outlined in the MSUP and Conditions of Approval. These standards would be followed on BLM surface ownership lands.
4. Prior to construction, the Companies would submit an APD package to BLM. This package would contain individual APDs for each drill site, as well as the MDP, MSUP, WMP, schematics of facilities, and ROW applications for pipelines, utilities, and access roads. APDs submitted by the Companies would show the layout of the drill pad over the existing topography, the dimensions of the pad, cross sections of the cuts and fills (when required), the location and dimensions of reserve pits, and locations of access roads.
5. The Companies would slope-stake construction when required by the BLM (for example, in steep or unstable slopes) and receive approval from the BLM before construction begins.
6. BLM would require roads to be crowned with a 0.3- to 0.5-foot crown, and ditched. The topsoil would be graded over the cut slope so no berm is left at the top of the cut slope.
7. BLM would require that culverts be covered with a minimum of 12 inches of fill or one-half the diameter of the pipe, whichever is greater. The inlet and outlet will be set flush with existing ground and lined up in the center of the draw. Before the area is backfilled, the bottom of the pipe will be bedded on stable ground that does not contain expansive or clay soils, protruding rocks that would damage the pipe, or unevenly sized material that would not form a good seat for the pipe. The site would be backfilled with unfrozen material and rocks no larger than 2 inches in diameter. Care would be exercised to thoroughly compact the backfill under the haunches of the conduit. The backfill would be brought up evenly in 6-inch layers on both sides of the conduit.

8. Additional culverts would be installed in the existing access road as needed or as directed by BLM.
9. The access roads would be surfaced with an appropriate grade of aggregate or gravel to a depth of 4 inches before the drilling equipment or rig is moved onto the pad.
10. BLM would require that access roads be maintained in a safe and usable condition. A regular maintenance program would include, but is not limited to, blading, ditching, installing or cleaning culverts, and surfacing.
11. The written approval of the authorized officer will be obtained before snow removal outside the new and existing roadways is undertaken. If approval is given, equipment used for snow removal operations outside the road ditches will be equipped with shoes to keep the blade off the ground surface. Special precautions will be taken where the surface of the ground is uneven to ensure that equipment blades do not destroy the vegetation.
12. BLM would require that wing ditches be constructed, as necessary, to divert water from road ditches.
13. Trenches that are open for the installation of pipelines should have plugs placed no more than 1,000 feet apart to allow livestock and wildlife to cross the trench or walk out of it, if needed. Placement of plugs would be determined in consultation with BLM and any affected landowner.
14. Procedures would be implemented to prevent livestock or wildlife from falling into open excavations. Procedures could include temporary covers, fencing, or other means acceptable to BLM and any affected landowner.

Resource-Specific Requirements

The Companies propose to implement the following resource-specific mitigation measures, procedures, and BLM management requirements on public lands.

Geology, Minerals, and Paleontology

Mitigation measures presented in the sections of this EA on Soils and Water Resources would avoid or minimize many of the potential impacts to surface mineral resources. BLM and WOGCC policies on casing and cementing would protect subsurface mineral resources from adverse impacts.

Scientifically significant paleontological resources that may occur within the Lance Formation, the only geologic formation of concern exposed at the surface in the Project Area, would be protected through the following mitigation measures:

1. If recommended by BLM, each proposed facility located in areas of known and potential vertebrate paleontological resources would be surveyed by a BLM-approved paleontologist before any surface disturbance is allowed (BLM 1987 and 1990).
2. Discovery. Project personnel would make contingency plans for the accidental discovery of significant fossils. If construction personnel discover fossils during implementation of the project, the BLM would be notified immediately. If the fossils could be adversely affected, construction would be redirected or halted until a qualified paleontologist had assessed the importance of the uncovered fossils, the extent of the fossiliferous deposits, and had made or implemented recommendations for further mitigation.
3. Field Survey. No specific data currently exist on deposits of high or undetermined paleontologic potential in Project Area. For that reason, field survey for paleontologic resources would be conducted on a case-by-case basis, as directed by the BLM. These resources would be surveyed in areas where surface exposures of the Browns Park, Green River, or Wasatch Formations occur. A field survey may result in the identification of additional mitigation measures needed to reduce adverse impacts to fossil resources. This mitigation may include collection of additional data or representative samples of fossil material, monitoring excavation, or avoidance. In some cases, no action beyond the measures taken during the field survey may be necessary.

A report would be submitted to the BLM after each field survey is complete. The report will describe in detail the results of the survey, with a list of fossils collected, if any, and may recommend additional mitigation measures. If scientifically significant fossils are collected, the report must document the curation of specimens into the collection of an acceptable museum repository and must contain appropriate geologic records for the specimens.

Air Quality

1. All activities conducted or authorized by BLM must comply with local, state, tribal, and federal air quality regulations and standards. The Companies would adhere to all applicable ambient air quality standards, permit requirements (including preconstruction, testing and operating permits), standards for motorized equipment, and other regulations, as required by the WDEQ-AQD.
2. The Companies would not allow garbage or refuse to be burned at well locations or other facilities. Before any wells are vented or flared, WDEQ-AQD would be notified as required by Wyoming Air Quality Standards and Regulations, Chapter 1, Section 5 *Reporting Guidelines for Well Flaring and Venting*. Test periods longer than 15 days would require authorization by WOGCC, in accordance with Chapter 3, Section 40 *Authorization for Flaring and Venting of Gas*.
3. On federal land, the Companies would immediately abate fugitive dust (by application of water, chemical dust suppressants, or other measures) when air quality is impaired, soil is lost, or safety concerns are noticed by the Companies or identified by the BLM or the

WDEQ-AQD. These concerns include, but are not limited to, actions that exceed applicable air quality standards. BLM would approve the control measure, location, and application rates. If watering is the approved control measure, the operator must obtain the water from state-approved sources in accordance with any applicable regulations.

Soils

1. The Companies would reduce the area of disturbance to the absolute minimum necessary for construction and production operations while providing for the safety of the operation.
2. Where feasible, the Companies would locate pipelines immediately adjacent to roads to avoid creating separate areas of disturbance and to reduce the total area of disturbance.
3. The Companies would avoid using frozen or saturated soils as construction material.
4. The Companies would minimize construction in areas of steep slopes.
5. Cut slopes would be designed in a manner that would retain topsoil, and facilitate use of surface treatment such as mulch and subsequent revegetation.
6. The Companies would selectively strip and salvage topsoil or the best suitable medium for plant growth from all disturbed areas. Topsoil would be removed and conserved to a minimum depth of 6 inches and a maximum of 12 inches from all drill locations, unless otherwise agreed by the BLM and the operator.
7. Where possible, disturbance to vegetated cuts and fills would be minimized on existing improved roads.
8. The Companies would install runoff and erosion control measures such as water bars, berms, and interceptor ditches if needed.
9. The Companies would install culverts for ephemeral and intermittent drainage crossings. In addition, drainage crossing structures would be designed to carry the 25-year discharge event, or as otherwise directed by the BLM.
10. Layout of the access roads may require minor variations in routing to avoid steep slopes adjacent to ephemeral or intermittent drainage channels. Where possible, the Companies would maintain a 100-foot wide buffer of natural vegetation (not including wetland vegetation) between construction and ephemeral and intermittent channels.
11. The Companies would include adequate drainage control devices and measures in the design of roads (for example, berms and drainage ditches, diversion ditches, cross drains, culverts, out-sloping, and energy dissipaters). These devices and measures would be located at sufficient intervals and intensities to adequately control and direct surface runoff above, below, and within the road to avoid erosive,

concentrated flows. In conjunction with surface runoff or drainage control measures, the Companies would use erosion control devices and measures such as temporary barriers, ditch blocks, erosion stops, matts, mulches, and vegetative covers. In addition, the Companies would implement a revegetation program as soon as possible to reestablish the soil protection afforded by vegetation.

12. When construction that is not specifically required for production operations is complete, the Companies would restore topography to near pre-existing contours at the well sites, along access roads and pipelines, and other facilities sites. The Companies also would replace up to 6 inches of topsoil or suitable plant growth material over all disturbed surfaces; apply fertilizer as required; seed; and mulch.

Water Resources

Other mitigation measures listed in the sections of this EA on Soils, and Vegetation and Wetlands would apply to Water Resources.

1. Applications would be submitted for all necessary NPDES permits as required by the Water Quality Division (WQD) of WDEQ for discharge of produced water into ephemeral drainages. Plans for surface discharge are described in the WMP ([Appendix D](#)).
2. The Companies would limit construction of all drainage crossings to no-flow or low-flow periods.
3. The area of disturbance would be minimized within perennial, ephemeral, and intermittent drainage channels.
4. BLM would prohibit construction of well sites and other non-linear features within 500 feet of surface water and riparian areas. BLM would grant possible exceptions for linear features based on a site-specific environmental analysis and site-specific mitigation plans.
5. The Companies would design channel crossings to minimize changes in channel geometry and subsequent alterations in flow hydraulics.
6. Layouts of the access roads may require minor variations in routing to avoid steep slopes adjacent to ephemeral or intermittent drainage channels. Where possible, a 100-foot wide buffer of natural vegetation (not including wetland vegetation) would be maintained between construction and ephemeral and intermittent channels.
7. Interceptor ditches, sediment traps, water bars, silt fences, and other revegetation and soil stabilization measures would be designed and constructed, as needed.
8. The Companies would construct channel crossings by pipelines such that the pipe is buried a minimum of 4 to 6 feet below the channel bottom, as specified by BLM.

9. Disturbed channel beds would be regraded to the original geometric configuration and would contain the same or similar bed material.
10. Wells must be cased during drilling, and all wells cased and cemented in accordance with Onshore Order No. 2 to protect all high-quality aquifers. High-quality aquifers exhibit known water quality of 10,000 milligrams per liter total dissolved solids (TDS) or less. Well casing and welding must be of adequate integrity to contain all fluids under high pressure during drilling and well completion. Furthermore, wells would adhere to the appropriate BLM cementing policy.
11. The reserve pits would be constructed in cut rather than fill materials. Fill material must be compacted and stabilized, as needed. The subsoil material of the pit to be constructed should be inspected to assess stability and permeability and to evaluate whether reinforcement or lining is required. If lining is required, the reserve pit must be lined with a reinforced synthetic liner at least 12 mils thick and with a bursting strength of 175 by 175 pounds per inch (American Society for Testing and Materials [ASTM] Standard D 75179). Use of closed or semi-closed drilling systems should be considered in situations where a liner may be required.
12. Two feet of freeboard must be maintained on all reserve pits to ensure they are not in danger of overflowing. Drilling operations must be shut down if leakage is found outside the pit until the problem is corrected.
13. Hydrostatic test water used in conjunction with pipeline testing, and all water used during construction or dust abatement must be extracted from sources that contain sufficient quantities and with appropriation permits approved by the State of Wyoming.
14. Hydrostatic test water would be injected into an authorized deep injection well, in compliance with all applicable requirements.
15. All concentrated water flows must be discharged within the ROW for an access road onto or through an energy dissipater structure (such as riprapped aprons and discharge points) and into undisturbed vegetation.
16. If required by the applicable regulations, the Companies would develop and implement a pollution prevention plan (PPP) for storm water runoff at drill sites as required per WDEQ permit requirements under NPDES. All required WDEQ permits will be in place before water is discharged.
17. The Companies would exercise stringent precautions against pipeline breaks and other potential accidental discharges of oil or hazardous chemicals into adjacent streams. If liquid petroleum products are stored on site in sufficient quantities (per the criteria contained in Title 40 CFR Part 112), a Spill Prevention Control and Countermeasures (SPCC) plan would be developed in accordance with 40 CFR Part 112.

18. The Companies would coordinate all crossings or encroachments of waters of the U.S. with the U.S. Army Corps of Engineers (COE).
19. BLM must approve in writing any changes in the method or location for disposal of produced water.

Vegetation, Wetlands, and Noxious Weeds

Other mitigation measures under the section on Soils and Water Resources of this EA would also apply to vegetation and wetlands.

1. Noxious weed monitoring forms must be filed with the BLM, and the Companies must implement, if necessary, a weed control and eradication program.
2. The Companies would evaluate all project facility sites for occurrence and distribution of waters of the U.S., special aquatic sites, and jurisdictional wetlands. All project facilities would be located out of these sensitive areas. If complete avoidance is not possible, the Companies would minimize impacts through modification and minor relocations. The Companies will comply with applicable regulations for any activities that involve dredge or fill of wetlands.
3. An approved Pesticide Use Proposal would be obtained before herbicides or other pesticides are applied on BLM surface ownership lands to control noxious weeds.
4. Disturbed areas would be seeded and stabilized in accordance with BLM-approved reclamation guidelines.

Range Resources and Other Land Uses

Mitigation requirements listed under sections of this analysis on Soils, Vegetation, Wetlands, Noxious Weeds, and Wildlife also apply to Range Resources and Other Land Uses.

1. The Companies would coordinate with the affected livestock operators to ensure that livestock control structures remain functional (as directed by the livestock operator) during drilling and production operations, and to coordinate timing of activities planned.
2. When necessary, traffic control and speed limits would be used to limit potential conflicts.

Wildlife

1. During reclamation, the Companies would establish a variety of forage species that would return the land to a condition that approximates or is equal to its state before disturbance.

2. The Companies would prohibit unnecessary off-site activities of operational personnel near the drill sites. The Companies also would inform all project employees of applicable wildlife laws and the potential penalties associated with unlawful take and harassment.
3. The Companies would limit construction within crucial winter range for big game from November 15 to April 30, unless authorized by BLM.
4. A raptor survey would be completed before construction begins to ensure that well sites are located away from potential conflict areas.
5. The Companies would survey and clear well sites within 1 mile of raptor nests identified in the raptor survey before construction or drilling can begin during the raptor nesting period (February 1 through July 31).
6. When an “active” raptor nest is located 0.75 to 1 mile from a proposed well site (depending on species and line of sight), the Companies must restrict construction during the critical nesting season for the species. The distance would be increased to within 1 mile of a proposed well site for listed and BLM sensitive species (Chapter 3).
7. Raptor nests must be inventoried annually to evaluate potential nesting activity in areas where work may be occurring during the raptor nesting period from February 1 to July 31. Inventories will be conducted annually by BLM.
8. Construction and surface occupancy cannot occur any time within 0.25 mile of existing leks for greater sage-grouse.
9. The Companies must protect leks for greater sage-grouse during the breeding, egg-laying, and incubation period (March 1 through June 30) by restricting construction within a 2-mile radius of active leks for greater sage-grouse. Exceptions may be granted if the activity would occur in unsuitable nesting habitat.
10. Construction, drilling, or other activities that could disrupt nesting areas are prohibited during the period from February 1 to July 31 (raptors) and from March 1 to June 30 (greater sage-grouse and sharp tailed grouse) for the protection of nesting areas for these species. An exception would be approved only after a thorough, site-specific analysis concluded that a negative impact would not occur.
11. Surface occupancy or use within 0.25 mile of a greater sage-grouse strutting or dancing ground will be restricted or prohibited unless the operator and surface managing agency arrive at an acceptable plan for mitigation of anticipated impacts.
12. All pits and open cellars must be fenced for the protection of wildlife and livestock. Fencing must be in accordance with BLM specifications. Netting must be placed over all production pits to eliminate any hazard to migratory birds or other wildlife. Netting is also required over reserve pits that have been identified as containing oil or hazardous substances as these terms are defined in the Comprehensive Environmental Response,

Compensation, and Liability Act (CERCLA) Section 101 (14), as determined by visual observation or testing. The mesh diameter shall be no larger than 1 inch.

Fisheries

1. No mitigation for fisheries is needed beyond the measures indicated under Water Resources and Special Status Species.

Special Status Species

Special Status Plants

1. The Companies would employ site-specific recommendations developed by the BLM interdisciplinary team (IDT) for staked facilities.
2. The occurrence and distribution of two T&E plants (Ute ladies'-tresses orchid and western prairie fringed orchid) and seven BLM sensitive plants (Laramie columbine, Nelson's milkvetch, Cedar Rim thistle, Weber's scarlet gilia, Gibben's beardtongue, persistent sepal yellowcress, and Laramie false sagebrush) will require specific consideration during the APD process.
3. Impacts caused by clearing and soil handling must be minimized.
4. Clearance surveys must be performed for plant species of concern.

Recreation

Measures under the section of the EA on Wildlife, Transportation, Soils, Health and Safety, and Water Resources apply to Recreation.

1. The Companies must minimize conflicts between project vehicles and equipment and recreation traffic by posting warning signs, implementing operator safety training, and requiring project vehicles to adhere to low speed limits.

Visual Resources

1. Roads, pipeline corridors, drill rigs, wellheads, and production facilities must be screened from view to the extent possible, when specified by BLM.
2. The Companies must paint structures at wells and central facilities with flat colors (such as Carlsbad Canyon) that blend with the adjacent undisturbed terrain. This measure does not apply to structures that require safety coloration in accordance with the requirements of the Occupational Safety and Health Administration (OSHA).

Cultural Resources

1. A Class III inventory for cultural resources has been done, but if the area of potential effect were to change, additional inventory would be required.
2. Avoidance is the preferred method for mitigating adverse effects to a property that is considered eligible for, or is already on, the NRHP.
3. Adverse effects to cultural or historical properties that cannot be avoided would be mitigated by preparing and implementing a cultural resources mitigation plan. Mitigation plans would be developed as needed for eligible sites that would be impacted.
4. If cultural resources are discovered at any time during construction, all construction would halt and BLM would be immediately notified. Work would not resume until BLM issues a Notice to Proceed.

Socioeconomics

1. Project activities must be coordinated with ranching operations to minimize conflicts that involve movement of livestock or other ranch operations. Coordination would include scheduling project activities to minimize potential disturbance of large-scale livestock movements. The Companies would establish effective and frequent communication with affected ranchers to monitor and correct problems and coordinate scheduling.

Transportation

1. Existing roads would be used as collectors and local roads whenever possible. Standards for road design would be consistent with BLM Road Standards Manual Section 9113. The proposed access road would be constructed to the BLM standard for a local road.
2. Roads that are not required for routine operation and maintenance of producing wells and ancillary facilities or field production would be permanently blocked, reclaimed, and revegetated.
3. Areas with important resource values, steep slopes, and fragile soils would be avoided where possible in planning for new roads.
4. Permits are required from Carbon County for any access to or across a county road or for any pipeline that crosses a county road. These permits would be acquired before additional roads are built. All roads on public lands that are not required for operation and maintenance of field production would be permanently blocked, re-contoured, and seeded. Roads on private lands would be treated in a like manner, depending on the desires of the landowner.

5. The Companies would be responsible for preventive and corrective maintenance of roads in the Project Area throughout the duration of the project. Maintenance may include blading, surfacing, cleaning ditches and drainage facilities, abating dust, controlling noxious weeds, or other requirements as directed by the BLM or the Carbon County Road and Bridge Department.
6. Except in emergencies, access would be limited to drier conditions to prevent severe rutting of the road surface. No construction or routine maintenance activities would be performed during periods when the soil is too wet to adequately support construction equipment. If such equipment creates ruts in excess of 4 inches deep, the soil would be considered too wet to adequately support construction equipment. Culverts would be installed where needed to allow drainage in all draws and areas of natural drainage. Low water crossings would be used where applicable. Onsite reviews would be conducted with BLM personnel for approval of proposed access before any construction begins.

Health and Safety

Measures listed under the section of the EA on Air Quality and Water Quality also apply to Health and Safety.

1. Sanitation facilities installed on the drill sites and any resident camps would be approved by the WDEQ.
2. To minimize undue exposure to hazardous situations, the Companies would comply with all applicable rules and regulations (such as Onshore Orders and OSHA requirements) that would prevent the public from entering hazardous areas and would post warning signs to alert the public of truck traffic.
3. The Companies would haul all garbage from the drill site to a state-approved sanitary landfill for disposal. In addition, the Companies would collect and store any garbage or refuse on location in containers approved by the BLM until it can be transported.
4. During construction and when production operations begin, the Companies would maintain an inventory of chemicals or hazardous substances for all items that may be at the site. The Companies would institute a Hazard Communication Program for employees and would require subcontractors to establish programs in accordance with OSHA regulations at 29 CFR 1910.1200. These programs are designed to educate and protect employees and subcontractors with respect to any chemicals or hazardous substances that may be present in the work place. In addition, Material Safety Data Sheets (MSDS) would accompany every chemical or hazardous material that is brought on location and would become part of the file maintained at the Red Rim field office, as required by 29 CFR 1910.1200. All employees would receive proper training in storage, handling, and disposal of hazardous substances.

5. SPCC Plans would be written and implemented as necessary, in accordance with 40 CFR Part 112, to prevent discharge into navigable waters of the United States.
6. If quantities that exceed 10,000 pounds or the threshold planning quantity (TPQ) as designated by the RFO are to be produced or stored in association with the project, chemical and hazardous materials would be inventoried and reported in accordance with the toxic release inventory (TRI) requirements set forth in Title III of the Superfund Amendments and Reauthorization Act (SARA) and codified at 40 CFR Part 335. The required Section 311 and 312 forms would be submitted at the specified times to the state and county emergency management coordinators and the local fire departments.
7. Any hazardous wastes, as defined by the Resource Conservation and Recovery Act (RCRA), would be transported and disposed of in accordance with all applicable federal, state, and local regulations.
8. All storage tanks and compressor facilities that are designed to contain oil, glycol, produced water, or other fluid that may constitute a hazard to public health or safety, must be surrounded by a secondary means of containment for the entire contents of the largest single tank in use, plus 1 foot of freeboard. The Companies would use 3.5-foot berms around affected storage tanks and facilities. The containment or diversionary structure must be impervious to any oil, glycol, produced water, or other hazardous fluid for 72 hours. In addition, it would be constructed so that any discharge from a primary containment system would not drain, infiltrate, or otherwise escape to groundwater, surface water, or navigable waters before cleanup is completed.

Noise

1. The Companies would muffle and maintain all motorized equipment according to manufacturer's specifications and Best Management Practices .
2. In any area of operations (such as a drill site or compressor station) where noise levels may exceed safe limits specified by OSHA, the Companies would provide and require that employees use proper personal protective equipment.
3. In addition to other restrictions on activities near leks, the BLM will require that noise levels be limited to no more than 10 decibels on the A-weighted scale (dBA) above background levels at leks for greater sage-grouse that are located on public lands. This scale simulates human hearing by placing less emphasis on lower frequency noise. The BLM will require that compressor engines located on public lands be enclosed in a building and located at least 600 feet away from sensitive receptors or sensitive resource areas to comply with these limits on noise levels.

14. LESSEE'S REPRESENTATIVE AND CERTIFICATIONS

Representative for Anadarko E & P Company

Name and Title: William M. Fowler, Environmental and Regulatory Affairs Manager
Address: 1201 Lake Robbins Drive
City/State/Zip: The Woodlands, Texas 77380
Phone: (832) 636-3167

Bonding

BLM Nationwide Bond, WY 1280, \$150,000

Certification

I hereby certify that I, or persons under my direct supervision, have inspected the proposed drill sites and access routes; that I am familiar with the conditions which currently exist; that the statements made in this plan are, to the best of my knowledge, true and correct; and that the work associated with the operations proposed herein will be performed by AEPC and its contractors and subcontractors in conformity with this plan and the terms and conditions under which it is approved. This statement is subject to the provisions of 18 U.S.C 1001 for the filing of a false statement.

I also certify that AEPC will comply with the provisions of the law or the regulations governing the Federal or Indian right of reentry to the surface under 43 CFR 3814.

I also certify that AEPC has reached or will reach an agreement with the surface owner(s) and surface lessee(s) regarding the requirements for the protection of surface resources and reclamation of disturbed areas and/or damages in lieu thereof, or if an agreement cannot be reached, will comply with the provisions of the law or the regulations governing Federal or Indian right of reentry to the surface under 43 CFR 3814.

I also certify that:

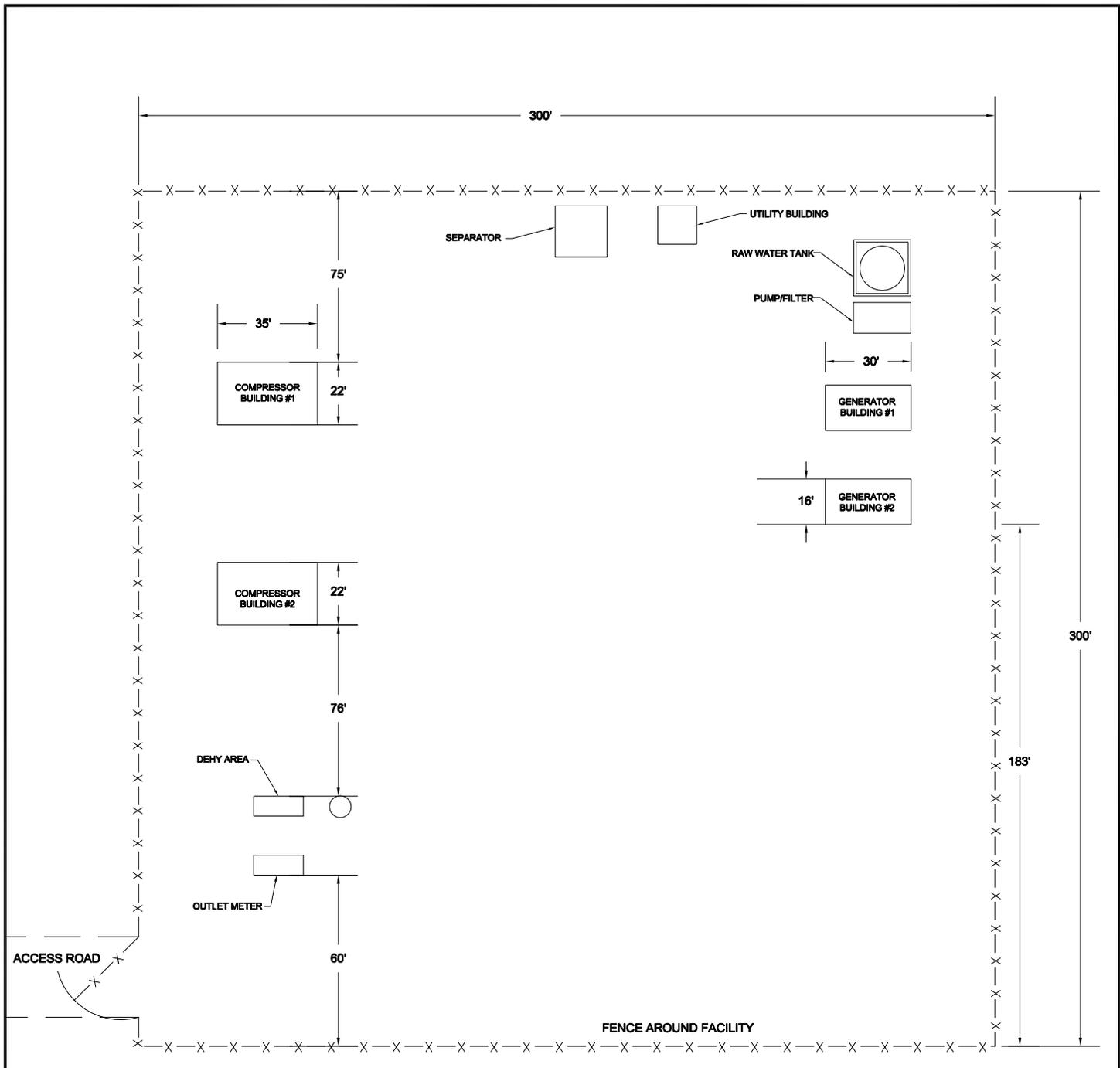
- A. All potentially affected landowners having properly permitted water wells with the WSEO within each producible well's Circle of Influence (one-half mile radius) will be offered a Water Well Agreement; and
- B. If a Water Well Agreement is not reached with the landowner, AEPC agrees to mitigate the impacts of its coal bed methane wells in accordance with State of Wyoming water laws; and
- C. Permits to Appropriate Groundwater have been applied for from the Wyoming State Engineer's Office, concurrently with these Applications for Permits to Drill.

I also certify that AEPC shall use its best efforts to conduct its approved operations in a manner that avoids adverse effects on any properties which are listed, or may be eligible for listing, in the National Register of Historic Places (NRHP). If historic or archaeological materials are uncovered during construction, the operator will immediately stop work that might further disturb such materials, and contact the authorized officer (or his/her representative) at the BLM Rawlins Field Office. Any paleontological resources or fossils discovered as a result of operations associated with these wells will be brought to the attention of the authorized officer or his/her representative immediately. All activities in the vicinity of such discoveries will be suspended until notified to proceed by the Authorized Officer.

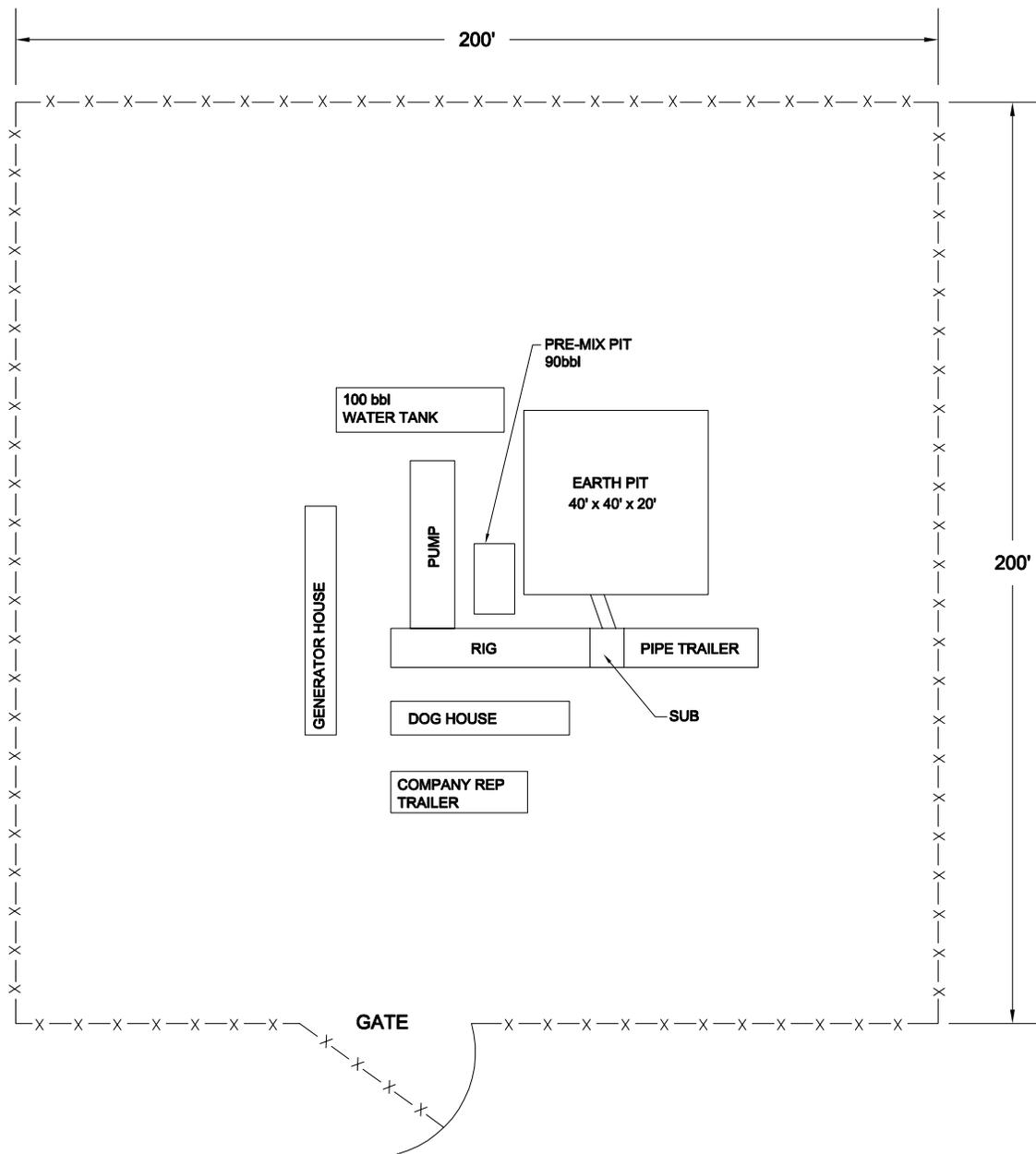
I also certify that AEPC shall use its best efforts to conduct its approved operations in accordance with the Project-wide Mitigation Measures and procedures outlined in Chapter 2 of the Environmental Assessment (EA) for this project.

By: _____
William M. Fowler
Environmental and Regulatory Affairs Manager
Anadarko E & P Company

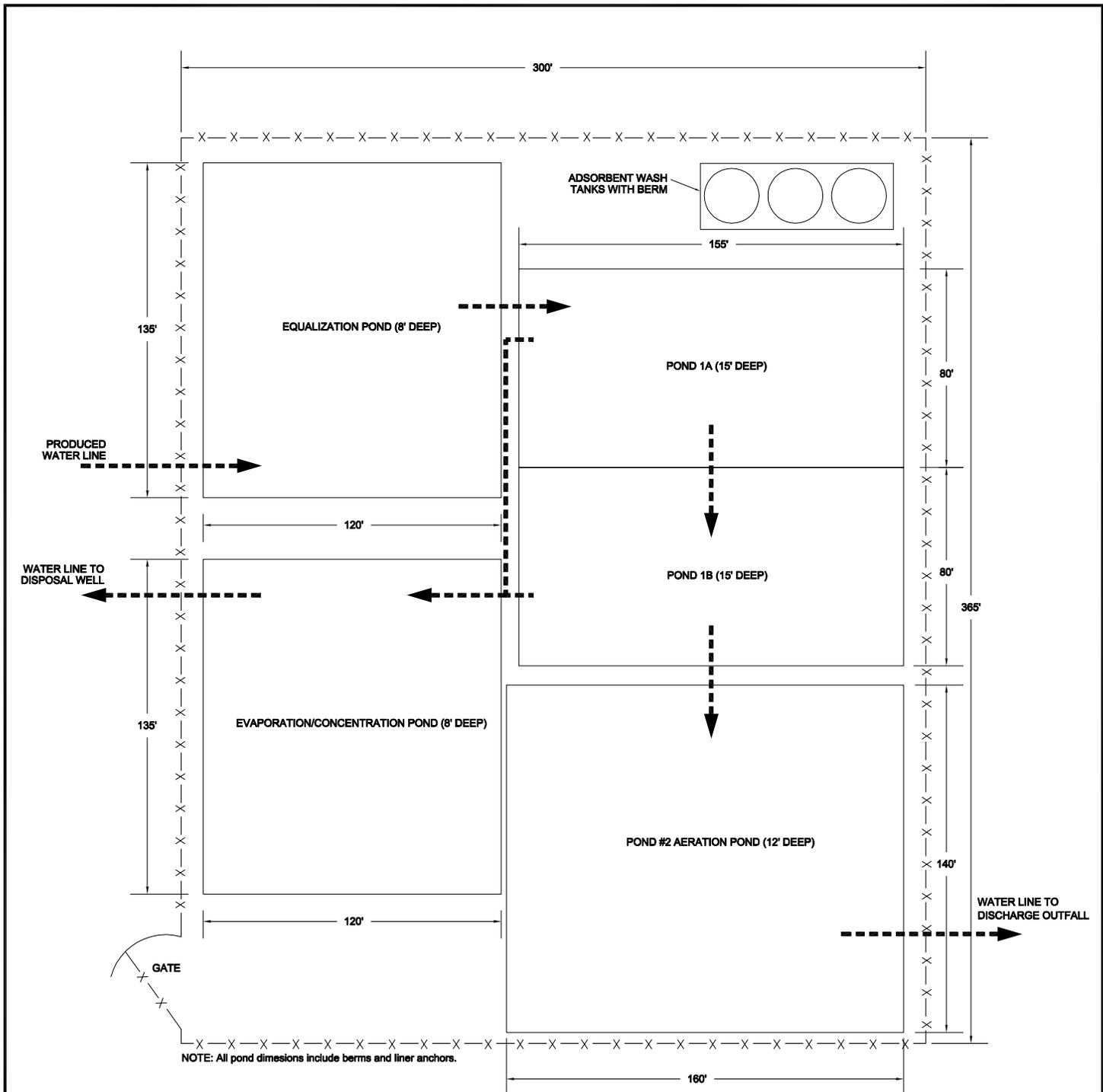
Date: _____



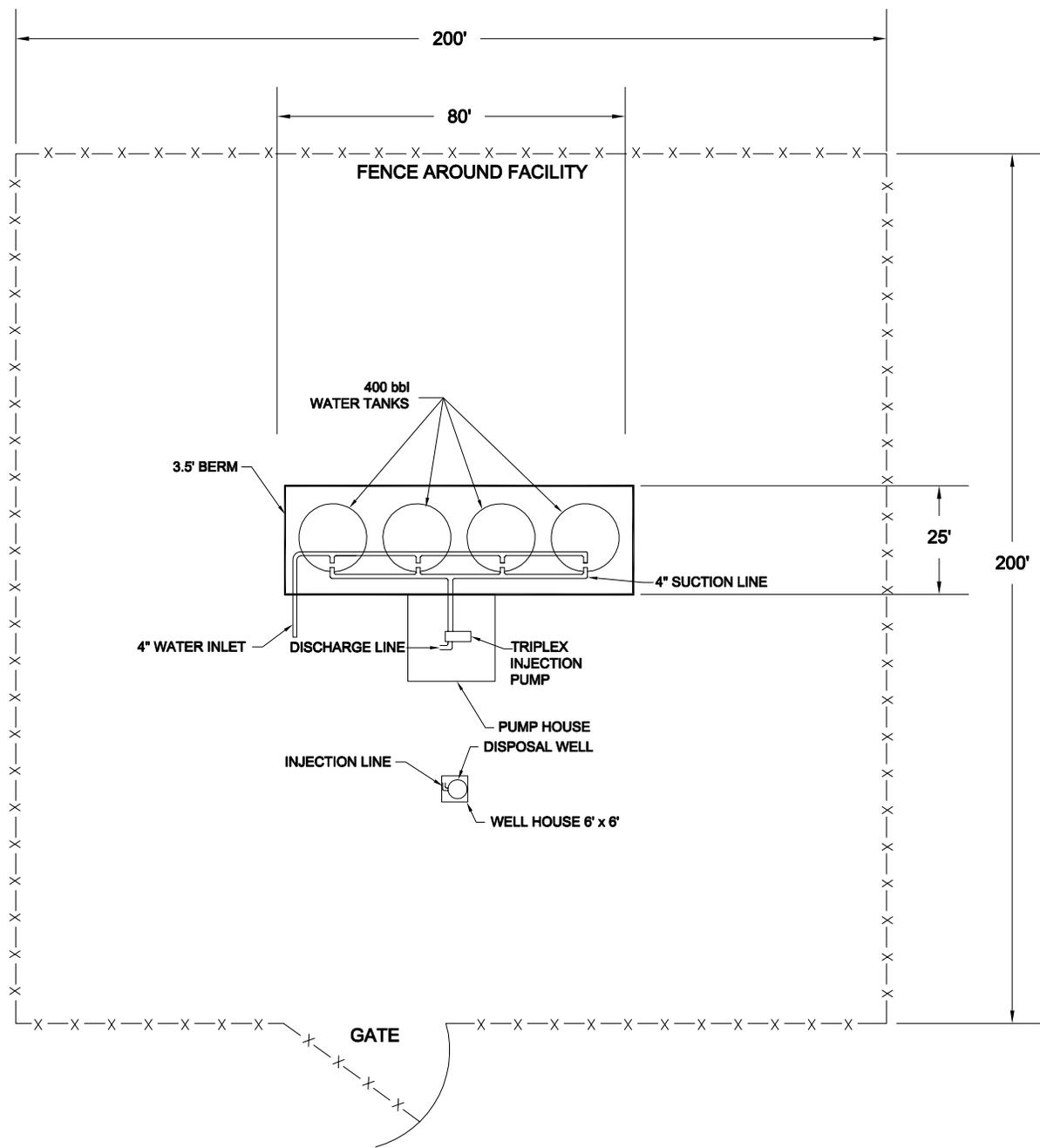
			
TYPICAL COMPRESSOR STATION			
SCALE: NTS	DATE: 07.09.03	DRAWN BY: ETC	



			
TYPICAL DRILL SITE LAYOUT			
SCALE: NTS	DATE: 10.08.03	DRAWN BY: ETC	

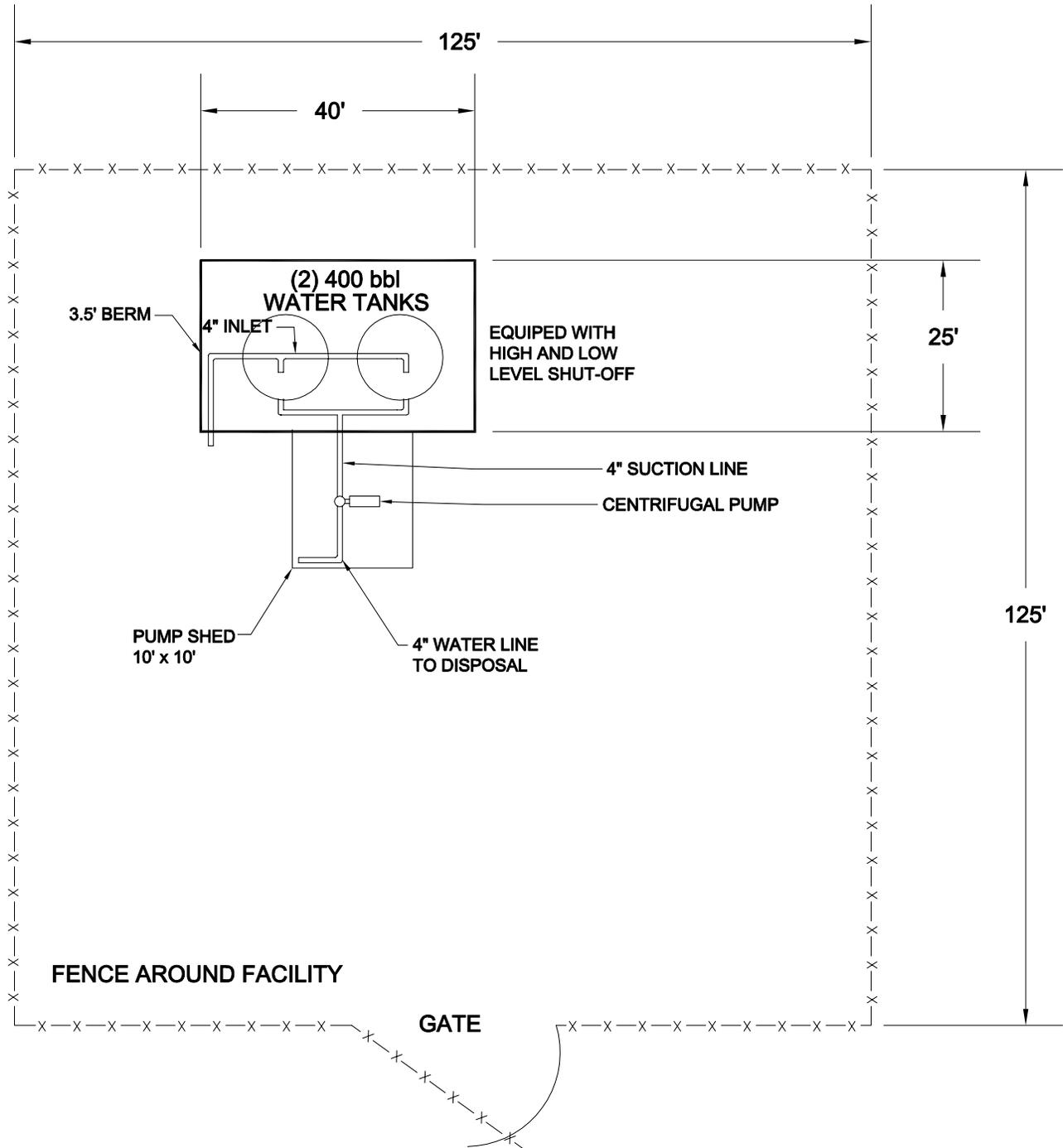


			
TYPICAL WATER CONDITIONING FACILITY			
SCALE: NTS	DATE: 06.23.03	DRAWN BY: ETC	

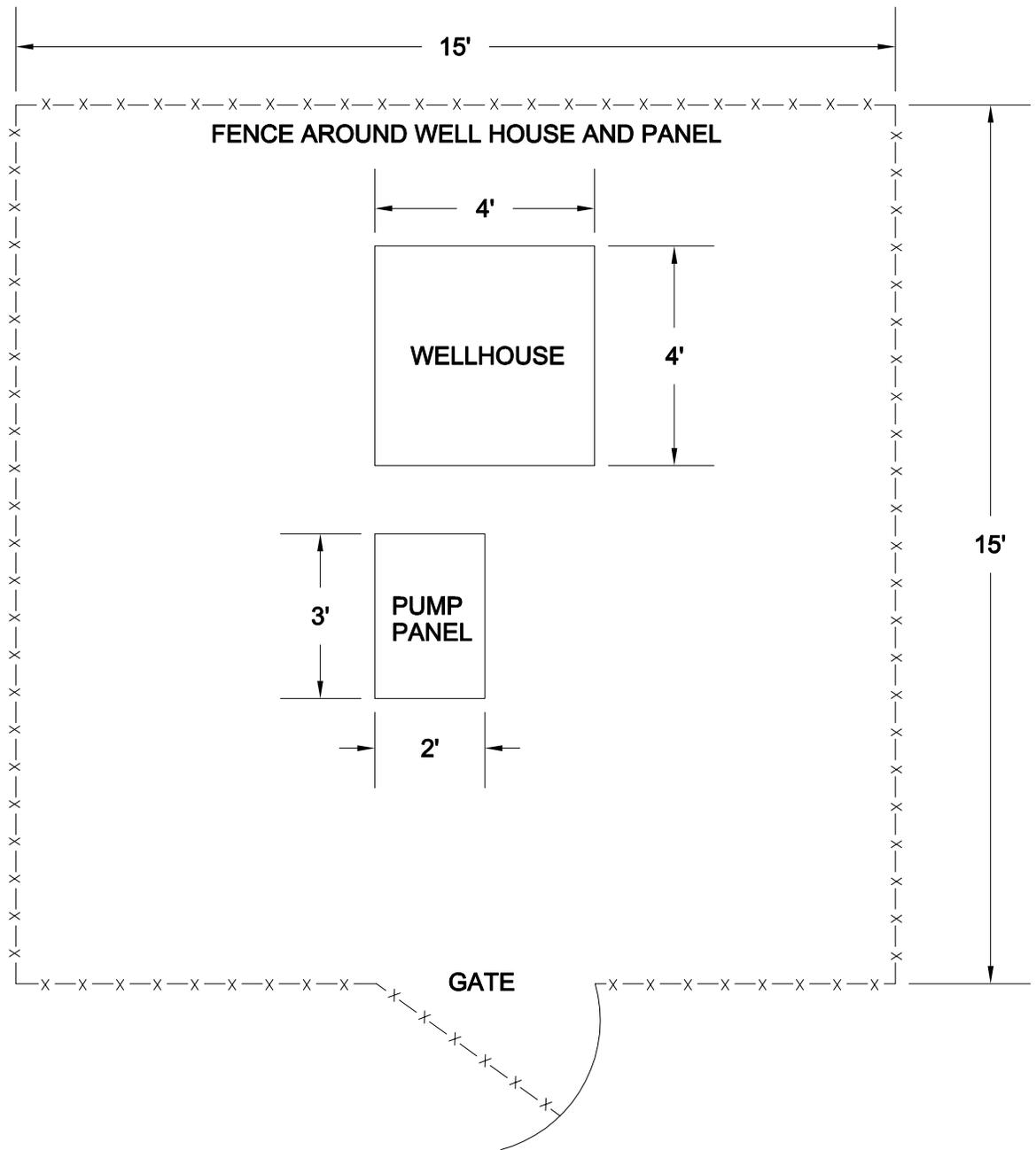


TYPICAL WATER DISPOSAL FACILITY

SCALE: NTS	DATE: 09.02.03	DRAWN BY: ETC	
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TYPICAL WATER TRANSFER FACILITY			
SCALE: NTS	DATE: 08.21.03	DRAWN BY: ETC	



			
TYPICAL WELL SITE			
SCALE: NTS	DATE: 10.08.03	DRAWN BY: ETC	FIGURE:

Appendix C

MASTER DRILLING PLAN (MDP) RED RIM PLAN OF DEVELOPMENT (POD)

OPERATORS (The Companies):
Warren E & P, Inc. (Warren)
Anadarko E & P Company (Anadarko)
Sections 20 & 28 in T20N R89W, 6th PM, Carbon County, Wyoming
BLM Leases: WYW149261, WYW150410

Drilling Plan for the subject wells listed below:

Gas Wells in Section 20

AR Federal 2089 NE20 (WYW149261)
AR Federal 2089 SE20 (WYW149261)
AR Federal 2089 SW20 (WYW149261)

Gas Wells in Section 28

AR Federal 2089 NW28 (WYW150410)
AR Federal 2089 NE28 (WYW150410)

Monitoring Well

BLM has requested that three to six groundwater monitoring wells be installed within the Atlantic Rim EIS study area during the interim drilling project. The locations of these monitoring wells have not yet been specified, however, one of them will be located in the Red Rim project area. The effects of interim drilling and development on the coal aquifer, including drawdown, will be monitored by these wells.

1. ESTIMATED TOPS OF IMPORTANT GEOLOGIC MARKERS

Formation	Depth
Lance	Surface
Lewis Shale	630' – 2460'
Almond	2880' – 4710'
Pine Ridge SS	3420' – 5250'
Allen Ridge	3560' – 5390'
TD (Gas Wells)	4050' – 5850'
Hatfield/Cherokee/Deep Creek	5965' – 6335'

2. ESTIMATED DEPTH OF ANTICIPATED WATER, OIL, GAS OR MINERAL FORMATIONS

Almond	Natural gas
Pine Ridge	Natural gas
Allen Ridge	Natural gas

The Lance Formation and Lewis Shale are not anticipated to contain any zones capable of producing water. There are several zones within the Mesaverde Group capable of producing fresh water, including the coal seams. The Companies propose to test the productive formations between 2,880' and 5,390'. Several coal seams may be tested for gas production to total depth. All shallow water zones will be protected with casing and cement. Cement will be brought above the base of the Lewis Shale to isolate all formations in the Mesaverde Group.

Planned Objective for Gas Wells: Mesaverde

3. MINIMUM BLOW OUT PREVENTOR (BOP) REQUIREMENTS (refer to attached schematics)

1. The BOPE will conform to Onshore Shore Order #2. The blowout preventer equipment will consist of a 2000 psi W.P. Double Ram, Hydraulic Preventer (enclosed). All fill and kill lines will be 2000 psi W.P. From 0-160' there will be no pressure control. From 160'-1,600' the 2,000# system will provide control. Note: These wells are proposed as coal bed natural gas (CBNG) wells. Data from a number of CBNG wells drilled in the area indicate that the maximum anticipated surface pressure will not exceed 250 psi, thus the BOP will be tested to 1,000 psi (see attached schematic).
2. The BOP shall be pressure tested when initially installed, whenever any seal subject to pressure testing is broken, after repairs, or every 30 days.
3. The Companies shall notify the Rawlins BLM office 24 hours prior to the BOP test.

4. SUPPLEMENTAL INFORMATION

The primary objective of this project is to drill, stimulate, and produce natural gas from coal seams in recognized gas-producing formations of the Mesaverde Group. The coal seams are overpressured and are very unlikely to be in communication with overlying layers. Produced water will be conditioned and discharged as authorized by WDEQ in a NPDES permit or injected in one of two deep injection wells completed in the Cherokee/Deep Creek Sandstones. The coal seams will be perforated and stimulated by hydraulic enhancement or fracturing during testing. Fresh water, gelled water, and/or foam fracturing techniques will be used.

The following schematics that show typical facilities, operating standards, and methodologies, are attached to this MDP: [B.O.P.](#); [Bottom Flange](#); [Configuration Options](#); [Completed Well](#); and [Injection Well](#). Additional schematics for this POD are attached to the [Master Surface Use Program \(MSUP\)](#): [Drill Site Layout](#); [Well Site](#); [Water Disposal Facility](#); [Water Transfer Facility](#); [Water Conditioning Facility](#); and [Compressor Station](#).

5. CASING PROGRAM

<u>Hole Size</u>	<u>Casing Size</u>	<u>Casing Wt.</u>	<u>Grade</u>	<u>Joint</u>	<u>Depth Set</u>	<u>New/Used</u>	<u>Rng</u>	
12 ¼"	9 "	32.3#	H-40	ST&C	10% of well depth	New	3	
9 "	7"	23#	MC-50	LT&C	0-TD	New	3	
Surface Casing:		9 "	32.3 ppf	H-40	STC	Collapse	Burst	Tension
					Ratings:	1370	2270	254M

A. $Burst = [0.052 * FG * TVD (shoe)] - [Gas Gradient * TVD]$
 $= [0.052 * 8.8ppg * 580'] - [0.1psi/ft * 580']$
 $= 207.4psi$
 Safety Factor = Rating/Burst
 $= 2270/207.4$
 $= 10.94$

B. $Collapse = 0.052 * MW * TVD (shoe)$
 $= 0.052 * 8.8ppg * 580'$
 $= 265.4psi$
 Safety Factor = Rating/Collapse
 $= 1370/265.4$
 $= 5.16$

C. $Tension = Weight * MD * [1 - (MW/65.5ppg)]$
 $= 32.3ppf * 580' * [1 - (8.8ppg/65.5ppg)]$
 $= 16299 lbs.$
 Safety Factor = Rating/Tension
 $= 254,000/16299$
 $= 15.58$

Surface casing shall have centralizers on the bottom 3 joints of the casing, starting with the shoe joint.

Production Casing:	7"	23 ppf	MC-50	STC	Collapse	Burst	Tension	
					Ratings:	3110	3960	273M

- A. Burst = $[0.052 * 8.3\text{ppg} * 5800'] - [0.1\text{psi/ft} * 5800']$
= 1923.3psi
Safety Factor = Rating/Burst
= 3960/1923.3
= 2.06
- B. Collapse = $0.052 * 8.3\text{ppg} * 5800'$
= 2503.3psi
Safety Factor = Rating/Collapse
= 3110/2503.3
= 1.24
- C. Tension = $23\text{ppf} * 5800' * [1 - (8.3\text{ppg}/65.5\text{ppg})]$
= $23\text{ppf} * 5800' * .87$
= 116,058 lbs.
Safety Factor = Rating/Tension
= 273,000/116,058
= 2.35

6. MUD PROGRAM

Drilling mud will be used as the circulation medium. A fresh water, polymer, gel drilling mud will be used and visual monitoring will be done from spud to total depth. The anticipated mud weight will be between 8.3–10 ppg. Sufficient quantities of lost circulation material and barite will be available at the well site at all times for the purpose of assuring well control.

7. CEMENTING PROGRAM

The following is the proposed procedure for cementing the 9" surface pipe and 7" long string:

Surface Casing:

Lead: Class "C" Type III, 14.4 ppg, yield 1.44ft³/sk @ 101% excess. Compressive strength in 24 hours at 80°F 3100psi.

The surface casing shall be cemented back to surface. In the event cement does not circulate to surface or fall back of the cement column occurs, remedial cementing shall be done to cement the casing back to surface.

Long String:

Lead: Class "C" Type III, 14.4 ppg, yield 1.44ft³/sk @ 35% excess. Compressive strength in 24 hours at 95°F 3200psi.

Estimated top of cement back to surface.

8. LOGGING PROGRAM

Cores: Rotary Cores will be taken as needed to evaluate the coal seams.

DSTs: None Planned

Logs: Induction, GR, SP, Density, Neutron and Caliper – From surface to TD
Cement Bond Log – From 9" casing shoe to TD
Mud Logger – As needed.

9. PRESSURE DATA AND POTENTIAL HAZARDS

Bottom hole pressures anticipated at much less than 1,000 – 1,100 psi.
There is no history of hydrogen sulfide gas in the area and none is anticipated.

10. ANTICIPATED STARTING DATES AND NOTIFICATION OF OPERATIONS

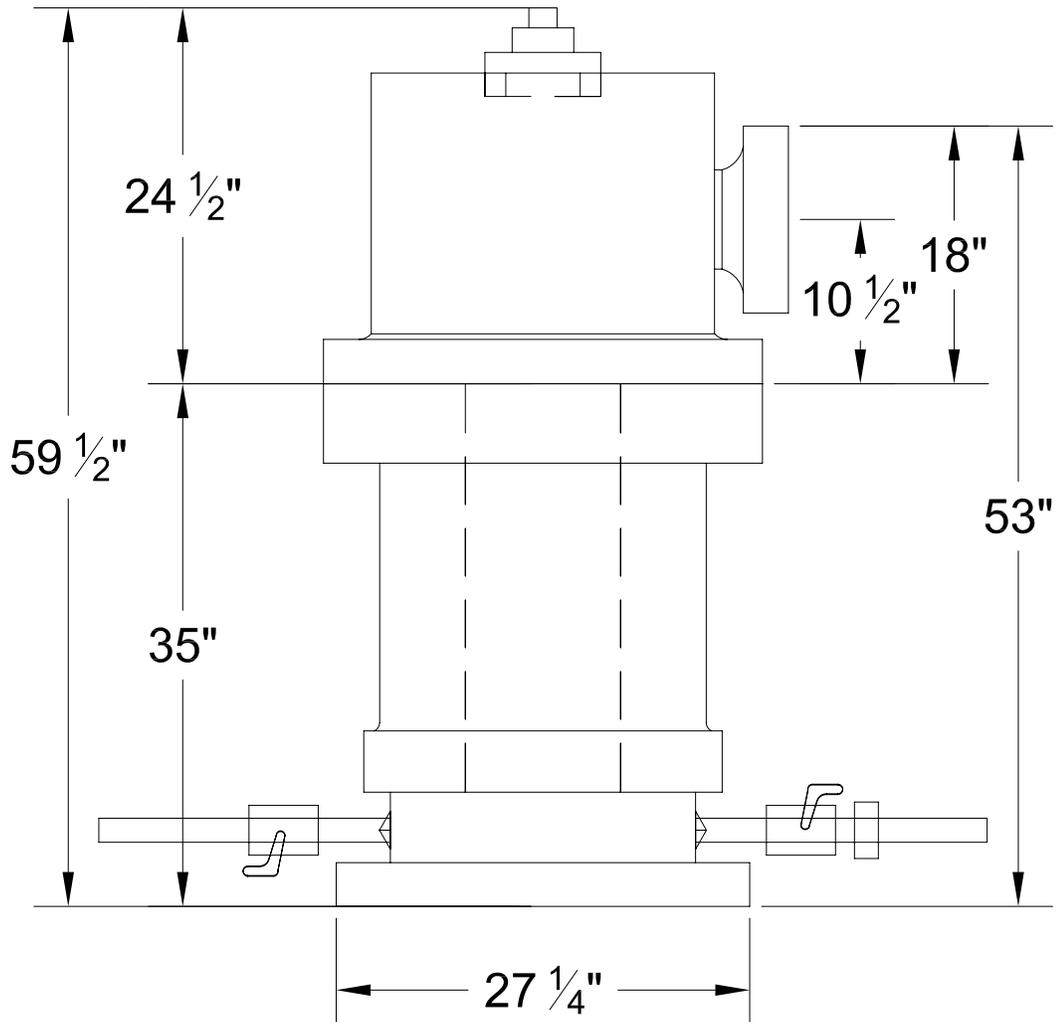
A. Anticipated Starting Dates:

Anticipated Commencement Date	- Fall 2003, or upon approval
Drilling	- Approximately 7 days per well
Completion	- Approximately 2 days per well
Initial Testing	- Approximately 7-14 days per well
Production Testing	- Approximately 6-12 months per well

Note: Drilling operations will commence as soon as practical after approval of all necessary permits including the Applications for Permits to Drill (APDs).

B. Notification of Operations:

Rawlins Field Office, BLM
1300 North Third St.
Rawlins, Wyoming 82301
(307) 328-4200

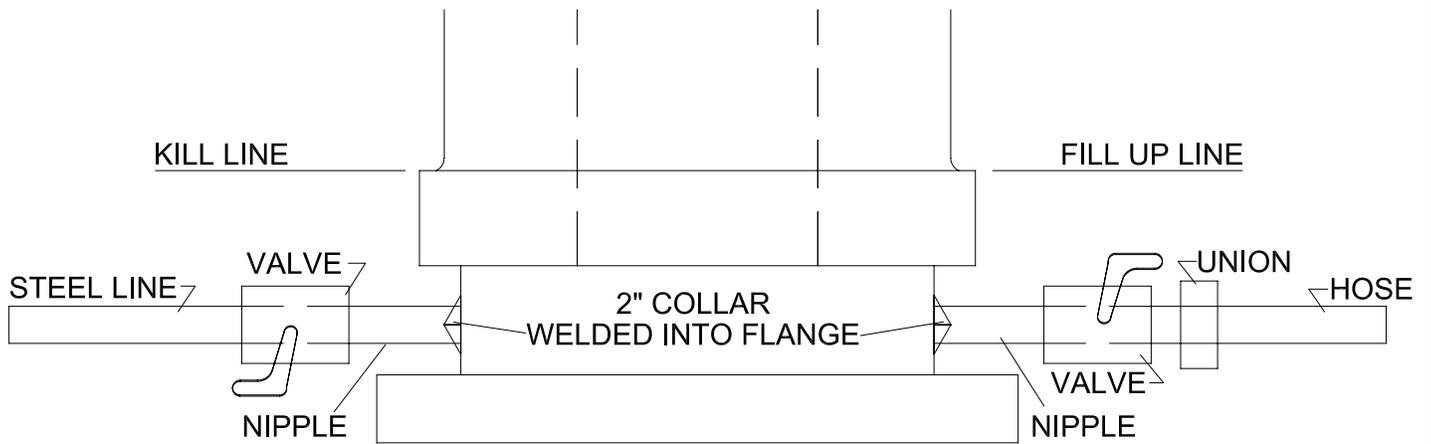


SPECIFICATIONS

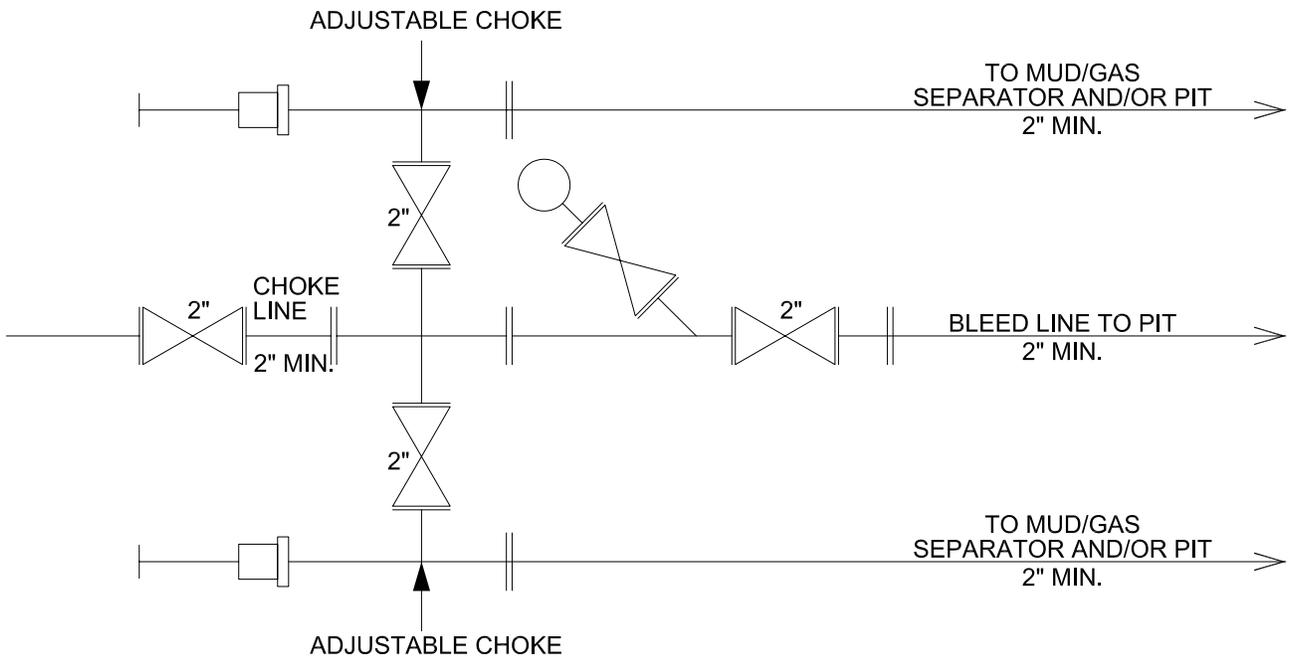
- 10" - 900 FLANGES ON B.O.P.
- 10" - 900 FLANGE ON ROTATING HEAD
- 6" - 600 FLANGE ON FLOWLINE
- 2" - COLLAR ON EACH SIDE OF B.O.P. AT BOTTOM

			
SCHEMATIC			
1500 P.S.I. REAGAN ANNULAR B.O.P			
SCALE: as noted	DATE: 05.04.01	DRAWN BY: MTM	FIGURE:

BOTTOM FLANGE ON ANNULAR B.O.P.



2M CHOKE MANIFOLD EQUIPMENT



SPECIFICATIONS

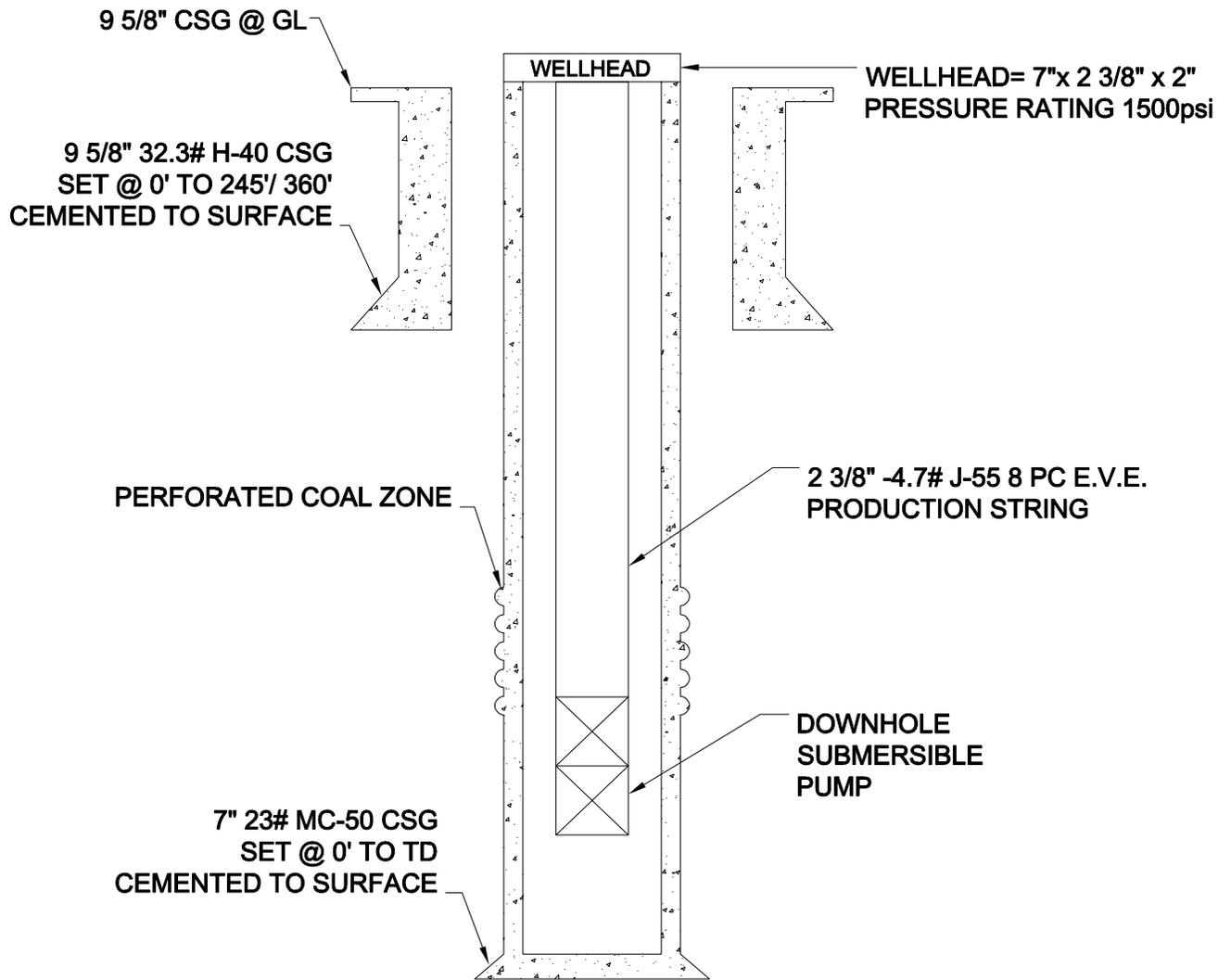
- 10" - 900 FLANGES ON B.O.P.
- 10" - 900 FLANGES ON ROTATING HEAD
- 6" - 600 FLANGES ON FLOWLINE
- 2" - COLLAR ON EACH SIDE OF B.O.P. AT BOTTOM



SCHEMATIC

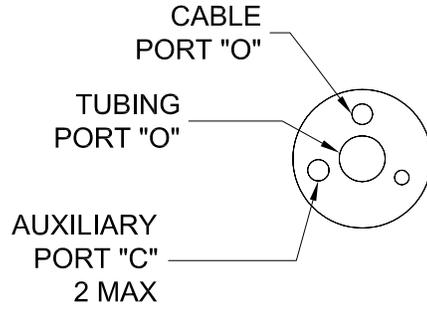
BOTTOM FLANGE ON ANNULAR B.O.P. &
2M CHOKE MANIFOLD EQUIPMENT

SCALE: as noted | DATE: 05.04.01 | DRAWN BY: MTM | FIGURE:



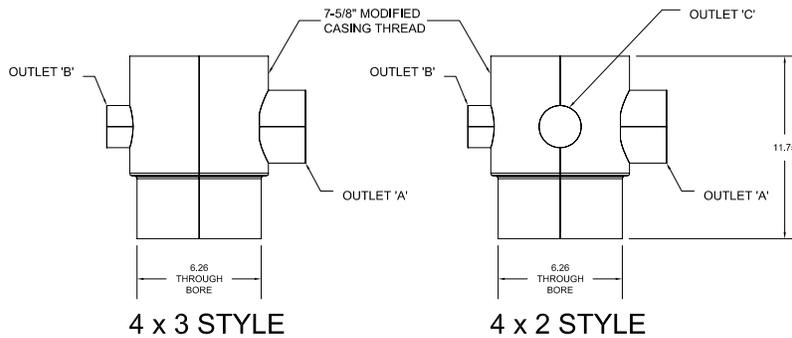
TYPICAL COMPLETED WELL

MANDREL STYLE



**GS-3 / GS-4
CENTERED HANGER
WITH CABLE PORT &
UP TO 2 AUX PORTS**

BODY STYLES



Standard Body Configurations

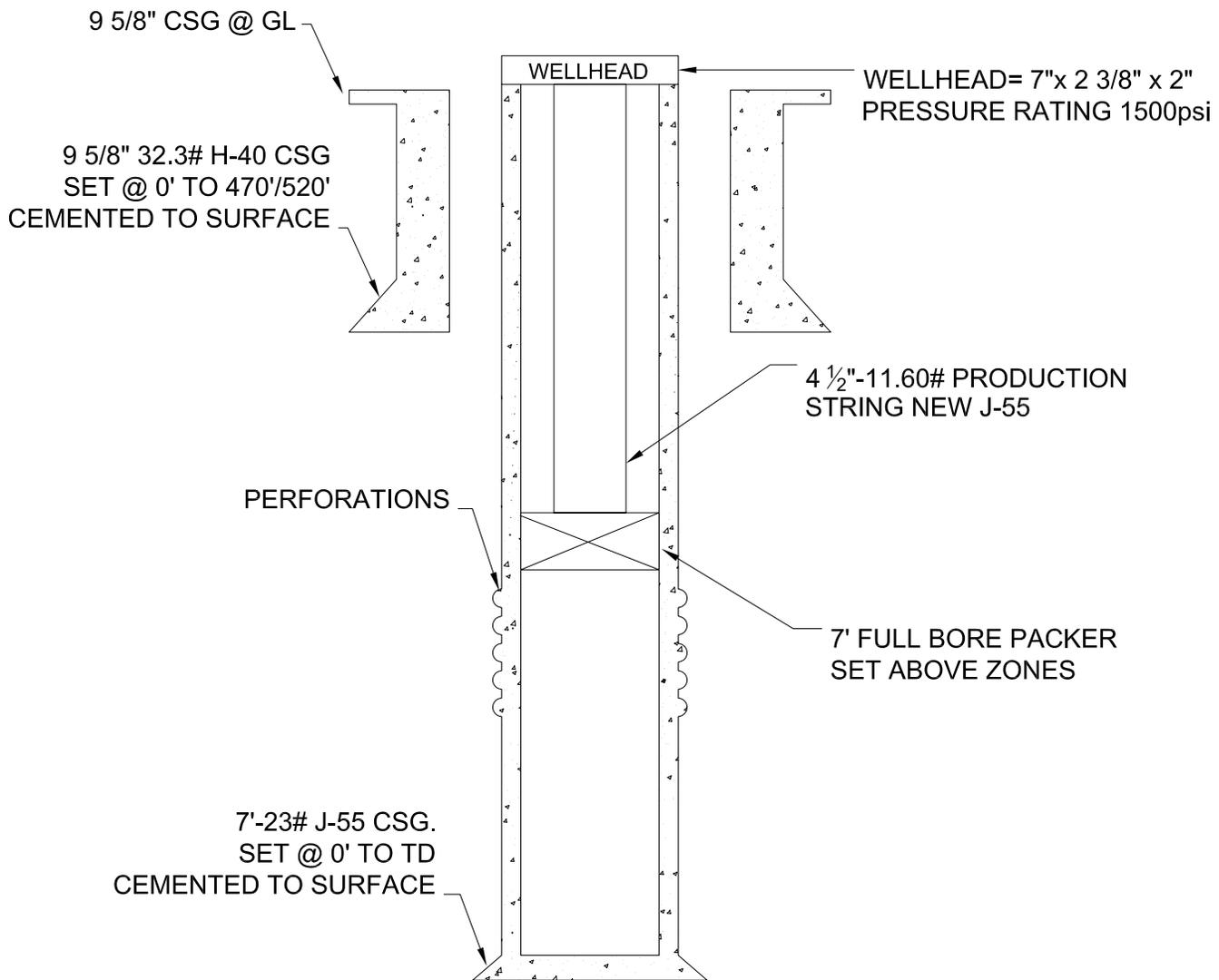
Body Style	Bottom Connection	Outlet "A"	Outlet "B"	Outlet "C"
4 x 2	7" Short Casing (Male or Female)	4" LP Female	2" LP Female	NA
4 x 3	7" Short Casing (Male or Female)	4" LP Female	3" LP Female	NA
4 x 2 x 2	7" Short Casing (Male or Female)	4" LP Female	2" LP Female	2" LP Female

Standard Mandrel Configurations

Mandrel Style	Port "C"	Port "D"	Port "E"	Approx Wt - LBS
GS-3	2-3/8" UPTBG Box Down X	1" LP	(1) 1/2" LP Box Up	26
GS-4	2-3/8" UPTBG Box Up	Box Up	(2) 1/2" LP Box Up	26



CONFIGURATION OPTIONS



TYPICAL INJECTION WELL

SCALE: NTS	DATE: 01.10.02	DRAWN BY: RLZ	FIGURE:
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**APPENDIX D
WATER MANAGEMENT PLAN**

**ATLANTIC RIM INTERIM DRILLING PROJECT
RED RIM PROPOSED ACTION**

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ATTACHMENTS

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Attachment 2 Water Quality Analysis
Attachment 3 Bench Test Results for Water Conditioning
Attachment 4 Outfall Design
Attachment 5 WSEO Surface Water Search
Attachment 6 Initial Periodic Monitoring Schedule

INTRODUCTION AND GEOGRAPHIC SETTING

Anadarko E&P Company (AEPC) and Warren E&P, Inc. (Warren), collectively referred to as “the Companies,” propose to explore for and potentially develop coal bed natural gas (CBNG) resources in the Red Rim area (Project Area) of the western portion of Carbon County, Wyoming (Figures 1-1 and 2-1 of the EA). Exploration and development in the Project Area would occur as part of the Red Rim Plan of Development (POD) for the Atlantic Rim Interim Drilling Project. Wells in the Project Area would be located 8 miles southwest of Rawlins, Wyoming, along Carbon County Road 605 (Twentymile Road), which intersects Interstate 80 (I-80) near Rawlins.

The Project Area lies within the Great Divide Basin. The Continental Divide splits around the Great Divide Basin, and isolates it as a closed basin. Therefore, any water entering the basin is contained within it.

A water management plan (WMP) must be prepared and approved for each individual POD under the Atlantic Rim interim drilling policy. This WMP for the Red Rim POD addresses handling of produced water during testing and production of the Red Rim gas wells. This project consists of nine proposed exploratory wells and seven existing wells. Of the nine proposed well locations, five would be on surface ownership lands administered by the Bureau of Land Management (BLM) Rawlins Field Office (RFO) and would develop federal minerals. One proposed well would be located on surface ownership lands administered by the RFO and would develop minerals owned by the State of Wyoming. The remaining proposed wells (three) would be located on fee lands and would develop fee minerals. There are currently seven gas wells on fee surface and minerals in the Red Rim Project Area that are existing or authorized. **Table D-1** summarizes the existing and proposed wells addressed in this WMP and will be updated if the Companies propose additional development.

Under alternative 1, all produced water from these wells would be discharged to ephemeral tributaries of Hadsell Draw on fee lands within the closed Great Divide Basin. Under alternative 2 waters from the federal leases would be re-injected (about 32% of the produced water) and water from fee and state leases would be surface discharged under both alternative 2 and 3. Under all alternatives, surface discharge of produced water would comply with terms, conditions, and monitoring requirements of a National Pollutant Discharge Elimination System (NPDES) permit issued by the Wyoming Department of Environmental Quality (WDEQ).

TABLE D-1 RED RIM PROJECT

Proposed Gas Wells			
Lease Number	Well Name	Well Number	Location
WYW-149261	AR Federal ¹	2089 NE20	T20N R89W Section 20 NENE
	AR Federal ¹	2089 SE20	T20N R89W Section 20 SESE
	AR Federal ¹	2089 SW20	T20N R89W Section 20 SWSW
WYW-150410	AR Federal ¹	2089 NW28	T20N R89W Section 28 SENW
	AR Federal ¹	2089 NE28	T20N R89W Section 28 NWNE
FEE/STATE LEASES	AR Fee	2089 NE16	T20N R89W Section 16 SWNE
	AR Fee	2089 SW16	T20N R89W Section 16 NESW
	AR State ¹	2089 SE16	T20N R89W Section 16 NWSE
	AR Fee	2089 NE29	T20N R89W Section 29 NENE
Existing or Authorized Gas Wells²			
Lease Information	Well Name	Well Number	Location
FEE LEASES	AR Fee	2089 NE21	T20N R89W Section 21 NENE
	AR Fee	2089 NW 21	T20N R89W Section 21 NENW
	AR Fee	2089 SW21	T20N R89W Section 21 NESW
	AR Fee	2089 SE21	T20N R89W Section 21 NESE
	AR Fee	2089 NW29	T20N R89W Section 29 SENW
	AR Fee	2089 SW29	T20N R89W Section 29 SWSW
	AR Fee	2089 SE29	T20N R89W Section 29 SESE
Proposed Injection Well			
FEE LEASE	AR Fee	29I	T20N R89W Section 29 NENE
Existing or Authorized Injection Well			
FEE LEASE	AR Fee	21I	T20N R89W Section 21 NENE
Proposed Facilities²			
FEE LEASE	Conditioning Facility	Bountiful	T20N R89W Section 29 NENE
FEE LEASE	Outfall	Bountiful 001 (RR-D1)	T20N R89W Section 29 SWNE
Existing or Authorized Facilities³			
Lease Information	Site Type	Name	Location
FEE LEASE	Conditioning Facility	Abundance	T20N R89W Section 21 NENE
FEE LEASE	Outfall	Abundance 002 (RR-D2)	T20N R89W Section 21 NENE
FEE LEASE	Outfall	Abundance 003 (RR-D3)	T20N R89W Section 21 NENE
FEE LEASE	Compressor Station	Red Rim	T20N R89W Section 21 SESE

Note: ¹ BLM surface ownership lands

² Facilities requiring authorization from BLM prior to construction under alternatives 2.

³ Facilities requiring no authorization from BLM prior to construction or development under all alternatives.

DESCRIPTION OF WATERSHED

The Project Area is located within the Great Divide Closed Basin, Hydrologic Unit Code (HUC) 14040200. Surface waters near the Project Area include the ephemeral to intermittent Separation Creek, ephemeral tributaries including Hadsell Draw, and several unnamed ephemeral channels and constructed ponds.

The drainage area of Hadsell Draw is 27 square miles. The average slope is between 4 to 6 percent throughout this low-gradient drainage basin. This drainage consists of undisturbed rangeland and is grazed at different times of the year by domestic livestock and resident wildlife. A mixture of sagebrush and native grasslands characterizes the drainage basin. Hadsell Draw is a sinuous, well-defined, and vegetated channel. The tributaries — Bountiful and Abundance — are less sinuous than the main stem and are characterized by vegetated channels. The floodplain and tributary system of Hadsell Draw is well developed, with no observed significant erosion features along established channels (i.e. headcuts greater than 1ft. in drop).

The first major tributary to Hadsell Draw is Abundance Tributary, and the second is Bountiful Tributary. The drainage area is 3.55 square miles for the Abundance Tributary and 0.93 miles for the Bountiful Tributary. The average slope is between 5 to 7 percent throughout the low-gradient drainage basin of Abundance Tributary, and the average slope is between 7 to 9 percent for Bountiful Tributary. The drainages consist of mostly undisturbed rangeland, grazed at different times of the year by domestic livestock and resident wildlife. A mixture of sagebrush and native grasslands characterizes each drainage basin. Abundance and Bountiful Tributaries exhibit sinuous, and vegetated channels, whereas side channels to these tributaries are not sinuous, although they are vegetated. The floodplain and tributary systems are well developed, with no significant erosion features (i.e. headcuts greater than 1ft. in drop) along established channels. However, there are many small erosional features due to grade changes in the channel or lateral adjustments.

There are no designated floodplains within the Project Area. No wetlands have been identified within the Project Area. The principal riparian habitat consists of a narrow band of vegetation along intermittent Hadsell Draw and its tributaries. This vegetation is mostly moisture tolerant grasses, sedges and rushes. Land use within and adjacent to the Project Area includes cattle grazing, wildlife habitat, oil and gas exploration, and dispersed outdoor recreation.

The average annual total precipitation collected at Rawlins, Wyoming from March 6, 1951, to March 31, 2003, is 9.2 inches (WRCC 2003). Precipitation is greatest during the summer, although minor peaks occur in April, May, and October.

PRODUCED WATER DISPOSAL

Three discharge points are proposed for the water produced from the Red Rim wells, with two located on Abundance Tributary and one on Bountiful Tributary. The proposed discharge points are shown in Figure 2-1 of the EA (Project Map). Data from the nearby existing wells indicate an average maximum flow rate per well of 32 gallons per minute (gpm). All calculations for this WMP therefore assume an average flow rate of 32 gpm for each well. It is further assumed that all wells in the Project Area will produce similar flow rates. A tabulation of the approximate existing, proposed, and potential discharges within Hadsell Draw is shown in **Table D-2**. The wells proposed in the Project Area would be piped to the discharge points proposed in the Companies' National Pollutant Discharge Elimination System (NPDES) permit application. Flow rates for Hadsell Draw and its tributaries may vary at different times of the year, and the figures presented are best estimates for the outfalls. The wells in the Project Area addressed in this WMP will add approximately 1.14 cubic feet per second (cfs) to the natural channel of Hadsell Draw under alternative 1 and 0.78 cfs under alternatives 2 and 3. Under full development, reasonably foreseeable future actions in the Red Rim POD could include a total of 24 wells. The flow estimated for the full development scenario in the Hadsell Draw watershed is 1.71 cfs for alternative 1 and 1.16 cfs for alternative 2 and 3, assuming the same distribution of federal leases and other leases.

TABLE D-2 EXISTING AND PROPOSED DISCHARGE

Watershed Name	Number of Existing or Authorized Gas Wells	Number of Proposed Gas Wells¹	Possible Maximum Number of Gas Wells²	Existing and Proposed Discharge (gpm)	Maximum Discharge with Watershed Development³ (gpm)
Bountiful Tributary to Hadsell Draw (Outfall RR-D1)	3	3	7	192	224
Abundance Tributary to Hadsell Draw (Outfalls RR-D2 or RR-D3)	4	6	17	320	544
Total Discharge to Hadsell Draw	7	9	24	512	768

¹Wells may be connected to more than one discharge, increasing the total number of proposed wells discharging to a specific outfall.

²Based on a maximum of 24 wells per POD under the interim drilling policy.

³Discharge from maximum development of the Red Rim POD.

Stormwater discharges during construction would be managed in accordance with a stormwater permit issued by the WDEQ.

BENEFICIAL USE OF PRODUCED WATER

Produced water from the Red Rim wells could be available for potential beneficial use on the landowner's ranch. The landowner's priority is to provide additional watering facilities for various livestock and wildlife on the ranch. The Companies have therefore agreed to install five stock tanks at various locations around the ranch. The location of these stock tanks is illustrated in Figure 2-1 of the EA (Project Map). A stock tank will be installed at each outfall, and will be allowed to overflow to the ephemeral drainages in accordance with an approved NPDES permit. The remaining two dispersed stock tanks, located northeast of the proposed AR State 2089 NE 16 well, and south of the proposed AR Federal 2089 NE 28 well, will contain a small portion of the water produced from gas wells (about 8.1 acre-feet/year per well) for use by livestock and wildlife. This water will be piped into tire tanks with shut-off valves that would not discharge produced water onto the surface at these locations.

In addition to installing the stock tanks, the Companies have agreed to permit and upgrade an existing reservoir. Abundance Reservoir, located in the NESE of Section 16 in T20N R89W will be upgraded with an outlet structure and permitted through the Wyoming State Engineers Office (WSEO) as a stock pond. The reservoir will be designed in accordance with WSEO standards to accommodate the proposed discharge from the wells. This reservoir is discussed in detail in a later section.

Produced water may be utilized as make-up water for nearby drilling and completion operations. Any water produced during drilling or well completing would be contained on each drilling location in the reserve pit. During well testing, water produced from the Mesaverde aquifer will be collected on location in closed tanks and trucked to an authorized disposal facility until authorized disposal facilities (NPDES outfalls and injection wells) are operational.

All waters used to test the integrity of the gas gathering pipelines will be injected into an authorized water disposal facility in compliance with all applicable requirements.

Dust abatement will comply with all applicable WOGCC requirements. Only water suitable for livestock use would be used for dust abatement.

HYDROLOGIC ANALYSIS OF WATERSHED

Hadsell Draw and Abundance and Bountiful Tributaries are ephemeral drainages that flow mostly in response to precipitation and snowmelt. These streams are supplemented by bedrock discharge but do not maintain a quantifiable baseflow.

Peak flow for Hadsell Draw and Abundance and Bountiful Tributaries were calculated using regression equations developed by the USGS Miller (2003) and H.W. Lowham (1988). These equations relate physical and climatic characteristics of the drainages to flow characteristics of gaged streams, and provide a tool for estimating mean annual and peak flow in drainages where gaging data are not available. Due to a lack of measured flow data for these ephemeral drainages, it is difficult to make flood flow comparisons other than empirically. Flow monitoring, the establishment of permanent cross-sections and field verification of channel morphology described in **Attachment 6** will be employed to more accurately characterize peak flows in these drainages.

Calculated values for the 2-year, 5-year, 10-year, 25-year, 50-year and 100-year 24-hour storm events, as well as mean annual flow for Hadsell Draw, Abundance Tributary, and Bountiful Tributary were tabulated and are represented in **Table D-3**. The flow estimates calculated and the hydrologic and geomorphic characteristics of these drainages are provided in **Attachment 1**.

TABLE D-3 ANALYSIS OF PEAK FLOW

Drainage	Recurrence Interval (years)	Peak Discharge (cfs) 95% Confidence Intervals (low, high)
<i>Hadsell Draw</i>	2	100 (29, 342)
Mean Annual Flow = 0.54 cfs	5	249 (82, 759)
= 388.2 ac-ft/yr	10	395 (133, 1177)
	25	631 (209, 1907)
	50	845 (270, 2644)
	100	1088 (331, 3579)
<i>Abundance Tributary to Hadsell Draw</i>	2	29 (8, 100)
Mean Annual Flow = 0.09 cfs	5	79 (26, 240)
= 65.3 ac-ft/yr	10	131 (44, 390)
	25	220 (73, 664)
	50	304 (97, 951)
	100	403 (123, 1327)
<i>Bountiful Tributary to Hadsell Draw</i>	2	13 (4, 44)
Mean Annual Flow = 0.03 cfs	5	37 (12, 112)
= 20.0 ac-ft/yr	10	63 (21, 188)
	25	110 (36, 351)
	50	155 (49, 484)
	100	210 (64, 689)

REPRESENTATIVE ANALYSIS OF WATER QUALITY

A complete laboratory analysis of a sample from a representative gas well discharge is included in **Attachment 2**. This sample was collected from a fee well in the SE quarter of Section 9 in T18N R89W. This analysis indicates a relatively low level of total dissolved solids (TDS) (1,028 milligrams per liter [mg/L]) for discharge waters; the pH is higher than average, or slightly alkaline (8.50). The presence of sulfates (28 mg/L), chlorides (59 mg/L), and radium (0.45 picocuries per liter [pCi/L]) were minimal, while total petroleum hydrocarbons (TPH) were undetectable. Concentrations of lead at 5.5 micrograms per liter ($\mu\text{g/L}$) and zinc at 141 $\mu\text{g/L}$ are relatively high and will be monitored after the water is discharged from the conditioning process discussed in the next section.

OVERVIEW AND PREDICTED RESULTS OF WATER CONDITIONING

The analysis of water samples shown in **Attachment 2** is typical of the quality of water produced by wells completed in the Mesaverde coals within the Atlantic Rim area. The water typically varies in concentrations for key constituents, as shown in **Table D-4**.

TABLE D-4 RANGE OF CONSTITUENTS IN RAW WATER

Constituent/Quality	Range of Values
Barium, $\mu\text{g/L}$	235 – 2,400
Sodium, mg/L	439 – 900
Calcium, mg/L	4 – 34
Magnesium, mg/L	5 – 18
Electrical Conductivity (EC), $\mu\text{mhos/cm}$	1,800 – 3,800
Total Dissolved Solids (TDS), mg/L	1,000 – 1,800
Sodium Adsorption Ratio (SAR), unitless	21 - 50

Notes: $\mu\text{g/L}$ = micrograms per liter
 mg/L = milligrams per liter
 $\mu\text{mhos/cm}$ = microhmos per centimeter

In general, the quality of the produced water that the Companies envision under the project meets WDEQ guidelines for livestock and wildlife watering. The Companies propose to condition the produced water to irrigation-quality water, which, when surface discharged, may enhance natural infiltration.

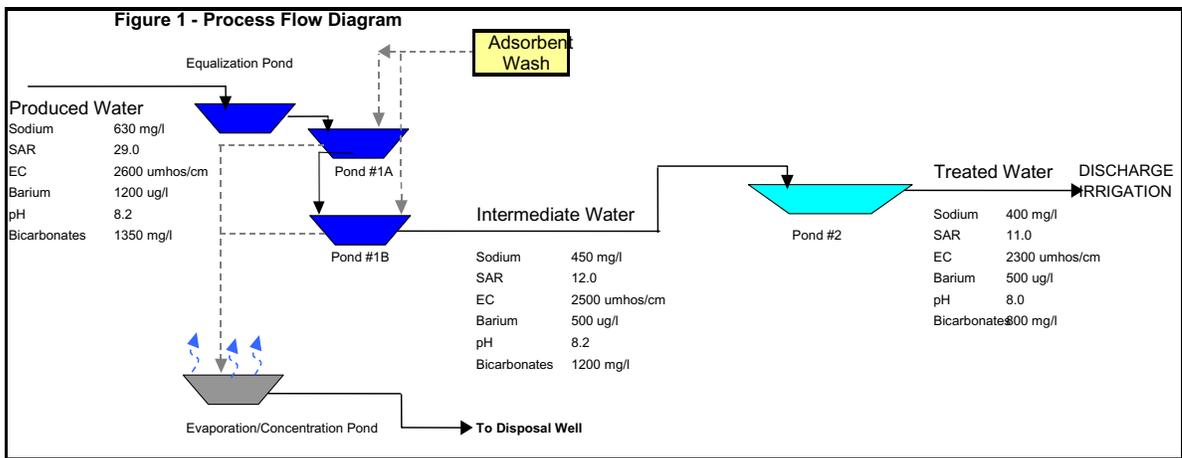
A proprietary process will be used to condition the water to irrigation quality. This water conditioning facility would be non-commercial; therefore, the ponds used for conditioning produced water will be permitted through the BLM, WSEO, or the WOGCC, as appropriate. The process is natural mineral-based and minimizes the use of mechanical equipment, does not operate under high pressure, has no potentially harmful chemical additives, and can condition the water to irrigation quality economically. Because of the potential proprietary nature of the process, its description is limited. This process will be the first full-scale application of its kind in the Atlantic Rim EIS study area and will require extra attention to minimize start-up problems and allow for scale-up of pilot tests.

Two water conditioning facilities will be constructed on fee lands in the Project Area under alternative 1. The Abundance Treatment Site will be located in the NENE of Section 21 in T20N R89W, and the Bountiful Treatment Site will be located in the SWNE of Section 29 in T20N R89W. Each site will discharge to one of the three outfalls described earlier. Under alternative 2 and 3 the Bountiful Treatment Site and outfall may not be needed with the lower volume of produced water. The Companies will notify the BLM if produced water volumes require the use of the Bountiful Treatment Site and outfall under alternative 2.

The conditioning process consists of two parts. The first part uses naturally occurring materials to act as an adsorbent of sodium ions, metals, and other cations while allowing the water and anions to pass through. The second part uses aeration to reduce the concentration of bicarbonates and increase the irrigation quality of the water. This process is described in greater detail below.

A process flow diagram is shown in **Figure D-1**. The produced water is routed to an equalization pond that creates a buffer on the process for the inlet volume. From the equalization pond, water is routed to Pond #1A and on to Pond #1B, which is operated in series with Pond #1A. Pond #1A reduces the concentration of sodium and increases concentrations of calcium and magnesium in the water. Pond #1B further reduces the concentration of sodium while also reducing concentrations of anions, and particularly of bicarbonates. Throughout Ponds #1A and #1B, the concentrations of certain metals such as arsenic, radium, and barium are reduced, if they are present in the water. There will be no designated or beneficial uses of the water contained in the equalization pond or in Ponds #1A or #1B.

Figure D-1 Process Flow Diagram



The effluent from the first set of ponds is then routed to Pond #2 (refer to **Figure D-1**). In the second process, the water is allowed to aerate and oxidize bicarbonates, reducing the concentration of bicarbonate ions in the water. The reduction in bicarbonates should reduce the EC and TDS of the water from the intermediate step. At some time, the Companies may allow for enhanced aeration via mechanical processes. However, the Companies initially intend to allow a natural process to occur in Pond #2, but may add

equipment as necessary to achieve the required results. Additional equipment needed to enhance aeration of the system will be permitted through the appropriate state or federal agency and will be designed to meet the standards required for operation.

The effluent from Pond #2 will be considered irrigation-quality water with the range of characteristics as shown in **Table D-5**. The ranges shown for each characteristic or constituent of the water are independent of the other constituents listed in **Table D-5**. For example, the high values for concentrations of calcium, magnesium, and sodium do not correlate to the high value of the range of possible SAR values.

TABLE D-5 RANGE OF CHARACTERISTICS FOR CONDITIONED WATER

Constituent/Quality	Range of Values
Barium, µg/L	100 – 500
Sodium, mg/L	300 – 450
Calcium, mg/L	20 – 120
Magnesium, mg/L	20 – 40
Electrical Conductivity (EC), µmhos/cm	2,000 – 2,800
Total Dissolved Solids (TDS), mg/L	1,000 – 1,800
Sodium Adsorption Ratio (SAR), unitless	9.0 - 12

Notes: µg/L = micrograms per liter
 mg/L = milligrams per liter
 µmhos/cm = microhmos per centimeter

Periodically and as needed, Ponds #1A and #1B will be washed with a modifying solution to regenerate their conditioning ability. The wastewater from a pond wash will be a concentrated brine solution that will be stored in the evaporation/concentration pond. This concentrated brine will be approximately 2 to 3 percent of the inlet volume. Thus, for a conditioning site operating at 15,000 barrels per day (BPD) (439.5 gallons per minute [gpm]), approximately 300 BPD of concentrated brine will be routed to the evaporation/concentration pond. There will be no designated or beneficial uses of the water contained in this pond. Instead, water from the evaporation/concentration pond will be injected into one of two injection wells being permitted as part of the Application for Permit to Drill (APD) process.

All ponds in the process will be engineered and constructed by qualified contractors that are bonded in the State of Wyoming. The evaporation/concentration pond will be lined with a single layer of 60-mil high-density polyethylene (HDPE) to prevent any loss of fluid to shallow aquifers or surrounding soils. Ponds #1A and #1B will also be lined with a single layer of 60-mil HDPE to prevent loss of the conditioning medium. Pond #2 will be an unlined, open earthen pond. Because of the pond design and its longer retention time, higher infiltration and evapotranspiration rates through Pond #2 are anticipated. Water from Pond #2 will flow to either Outfall RR-D1 on the Bountiful Tributary or to Outfalls RR-D2 and RR-D3 on the Abundance Tributary.

The evaporation/concentration pond will be large enough to store brine solution for a number of weeks. The brine solution will be disposed of in either of two saltwater injection wells currently being permitted by the Companies. The AR Fee 21I well located in NENE of Section 21 in T20N R89W and the AR Fee 29I well located in the NWNE of Section 29 in T20N R89W will be permitted as water injection wells and will

manage the majority of the concentrated brine for disposal. At some point, the evaporation/concentration pond will be allowed to dry, and all remaining solids will be disposed of at a certified disposal facility.

The results of the initial pilot plant testing for this conditioning process are included in **Attachment 3**. This pilot testing used water samples from the Sun Dog POD gas wells, which are currently producing. The water samples collected from various points in the Sun Dog system are also produced from the Mesaverde coal seams. The characteristics of the unconditioned water are listed in each table in the row marked "RAW #1" or "RAW #2." Certain critical characteristics of the water were tracked versus retention time for the process, and the results are shown in the subsequent rows of each test below the row labeled "RAW." As shown, in both pilot tests, SAR was reduced to below 9 and EC was reduced below 2,900 $\mu\text{mhos/cm}$. Both tests used water from wells completed in the Mesaverde coals; similar tests used other produced waters of varying qualities, with comparable results.

DESCRIPTIONS OF FACILITIES

Multiple facilities will be installed or upgraded in the Hadsell Draw, Abundance, and Bountiful drainages to manage potential water discharges and naturally occurring storm events, depending on the alternative selected. These facilities include three proposed outfall structures, two proposed injection wells, an existing reservoir, two conditioning facilities, 27 proposed culverts, and five stock watering facilities. Each facility is explained below and is illustrated on Figure 2-1 of the EA (Project Map).

OUTFALLS

The proposed outfall structures listed in **Table D-6** for discharge of produced water will be installed in three locations on fee lands in Hadsell Draw, under alternative 1. The locations of the outfalls were determined in consultation with the landowner. Furthermore, outfall locations were selected in accordance with the proposed NPDES permit application and the WDEQ's preference for minimizing the amount of water that would discharge to a given channel section, thereby reducing localized erosion. If the water production from the proposed wells is less than anticipated, the Companies may elect not to construct one of the outfalls in Section 21. The outfall in Bountiful Tributary may not be necessary under alternatives 2 or 3.

Outfalls will be located in stable, well-developed, low-gradient channels or as close as possible to the main stem to minimize surface erosion. Each outfall will consist of a vertical discharge pipe set inside a rubber tire stock tank surrounded by a scoria or rock riprap pad. A drain will be set in a suitable scoria or rock trench that slopes to the channel bottom to prevent discharged water from eroding the channel bank. The design of the outfall is illustrated in **Attachment 4**. Energy dissipation devices will be incorporated into the outfall structure to further dissipate discharged water and decrease the probability of erosion.

Produced water will be conditioned and then discharged through outfalls RR-D1, RR-D2, and RR-D3 to Abundance and Bountiful Tributaries, under alternative 1. Two outfalls will be used to help distribute and manage the effluent flows and reduce the potential for erosion in Abundance Tributary. Under alternative 2, the Bountiful outfall and treatment facility would not be constructed without BLM notification and a change to the decision record. Under alternatives 1 and 3 the Bountiful outfall and treatment facility would be constructed at the discretion of the Companies.

TABLE D-6 OUTFALL LOCATIONS AND CONTRIBUTING WELLS

Outfall	RR-D1	RR-D2	RR-D3
Location	T20N R89W Sec 29 SWNE	T20N R89W Sec 21 NENE	T20N R89W Sec 21 NENE
Contributing Wells	AR Fee 2089 SE 29	AR Federal 2089 SW 20	AR Federal 2089 SW 20
	AR Fee 2089 SW 29	AR Federal 2089 SE 20	AR Federal 2089 SE 20
	AR Fee 2089 NW 29	AR Federal 2089 NE 20	AR Federal 2089 NE 20
	AR Fee 2089 NE 29	AR Fee 2089 NE 21	AR Fee 2089 NE 21
	AR Federal 2089 NW 28	AR Fee 2089 SE 21	AR Fee 2089 SE 21
	AR Federal 2089 NE 28	AR Fee 2089 NW 21	AR Fee 2089 NW 21
		AR Fee 2089 SW 21	AR Fee 2089 SW 21
		AR State 2089 SW 16	AR State 2089 SW 16
		AR State 2089 NE 16	AR State 2089 NE 16
		AR State 2089 SE 16	AR State 2089 SE 16

WATER INJECTION WELLS

Two water injection wells, AR Fee 21I, located in the NENE of Section 21 in T20N R89W, and AR Fee 29I, located in the NWNE of Section 29 in T20N R89W, will be used for disposal of the concentrated brine solution created during the water conditioning process or for untreated waters as needed. These two injection wells will dispose of the majority of the concentrated brine solution. All water disposal plans will be permitted with the applicable State agency regulating these facilities, including but not limited to the WOGCC or WDEQ.

At each injection facility, centrifugal pumps, reciprocating pumps, filter systems, and tanks will be used to remove solids from the waste stream and to pump the waste water to pressures sufficient to allow downhole disposal of the water. The minimum capacity of each injection well is 5,000 BPD. The total produced water for the existing and proposed project before treatment would be 23,400 BPD (approximately 15,920 BPD from state and fee and 7,480 BPD from federal leases). The maximum discharge considering potential future development in the watershed would be 35,100 BPD. Of this water 2-3 % will need to be injected as a brine solution, leaving approximately 9,400 BPD available for injection of other water or 9,100 BPD for the future development scenario. Therefore, under alternative 1 the injection wells would be sufficient for water disposal from federal leases.

The injection targets for each injection well are the Hatfield, Cherokee and Deep Creek Sandstones, located approximately 5,965 to 6,335 feet below the surface. These injection wells are stratigraphically below the coal zones being explored. These sandstones are isolated above and below by competent shale barriers that would prevent initiation and propagation of fractures through overlying strata to any zones of fresh water. Maximum pressure requirements for the injection zone would be established through injectivity tests that would identify fracture pressure limits to prevent the overlying shale from being breached by fractures. Injection horizons will not be exceeded based on injectivity tests and applicable permit limits, as requested by the State of Wyoming and BLM.

The injection wells will be drilled, cased, and cemented from total depth (50 feet below the base of the Hatfield, Cherokee and/or Deep Creek Sandstone) to the surface. The injection horizon will be tested to determine its suitability for water disposal prior to any injection activities. The open-hole log and injectivity test will be provided to all necessary agencies. Also, prior to injection of the concentrated brine solution, a water analysis from the injection horizon will be obtained and provided to all necessary agencies.

RESERVOIRS

There are no existing permitted reservoirs in the Project Area, according to a recent search of the WSEO database (see **Attachment 5**). Two existing reservoirs may be affected by discharge in the Project Area, however the Espy reservoir will not receive surface discharges during low flow conditions (July – March), discharge will however add to natural flows that may reach this reservoir during storm events during the low flow period.. These reservoirs and associated data are presented in **Table D-7** below. Mean annual flow has been estimated for each of these reservoirs and does not consider the storage effects from upstream reservoirs.

TABLE D-7 RESERVOIRS

Reservoir Information	Abundance	Espy
WY SEO Permit #	N/A	N/A
Location	NESE Sec 16, T20N, R89W	NESE Sec 3, T20N, R89W
Structural Condition	Poor	Poor
Capacity (ac-ft)	<5	5-10
Basin Area (mi ²)	1.83	N/A
Mean Annual Flow (ac-ft)	54.9	N/A
Average Maximum Discharge (gpm)	585	N/A
Crest Length (feet)	472	300
Width (feet)	449	150
Depth (feet)	5	10
Outflow Pipe	Yes	No
Spillway	Earthen	None

These reservoirs were examined during field reconnaissance and showed signs of significant deterioration or failures.

To accommodate discharge from the Red Rim wells, Abundance Reservoir will require modification and upgrade by installing a drop-inlet spillway structure (an agri-drain). This modification will enable the reservoir to better manage additional flows and to comply with newly established WSEO permitting requirements that are specific to water produced during recovery of natural gas. Abundance Reservoir will be permitted as a stock reservoir in accordance with the pertinent requirements of WSEO. In the reservoir design, the WSEO generally requires a minimum of 2 feet of freeboard, and inside embankments no steeper than 3:1 (horizontal:vertical). Furthermore, the reservoir must be equipped with a controllable low-level outlet pipe to allow for proper regulation. For stock watering purposes, the reservoir will be less than 20 acre-feet in capacity and the

dam height will be less than 20 feet. A copy of the approved WSEO permit will be provided to the BLM for their files when available.

Espy Reservoir is an on-channel reservoir located within Hadsell Draw. The Companies do not propose any modifications to this reservoir. Produced water flows are not expected to reach this reservoir (located in section 3 of T20N R89W) during low flow conditions (July – March typically, defined for analysis as the period where the channel would under natural flow conditions be dry). However, natural flows may reach this reservoir in response to large rainstorms during the low flow period, and these flows will be augmented by surface discharges. Produced water will be managed accordingly using deep well injection as necessary to ensure that flows do not reach this reservoir during low flow conditions. Deep injection will only be used if flows are making it to the reservoir during low flow conditions. If additional injection wells are needed to manage these discharges they will be added and permitted as necessary.

CONDITIONING FACILITIES

Two water conditioning facilities will be installed on fee lands in the Red Rim Project Area, under alternative 1. Under alternative 2 it is likely that the Bountiful treatment facility and outfall wouldn't be needed. The area covered by each conditioning facility is expected to be 365 feet long by 300 feet wide. Both conditioning facilities will be fenced to limit access by livestock.

It is anticipated that the conditioning ponds will be used for the length of time that the wells described in this WMP produce, plus the length of time for production of other wells added to the conditioning facility. When production of the gas wells is complete, all zeolite materials from the ponds, and the liquid and solid materials in the ponds will be disposed of in accordance with all applicable permit requirements, standards, and regulations. The Companies will seek surface owner approval and provide BLM with design drawings/layout of the Bountiful water conditioning facility. All ponds and disturbed areas will be filled, covered, and remediated per WOGCC and BLM requirements.

RESERVE PITS

Temporary reserve pits would be constructed at each drill location to contain drilling fluids and initial pressure testing. These pits would be reclaimed after well completion operations and no discharge of produced water would occur in these pits after the initial well completion operations. The Companies estimate that each reserve pit would be open for 2 to 8 weeks to allow pit fluids to evaporate.

The reserve pits would be constructed in cut rather than fill materials. Fill material would be compacted and stabilized, as needed. The subsoil material of the pits would be inspected to assess stability and permeability and to evaluate whether reinforcement or lining would be required. If lining is required, the reserve pit would be lined with reinforced synthetic liner at least 12 mils thick and with a bursting strength of 175 by 175 pounds per inch (American Society for Testing and Materials [ASTM] Standard D

75179). Use of closed or semi-closed drilling systems would be considered in situations where a liner may be required.

Two feet of freeboard would be maintained in all reserve pits to ensure they are not in danger of overflowing. Drilling operations would be shut down if leakage is found outside the pit until the problem is corrected.

CULVERTS

The main access road and existing improved and unimproved roadways within the Project Area cross channels at existing culvert crossings. Some proposed road improvements will cross drainages and may require installation of culverts. The proposed roadway system uses existing improved roads and proposed locations that avoid channels where possible to minimize effects. If necessary, culverts will be a minimum of 18 inches in diameter and will be sized to adequately manage existing and potential flows. The proposed road culverts (27 total) are illustrated in Figure 2-1 of the EA (Project Map). These crossings will be monitored for adequate capacity and potential buildup of ice during the winter. Methods for culvert installation are described in the MSUP and in Chapter 2 of the Red Rim EA.

STOCK WATERING FACILITIES

Five stock tanks will be installed in the Project Area, as shown in Figure 2-1 of the EA (Project Map). A stock tank will be located at each of the three proposed outfalls, and will be designed to overflow and discharge to surface drainages. The other two stock tanks will be installed using a float valve to manage flows to the tanks and prevent discharge to the surface. All of these stock tanks will provide a source of water to livestock and resident wildlife.

EXISTING AND POTENTIAL EROSION

Surface disturbance associated with road construction, drilling, and installing pipelines or utilities could increase the potential for erosion and are discussed in the main body of the EA. The Companies would implement the mitigation measures described in Chapter 2 of the EA to control wind and water erosion at disturbed sites so that interim drilling and development in the Project Area would not affect surface drainages.

Increased surface water runoff and off-site sedimentation caused by soil disturbance, impairment to surface water quality, and changes in stream channel morphology may be caused by construction of roads, drill locations, and pipeline crossings. Construction would occur over a relatively short period, however. Impacts from construction would likely be greatest in the short term and would decrease over time as a result of stabilization, reclamation, and revegetation. Construction disturbance would not be uniformly distributed across the Project Area, but instead would be concentrated near the drill locations and access or utility routes.

The receiving channels of Hadsell Draw, Abundance Tributary, and Bountiful Tributary were inspected for erosional features and potential degradation. No significant erosion or potential erosion features were found. Although there are small erosional features that may be exacerbated by surface discharge, these will be evaluated during monitoring, as described in the Monitoring and Mitigation section. Hadsell Draw exhibits many pothole-type features that will fill and be submersed as the influence of discharge water progresses downstream. These potholes do not pose any significant potential for erosion and will be monitored during scheduled inspections and after major storm events. All channels will be monitored after discharges from federal wells as per BLM guidelines.

As described previously, outfalls will be located in stable, well-developed, low-gradient channels or as close as possible to the main stem to minimize surface erosion. Each outfall will consist of a vertical discharge pipe set inside a rubber tire stock tank surrounded by a scoria or rock riprap pad. A drain will be set in a suitable scoria or rock trench that slopes to the channel bottom to prevent discharged water from eroding the channel bank. Energy dissipation devices will be incorporated into the outfall structure to further dissipate discharged water and decrease the probability of erosion.

DOWNSTREAM IMPACTS

Continuous discharge to previously ephemeral drainages will cause native vegetation to undergo changes that could affect the stability of existing impoundments and natural channels. As these changes occur, native dryland grass communities will be most likely be replaced with wetland species that are more tolerant and characteristic of perennial flows. Bank stability may also improve with the transition to wetland species. Some wetland species are less desirable to domestic livestock and wildlife, however others may be preferentially grazed during normal operations. During this transition period, natural channels may appear to support more limited vegetative cover for a short period while wetland species become established. Vegetation will be monitored as described in the Monitoring and Mitigation section.

Surface drainages may be affected by increased flows from discharges of produced water where channels are not stable or armored. All channels that receive discharged water will be monitored for degradation, as described in the Monitoring and Mitigation section. Furthermore, the Companies will work with downstream landowners to mitigate potential problems with access by installing additional or modifying existing channel crossings.

Downstream impacts should be minimal since the discharge should not reach the reservoir on Handsell draw below the confluence with Abundance tributary (T20N R89W, Section 3) during low flow conditions. Discharges will add to the salt loading of the channel beds in the Handsell draw system. Salt loading will be monitored as described in the Monitoring and Mitigation section at the soil sample locations and actions taken as described.

MONITORING AND MITIGATION

Aquifers and groundwater quality are not anticipated to be affected by the project provided the mitigation measures that are described in Chapter 2 of the EA are implemented. A groundwater monitoring program is being established for the Atlantic Rim EIS study area, including one monitoring well located in the Red Rim Pod. Water from the Cherokee or Deep Creek Sandstones will be analyzed and the results provided to all necessary regulatory agencies before injection begins. It is anticipated that the produced water that would be injected would be of equal or higher quality in regard to class of use as defined by WDEQ Ground Water Division regulations.

Testing of CBNG resources likely would lower the hydraulic head in the affected coal seam aquifer. (The reduction of hydraulic head in an aquifer also is referred to as drawdown.) Relative to the available drawdown within the aquifer, the effect on the coal aquifer during the interim drilling project is expected to be small. BLM has requested that three to six groundwater monitoring wells be installed within the Atlantic Rim EIS study area during the interim drilling project. Two of these wells have been drilled and the third will be located at this pod. The effects of interim drilling and development on the coal aquifer, including drawdown, will be monitored by these wells and they will provide data for a groundwater model to look at potential impacts from alternatives in the EIS. Monitoring wells do not count toward the limit of 24 proposed wells in a POD under the Interim Drilling Policy.

The water level also may be lowered or drawn down in existing wells within the 1/2-mile radius of individual exploratory wells completed in the Mesaverde aquifer. The potential yield from the nearby water wells may be affected by removal of groundwater. Other wells completed in the coal seams could be affected by the project; however, no other wells permitted by the WSEO are known to occur within 1 mile of the Project Area. Potential effects on water wells would be minimized by a water well agreement, as described in the Master Surface Use Program (MSUP) ([Appendix B](#) of the EA) and the other mitigation measures described in Chapter 2 of the EA.

The Companies will initiate a monitoring plan for the receiving channels within the Project Area. The Companies will establish a set of baseline data of the physical and biological condition of the receiving channels, where applicable, and perform scheduled monitoring to assess the impact from flows of produced water. The Companies in coordination with the BLM will employ internal company resources as well as qualified third-party contractors to assist in acquiring baseline data and perform the monitoring. The monitoring and mitigation plan is described in detail below. The monitoring schedule is included in **Attachment 6**.

A. Baseline Data Acquisition

The Companies will collect data to evaluate the current conditions of soil, vegetation, and bank stability in the proposed receiving channels for the Red Rim wells. These data will form the baseline for initial channel conditions, and serve as a checkpoint for future monitoring to indicate both positive and negative changes in the physical and biological

condition of the receiving channels. A baseline data report including all data collected will be provided to the BLM after this effort is completed. Refer to **Attachment 6** for information on proposed monitoring points and timing.

1. *Soils* – The Companies will collect soil samples for laboratory analysis from areas that may be affected by proposed flow of water. Soil samples will be collected from the upper reaches of the Abundance and Bountiful Tributaries, and Hadsell Draw. Each location where a soil sample is collected will be recorded via global positioning system (GPS) so that samples can be collected at the same locations in the future during periodic monitoring. Proposed soil sample locations are shown on Figure 2-1 of the EA (Project Map). All soil samples will be analyzed, at a minimum, for pH, EC, SAR, texture, organic matter, and lime content. A subset of the surface soils, at the Companies' discretion, will be analyzed for clay mineralogy, boron, selenium, and molybdenum.

The Companies will walk the receiving channels and photo-document any natural seeps or conditions that have not experienced flow to date and that warrant further investigation. Each site will be recorded via GPS, and photos of the sites will be taken. These conditions may be, but are not limited to, naturally alkaline soil conditions, areas of limited vegetation growth, or soil anomalies.

2. *Vegetation* – The Companies will record vegetation present at each soil sample location discussed above. Vegetation species, type, and abundance will be recorded at each location. The Companies will also establish photo-monitoring points and use digital photography to document initial conditions of vegetation before flow of water commences. The Companies will set up photo-monitoring points along drainages where future discharges will occur and will take photographs before discharge begins. All photo-monitoring points will be recorded via GPS for continuous monitoring once discharge begins. These photos will document the initial density and quality of the vegetation in the receiving channels before flow of water begins.
3. *Channel Morphology* – The Companies will walk the proposed receiving drainages to photo-document and map any areas of possible instability in the channel or bank. The Companies will also install three flow-monitoring cross sections within the receiving channels to measure instantaneous flow of water downstream of the discharge points. These cross sections will be located on fee lands within Abundance and Bountiful Tributaries, and in Hadsell Draw downstream of the confluence with the two tributaries, as shown on Figure 2-1 of the EA (Project Map). The cross sections for flow monitoring will be established before water is expected to reach the drainages. Data collected at each cross section could be used to assess natural processes such as infiltration, and evapotranspiration, and allow comparison of how these processes are altered by continuous discharge of produced water. Furthermore, prior to

surface discharge, BLM may elect to install permanent flow measurement capabilities in Hadsell Draw.

B. Periodic Monitoring

The Companies will undertake an aggressive program to monitor many physical and biological parameters within the Red Rim Project Area to facilitate any necessary remedial actions. Data collected during periodic monitoring will be compared against initial baseline data, trended for statistical analysis, or compared with general academic or scientific studies. Summary reports including all data collected will be provided to the BLM annually. These comparisons will support evaluation of the effects of produced water on physical and biological changes that may be occurring in discharge drainages. Refer to **Attachment 6** for information on proposed monitor points and timing.

1. *Water Quality* – After this WMP for the Red Rim POD and associated NPDES permit are approved by the proper agencies and the Companies begin discharging water from the Red Rim wells, the Companies will collect water samples from various points associated with the project for chemical analysis. The Companies propose to sample water at the points listed below.

- ∅ All outfalls listed in **Table D-6**, assuming the outfall is active at the time of sampling.
- ∅ Any points of compliance (POCs) as established with WDEQ NPDES permit, if applicable.
- ∅ Hadsell Draw, at the confluence with Abundance Tributary, if flow reaches this point.

Initially, samples at these locations will be collected monthly for a period of 6 months after water begins to flow from the outfalls listed in **Table D-6**. After 6 months, the Companies will collect these samples at a frequency of not less than once every 3 months. Discharge or flow will be estimated when samples are taken from natural channels.

Each sample will be analyzed, at a minimum, for the constituents in **Table D-8**.

TABLE D-8 SAMPLE CONSTITUENT ANALYSIS

Total Petroleum Hydrocarbons	Dissolved Manganese
pH	Total Alkalinity
Specific Conductance	Calcium
Dissolved Iron	Magnesium
Total Barium	Sodium
Chlorides	Potassium
Sulfates	Bicarbonate
Total Arsenic	Fluoride
SAR	

2. *Produced Water-Related Flow* – Continuous flow rates will be recorded for each gas well after startup. In addition, flow meters or weir plates will be installed at outfalls to monitor the amount of water discharged into the tributaries of Hadsell Draw.
3. *Soils* – The Companies will collect soil samples from the points sampled and by the methods describe under the baseline data acquisition section. Samples will initially be analyzed annually for the first 2 years of the project, beginning when flow starts from the discharge points listed in **Table D-6**. After 2 years, soil samples will be collected at a minimum frequency of once every 2 years, with additional soil samples to be collected at the discretion of the Companies. Results for these soil samples will be used for comparison with baseline data to investigate the effect of produced water on soils. Refer to Figure 2-1 of the EA (Project Map) for proposed soil sample locations.
4. *Vegetation* – The Companies will use photo-documentation at the established photo-monitoring points along the receiving channels to record the growth and vigor of riparian species or zonation of other species. Vegetation species, type, and abundance will be recorded at the soil sampling locations. Initially, photos will be taken annually during the middle of each growing season. If the Companies determine that photo-documentation indicates that growth and vigor of riparian species is stable, photo-documentation will be conducted every other year.

The Companies will also walk the channels to record the vegetation present. This vegetation inventory will occur once per year, during the period between June and September, and will be conducted by qualified third-party experts or contractors. The Companies will use the photo-documentation and inventory to track changes in vegetation along the receiving channels and in the banks and alluvial swales immediately surrounding the channels.

5. *Channel Morphology* – The Companies will initiate periodic monitoring of the receiving channels to identify any negative impact on bank stability associated with discharge of produced water. Company personnel will visually inspect each discharge point on a monthly basis for the first year of flow from the discharge points listed in **Table D-6** and every 6 months in all subsequent years while discharge continues. Inspectors will note the condition of the outfall site, check for evidence of erosion downstream of any structures constructed for energy dissipation and will schedule any remedial work required at the outfalls.

Abundance Reservoir will be inspected quarterly and after a 25-year or larger storm event for the first year of operation after discharge begins from the points listed in **Table D-6**. Field personnel will check the reservoir on a bi-annual basis and after a 25-year or larger storm event

during each subsequent year. Inspectors will note the condition of the outlet pipe and spillway, check for evidence of erosion or deterioration, and schedule any remedial work required at the reservoir.

Company personnel and a qualified third-party contractor will walk the receiving channels associated with this project once each 6 months during the first 2 years after flow begins from the points located in **Table D-6**. Thereafter, Company personnel or a qualified third-party contractor will walk the receiving channels once per year and after any 25-year or larger storm events. Inspectors will note the condition of the channels, channel banks, and alluvial areas, check for evidence of erosion or instability, and schedule any remedial work required.

6. *Groundwater Monitoring Wells* – BLM has requested that three to six groundwater monitoring wells be installed within the Atlantic Rim EIS study area during the interim drilling project. One of these wells will be located in the Red Rim Project Area. The effects of interim drilling and development on the coal aquifer, including drawdown, will be monitored by these wells.

C. Data Distribution

1. *Baseline Data* – The Companies will deliver baseline data that have been collected on soil, vegetation, and channel morphology to the BLM within 90 days after the data are received. These data will include but not be limited to the following:

- ∅ Digital photos from photo-documentation
- ∅ Laboratory analysis of soil samples
- ∅ Maps showing soil and water sample locations
- ∅ Laboratory analysis for water samples
- ∅ Produced water flow
- ∅ Vegetation inventories
- ∅ Channel and Bank stability issue inventories

2. *Periodic Monitoring* – The Companies will deliver data associated with the periodic monitoring program, as outlined above, to the BLM within 90 days after the data are received. These data will include but not be limited to the following:

- ∅ Digital photos from photo-documentation points
- ∅ Laboratory analysis of soil samples
- ∅ Maps showing soil and water sample locations and areas of interest
- ∅ Results from channel walks noting vertical or lateral adjustments.
- ∅ Laboratory analysis for water samples
- ∅ Produced water flow

3. *Additional Reporting* – The Companies will also file with the BLM RFO any scope of work and results of studies on water discharge conducted by the Companies in conjunction with other regulatory, government, or academic agencies. These other bodies may include the University of Wyoming, the U.S. Environmental Protection Agency (EPA), WDEQ, Natural Resource Conservation Service (NRCS), U.S. Geologic Survey (USGS), or local conservation districts. The scope of work and results of these studies will be filed with BLM within 90 days after the Companies receive the documents. Under alternative 2, if the Bountiful treatment facility and outfall are needed the Companies will notify the BLM at least 3 months in advance.

D. Mitigation Plan

1. *Soils* – The Companies’ periodic monitoring of soil characteristics will be examined and evaluated for patterns or areas of concern that are not caused by traditional seasonal variation and significant storm events. Should the evaluations identify discharge as the source of accelerated channel erosion, the Companies will undertake remedial action for the soils, provided that the condition was not identified in the baseline data as previously existing. Mitigation techniques may include:

- ∄ Revegetate with saline tolerant species
- ∄ Treat soil
- ∄ Promote natural leaching after discharge has ended
- ∄ Remove saline or sodic soils

Before any remedial techniques are applied, the Companies will consult with BLM and other pertinent organizations to develop a mitigation strategy. Remediation methods may require approval of WDEQ or other regulatory agencies. Any necessary approvals will be obtained before remediation begins.

2. *Vegetation* – Vegetation species within the immediate area of the stream channels are likely to change as a result of the presence of continuous water flow. Given this change, the Companies will undertake remedial action if range conditions immediately adjacent to the zone of influence experience a detrimental effect from the produced water. The Companies will rely on the baseline information and periodic monitoring (photo-documentation and vegetative inventories) to identify potential changes in vegetation outside the zone of influence. The zone of influence is defined as areas within the drainage where discharged water and soil interact.

If a third-party expert in biology, in conjunction with the Companies, or a Range Specialist with the BLM concludes that a detrimental effect to vegetation is occurring outside the zone of influence, the Companies will undertake investigations in conjunction with BLM to identify the reasons.

Possible reasons for changes to vegetative communities outside the zone of influence could include, but would not be limited to:

- ∄ Changes in livestock stocking rates;
- ∄ Changes in grazing patterns (due to water availability);
- ∄ Changes in climate – short term or long term;
- ∄ Range fires

Mitigation measures for discharge-related effects might include:

- ∄ Changes in grazing management such as time and use or fencing
- ∄ Enhanced propagation of native riparian species
- ∄ Revegetation with saline-tolerant species
- ∄ Removal of saline soils

Before any remedial techniques are applied, the Companies will consult with BLM and other pertinent organizations to develop a mitigation strategy. Remediation methods may require approval of WDEQ or other regulatory agencies. Any necessary approvals will be obtained before remediation begins.

The monitoring program will also obtain data on a frequent basis that will evaluate the health of vegetation within the zone of influence. In addition to water quality concerns, health of the riparian zone depends on the volume of flow from produced water. As development matures, flows will decrease and riparian species will be replaced by species associated with upland dry soils. If a third-party expert in biology selected by the Companies or a BLM biologist concludes that a detrimental effect to riparian vegetation is occurring within the zone of influence, the Companies will undertake investigations in conjunction with BLM to identify the reasons. This expert would work in conjunction with the Companies, and detrimental effects would be other than any caused by reductions in flow. The Companies will undertake remedial action if it is determined that riparian species within the zone of influence experience a detrimental effect from the produced water so that stability of the channel is threatened.

Evaluation and mitigation of changes to vegetation within the zone of influence will include the same considerations listed above for changes to vegetation outside the zone of influence.

3. *Channel Morphology* – If, through evaluations, it becomes apparent that undue bank erosion or vertical or lateral channel adjustments can be attributed to discharges, the Companies will undertake immediate remedial actions. These actions may include, but will not be limited to:

- ∄ Channel stabilization including armoring or other low impact methods.

- ∄ Redirection of flows at the outfalls to reduce flow in the areas of concerns
- ∄ Installation of stabilization structures (Plans will be submitted to the BLM for review).
- ∄ Re-sloping, matting, and planting or seeding
- ∄ Installation of flow piping to bypass surface flow along areas of concern

4. *Future Sources of Water* – As the project nears the end of its expected operating life, the Companies will work with local landowners, BLM, and other affected parties to establish sources of water for livestock. Establishment of these sources of water may include, but will not be limited to, the following: transfer title and operation of water producing wells to private landowners; drill additional shallow groundwater wells; and place water troughs in appropriate locations. The Companies will work in good faith with local landowners and affected agencies on the financial and operational division of continuing these management practices.

E. Cooperation

The Companies will work cooperatively to assess the impact of produced water on biologic parameters. This assessment will occur in conjunction with organizations such as BLM, WDEQ Water Quality Division, WDEQ Air Quality Division, NRCS, USGS, University of Wyoming, EPA, U.S. Fish and Wildlife Service, Coalbed Methane Coordination Coalition, Joint Powers Board, Local Conservation Districts, and many other legitimate agencies and groups. The Companies will seek to provide assistance or site access to these agencies when appropriate for legitimate studies or monitoring of the biologic systems that surround the receiving channels associated with this project. The Companies, however, reserve all rights granted to it as a landowner and leaseholder in Carbon and Sweetwater County, Wyoming.

F. Summary

The Companies will initiate an aggressive monitoring plan of the receiving channels of the Project Area. The Companies will begin the monitoring plan by establishing a set of baseline data of the physical and biological condition of the receiving channels, where applicable. In addition, they will continue scheduled monitoring to assess the impact of water flows on these conditions. The Companies will employ internal company resources as well as reputable third-party contractors to assist in acquiring the baseline data and the monitoring plan. The monitoring plan includes the following details:

- ∄ Baseline Data Acquisition – Acquisition of necessary data to establish the current conditions of soils, vegetation, and channel morphology. Refer to **Attachment 6** for information on the proposed monitor points and timing.
- ∄ Periodic Monitoring – Continued monitoring of physical and biological conditions associated with discharge of produced water into receiving channels on land monitored by BLM, including water quality, soils, vegetation, and channel morphology. Refer to **Attachment 6** for information on proposed monitor points and timing.

- € Data Distribution – Distribution of all relevant data associated with the monitoring plan outlined to the BLM in a timely and efficient manner.
- € Mitigation – Measures that include trigger points and anticipated actions of the Companies to mitigate any detrimental effects associated with flow of produced water.
- € Cooperation –The Companies will cooperate with relevant agencies to continue to study the effects of discharge.

ATTACHMENT 1 –HYDROLOGIC ANALYSIS OF WATERSHED

Hydrologic Watershed Field Analysis Summary Sheet

POD Name: Red Rim

Watershed Involved: Hadsell Draw

Watershed Area (Miles²)	27.0
Average Watershed Slope (ft/mi)	348.4
Geographic Factor	0.8
Average Annual Precipitation (inches)	9.2

Existing Channel Information:

Average Bank Full Width (feet)	12
Average Channel Slope (feet/foot)	0.07
Average Channel Width (feet)	10
Average Channel Depth (feet)	2

General Channel Condition:

Channel condition is good. Main stem and tributaries are well defined and stable. No apparent head cuts.

Channel Vegetative Cover / Dominant Species:

The mainstem and tributaries of possess well vegetated channels primarily composed of a mixture of Sagebrush and Native grasses.

Mean Annual Flow (cfs)	0.54
Mean Annual Flow (Ac-ft/year)	388.2

Peak Flow Analysis:			
Recurrence Interval (Years)	Probability That Value will be Exceeded (Percent)	Peak Flow (cfs/Miles²)	Complete Basin Peak Flow (cfs) Lowham (1988)
2	0.5	4.4	117.5
5	0.2	10.1	272.6
10	0.1	15.6	420.7
25	0.04	24.6	665.4
50	0.02	32.6	880.4
100	0.01	42.1	1136.1

Hydrologic Watershed Field Analysis Summary Sheet

POD Name: Red Rim

Watershed Involved: Abundance Tributary to Hadsell Draw

Watershed Area (Miles²)	<u>3.6</u>
Average Watershed Slope (ft/mi)	<u>294.0</u>
Geographic Factor	<u>0.8</u>
Average Annual Precipitation (inches)	<u>9.2</u>

Existing Channel Information:

Average Bank Full Width (feet)	<u>15</u>
Average Channel Slope (feet/foot)	<u>0.06</u>
Average Channel Width (feet)	<u>N/A</u>
Average Channel Depth (feet)	<u>N/A</u>

General Channel Condition:

Channel condition is good. Main stem and tributaries are well defined and stable. No apparent head cuts.

Channel Vegetative Cover / Dominant Species:

The mainstem and tributaries of possess well vegetated channels primarily composed of a mixture of Sagebrush and Native grasses.

Mean Annual Flow (cfs) 0.09

Mean Annual Flow (Ac-ft/year) 65.3

Peak Flow Analysis:			
Recurrence Interval (Years)	Probability That Value will be Exceeded (Percent)	Peak Flow (cfs/Miles²)	Complete Basin Peak Flow (cfs) Lowham (1988)
2	0.5	11.7	41.5
5	0.2	28.5	101.6
10	0.1	44.8	159.5
25	0.04	73.4	261.3
50	0.02	98.9	352.0
100	0.01	129.8	462.2

Hydrologic Watershed Field Analysis Summary Sheet

POD Name: Red Rim

Watershed Involved: Bountiful Tributary to Hadsell Draw

Watershed Area (Miles²)	0.93
Average Watershed Slope (ft/mi)	473.2
Geographic Factor	0.8
Average Annual Precipitation (inches)	9.2

Existing Channel Information:

Average Bank Full Width (feet)	15
Average Channel Slope (feet/foot)	0.09
Average Channel Width (feet)	N/A
Average Channel Depth (feet)	N/A

General Channel Condition:

Channel condition is good. Main stem and tributaries are well defined and stable. No apparent head cuts.

Channel Vegetative Cover / Dominant Species:

The mainstem and tributaries of possess well vegetated channels primarily composed of a mixture of Sagebrush and Native grasses.

Mean Annual Flow (cfs)	0.03
Mean Annual Flow (Ac-ft/year)	20.0

Peak Flow Analysis:			
Recurrence Interval (Years)	Probability That Value will be Exceeded (Percent)	Peak Flow (cfs/Miles²)	Complete Basin Peak Flow (cfs) Lowham (1988)
2	0.5	20.8	19.3
5	0.2	52.9	49.2
10	0.1	84.1	78.2
25	0.04	141.5	131.6
50	0.02	193.0	179.5
100	0.01	256.8	238.8

ATTACHMENT 2 – WATER QUALITY ANALYSIS

Client: **PETROLEUM DEVELOPMENT CORP.**
 Sample ID: **AR Fee 1890 SE 9**
 Project ID: **Atlantic Rim POD 4**
 Laboratory ID: **P010657**

Date Sampled: 07/19/01
 Date Received: 07/20/01
 Date Reported: 08/10/01

ANALYTE	RESULT	DETECTION LIMIT	METHOD	DATE ANALYZED
Total Dissolved Solids	1028	5 mg/L	EPA 160.1	07/24/01
pH	8.5	0.1 s.u.	EPA 150.1	07/28/01
Bicarbonate	994	1 mg/L	EPA 310.1	07/28/01
Sulfate	28	5 mg/L	EPA 300.0	07/28/01
Fluoride	2	0.1 mg/L	EPA 300.0	07/28/01
Chloride	59	5 mg/L	EPA 300.0	07/28/01
Specific Conductance	1770	5 µmho/cm	EPA 120.1	07/25/01
Radium²²⁶	0.457 ± 0.235	0.2 pCi/L	EPA 903.0	07/31/01
Total Petroleum Hydrocarbons	< 1	1 mg/L	EPA 1664	08/05/01
Aluminum	< 50	50 µg/L	EPA 200.8	08/08/01
Total Antimony	< 5	5 µg/L	EPA 200.8	08/08/01
Total Arsenic	7.3	0.5 µg/L	EPA 200.8	08/08/01
Total Barium	235	100 µg/L	EPA 200.8	08/08/01
Total Beryllium	< 0.03	0.03 µg/L	EPA 200.8	08/08/01
Boron	0.4	0.1 mg/L	EPA 200.8	08/08/01
Cadmium	< 0.1	0.1 µg/L	EPA 200.8	08/08/01
Chromium	3	1 µg/L	EPA 200.8	08/08/01
Copper	6	1 µg/L	EPA 200.8	08/08/01
Cyanide (Total)	< 5	5 µg/L	EPA 335.2/3	08/01/01
Dissolved Iron	< 30	30 µg/L	EPA 236.2	08/06/01
Total Iron	1325	30 µg/L	EPA 236.2	08/06/01
Dissolved Manganese	35	10 µg/L	EPA 243.2	08/06/01
Total Manganese	53	10 µg/L	EPA 243.2	08/06/01
Nickel	11	10 µg/L	EPA 200.8	08/08/01
Lead	5.5	2 µg/L	EPA 200.8	08/08/01
Mercury	< 0.1	0.1 µg/L	EPA 245.1	08/07/01
Phenol	< 50	50 µg/L	EPA 420.1/2	08/10/01
Selenium	< 5	5 µg/L	EPA 200.8	08/08/01
Silver	< 3	3 µg/L	EPA 200.8	08/08/01
Total Thallium	< 10	10 µg/L	EPA 200.8	08/08/01
Zinc	141	10 µg/L	EPA 200.8	08/08/01
Total Hardness	33	10 mg CaCO₃/L	SM 2340 B.	07/31/01
Sodium	19.1	0.1 meq/L	EPA 273.1	07/31/01
Magnesium	0.4	0.1 meq/L	EPA 242.1	07/31/01
Calcium	0.2	0.1 meq/L	EPA 215.1	07/31/01
Sodium Adsorption Ratio	33.0			07/31/01

Comments:
References:

All analyses completed within EPA established holding times.
 Methods for Chemical Analysis of Water and Wastes, EPA/600/4-79-020, 1983
 Standard Methods for the Examination of Water and Wastewater, APHA, AWWA, WEF, 19th Ed., 1995

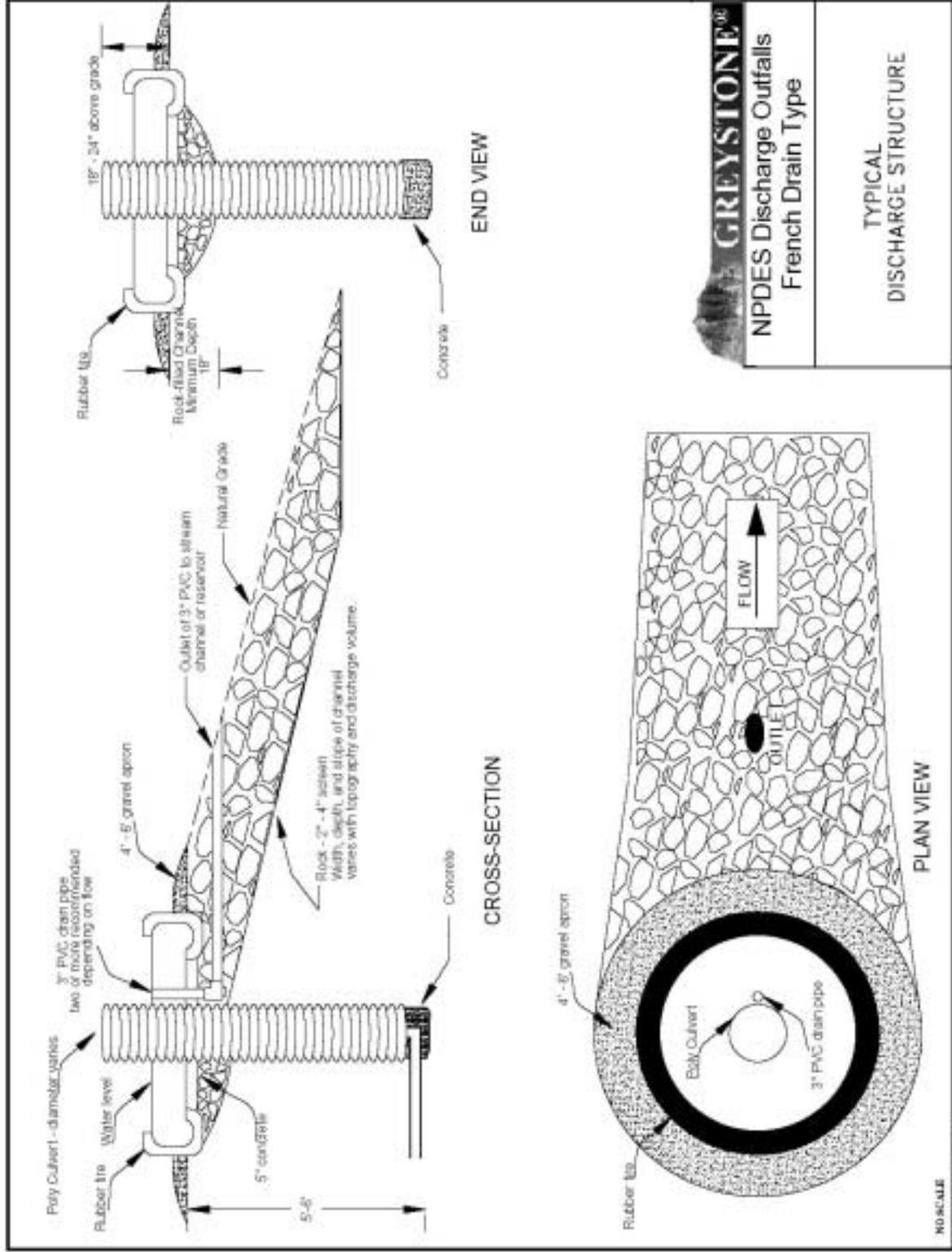
ATTACHMENT 3 – BENCH TEST RESULTS FOR WATER CONDITIONING

SUMMARY OF RESULTS FOR BENCH TEST OF WATER CONDITIONING

Prepared for: Anadarko Petroleum Corporation

Sample	Ca mg/L	Ca meq/l	Mg mg/L	Mg meq/l	Na mg/L	Na meq/l	SAR	EC mmhos	HCO3 mg/L	Ba µg/L	Fe mg/L
Raw #1	13.3	0.67	4.9	0.41	912	39.7	54.3	3840	1854	1180	ND
R1	30.2	1.51	136.5	11.38	699.2	30.4	12.16	4250	1177	230	ND
R2	12.6	0.63	128.9	10.74	544.1	23.66	9.9	4333	1678	173	ND
R3	12.2	0.61	118.8	9.9	532.1	23.13	10.06	3980	1880	136	ND
S1	101.5	5.08	43.6	3.63	433	18.83	8.96	2610	777	103	ND
S2	121.4	6.07	33.6	2.82	439.4	19.1	9.09	2590	679	125	ND
S3	98.7	4.94	12.8	1.07	489.8	21.3	12.3	2880	603	156	ND
Raw#2	21.2	1.06	6.1	0.51	689	38.65	43.5	3910	1899	1070	ND
R'1	18.8	0.94	122.2	10.18	619	26.91	11.4	4545	1808	221	ND
R'2	23.6	1.18	143.3	11.94	623.4	27.1	10.58	4214	1618	216	ND
R'3	12.9	0.65	116.6	9.72	518.2	22.53	9.88	3988	1701	179	ND
S'1	191.6	9.56	23.4	1.95	499.6	21.72	9.05	2890	998	143	ND
S'2	145.3	7.27	43.3	3.61	438.7	19.07	8.18	3145	897	142	ND
S'3	145.9	7.3	42.3	3.53	444.9	19.34	8.3	3266	766	156	ND
S'4	122.6	6.13	33.6	2.8	432.8	18.82	8.92	2988	787	124	ND
R4	32.1	1.61	101.1	8.43	528.8	22.99	10.27	3544	1455	166	ND
S4	108.7	5.44	22.1	1.84	466.5	20.28	10.67	2786	764	123	ND
Avg.S3 & S4	103.7	5.185	17.45	1.45417	478.15	20.7891	11.49	2834	683.5	139.5	ND

ATTACHMENT 4 – OUTFALL DESIGN



GREYSTONE[®]
NPDES Discharge Outfalls
French Drain Type
TYPICAL
DISCHARGE STRUCTURE

ATTACHMENT 5 – WSEO SURFACE WATER SEARCH

Wyoming State Engineer's Office Surface Water Search

Cert. Rec.	Pfx	Permit No.	Sfx	Tns	Rng	Sec	Qtr	Qtr/ Qtr	Acres	Status	SupTy	Ov Status	Uses	Facility Name	Applicant	Source	Priority	Una Amt	Una Unit	rCap Tot
		P1148R		20	89	16	8	SEW		PU	ORI	ADJ	STO, IRR	Cullin Reservoir	JOHN J. CULLIN	SOLO DRAW	11/07/ 1907	38.15	ACFT	38.15
		P1148R		20	89	16	8	SEW		PUO	ORI	ADJ	IRR	Cullin Reservoir	JOHN J. CULLIN	SOLO DRAW	11/07/ 1907	38.15	ACFT	38.15
		P1148R		20	89	16	9	NESW		PU	ORI	ADJ	STO, IRR	Cullin Reservoir	JOHN J. CULLIN	SOLO DRAW	11/07/ 1907	38.15	ACFT	38.15
		P8076D		20	89	9	12	SESW	5	ADJ	SEC	ADJ	IRR	Cullin Ditch	JOHN J. CULLIN	SOLO DRAW	11/07/ 1907	0	CFS	
		P8076D		20	89	9	15	SWSE	5	ADJ	SEC	ADJ	IRR	Cullin Ditch	JOHN J. CULLIN	SOLO DRAW	11/07/ 1907	0	CFS	
		P8076D		20	89	16	2	NWNE	12	ADJ	SEC	ADJ	IRR	Cullin Ditch	JOHN J. CULLIN	SOLO DRAW	11/07/ 1907	0	CFS	
		P8076D		20	89	16	3	SWNE	8	ADJ	SEC	ADJ	IRR	Cullin Ditch	JOHN J. CULLIN	SOLO DRAW	11/07/ 1907	0	CFS	
		P8076D		20	89	16	5	NENW	35	ADJ	SEC	ADJ	IRR	Cullin Ditch	JOHN J. CULLIN	SOLO DRAW	11/07/ 1907	0	CFS	
		P8076D		20	89	16	6	NWNW	5	ADJ	SEC	ADJ	IRR	Cullin Ditch	JOHN J. CULLIN	SOLO DRAW	11/07/ 1907	0	CFS	
		P8076D		20	89	16	7	SWNW	30	ADJ	SEC	ADJ	IRR	Cullin Ditch	JOHN J. CULLIN	SOLO DRAW	11/07/ 1907	0	CFS	
		P8076D		20	89	16	8	SEW	20	ADJ	SEC	ADJ	IRR	Cullin Ditch	JOHN J. CULLIN	SOLO DRAW	11/07/ 1907	0	CFS	
		P8076D		20	89	16	8	SEW		PUD	SEC	ADJ	IRR	Cullin Ditch	JOHN J. CULLIN	SOLO DRAW	11/07/ 1907	0	CFS	
		P8076D		20	89	16	10	NWSW	5	ADJ	SEC	ADJ	IRR	Cullin Ditch	JOHN J. CULLIN	SOLO DRAW	11/07/ 1907	0	CFS	
C34/258A	P	1148	R	20	89	16	8	SEW		PU	ORI	ADJ	IRR, STO	Cullin Reservoir	John J. Cullen	Solon Draw	11/07/ 1907			
C34/258A	P	1148	R	20	89	16	8	SEW		PUO	ORI	ADJ	IRR, STO	Cullin Reservoir	John J. Cullen	Solon Draw	11/07/ 1907			
C34/258A	P	1148	R	20	89	16	9	NESW		PU	ORI	ADJ	IRR, STO	Cullin Reservoir	John J. Cullen	Solon Draw	11/07/ 1907			
C34/259A	P	8076	D	20	89	16	2	NWNE	12	ADJ	SEC	ADJ	IRR	Cullin Ditch	John J. Cullen	Solon Draw	11/07/ 1907			
C34/259A	P	8076	D	20	89	16	3	SWNE	8	ADJ	SEC	ADJ	IRR	Cullin Ditch	John J. Cullen	Solon Draw	11/07/ 1907			
C34/259A	P	8076	D	20	89	16	5	NENW	35	ADJ	SEC	ADJ	IRR	Cullin Ditch	John J. Cullen	Solon Draw	11/07/ 1907			
C34/259A	P	8076	D	20	89	16	6	NWNW	5	ADJ	SEC	ADJ	IRR	Cullin Ditch	John J. Cullen	Solon Draw	11/07/ 1907			
C34/259A	P	8076	D	20	89	16	7	SWNW	30	ADJ	SEC	ADJ	IRR	Cullin Ditch	John J. Cullen	Solon Draw	11/07/ 1907			
C34/259A	P	8076	D	20	89	16	8	SEW	20	ADJ	SEC	ADJ	IRR	Cullin Ditch	John J. Cullen	Solon Draw	11/07/ 1907			
C34/259A	P	8076	D	20	89	16	8	SEW		PUD	SEC	ADJ	IRR	Cullin Ditch	John J. Cullen	Solon Draw	11/07/ 1907			
C34/259A	P	8076	D	20	89	16	10	NWSW	5	ADJ	SEC	ADJ	IRR	Cullin Ditch	John J. Cullen	Solon Draw	11/07/ 1907			
C34/259A	P	8076	D	20	89	9	12	SESW	5	ADJ	SEC	ADJ	IRR	Cullin Ditch	John J. Cullen	Solon Draw	11/07/ 1907			
C34/259A	P	8076	D	20	89	9	15	SWSE	5	ADJ	SEC	ADJ	IRR	Cullin Ditch	John J. Cullen	Solon Draw	11/07/ 1907			

ATTACHMENT 6 – INITIAL PERIODIC MONITORING SCHEDULE

Appendix E

Sensitive Plant, Wildlife, and Fish Species Potentially Present Red Rim Project Area.¹

Plant Species				
Common Name	Scientific Name	Sensitivity Status ²	Habitat	Occurrence Potential ³
Laramie columbine	<i>Aquilegia laramiensis</i>	G2/S2, FSR2	Crevices of granite boulders and cliffs, 6,400-8,000'	unlikely
Nelson's milkvetch	<i>Astragalus nelsonianus</i>	G2/S2 CO	Alkaline clay flats, shale bluffs and gullies, pebbly slopes, and volcanic cinders in sparsely vegetated sagebrush, juniper, and cushion plant communities at 5,200-7,600'	possible
Cedar Rim thistle	<i>Cirsium aridum</i>	G2Q/S2	Barren, chalky hills, gravelly slopes and fine textured, sandy-shaley draws 6,700-7,200'	possible
Weber's scarlet gilia	<i>Ipomopsis aggregata ssp. weberi</i>	G5T1T2Q/S1,FSR2	Openings in coniferous forests and scrub oak woodlands 8,500-9,600'	unlikely
Gibbens' beardtongue	<i>Penstemon gibbensii</i>	G1, S1, BLM	Sandy or shaley (often Green River Shale) bluffs and slopes, 5,500-7,500 ft. Associated vegetation: <i>Juniperus</i> spp., <i>Cirsium</i> spp., <i>Eriogonum</i> spp., <i>Elymus</i> spp., <i>Amelanchier alnifolia</i> , <i>Chrysothamnus</i> spp., <i>Thermopsis</i> spp., <i>Arenaria</i> spp., and <i>Astragalus</i> spp.	possible
Persistent sepal yellowcress	<i>Rorippa calycina</i>	G3/S2S3	Riverbanks and shorelines, usually on sand soils near high water line	unlikely
Laramie false sagebrush	<i>Sphaeromeria simplex</i>	G2/S2	Cushion plant communities on rocky limestone ridges and gentle slopes 7,500 - 8600'	unlikely
Wildlife Species				
Common Name	Scientific Name	Sensitivity Status ²	Occurrence Potential ³	
Mammals				
Dwarf shrew	<i>Sorex nanus</i>	G4/S253,R2,NS53	Likely	
Wyoming pocket gopher	<i>Thomomys clusius</i>	R2, G2/S1S2, NSS4	Likely	
White-tailed prairie dog	<i>Cynomys leucurus</i>	G4/S2S3, NSS7	Present	
Swift fox	<i>Vulpes velox</i>	R2, G2/S2S3, NSS3	Likely	
Fringed myotis	<i>Myotis thysanodes</i>	R2, G5/S1B, S1N, NSS2	Possible	
Long-eared myotis	<i>Myotis evotis</i>	G5/S1B, S1?N, NSS2	Possible	
Townsend's big-eared bat	<i>Corynorhinus townsendii</i>	R2/R4, G4/S1B, S2N, NSS2	Possible	
Birds				
Baird's sparrow	<i>Ammodramus bairdii</i>	G4/S1B, SZN, R2, NSS4	Unlikely	
Sage sparrow	<i>Amphispiza belli</i>	G5/S3B, SZN	Present	
Brewer's sparrow	<i>Spizella breweri</i>	G5/S3B, SZN	Present	
Long-billed curlew	<i>Numenius americanus</i>	G5/S3B, SZNR2, NSS3	Unlikely	

Sage thrasher	<i>Oreoscoptes montanus</i>	G5/S3B, SZN	Present
Mountain Plover	<i>Charadrius montanus</i>	G2/S2B, SZN	Possible
Western burrowing owl	<i>Athene cunicularia</i>	R2, G4/S3B, SZN, NSS4	Present
Yellow-billed cuckoo	<i>Coccyzus americanus</i>	G5/S2B, SZN, R2, NSS2	Unlikely
Loggerhead shrike	<i>Lanius ludovicianus</i>	G5/S4B, SZN, R2	Present
Columbian sharp-tailed grouse	<i>Tympanuchus phasianellus columbianus</i>	R2/R4, G4T3/S1	Possible
Greater sage-grouse	<i>Centrocercus urophasianus</i>	G5/S3	Present
White-faced ibis	<i>Plegadis chihi</i>	G5/S1B, SZN, R2, NSS3	Unlikely
Trumpeter swan	<i>Cygnus buccinator</i>	R2/R4, G4/S1B, S2N, NSS2	Unlikely
Peregrine falcon	<i>Falco peregrinus</i>	G4/T3/S1B, S2N, R2, NSS3	Possible
Ferruginous hawk	<i>Buteo regalis</i>	R2, G5/S23B, S4N, NSS3	Present
Northern goshawk	<i>Accipiter gentilis</i>	R2/R4, G5/S23B, S4N, NSS4	Present
Amphibians			
Boreal toad	<i>Bufo boreas boreas</i>	G4T4/S2, R2, R4, NSS1	Unlikely
Great Basin spadefoot toad	<i>Spea intermontanus</i>	G5/S4, NSS4	Possible
Northern leopard frog	<i>Rana pipiens</i>	G5/S3, R2, NSS4	Likely

¹ - Source: USDI-BLM (2002) and Hayden-Wing Associates (2003)

² - Definition of status:

G Global rank: Rank refers to the range-wide status of a species.

T Trinomial rank: Rank refers to the range-wide 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.

? Questions exist regarding the assigned G, T, or S rank of a taxon.

WGFD Native Species Status Codes - Fish and Amphibians

NSS1 - Populations are physically isolated and/or exist at extremely low densities throughout range. Habitats are declining or vulnerable. Extirpation appears possible. The Wyoming Game and Fish Commission mitigation category for Status 1 species is "Vital". The mitigation objective for this resource category is to realize "no loss of habitat function". Under these guidelines, it will be very important that the project be conducted in a manner that avoids alteration of habitat function.

NSS2 - Populations are physically isolated and/or exist at extremely low densities throughout range. Habitat conditions appear to be stable. The Wyoming Game and Fish Commission mitigation category for Status 2 species is also "Vital". The mitigation objective for this resource category is to realize "no loss of habitat function". Under these guidelines, it will be very important that the project be conducted in a manner that avoids alteration of habitat function.

NSS3 - Populations are widely distributed throughout its native range and appear stable. However, habitats are declining or vulnerable. The Wyoming Game and Fish Commission mitigation category for Status 3 species is "High." The mitigation objective for this resource category is to realize "no net loss of habitat function within the biological community which encompasses the project site". Under these guidelines, it will be important that the project be conducted in a manner that avoids the impact, enhances similar habitat or results in the creation of an equal amount of similarly valued fishery habitat.

NSS4-7 - Populations are widely distributed throughout native range and are stable or expanding. Habitats are also stable. There is no special concern for these species.

WGFD Native Species Status Codes - Birds and Mammals

NSS1 - Populations are greatly restricted or declining, extirpation appears possible. AND On-going significant loss of habitat.

NSS2 - Populations are declining, extirpation appears possible; habitat is restricted or vulnerable but no recent or on-going significant loss; species may be sensitive to human disturbance. OR Populations are declining or restricted in numbers and/or distribution, extirpation is not imminent; ongoing significant loss of habitat.

NSS3 - Populations are greatly restricted or declining, extirpation appears possible; habitat is not restricted, vulnerable but no loss; species is not sensitive to human disturbance. OR Populations are declining or restricted in numbers and/or distribution, extirpation is not imminent; habitat is restricted or vulnerable but no recent or on-going significant loss; species may be sensitive to human disturbance. OR Species is widely distributed; population status or trends are unknown but are suspected to be stable; on-going significant loss of habitat.

NSS4 - Populations are declining or restricted in numbers and/or distribution, extirpation is not imminent; habitat is not restricted, vulnerable but no loss; species is not sensitive to human disturbance. OR Species is widely distributed, population status or trends are

unknown but are suspected to be stable; habitat is restricted or vulnerable but no recent or on-going significant loss; species may be sensitive to human disturbance.

NSS5 - Populations are declining or restricted in numbers and/or distribution, extirpation is not imminent; habitat is stable and not restricted. OR Species is widely distributed, population status or trends are unknown but are suspected to be stable; habitat is not restricted, vulnerable but no loss; species is not sensitive to human disturbance.

NSS6 - Species is widely distributed, population status or trends are unknown but are suspected to be stable; habitat is stable and not restricted.

NSS7 - Populations are stable or increasing and not restricted in numbers and/or distribution; habitat is stable and not restricted.

³ - Occurrence potential based upon presence of habitat and known distribution.